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"The Heavens Proclaim the Glory of God..." A Study in Rabbinic Cosmology

The present article is an attempt to partially fill the gap in the scholarship regarding rabbinic understanding of the structure of the physical universe. It presents a systematic study of one central element of rabbinic cosmology: the views about the nature and structure of the heavens attributed to the rabbis of the Land of Israel. It is demonstrated that, living at the cusp of two of the great intellectual traditions of the ancient world, the Ancient Near Eastern and the Hellenic, these rabbis produced a distinctive body of ideas about the cosmos, drawing both on Eastern and Western sources.

1. INTRODUCTION

Cosmology is one of the fundamental components of any society's overall worldview. Since Durkheim, social scientists have repeatedly demonstrated that the way in which a culture understands the structure of the physical universe is intimately tied up with its social order, ritual practices and metaphysical beliefs.[1]

In the case of rabbinic culture, cosmology has even greater significance. The study of rabbinic cosmology has the potential to shed light on one of the central issues of modern rabbinic scholarship: the relationship of the rabbis to the cultures that surrounded them, most notably the cultures of ancient Greece and Mesopotamia.[2] Cosmology is one of the few realms of rabbinic endeavor that

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1 Emile Durkheim and Marcel Mauss, *Primitive Classification* (London: Cohen & West, 1963). For a survey and bibliography of the study of cosmology in modern anthropology, see Signe Howell, "Cosmology," *Encyclopedia of Social and Cultural Anthropology*, ed. Alan Bernard and Jonathan Spencer (London: Routledge, 1996), pp. 129-32.

2 For critical surveys of the vast literature about the relationship between Rabbinic and Greco-Roman culture, see Peter Schäfer, "Introduction," *The Talmud Yerushalmi and Graeco-Roman Culture*, Vol. 1, pp. 1-26, and Catherine Hezser, "Interfaces Between

directly overlaps with an important area of concern for both Greek and Mesopotamian writers. It is thus possible to evaluate the relationship between rabbinic cosmology and that of other ancient cultures in a manner that is impossible with regard to most other aspects of rabbinic thought.

On a more technical level, many rabbinic texts, both halakhic and aggadic in nature, make either explicit or implicit reference to various cosmological objects and phenomena. We can only properly understand these passages by explicating the various technical terms and constructs used by the rabbis to describe the cosmos.

It is therefore most striking that the leading scholars of rabbinic literature of the past half-century have neglected the study of the rabbis' cosmological beliefs. Urbach, in his encyclopedic survey of rabbinic thought, *The Sages*, devotes an entire chapter to rabbinic cosmogonies, analyzing the range of rabbinic attitudes toward the creation of the universe.[3] However, he does not consider what the rabbis thought the universe actually looks like now that the creation is complete. Similarly, Lieberman, in his essay "The Natural Science of the Rabbis," focuses on biology and medicine, rather than on physics or cosmology.[4] The only notable piece of academic writing devoted to the question of rabbinic cosmology is a brief article,

Rabbinic Literature and Graeco-Roman Philosophy," *The Talmud Yerushalmi and Graeco-Roman Culture*, Vol. 2, ed. Peter Schäfer and Catherine Hezser (Tübengen: Mohr-Siebeck, 2000), pp. 161-87. Both of these volumes contain many other useful essays on the various aspects of this question. The issue of the relationship between the rabbis and the culture of ancient Mesopotamia has unfortunately merited much less study. See Markham J. Geller, "The Influence of Ancient Mesopotamia on Hellenistic Judaism," *Civilizations of the Ancient Near East*, ed. Jack M. Sasson (New York, 1995), pp. 43-54. See also Stephen J. Lieberman, "A Mesopotamian Background for the So-Called 'Measures' of Biblical Hermeneutics?" *HUCA*, LVIII (1987): 157-225; Ben Zion Wacholder and David Weisberg, "Visibility of the New Moon in Cuneiform and Rabbinic Sources," *HUCA*, XLII (1971): 227-42, and Shalom E. Holtz, "'To Go and Marry Any Man That You Please': A Study of the Formulaic Antecedents of the Rabbinic Writ of Divorce," *Journal of Near Eastern Studies*, 69,4 (2001): 241-58. On the survival of Near Eastern mythological motifs in rabbinic biblical exegesis see Irving Jacobs, "Elements of Near Eastern Mythology in Rabbinic Aggada," *Journal of Jewish Studies*, 28:1 (1977): 1-11 and Umberto Cassuto, "The Israelite Epic," *Biblical and Oriental Studies*, Vol. II (Jerusalem, 1975), pp. 82-102.

3 E.E. Urbach, *The Sages: Their Concepts and Beliefs* (Cambridge: Harvard University Press, 1975), pp. 184-213.

4 E.E. Halevy also neglects the issue of cosmology in his voluminous thematic compilations of rabbinic sources and their Greco-Roman parallels. See especially *The World of Aggadah: The Aggadah in Light of Greek Sources* (Tel Aviv: Dvir, 1972) [Hebrew] and *The Values of Aggadah and Halacha in Light of Greek and Latin Sources*, 3 vols. (Tel Aviv: Dvir, 1979) [Hebrew].

written in Hebrew, published in 1966 by Sarfatti, entitled "Talmudic Cosmography."[5]

The present article is an attempt to partially fill this significant gap in the scholarship by presenting a systematic study of one central element of rabbinic cosmology: the views about the nature and structure of the heavens attributed to the rabbis of the Land of Israel. Attention is primarily focused on the cosmological speculation found in Bereshit Rabba (BR), the fifth-century Palestinian midrash on Genesis, and those found in the roughly contemporaneous Palestinian Talmud (PT). Other Palestinian sources will also be utilized, as well as Palestinian traditions cited in the Babylonian Talmud (BT).

It is demonstrated that, living at the cusp of two of the great intellectual traditions of the ancient world, the rabbis produced a distinctive body of ideas about the cosmos that draws both on Eastern and Western sources. The rabbis' understanding of the heavens is deeply rooted in Ancient Near Eastern traditions that are reflected in the centuries-old Hebrew, Akkadian and Sumerian sources. However, the rabbis were not thoroughly Semitic in their scientific orientation. They were to some extent aware of, and influenced by, the relatively new Greek ideas about the universe. There are a few instances in which elements of Greek scientific theories appear in rabbinic sources. In numerous other cases, the ways in which the rabbis present their ideas about the cosmos reveal striking similarities to the scientific methods first pioneered by the pre-Socratic philosophers. Finally, some of the explanations of cosmic phenomena presented by the rabbis appear to have been invented by the rabbis independent of any outside influence. This demonstrates that the rabbis did not merely pass on received ideas, but also engaged in a modicum of original cosmological speculation. The result is a synthetic body of scientific literature that is neither truly Eastern nor Western, but uniquely rabbinic.

2. ANCIENT COSMOLOGIES

Before proceeding with an analysis of the rabbinic sources, a brief review of the cosmological theories that might have influenced the rabbis is in order.

5 G. Sarfatti, "Talmudic Cosmography," *Tarbiz*, 35 (1966): 137-48 [Hebrew]. See also A. Arzi, "Astronomy in Rabbinic Sources," *Mahanayim*, 125 (1971): 30-35. More recently Hans-Jurgen Becker, "Earthquakes, Insects, Miracles, and the Order of Nature," *The Talmud Yerushalmi and Graeco-Roman Culture*, Vol. 1, ed. Peter Schäfer (Tübengen: Mohr-Siebeck, 1998), pp. 287-96, touches on some more general issues in rabbinic cosmology.

2.1 Biblical and Babylonian Cosmologies

Neither the Bible nor the cuneiform literature in our possession contains a systematic account of the structure of the cosmos. However, cosmological information is scattered throughout both canons. In the Bible, we find this information in the creation accounts of Genesis 1-3, and in numerous other brief references found mainly in the prophetic, poetic, and wisdom traditions.[6] Our knowledge of Babylonian cosmology similarly draws on cosmogonic sources such as the so-called Babylonian creation epic, *Enuma Elish*, as well as mythic accounts of heavenly journeys and astronomical and astrological texts.[7]

There is a fundamental agreement between the various cosmological models found in the Bible and cuneiform literature. All of them seem to posit a flat, probably disk-shaped world.[8] The heavens are made of a solid material. They are either disk-shaped, hovering over the earth, or dome-shaped, completely enclosing the surface of the earth.[9] Above the heavens is the celestial ocean, which is the source of rain. Above that lies the abode of the divine power or powers.[10] The earth rests on a second great reservoir, below which, presumably, is the underworld.[11]

2.2 Greek Cosmologies

The field of Greek cosmology is far more diverse and complex than that of Ancient Near Eastern cosmology. We will briefly look at three key schools in the history of Greek thought.

The earliest sources of Greek cosmological ideas are the works of the great epic poets of the eighth century BCE, Homer and Hesiod. The early Greeks believed in a flat earth, apparently surrounded by the Ocean.[12] The heavens were perceived to be flat and solid, supported above the earth by pillars.[13] Some scholars understand

6 Luis I.J. Stadelmann, *The Hebrew Conception of the World* (Biblical Institute Press: Rome, 1970), provides a good synthesis of the relevant biblical texts.

7 Wayne Horowitz, *Mesopotamian Cosmic Geography* (Eisenbrauns: Winona Lake, 1998), pp. 3-208 provides the most complete and authoritative survey of the field of Mesopotamian cosmography currently available.

8 Horowitz, p. 334; Stadelmann, pp. 126-27.

9 Horowitz, pp. 264-65; Stadelmann, pp. 45-61.

10 Horowitz, pp. 250-52, 262; Stadelmann, pp. 44-47.

11 Horowitz, pp. 344, 348; Stadelmann, p. 166.

12 D.R. Dick, *Early Greek Astronomy to Aristotle* (Thames and Hudson: Great Britain, 1970), p. 29.

13 Dick, p. 30, and Charles H. Kahn, *Anaximander and the Origins of Greek Cosmology* (Columbia University Press: New York, 1960), pp. 138-39.

the epic poets to have envisioned dome-shaped heavens.[14] The cosmology that emerges from these texts is thus remarkably similar to, and was likely influenced by, the Ancient Near Eastern cosmological model described above.

The origins of the systematic Greek study of the cosmos have been traced to the Ionian city of Miletus in the sixth century BCE. There, Anaximander and Anaximenes, following the work of Thales, are believed to have laid the foundations of Greek physics. Though their work has survived only in fragments and in second- and third-hand sources, modern scholars have reconstructed many of their physical theories. Among Anaximander's major breakthroughs was the idea that the earth was not flat, but cylindrical in shape. More importantly, Anaximander inaugurated the Western cosmological tradition by arguing that the world does not rest in the water, or on anything else. Rather, "the earth stays aloft, not supported by anything, but staying where it is at the same distance from everything."[15] For Anaximander, the earth sat at the center of the universe, surrounded by a series of hoops or bands upon which the heavenly bodies circle the earth.[16] Anaximenes reverted to a more traditional conception of the earth as a disk, covered by a hemispherical sky. Yet, he too rejected the notion that the earth rests in water. According to Anaximenes, the world floats in the air.[17]

Finally, we come to what may be called the classical Greek theory of the cosmos. This theory posits the earth as a globe surrounded by a system of rotating spheres and circles, in which are imbedded the heavenly bodies. Plato, Aristotle, the Stoics, and the great astronomer of the second century CE, Ptolemy of Alexandria, all embraced this theory in one form or another.[18] This model was widely accepted in the Roman world.[19] In its Ptolemaic form, the geocentric, sphere-based conception of the universe remained dominant in the West until the Renaissance.

14 Kahn, p. 138 n. 1; M.R. Wright, *Cosmology in Antiquity* (Routledge: London, 1995), pp. 16-18; For another interpretation of Hesiod's cosmology see Maja E. Pellikan-Engel, *Hesiod and Parmenides: A New View on Their Cosmologies and on Parmenides' Proem* (Amsterdam, 1974), pp. 15-19.

15 Hippolytus, *Refutations* 1.6.3, cited in Wright, p. 39.

16 Kahn, pp. 78-89.

17 Dick, p. 46.

18 Dick, pp. 92-150, 191-219; Wright, pp. 31-32, 36.

19 Wright, pp. 34-35.

3. THE RABBINIC VIEW OF THE HEAVENS

The rabbis clearly inherited their fundamental understanding of the heaven from their Ancient Near Eastern predecessors. Like their biblical and Mesopotamian predecessors, the rabbis viewed the heavens as a solid object spread out over the Earth.[20] The rabbis referred to this solid part of the sky using the biblical term *raki'a*, commonly translated as "firmament." They alternatively described the firmament as either a dome (*kippah*) or as a great tent pitched across the earth.[21] The tent image has its roots in biblical descriptions of the heavens.[22] In contrast, the depiction of the sky as a dome lacks clear biblical precedent. The rabbinic use of the term *kippa* to describe the heavens does however bear a striking resemblance to the Akkadian term, *kippat šamê*, which similarly refers to the shape of the heavens. However, as Horowitz points out, unlike Hebrew *kippot*, which are three-dimensional domes, "Akkadian *kippatu* are always flat circular objects such as geometric hoops or circles, rather than three-dimensional domes."[23] It seems that these two cognate terms reflect contrasting understandings of the shape of the heavens. The relationship between these Akkadian and the Hebrew terms requires further study.

3.1 The Composition of the Firmament

With regard to the composition of the firmament, the rabbis generally believed that the firmament was composed of water:[24]

> הקב"ה לא קירה עולמו[25] אלא במים.
> (T)he Holy One, blessed be He, roofed over His world with nought but water (BR 4:1).[26]

20 Sarfatti (1966), p.141.

21 The term "*kippah*" is used with reference to the firmament in BR 4:5, 6:8, 44:12 and 48:6.The tent image appears in BR 1:3, 3:8, 12:13 and PT Berachot 2d. However, see BR 4:5 beginning with the words, "The thickness of the firmament equals that of the earth. ..." This text would seem to suggest that both the heavens and the earth are flat disks.

22 Is. 40:22, Ps. 104:2.

23 Horowitz, p. 264.

24 Bereshit Rabba texts cited from Theodor and Albeck edition (reprinted Jerusalem, 1996). This text was checked against the variants brought by Theodor and Albeck and the facsimile of MS Vat. Ebr. 30 ("MS Vatican").

25 MS Vatican 30 and other MSS read "את עולמו כולו".

26 All translations of Bereshit Rabba and the Babylonian Talmud are taken from the Soncino translations (London: Soncino Press, varying dates). We have maintained the translators' system of transliteration and, in most cases, punctuation. All other translations are those of the author.

The rabbis did not believe that the firmament was made up of conventional liquid water. Rather, they saw it as being composed of some sort of solid water. Thus, Rav explains that,

> לחים היו מעשים[27] ובשיני קרשו 'יהי רקיע' יחזק הרקיע.
> [God's] handiwork [the heavens] was in fluid form, and on the second day, it congealed (BR 4:2).

Similarly, another tradition states that the firmament was formed when a thin layer of water at the center of the primordial ocean solidified:

> רבנין אמ' לה בשם ר' חנינא ר' פינחס ר' יעקב בר' בון בשם ר' שמואל בר נחמן בשעה שאמר הקב"ה יהי רקיע בתך המים גלדה טיפה האמצעית ונעשו שמים....
> Our rabbis said the following in the name of R. Hanina, while R. Phinehas and R. Jacob b. R. Bun said it in the name of R. Samuel b. Nahman: When the Holy One, blessed be He, ordered: "Let there be a firmament in the midst of the waters," the middle layer of water solidified, and the... heavens ...were formed (ibid.).

Yet another tradition compares the formation of the firmament to the curdling of milk into cheese (BR 4:7).

The notion that the firmament is made of water is suggested by the fact that, in the biblical and rabbinic views, the firmament holds up the celestial ocean. Cuneiform literature similarly preserves a tradition that the heavens are composed of water.[28] Indeed, the midrashic etymology of the word "*shamayim*" – "heavens," as a contraction of "*sham mayim*" – "water there" (BT Hagigah 12a),[29] has an almost exact parallel in the Mesopotamian tradition. One Akkadian scholarly text derives the cognate Akkadian term *šamê* from the two words, ***ša mê***, meaning "of water."[30]

A second series of rabbinic traditions sees the heavens as being made up of a combination of water and fire. Another midrashic etymology for "*shamayim*" derives the word from a contraction of "***esh u-mayim***" (BR 4:7, BT Hagigah 12a).[31]

27 MS Vatican 30 reads more plausibly "...לחים היו שמים ביום הראשון ובשני."

28 Horowitz, pp. 262-63. Other Mesopotamian sources record a belief in heavens made of stone.

29 Cited in the name of the Palestinian *amora* R. Yosi bar Hanina.

30 Horowitz, p. 224.

31 BR 4:8, BT Hagigah 12a. Most versions of BR attribute this reading to Rav, whereas MS Vatican 30 attributes it to Levi as well. BT on the other hand records this as a tannaitic tradition.

Two passages describe God as creating the heavens through a combination of fire and water:

> אמר ר' חנינא יצאת האש מלמעלה וליחכה פני הרקיע , ר' יוחנן כשהיה מגיע לפסוק ברוחו שמים שפרה (איוב כו:יג) היה אומר יפה לימדני ר' חנינא, אמר ר' יודן בר' שמעון יצאת האש מלמעלה ולהטה פני הרקיע.
>
> R. Hanina said: The fire came forth from above and dried the face of the firmament. When R. Johanan came to the verse, "by His breath... the heavens are smoothed" (Job 26:13), he would say, "R. Hanina taught me well." R. Judah b. R. Simon said: The fire came forth from above and burnished the face of the firmament (BR 4:2).

> ד' אבא בר כהנא מש' רב נטל הקב"ה אש ומים ופתכן זה בזה ומהן נעשו שמים.
>
> R. Abba b. Kahana said in Rab's name: The Holy One, blessed be He, took fire and water and beat them up together, and from them the heaven was made (BR 4:7).

Although the idea that the heavens are composed of fire and water does not appear to have any parallel in biblical or other Ancient Near Eastern sources, similar ideas are found in the Greek record. Anaximander is credited with saying that "the heavens are formed from a mixture of hot and cold."[32] For Anaximander, hot and cold correspond to fire and "*aer*."[33] As Kahn demonstrates, the Greek term "*aer*" does not translate so simply into the English "air," but rather is virtually identical to "the primeval moisture which lay around the earth before the sea was formed."[34] Thus, like the rabbis, Anaximander saw the skies as being formed through a combination of fire and moisture.

It is difficult to make a strong case for the possibility that the rabbis were influenced by this Milesian theory. The rabbis could easily have come up with this idea independently. For R. Shimon bar Yochai , the conclusion that the heavens are composed of fire and water emerges naturally from the observation that the heavens are home to both the fiery heavenly bodies and the source of the rain:

> הרקיע של מים וככבים של אש והן דרין זה אם זב ואינם מזיקי' זה את זה.
>
> The firmament consists of water and the stars consist of fire and they dwell together and do not harm each other (Pesikta de-Rav Kahana 1:3).

32 Quoted in Kahn, p. 57.
33 Kahn, p. 87.
34 Kahn, p.101.

Furthermore, it seems unlikely that a single element of Anaximander's theory, ripped from its context, was transmitted across the Mediterranean and through the centuries to reach the rabbis of late antique Palestine. It is at least as likely that this idea was developed independently in Miletus and the Land of Israel.

3.2 The Thickness of the Firmament

One of the most significant disputes about the nature of the heavens was related to the thickness of the firmament. One school of thought held that the firmament is extremely thin. We find R. Joshua b. R. Nehemiah stating that the firmament is כב' וג' אצבעות[35] "about two or three fingers in thickness" (BR 4:5). A similar position is attributed to Ben Zoma, during his famous pre-death conversation with R. Joshua.[36] Some rabbis go so far as to compare the firmament to fine gold leaf.[37] In contrast, other rabbis posited that the firmament is fantastically thick. One source states that the firmament is a 500-years' journey thick (BR 6:6). In PT Berachot 2c, Rabbi Judah estimates the firmament's thickness more conservatively, as a 50-year journey.

The dispute as to whether the firmament is very thick or very thin may have had halakhic implications. The rabbis debated the length of "*bein hashemashot*," the twilight period that marks the transition from day to night and vice versa. BT Shabbat 34b records a *baraita* that sums up the disagreement:

> תנו רבנן: בין השמשות ספק מן היום ומן הלילה[38], ספק כולו מן היום, ספק כולו מן הלילה — מטילין אותו לחומר שני ימים. ואיזהו בין השמשות — משתשקע החמה כל זמן שפני מזרח מאדימין, הכסיף התחתון ולא הכסיף העליון — בין השמשות, הכסיף העליון והשוה לתחתון זהו לילה דברי רבי יהודה. רבי נחמיה אומר: כדי שיהלך אדם משתשקע החמה חצי מיל. רבי יוסי אומר: בין השמשות כהרף עין, זה נכנס וזה יוצא, ואי אפשר לעמוד עליו.
>
> Our rabbis taught: As to twilight [period] it is doubtful whether it is partly

35 MS Vatican 30 reads שתים בשלושה אצבעות.
36 BR 2:4, T. Hagigah 2, PT Hagigah 77a, BT Hagigah 15a.
37 This is clearly the intention of R. Judah b. R. Simon in BR 4:2, when he uses the term "*matlit*" to describe the firmament. Similarly, in PT Berachot 2c and in the standard printed and Theodore-Albeck editions of BR 4:5, R. Aha states in the name of Rabbi Hanina that the firmament is like a "*tas*." See Daniel Sperber, "Etymological Studies in Rabbinic Hebrew," *Leshonenu*, 36 (1971-72): 261-62. However, MS Vatican 30 reads here "*t'm*," whose meaning in this context I cannot determine.
38 מן היום ומן הלילה is absent from MS Munich (Munich Codex) and other MSS and commentaries, see *dikduke soferim*, ad loc.

day and partly night or the whole of it [belongs to the] day or the whole of it night: [therefore] it is cast upon the stringencies of both days. And what is twilight? From sunset as long as the face of the east has a reddish glow: when the lower [horizon] is pale but not the upper, it is twilight; [but] when the upper [horizon] is pale and the same as the lower, it is night. This is the opinion of R. Judah. R. Nehemiah said: For as long as it takes for a man to walk half a *mil* from sunset. R. Jose said: Twilight is the twinkling of an eye, one entering and the other departing, and it is impossible to determine it.

R. Judah's position that *bein hashemashot* consists of the entire period from sunset to complete nightfall[39] is apparently directly linked to his beliefs about the thickness of the firmament. This is the same R. Judah we saw above, cited as stating that the firmament is a fifty-years' journey in length. In that passage in PT Berachot 2c, R. Judah elaborates on his understanding of the relationship between the thickness of the firmament and the processes of the rising and the setting of the sun:

רתני בשם רבי יודה: עוביו של רקיע מהלך חמשים שנה אדם בינוני מהלך ארבעים מיל ביום עד שהחמה נוסרת ברקיע מהלך חמשי' שנה אדם מהלך ארבעת מיל נמצאת אומר שעוביו של רקיע אחד מעשרה ביום.

It was taught in the name of R. Judah: The thickness of the firmament is a fifty-year journey. An average man can walk forty *mil* in one day. In the time in which the sun passes though the firmament, a fifty-year journey, a man can walk four *mil*. Thus, the [time it takes the sun to pass though the] thickness of the firmament is equal to one-tenth of the day.[40]

Implicit in R. Judah's calculations is the fact that the sun's passage through the firmament is an observable phenomenon.[41] Otherwise, he would not have been able to calculate the fact that it takes one-tenth of the day. R. Judah apparently identified the hour or more between sunset and complete nightfall with the sun's

39 For simplicity's sake, the *baraita* deals only with the case of the evening *bein hashemashot*. The equivalent cases for the morning are obviously implied.

40 For an alternate reading and potential emendation of this passage see Louis Ginzberg, *A Commentary on the Palestinian Talmud*, Vol. I (New York: Ktav, 1971), pp. 51-52. His reading does not materially affect my argument.

41 For more on the topic of the sun's movements in and around the firmament see below, section 3.5.2.

passing through the firmament.[42] R. Judah's maximal definition of *bein hashemashot* as spanning the entire period from sunset to nightfall thus corresponds to his opinion that the firmament is a fifty-years' journey in length. R. Yosi's proposition that *bein hashemashot* is an infinitesimally short period of time might similarly be based on a calculation of the time it takes the sun to pass through the firmament. It would follow that R. Yosi was a proponent of the position that the firmament is extremely thin. R. Nehemiah's position that *bein hashemashot* lasts for as long as it takes to walk half a mile does not correlate directly with any known position about the thickness of the firmament. It is possible that he had his own opinion either about the thickness of the firmament or about the observable phenomenon that corresponds to the sun's passing through the firmament.

3.3 Multiple Firmaments

One of the less intuitive aspects of rabbinic cosmology is the widespread belief in multiple firmaments. Many sources posit the existence of a second firmament beyond the one that stands directly over our heads.[43] The passage in BR 4:2 cited above, about the hardening of the firmament, refers to the creation of a second, upper firmament as well.

בשעה שאמר הקב"ה יהי רקיע בתך המים גלדה טיפה האמצעית ונעשו שמים התחתונים ושמי שמים העליונים.

When the Holy One, blessed be He, ordered: "Let there be a firmament in the midst of the waters," the middle layer of water solidified, and the nether heavens and the uppermost heavens were formed.

A second firmament divides between the "lower heavens" and the "highest heavens." Both parts of the heavens appear to be filled with water. A similar passage in the Mechilta (Bachodesh 4) describes how, when descending upon Mt. Sinai, God pushed down the upper heavens and the lower heavens until they reached the top of the mountain, and then sat upon the heavens as if they were pillows.

To the rabbis, the idea of a double firmament was biblical in origin. They understood the biblical term *shemei ha-shamayim* as referring to the heavens above the second firmament. Yet, as Stadelmann points out, *shemei ha-shamayim* does

42 BT, ad. loc. sets R. Judah's *bein hashemashot* as being only 3/4 of a mile, much closer to R. Nehemiah's position.

43 For a survey of rabbinic and other late antique Jewish and Christian sources that take this view see Louis Ginzberg, *The Legends of the Jews*, Vol. 5 (Philadelphia, 1947), pp. 10-11 n. 22.

not really suggest the existence of a second firmament above the first. According to Stadelmann, the biblical *shemei ha-shamayim* is a poetic term that is probably best translated as "the highest heavens."[44] At best, this phrase refers to the space above the first firmament. While there does not seem to be any biblical precedent for this rabbinic scheme of the heavens, it may well have its roots in ancient Mesopotamian traditions. Two first-millennium Akkadian texts, KAR 307 and AO 8196, describe a three-tiered heaven.[45] A comparable scheme is implied in *Enuma Elish*.[46] This Babylonian vision of a tripartite heaven may be the source of the rabbinic conception of two firmaments dividing the heavens into three parts.[47]

Several Palestinian sources state that there are seven firmaments.[48] However, it is only in the Babylonian Talmud, Hagigah 12b, that we find the Palestinian rabbi Reish Lakish expounding the idea of seven heavens as a fully developed cosmological theory:

> אמר רבי יהודה: שני רקיעים הן, שנאמר: (דברים י:יד) "הן לה' אלהיך השמים ושמי השמים." ריש לקיש אמר: שבעה, ואלו הן: וילון, רקיע, שחקים, זבול, מעון, מכון, ערבות. וילון — אינו משמש כלום, אלא נכנס שחרית ויוצא ערבית, ומחדש בכל יום מעשה בראשית,[49] שנאמר (ישעיהו מ:כב) "הנוטה כדק שמים וימתחם כאהל לשבת." רקיע — שבו חמה ולבנה כוכבים ומזלות[50] קבועין, שנאמר (בראשית א:יז) "ויתן אתם אלהים ברקיע השמים." שחקים — שבו רחיים עומדות וטוחנות מן לצדיקים, שנאמר (תהלים ע"ח:כג) "ויצו שחקים ממעל ודלתי שמים פתח וימטר עליהם מן לאכל וגו'." זבול — שבו ירושלים ובית המקדש, ומזבח בנוי, ומיכאל השר הגדול עומד ומקריב עליו קרבן, שנאמר (מלכים א' ח:יג) "בנה בניתי בית זבל לך מכון לשבתך עולמים." ומנלן דאיקרי שמים — דכתיב (ישעיהו ס"ג:טו) הבט משמים וראה מזבל קדשך ותפארתך. מעון — שבו כיתות של מלאכי השרת, שאומרות שירה בלילה וחשות ביום, מפני כבודן של ישראל, שנאמר (תהלים מ"ב:ט) "יומם יצוה ה' חסדו ובלילה שירה עמי."

> R. Judah said: There are two firmaments, for it is said: "Behold, unto the Lord thy God belongeth heaven and the heaven of heavens" (Deut. 10:14). Resh Lakish said: [There are] seven, namely *Wilon*, *Rakia*, *Shehakim*, *Zebul*, *Ma'on*, *Makon*, *'Araboth*. *Wilon* serves no purpose except that it enters in the morning and goes forth in the evening, and renews everyday the work of creation, for it is said: "that stretcheth out the heavens like a curtain, and spreadeth them out as a tent to dwell in" (Is. 40:22). *Rakia* is that in which the sun, the moon, stars and constellations are set, for it is said: "And God set them in the firmament [*Rakia*] of the heavens" (Gen. 1:17). *Shehakim* is that in which millstones stand and grind manna for the righteous, for it is said: "And He commanded the skies [*Shehakim*] above, and opened the doors of heaven; and he caused manna to rain upon them for food etc." (Ps. 78:23). *Zebul* is that in which [the heavenly] Jerusalem and the Temple and the Altar are built, and Michael, the great Prince, stands and offers thereon an offering, for it is said: "I have surely built Thee a house of habitation [*Zevul*], a place for Thee to dwell forever" (I Kgs. 8:13). And whence do we know that it is called heaven? For it is written: "Look down from heaven, and see, even from Thy holy and glorious habitation" (Is. 63:15). *Ma'on* is that in which there are companies of Ministering Angels, who utter [divine] song by night, and are silent by day for the sake of Israel's glory, for it is said: "By day the Lord doth command his lovingkindness, and in the night His song is with me" (Ps. 42:9) ... *Makon* is that in which there are stores of snow and stores of hail, and the loft of harmful dews and the loft of rain drops, the chamber of the whirlwind and storm and the caves of vapor and their doors are of fire .... *'Araboth* is that where there are Right and Judgment and Righteousness, the treasures of life and the treasures of peace and the treasures of blessing, the souls of the righteous and the spirits and the souls which are yet to be born, and dew wherewith the Holy One, blessed be He, will Hereafter revive the dead.

Reish Lakish envisions a seven-tiered heaven. Each tier has its own name and houses a different "department" in the heavenly hierarchy: the visible celestial bodies, the source of the manna, the heavenly Jerusalem, the Ministering Angels, the source of meteorological phenomena, and finally the place of divine reward for the righteous.[51] The idea of a seven-fold heaven has no basis in Scripture. While

44 Stadelmann, pp. 41-42.
45 See Horowitz, pp. 3-19.
46 Horowitz, pp. 3-19 and 243-50.
47 Note that Paul also apparently believed in a three-fold heaven. See 2 Corinthians 12:2.
48 Avot de Rabbi Natan version 'A,' chapter 37, Vayikra Rabba 29:11, Bereshit Rabba 19:7, *Pesikta de-Rab Kahana*, 1:1 See also PT Berachot 13a, "and thus from each firmament to the next... ."
49 MS Munich adds here "ומנא לן דאיקרי שמים."
50 Previous two words absent from MS Munich.
51 For a detailed analysis of this passage and a consideration of its relationship to apocalyptic literature see Peter Schaefer, "From Cosmology to Theology: The Rabbinic Appropriation of Apocalyptic Cosmology," in *Creation and Recreation in Jewish Thought: Festschrift in Honor of Joseph Dan on the Occasion of his Seventieth Birthday*, ed. Rachel Elior and Peter Shäfer (Mohr Siebeck, 2005), pp. 39-58.

some have argued that there is a Sumerian cosmographic tradition of seven heavens, the interpretation of the relevant texts remains in dispute.[52] It is also possible that this notion shows the influence of Greek cosmography. The classical Greek model of the universe posited a spherical earth surrounded by seven concentric spheres: one each of the sun, moon, and the five visible planets. Sarfatti rejects any relationship between the seven heavens of the rabbis and the seven spheres of the Greek cosmologists.[53] He notes that in the Jewish sources there is no connection between the seven heavens and the seven moving heavenly bodies. Indeed, in the passage cited above, all of the heavenly bodies are fixed in the second firmament. Nevertheless, this possibility should not be dismissed out of hand. For all of their differences, the fact remains that both the Greeks and the rabbis knew of a cosmic model that involves a seven-fold heaven. There is nothing intuitively obvious about such a model. It is thus possible that the rabbinic idea of seven firmaments represents the integration of a Greek idea into the rabbis' essentially traditional Near Eastern cosmology. The result is an entirely original rabbinic model of the heavens.

Whatever its origins, the rabbinic belief in seven heavens is well attested in extra – and post-talmudic sources. The idea appears in later rabbinic texts[54] and throughout the Jewish apocalyptic and mystical literature of the period.[55] Indeed, Scholem traces the origins of this conception to mystical accounts of the ascent of the soul to heaven.[56] The Koran similarly speaks of seven heavens.[57] Whatever its source, by the end of the Talmudic period, the belief in seven heavens had wide currency in the Jewish and Jewish-influenced world.

3.4 The Upper Waters

In contrast to the concept of multiple firmaments, the rabbinic belief in a celestial ocean above the firmament is both intuitive and well attested in the Bible and

52 Horowitz, pp. 208-20.
53 Sarfatti (1966), p. 145.
54 See Ginzberg, ibid.
55 See Schaefer, ibid., P. Alexander, "Introduction" to 3 Enoch, in James Charlesworth, *The Old Testament Pseudepigrapha*, Vol. 1, p. 239 and Ginzberg, ibid. See also " 'Re'uyot Yehezqel': A Critical Edition and Commentary," *Temirin*, 1 (1972): 101-39 and Peter Schaefer, "In Heaven as it is in Hell: The Cosmology of *Seder Rabbah di-Bereshit*," in *Heavenly Realms and Earthly Realities in Late Antique Religions*, ed. Ra'anan S. Boustan and Annette Yoshiko Reed (Cambridge: Cambridge University Press, 2004), pp. 233-74.
56 Gershom Scholem, *Major Trends in Jewish Mysticism* (New York, 1941), p. 54.
57 Sura 65 verse 12 and Sura 78 verse 12.

Ancient Mesopotamian.[58] The origin of the belief in such a heavenly reservoir is the need to account for the seemingly limitless supply of water that emerges from the heavens in the form of rain. One might naturally assume that part of the function of the firmament is to hold up these upper waters. Still, at least some of the rabbis did not take this view:

> אמר ר' תנחומא אנא א' טע' אילו נאמר: 'ויעש אלהים את הרקיע ויבדל בין המים וגו' אשר על הרקיע' הייתי אומר על גופו שלרקיע המים נתונים, כשהוא אומר 'ובין המים אשר מעל לרקיע' הרי המים העליונים תלוים במאמר.
>
> R. Tanhuma said: I will state the proof. If it said: "And God made the firmament, and He divided between the waters ... which are *upon* the firmament," I would say that the water lies directly upon the firmament itself. Since, however, it is stated, "And between the waters which are above the firmament," it follows that the upper waters are suspended by the word [of God] (BR 4:3).

According to R. Tanhuma, the upper waters do not rest on the firmament, but rather are suspended above them. In the lines that follow, other rabbis compare the levitation of the upper waters to the hovering of a flame over a candle. Alternatively, they suggest that it can be compared to the way in which water can be held inside a clepsydra.[59] The clepsydra, a type of water clock, had a narrow opening on top and a perforated base. By placing one's finger over the top opening, a person could create suction that would prevent the water inside from coming out of the bottom. The rabbis may have concluded that the upper waters are suspended in space because a dome-shaped firmament is not an appropriate shape to support the upper waters. Water rolls right off the top of a dome. Hence, they posited that the upper waters were suspended above the firmament by some other force.

3.5 The Heavenly Bodies and Precipitation

Having explicated the range of rabbinic opinion on the nature and structure of the heavens, I will now explore the rabbis' ideas about the various objects and phenomena that are housed in the heavens. The rabbis thought that the heavenly bodies are all set in the surface of the firmament and travel along it in the course of their movements.[60] According to at least one source (BR 6:6), they are set on the second firmament. This is so that the waters above the first firmament can serve as

58 Stadelmann, pp. 46-47 and Horowitz, pp. 262-63.
59 "*farkâs*." See Jastrow, s.v. "*'rpekhâs*."
60 On the rotation of the planets around the earth see BR 10:4.

a kind of filter to lessen the power of the sun. Otherwise, the heat of the sun would burn up the world. The belief is not unlike our own understanding of the role of the atmosphere in filtering out the sun's harmful rays.

3.5.1 The path of the sun at night

In the rabbinic view, the sun moves each day from east to west across the firmament. Where then does the sun go at night? The following dispute is recorded in Bereshit Rabba (6:8):

> כיצד גלגל חמה ולבנה שוקעים, ר' יהודה בר' לעיי ורבנן, ר' יהודה אומר מאחורי כיפה ולמעלה, רבנין אמרין מאחורי כיפה ולמטה, אמר ר' יונתן נראין דברי ר' יהודה בר' לעיי דאמר מאחורי כיפה ולמעלן בימות החמה שכל העולם חם והמעיינות צוננין, מלהון דרבנין דאמרין מאחורי כיפה ולמטה בימות הגשמים שכל העולם צונן והמעיינות פושרים.
>
> How do the orbs of the sun and the moon set? R. Judah b. R. La'i and the rabbis disagree. R. Judah said: Behind the vault and above it. The rabbis maintained: Behind the vault and below it. R. Jonathan said: the view of R. Judah b. La'i that it is behind the vault and above it is preferable in respect of summer, when the whole world is hot while the wells are cold; and the opinion of the rabbis that it is behind the vault and below it appears correct in respect of winter, when the whole world is cold and the wells are tepid.

The rabbis' position, that the sun and other heavenly bodies pass under the earth at night is well attested in ancient Canaanite and Babylonian mythologies as well as in classical Greek mythology.[61] It makes sense that the ancients, on seeing the sun descend below the horizon, would have assumed that the sun continued its circular trajectory under the earth throughout the night, re-emerging on the eastern horizon in the morning.

The other position, that the sun doubles back and travels through the high heavens at night, is less intuitive. Nevertheless, it is not without precedent in ancient literature. Several ancient Babylonian prayers similarly describe the sun as spending the night in an unseen portion of heaven.[62] It may be that this position grew out of a feeling that it would be inappropriate for a heavenly and possibly divine body such as the sun to spend half its time in the underworld. Hence, some ancients may

61 Stadelmann, p. 22; Pellikan-Engel, pp. 22-38. For a survey of the Babylonian texts relating to the sun's activities at night see Wolfgang Heimpel, "The Sun at Night and the Doors of Heaven in Babylonian Texts," *Journal of Cuneiform Studies*, 38 (1986): 127-51.

62 Horowitz, p. 251.

have posited that the sun actually spends all of its time in one part of the heavens or another.

Finally, we have R. Jonathan's opinion, that the path of the sun varies with the seasons, passing over the heavens in the summer and below the earth in the winter. This position appears to be a completely original attempt to account for empirically observed phenomena. R. Jonathan sought to explain not only the changing of the temperature through the seasons but also the counterintuitive fact that groundwater tends to be warmer than the air in the winter but colder than the air in the summer. Today, we explain this phenomenon as resulting from the fact that water has a higher heat capacity than air, and hence changes temperature more slowly. R. Jonathan's theory represents a prime example of original rabbinic scientific thinking. He synthesized two existing theories about the path of the sun at night into a new theory in order to account for a phenomenon observed regarding seasonal temperature fluctuations.

3.5.2 The sun's journey through the firmament

We previously saw that the rabbis believed that the sun passes through the firmament during twilight. It is not entirely clear how the sun was thought to move through the solid and possibly massive firmament twice each day. In the passage in PT Berachot 2c cited above, R. Judah uses the root ***n-s-r*** to describe this movement. This would suggest that the sun bores its way through the firmament each morning and evening. Alternatively, PT Rosh Hashanah 58a describes a system of 365 windows in the firmament through which the sun passes in the course of the year.[63]

3.5.3 Noise of the sun

Bereshit Rabba 6:7 reports the following conclusions about the sun's journey through the heavens:

> אמר ר' לוי ג' דברים קולן הולך מסוף העולם ועד סופו והבריות אינן שומעין, ואילו הן היום והגשמים והנפש בשעה שיוצאת. היום מניין? אמר ר' יהודה בר' לעיי: את סביר שהוא שף ברקיע ואינו אלא כמסר הזה שהוא נוסר בעץ.
>
> R. Levi said: The voice of three things travels from one end of the world to the other, yet no creature hears it, viz., the day [i.e. the sun], the rain, and the soul when it departs [from the body]. Whence do we know it of the day? Said Rabbi Judah b. La'i: You may think that it glides in heaven, but it is not so, being rather like a saw which saws through wood.

63 Such a system is attested to elsewhere in rabbinic literature. See Sarfatti (1966), pp. 142-44.

Maimonidies was the first to draw the parallel between this description of the sun making a tremendous yet inaudible noise, and the Pythagorean doctrine of the harmony of the spheres.[64] As we can see from Aristotle's account of this doctrine, the similarity between the two is quite striking:

> It seems to some thinkers [Pythagoreans], that bodies so great must inevitably produce a sound by their movement. Even bodies on the earth do so ... and as for the sun and the moon, and the stars, so many in number and enormous in size, all moving at a tremendous speed, it is incredible that they should fail to produce a noise of surpassing loudness. Taking this as their hypothesis, and also the speeds of the stars, judged by their consonances, they affirm that the sound of the stars as they revolve is concordant. To meet the difficulty that none of us is aware of this sound, they account for it by saying that the sound is with us right from birth and has thus no contrasting silence to show it up; for voice and silence are perceived by contrast with each other, and so all mankind is undergoing an experience like that of a copper smith, who becomes by long habit indifferent to the din around him.[65]

The idea that the heavenly bodies make thunderous sounds that we cannot sense is hardly intuitive. It is quite unlikely that R. Levi and his compatriots came up with this idea independent of the Pythagoreans. These rabbis likely learned it from their more hellenized neighbors. Nevertheless, there is no evidence that these rabbis had any understanding of the Pythagorean theory of celestial movements or its implications. Central to the Pythagorean theory is the belief that the sounds of the various heavenly bodies are in harmony with each other. There is no trace of such a belief among the rabbis. The rabbinic theory is apparently limited to the sun. There is no mention of noise emanating from the other heavenly bodies. Furthermore, the rabbis compare the noise of the sun to that of a saw going through wood. Far from harmony, the movement of the sun produces an ear-splitting cacophony. While this passage may reflect the fact that some rabbis picked up a few pieces of Greek cosmological theory, it does not show that rabbis actively engaged in the pursuit of Greek scientific ideas. Indeed, it is quite likely that the rabbis in our passage were not even aware of the fact that they were transmitting a Greek idea.

64 *The Guide to the Perplexed*, Part II, chapter 8. See also Theodor's note on this passage in BR.

65 Aristotle, *On the Heavens*, Book 2, chapter 9. Translation by W.K.C. Guthrie (Cambridge, 1953). See Wright's account of this concept, pp. 135-38.

3.5.4 The movements of the constellations

Though the rabbis believed that the heavenly bodies moved along the face of the firmament, they were well aware of the fact that not everyone held this belief. The Bavli in Pesachim 94b cites a *baraita* that records a dispute over this issue:

> תנו רבנן, חכמי ישראל אומרים: גלגל קבוע ומזלות חוזרין, וחכמי אומות העולם אומרים: גלגל חוזר ומזלות קבועין. אמר רבי: תשובה לדבריהם - מעולם לא מצינו עגלה בדרום ועקרב בצפון.
>
> Our Rabbis taught: The Sages of Israel maintain: The *Galgal* is stationary [fixed], while the *mazzaloth* [constellations] revolve; while the Sages of the nations of the world maintain: The *Galgal* revolves and the *mazzaloth* are stationary. Rabbi observed: This disproves their view [viz.,] we never find the Wain in the south or Scorpio to the north.

In this remarkable passage, the rabbis self-consciously place their own cosmological speculations into a comparative, cross-cultural context. Presumably, as Sarfatti argues, the "Sages of the Nations" here are the Greek cosmologists, especially of the classical school, who believed the constellations were embedded in a rotating sphere.[66] This is the only rabbinic text that I am aware of in which the rabbis apparently show an awareness of a Greek cosmology that is opposed to their own. The rabbis here display an understanding of at least the rudiments of the classical Greek conception of the universe.

Despite the fact that this text purports to demonstrate the differences between "gentile" and rabbinic cosmology, it may well also represent a striking instance of the influence of Greek science on the rabbis. The *baraita*'s use of the word *galgal* to refer to the firmament, as opposed to the usual term *kippah*, would seem to suggest that the rabbis understood that in the classical Greek model, the heavens are spherical rather than hemispherical. In the *baraita*, "the sages of Israel" assume that the heavens are shaped as a *galgal* as well. The authors of this *baraita* appear to have diverged from the mainstream rabbinic and Ancient Near Eastern conception of the heavens as a dome and embraced the Greek idea of a spherical heaven. Of course, it is also possible that *galgal* here simply connotes a hemisphere and does not have any revolutionary cosmological implications.

66 G. Sarfatti, "Three Comments Regarding Some Tannaitic Sources," *Tarbiz*, 32 (1963):140 [Hebrew]. See also Sarfatti (1966), pp. 146-48. Note, however, that Horowitz, pp. 14-15, argues that some ancient Babylonian texts similarly suggest a belief in the stars being fixed in a rotating heaven.

3.5.5 Precipitation

Finally we come to the question of the source of rainfall. The passages dealing with this issue present perhaps the most striking example of a Greek scientific theory finding its way into rabbinic discourse. Bereshit Rabba 13:10 records the following dispute: R. Joshua states:

> ממים העיליונים דכת' 'למטר השמים תשתה מים' (דברים יא:יא) והעננים מתגברים מן הארץ ועד לרקיע ומקבלים אותן כמפי הנוד דכת' 'יזוקו מטר לאידו' (איוב לו:כז).
> [The earth drinks] from the upper waters, for it is written, "And drinketh water as the rain of heaven cometh down" (Deut. 11:2); the clouds, however, mount up to heaven and receive them [the waters] as from the mouth of a bottle, for it is written, "They gather up water into its clouds" (Job 36:27).[67]

R. Joshua believes that the rain comes from the water that is suspended above the firmament. The clouds ascend to the firmament, where they receive water from above. Later, they deliver this water to the earth. This would seem to be the mainstream position among the rabbis, as it is often referred to elsewhere in rabbinic literature without challenge.[68] It is hardly surprising that this belief was widespread among the rabbis. Rainfall is consistently portrayed in a similar manner throughout the Bible and other Ancient Near Eastern literatures.[69]

The other theory of rainfall is that of R. Eliezer. His opinion appears to be more original:

> ד' אליעזר א': ממימי אוקיינוס דכת' 'ואיד יעלה מן הארץ והשקה וגו'' (בראשית ב:ו), אמר ליה ר' יהושע מימי אוקיינוס לא מים מלוחין הן אתמהא, אמר לו מתמתקים הן בעבים דכת' 'אשר ידלו שחקים' (איוב לו:כח) ואיכן הן נעשים נוחלים, בשחקים.
> R. Eliezer said: From the waters of the Ocean, for it is written, "But there went up a mist from the earth and watered, etc." Said R. Joshua to him: But surely the waters of the Ocean are salty! They are sweetened in the clouds, replied he, for it is written, "Which the skies distill" (Job 36:28). Where are they distilled [i.e. sweetened]? In the skies [clouds].

According to R. Eliezer, there is no connection between the waters above the firmament and rainwater. Rather, rainwater comes from the terrestrial ocean. Mist rises up from the ocean to the clouds, which eventually release the moisture as rain. R. Eliezer responds to the apparent discrepancy between the salt water in the ocean and sweet water that comes from the skies by claiming, on the strength of a

67 This dispute is also found in BT Taanit 9b.
68 E.g. BR 4:3 and 4:4
69 Stadelmann, pp. 120-26; Horowitz, pp. 262-63.

verse from Job, that the clouds function to purify the salt water into sweet water. Though this last point may seem questionable to modern science, the basic understanding of rain presented by R. Eliezer is quite similar to our own concept of the water cycle.

A variant of R. Eliezer's theory is reflected in another passage in Bereshit Rabba (4:5):

> הרקיע דומה לבריכה, ולמעלה מן הבריכה כיפה, ומחמת הבריכה כיפה מזעת, והיא מזעת טיפים עבות והן יורדין לתוך מים המלוחים ואין מתערבין.
> The firmament is like a lake, and above the lake is a vault, and through the heat of the lake the vault exudes moisture; it exudes heavy drops of water, which descend into the salt water yet do not combine with it.

This passage compares the formation of rain to the condensation of water on the roof of an enclosed cistern. The use of this image clearly implies an understanding of rain as the result of the evaporation of water on earth and its eventual condensation in the clouds.[70] This text also offers a different explanation as to why the rain is not salty. The salt water and the sweet water never actually mix in the ocean. Only the sweet water evaporates to the clouds.[71]

This remarkable explanation of rainfall has, to my knowledge, no precedent in the biblical and Ancient Near Eastern literatures. A similar theory was however, well known to the Greek world. Anaximander stated that, "rainfall arises from the vapor emitted under the action of the sun."[72] The early pre-Socratic Xenophanes of Colophon similarly explains rain as resulting

> from the heat of the sun, which causes all things to rise. For when moisture is drawn up from the sea, the sweet portion is separated because of the fineness of its parts, and it turns to mist and causes clouds to form and rain to fall in drops by its condensation.[73]

Aristotle forwarded a more complex version of this theory of the water cycle.[74] The understanding of rain as being a result of the evaporation and condensation of water was thus well established in Greek science. Educated people throughout the hellenized world likely knew of it. It is therefore most reasonable to suppose that R. Eliezer was influenced by Greek ideas in his understanding of rain. Unlike the

70 A similar description of condensation in an enclosed cistern is found in M. Machshirin 2:2.
71 See M. Parah for a parallel understanding of the dew cycle.
72 Kahn, p. 100.
73 Cited in Kahn, p. 105
74 *Meteorologica* 346^{b} 25 ff.

case of the harmony of the spheres, here we have an example of a complete Greek scientific theory reproduced in a rabbinic text. The Midrash's explanation as to why rain isn't salty like the sea even parallels that of Xenophanes. The argument between R. Joshua and R. Eliezer about the rain might thus be seen as reflecting a dispute between traditional Near Eastern and current Hellenistic science. However, as in the case of the noise of the sun, there is no evidence that R. Eliezer was aware of the Greek origins of his position.

3.6 The Rabbinic Understanding of the Heavens and its Roots

As I have demonstrated, the rabbis' view of the nature and structure of the heavens closely parallels Ancient Near Eastern perceptions on the matter, both in its broad conception and in many of its details. Though the rabbis' main source was certainly the Bible, they very likely had indirect access to other Ancient Near Eastern traditions about the heavens. Several of the rabbis' ideas about the heavens that have no source in the Bible have precedence in various Mesopotamian sources. Most notable among these are the widespread rabbinic belief in a multi-tiered heaven and R. Judah's position that the sun spends the night in the upper reaches of the heavens. The rabbis' use of the term *kippah*, as well as their etymology of the word *šâmayim*, quite possibly have their roots in Akkadian sources as well.

In addition, the rabbis also show some influence and awareness of Greek ideas about the cosmos. In the cases of R. Levi's silently noisy sun and R. Eliezer's water cycle, the rabbis were almost certainly inspired, perhaps unwittingly, by the Greek scientific theories. In the passage from the Babylonian Talmud about the motion of the heavenly bodies, the rabbis show an awareness of the Greek concept of rotating spheres and designate this idea as belonging to the "nations of the world." This passage might also reveal that some of the rabbis embraced some aspects of the Greek theory of the spheres. Finally, some parallels exist between various Greek theories and the rabbinic concept of seven heavens and the idea that the heavens are composed of fire and water. Thus, the rabbis were certainly not entirely closed to Greek scientific ideas and were quite possibly influenced by them. Further evidence of the impact of Greek ideas on rabbinic scientific thought will be presented in the following section dealing with scientific method.

Notwithstanding these signs of Mesopotamian and Greek influence, there are several rabbinic cosmological ideas and theories that have no parallels either in Ancient Near Eastern or Greek sources. The rabbis' idea that the upper waters hover over the firmament and R. Jonathan's view that the path of the sun at night varies with the seasons are prime examples of such apparently original ideas.

Similarly, the rabbinic conception of the heavens being composed of fire and water likely emerged independent of Greek influences. Finally, whatever its inspiration, the rabbinic formulation of the idea of a seven-tiered heaven does not appear in other sources. Examples such as these suggest that the rabbis were not merely passive transmitters of other people's cosmological ideas. Rather, they were engaged in original speculation in attempts to explain various observed phenomena. The rabbis thus represented a scientific culture of their own with its own unique cosmology.

4. THE RABBIS AND GREEK SCIENTIFIC METHOD

Thus far I have only analyzed the rabbis' conclusions about the nature and structure of the heavens. When looked at from this perspective, rabbinic cosmology appears to be rooted heavily in the Ancient Near Eastern tradition with only a light sprinkling of Greek influence. However, if we examine the methods and assumptions by which the rabbis came to and described these conclusions, we shall see that rabbinic cosmology may well bear the distinct imprint of the Greek scientific thinking.[75]

4.1 The Idea of "*Kosmos*"

In the Homeric literature, the word "*kosmos*" simply means "order." In particular, the term carries the meaning of something that is aesthetically pleasing as a result of its careful arrangement. It was likely the Milesians who first used this term to refer to the whole of the sensible world.[76] This linguistic innovation reflects a crucial development in Greek thought. The works of Homer, Hesiod, and other early Greek writers contain many statements and ideas out of which we can reconstruct their views of the structure of the heavens and the earth. However, "[n]one of them... presents a comprehensive account of the world as an ordered system."[77] This endeavor would only be taken up by the Greek thinkers of the sixth century BCE. They developed a new use for the term "*kosmos*," out of which developed a new intellectual discipline: cosmology. For the first time, Greek thinkers would engage in a systematic study of the universe predicated upon "a comprehensive view of the cosmos as an ordered whole."[78]

75 See Saul Lieberman, "The Natural Science of the Rabbis," *Hellenism in Jewish Palestine* (New York, 1950), pp. 180-93.

76 For a thorough account of the history of this term see Kahn, pp. 219-39.

77 Ibid., p. 201.

78 G.E.R. Lloyd, "Greek Cosmologies," *Ancient Cosmologies*, ed. Carmen Blacker and Michael Loewe (London, 1978), p. 200.

A similar trajectory might be traced through the development of Hebraic culture. As we have seen, the Bible contains enough information to allow us to reconstruct a fairly detailed account of the biblical authors' cosmological beliefs. However, as is the case with Homer and his colleagues, we do not find in the Bible systematic attempts to describe the whole of existence.[79] There is no biblical Hebrew equivalent to the Greek scientists' *kosmos*. Indeed, T.H. Gaster went so far as to argue that, to the ancient Hebrews, "the world was not one organic unity but a collection of disparate phenomena individually controlled and collectively disposed at the will of their collective creator."[80]

In contrast, the rabbis did have a sense of an ordered, integrated universe. The rabbinic use of the word *olam* to refer to the whole of the created order is similar to the Greek scientist's use of *kosmos*.[81] Certainly, the rabbis did not compose any comprehensive cosmographic studies on the order of those produced by the Greeks. However, the rabbis did show a more sustained and abstract interest in cosmology than did their predecessors. Furthermore, we do have a few brief texts that attempt to sketch out the structure and dimensions of the universe or at least a sizable part of it. We find a concise description of the entire universe in a passage in PT Berachot 2c, the first part of which we have already seen:

> דתני בשם רבי יודה עוכיו של רקיע מהלך חמשים שנה. אדם בינוני מהלך ארבעים מיל ביום. עד שהחמה נוסרת ברקיע מהלך חמשי' שנה. אדם מהלך ארבעת מיל. נמצאת אומר שעוביו של רקיע אחד מעשרה ביום. וכשם שעוביו של רקיע מהלך חמשים שנה כך עוביה של ארץ ועוביו של תהום מהלך חמשים שנה. ומה טעם? 'היושב על חוג הארץ' (ישעיה מ:כב) וכתיב: 'חוג שמים יתהלך' (איוב כב:יד) וכתיב: 'בחוקו חוג על פני תהום' (משלי ח:כח) 'חוג' 'חוג' לגזירה שוה.
>
> It was taught in the name of R. Judah: The thickness of the firmament is a fifty-years' journey.... And just as the thickness of the firmament is a fifty-years' journey, so too the thickness of the earth and of the *tehom* [the Deep].

R. Judah presents a neat, three-tiered view of the universe whose parts are equally balanced in thickness. In the midst of this description, R. Judah further establishes a 1:10 ratio between the thickness of the firmament and the distance across the

79 The evidence of the cuneiform literature also largely suggests a lack of interest in systematic cosmology. However, the Akkadian text KAR 307 30-38, cited by Horowitz, pp. 3-4, which does present a complete if brief cosmology, complicates the issue.

80 "Cosmogony," in *Interpreters Dictionary of the Bible*, Vol. I (New York, 1962), p. 702. See Louis Jacobs' response to this claim in "Jewish Cosmology," Blacker and Loewe, p. 67.

81 On the significance shift in the meaning of this word from biblical to rabbinic times see Max Kaddushim, *The Rabbinic Mind* (New York, 1952).

heavens. A more comprehensive measuring of the world from the surface of the earth upwards appears in Bereshit Rabba 6:6:

> מן הארץ עד הרקיע מהלך חמש מאות שנה ועובי הרקיע מהלך חמש מאות שנה ומרקיע עד רקיע מהלך ת"ק שנה.
>
> From the earth to the '*raki'a*' is a five-hundred-years' journey, and the thickness of the '*raki'a*' is a five-hundred-years' journey, and from the first '*raki'a*' to the next '*raki'a*' is a five-hundred-years' journey.

A full picture of the universe below the earth's surface is cited in PT Hagigah 77a:

> הארץ עומדת על מים "לרוקע הארץ על המים" (תהלים קלו:ו) והמים עומדים על הרים "על הרים יעמדו מים" (תהילים קד:ו) וההרי' עומדין על רוח "כי הנה יוצר הרים ובודא רוח" (ז:יג) והרוח תלויה בסערה "רוח סערה עושה דברו" (קמח:ח) וסערה עשאה הקב"ה כמין קמיע ותלייה בזרועו שנ' ומתחת זרועות עולם כי הנה יוצר הרים וגו'
>
> The earth stands on the waters, "who spread the earth over the water" (Ps. 136:6), and the waters stand on mountains, "the waters stood above the mountains" (Ps. 104:6), and the mountains stand on wind, "Behold, He who formed mountains And created the wind" (Amos 4:13), and the wind hangs by a thread [*se'arah*], "storm [*se'arah*] wind that executes His command" (Ps. 148:8), and the thread, God made into a sort of amulet and hung it from His arm, as it says, "A support are the arms of the Everlasting" (Deut. 34:27).

This description is most notable for the fact that it does not view the universe as resting on water as do the ancient mythological and biblical accounts. The water is merely an intermediate stage between the earth and the "mountains." As we have seen, the Milesians were also credited with rejecting the idea that the earth rests in water. More specifically, like Anaximenes and his followers, this rabbinic text sees the world as ultimately resting on air.[82]

4.2 The Use of Models

One of the most important implications of the Greek notion of the universe as *kosmos* is the belief that the world is unified and ordered by fundamental principles. As Wright explains,

> The Milesians were the first to be concerned with the basic nature and structure of the world as they attempted to simplify the range of phenomena

82 Wright, pp. 39-40

by finding explanations for the diversity in more fundamental principles, and so rendering the whole intelligible and accessible to rational analysis.[83]

In the course of this search for principles and systems, the Greek thinkers struck a powerful blow against the old mythological worldview: "The capricious world of divine intervention was being pushed aside, making room for order and regularity; *kosmos* was being substituted for *chaos*."[84] Previously, the Greeks, like other ancient peoples, believed that natural and especially heavenly and meteorological phenomena were directly controlled by the will of the god or gods. Now, the Greeks placed predictable, regular, natural laws between these phenomena and any autonomous divine powers.

Among the most important expressions of this search for universal principles was "the use of models as a method of approaching an understanding of the unknown from the known."[85] The Greeks used models based on their everyday experience to explain celestial phenomena and other inscrutable natural events. They presumed that the principles that apply to the world around us could also be used to explain the events of the heavens.

The rabbis also had a propensity to make use of models from their direct experience. We have seen how the rabbis compare the rain cycle to the condensation of moisture in an enclosed cistern. They compared the hardening of the firmament to the curdling of cheese, a model used by Aristotle to explain the formation of the fetus in the womb.[86] They likened the suspension of the upper waters above the firmament alternatively to the hovering of a flame or to the way in which water is held by suction inside a clepsydra. This last model is cited by Aristotle, in the name of Anaxagoras, to explain Anaximenes' view that the earth is suspended in air.[87] Similarly, R. Joshua compares the way water is split into rain drops in the clouds to the process of passing grain through a sieve (BR 13:10). In all of these cases, the rabbis seek to explain natural phenomenon through principles and processes from the world around them.

83 Ibid., p. 93.

84 David C. Lindberg, *The Beginnings of Western Science* (Chicago, 1992), pp. 26-27.

85 Wright, p. 7.

86 Aristotle, *Generation of Animals*, Book 2, chapter 4. On the role of this image in medieval Jewish literature, see Edward Reichman, "The Incorporation of Premodern Scientific Theories into Rabbinic Literature: The Case of Innate Heat," *The Torah U-Madda Journal*, 8 (1998-99): 189-90. The use of the curdling cheese image to explain the formation of the world is in fact found in many cultures. See Carlo Ginzberg, *The Cheese and the Worms* (Harmondsworth, 1982), pp. 57-58.

87 *Problems*, 914b10.

This attribution of natural occurrences to observable physical principles and processes found in the Palestinian sources contrasts sharply with the mythic approach taken in the Babylonian Talmud, Berachot 59a. There, earthquakes are attributed alternatively to God's groaning, His clapping His hands, or His rubbing His feet.[88] Whether or not there is a consistent gap between the rabbis of Babylonia and those of the Land of Israel on this point is a question that merits further study.[89]

4.2.1 Organic Models

Among the Greeks, "(t)he most important of the models for the cosmos was to see it as a living creature, and this model was so pervasive that it requires separate treatment."[90] This widespread view led many Greek thinkers to explain various cosmic phenomena in organic terms. Evidence of this tendency to see the world as an organism can also be found in rabbinic sources.

Among the most prevalent expressions of the Greek organic view of the cosmos is the concept of the world as a breathing organism and of air as the animating force in the world. Expressions of this idea include Plato's conception of the world soul and the Stoic doctrine of *pneuma*.[91] This trend of thought is generally traced back to Anaximenes, who stated: "As our soul, which is air, maintains us, so breath and air surround the whole cosmos."[92] A remarkably similar sentiment can be found in PT Hagigah 77a:

אדריינוס שאל לעקילס הגר, קושטין אתון אמרין דהין עלמא קיים על רוחא. אמ' ליה: אין. אמר ליה: מן הן את מודע לי. א"ל: אייתי לי הוגנין. אייתי ליה הוגנין. אטעונונון טעוניהון אקימון וארבעון נסתון וחנקון. אמר ליה: הא לך אקימון. אמר ליה: מן דחנקתון. א"ל: כלום חסרתנון לא רוחא היא דנפקת מינהון.

Hadrian asked Aquila the proselyte, "Is it true that you [rabbis] say that this world stands on the wind?" He said to him, "Yes." He said to him, "How will you prove it to me?" He said, "Bring me young camels." They brought him young camels. He placed loads upon them. He made them stand up and

88 See Michael Fishbane, "'The Holy One Sits and Roars': Mythopoesis and the Midrashic Imagination," *The Midrashic Imagination* (Albany, 1993), pp. 60-77.

89 Lieberman notes that there is much more magical material in the Babylonian Talmud than in the Palestinian. Saul Lieberman, *Greek in Jewish Palestine* (New York, 1942), p.110; see also Louis Ginzberg on *Jewish Law and Lore* (Philadelphia, 1955), pp. 22-24. For more on the Palestinian view of the natural order see Becker.

90 Wright, p. 56.

91 Ibid., pp. 61-63.

92 *Aetius* (1.2.4) as cited by Wright, p. 61.

lay [back] down. He then took them and choked them. He said to him, "Here, make them stand up." He said to him, "Now that you have choked them?!" He said to him, "Nothing is missing but the breath that has gone out of them."

Once again, we find rabbinic advocacy for the idea that the world is supported by air. Aquila argues that just as the camels are animated by breath (*ruḥa*), so too the world is supported by the winds (*ruḥa*). He unmistakably adopts the Greek view of the world as a living, breathing organism. It is perhaps not a coincidence that we find these words in the mouth of Aquila, a proselyte who had a Greek education.[93]

On another occasion (BR 4:4), we find R. Meir comparing the movement of water in the universe to the way in which we maintain our own body water.

כותי אחד שאל את ר' מאיר... אמר לו: אפשר "פלג אלהים מלא מים" (תהלים סה י) משמת ימי בראשית ולא חסר כלום אתמהא, אמר לו: היכנס רחוץ ושקול עצמך עד שלא תיכנס ושקול עצמך משתיכנס, הלך ושקל עצמו, לא חסר כלום, אמר לו: כל אותה הזיעה שיצאת לא ממך יצאת? אמר לו הין. ומה שאתה בשר ודם לא חסר מעינך כלום, מעינו שלהקב"ה על אחת כמה וכמה! הוי 'פלג אלהים מלא מים' משמת ימי בראשית ולא חסר כלום.

A Samaritan asked R. Meir:... "Is it possible that, 'the river of God is full of water' (Ps. 65:10), since the six days of Creation and has not been diminished at all: it is incredible!" "Go in and bathe, and weigh yourself before you enter and after you have gone in," replied he. He went and weighed himself, and his weight did not diminish at all. Said he to him: "Now, all that perspiration, did it not ooze from you?" "Yes," answered he. "Then if your fountain [of perspiration] did not in any way diminish, though you are a mere mortal, how much more is this true of the fountain of the Holy One, blessed be He!" Hence, "'The river of God is full of water' (Ps. 65:10), since the six days of Creation and has not been diminished at all."

R. Meir apparently believed that sweat comes from an inexhaustible water source inside the body. This inner reservoir always remains at the same level. Hence, R. Meir claims that body weight does not change as result of water loss.[94] He draws a parallel between the operation of the human body and the functioning of

93 For a further discussion of this passage and its relationship to Hellenistic philosophy, see E.E. Halevy, *The Historical-Biographical Aggadah in Light of Greek and Roman Sources* (Tel Aviv: Tel Aviv University, 1975), p. 438 [Hebrew].

94 This appears to be yet another original rabbinic scientific idea. I have been unable to find a parallel to this belief in other ancient medical traditions.

the heavens. Thus, the upper waters, which R. Meir, like the majority of his colleagues, believed to be the source of rain, are never lacking a single drop, even after a rainstorm. In a similar manner, R. Abba b. Kahana and R. Shmuel b. Nahman suggest digestive models to illustrate the way in which water is purified and broken down into droplets in the clouds (BR 13:10).

Finally, a careful examination of the suction model given for the suspension of the upper waters mentioned above will reveal that this model was also meant to be understood essentially as an organic one. This model comes from the same passage in Bereshit Rabba 4:4 in which R. Meir offers his body water model to the Cuthite:

כותי אחד שאל את ר' מאיר אמר לו אפשר המים העליונים תלוים במאמר, אמר לו הן, אמר לו הבא לי ארפכס, הביא לו אדפכס, נתן עליה טס שלזהב ולא עמדו המים, טס שלכסף ולא עמדו, כיון שנתן אצבעו עמדו מים, אמר לו אצבעך אתה נותן, אמר לו מה שאני בשר ודם אצבעי מעמדת המים, אצבעו שלהקב"ה על אחת כמה וכמה, הוי המים העליונים תלוים במאמר.

A Samaritan asked R. Meir: "Is it possible that the upper water is suspended by [God's] word?" "Yes," he answered. "Bring me a water-clock," he added. When he brought it, he placed a gold plate upon it, but the water did not stand still; then a silver plate, but the water did not stand still. But as soon as he placed his finger [upon the aperture], the water stood still. "But you have put your finger there," he objected, – "If my finger stays the water, though I am but of flesh and blood, How much more so the finger of the Holy One, blessed be He!" Hence the Upper waters are suspended by [God's] word.

R. Meir understood the suction action to be somehow dependent on the fact that the limb of a living being seals the hole on top of the clepsydra. He was apparently unaware that any airtight seal, organic or not, is sufficient to create a vacuum. R. Meir thus understood at least a part of the universe as being held together by a living force. It is important to note, however, that in this case the living force emanates not from the cosmos but from God Himself.

This last example brings home the point that while an organic view of the universe certainly existed among the rabbis, it did not carry with it the pantheistic implications that it took on with Plato and some of his colleagues and successors. If some rabbis believed that the universe was a living organism, they saw it merely as the largest of God's creations, not as some sort of divinity.

5. CONCLUSION

The rabbis of the Land of Israel were not merely passive transmitters of inherited ideas about the cosmos. Rabbinic cosmology is a dynamic synthesis of biblical texts, ancient Mesopotamian traditions, classical Greek scientific theories and methods, and the rabbis' own original speculations. In addition to enriching our knowledge of the history of science, the study of rabbinic cosmology raises some important issues regarding the rabbis' relationship with the major cultural currents of the ancient Mediterranean world. Though they were significantly influenced by both the Mesopotamian and the Greek cosmological traditions, the rabbis of the Land of Israel make virtually no direct reference to any of the non-biblical sources of their teachings. In some cases, the rabbis were most certainly ignorant of the fact that they were transmitting or adapting ideas that were first formulated by gentiles in far off lands. In other instances, some rabbis were likely aware of the sources of their ideas yet, for reasons about which we can only speculate, they chose not to credit these sources. The rabbis of the Land of Israel emerge as unwitting or, at times, consciously conflicted cosmopolitans. Their relationship with the cultural forces was one of creative tension shaped by the rabbis' curiosity, their ambivalence and their ignorance.

Zecharia Dor-Shav (Dershowitz)

5768: EGO, LANGUAGE AND FREEDOM OF CHOICE

It has been suggested that humankind possessed the sense of "I" (ego) at a relatively advanced point in its development. Until the times of ancient Greece, it is likely that most of humankind was unaware that thoughts, and/or inner voices experienced, were self-generated.

The development of enhanced social organization among *Homo Sapiens* supported increased neuronal processing, which led to exponentially expanded language development. This led, eventually, to the unique language ability that characterizes modern humankind.

It is rewarding to compare this developmental sequence with the traditional rabbinical exposition of the development of humankind, and the special attributes of Adam and Eve. *Hazal* define humankind as a spirit possessing words. Only then was Man given freedom of choice. It is striking to note the first recorded actions of Adam. After he *named* the animals and birds of the world, regarding woman he *said*, "This [creature] shall be called *ishah*." We note the difference between he "*named*" and he "*said*," the former being a mental pre-speech activity, the latter a verbal activity. We propose that the speaking spirit refers to humankind's verbal – rather than mental – activity.

Advanced understanding of reward and punishment was also required before Adam achieved a full sense of self, and could truly exercise free choice. This, we suggest, could only be achieved after man possessed advanced alphabetical language. The Talmud indicates that Adam, by the end of Creation, indeed had that ability.

Through Abraham, mankind matured and a sense of self, as well as an understanding of the responsibility for the consequences of one's behavior, became common to all.

INTRODUCTION

In this paper, we assume the midrashic position[1] that events described in Chapter 1 of Genesis are unique. As Rabbi Levi, in the name of Rabbi Chama Bar Chanina, taught:

> "And it was evening and morning, the sixth day" (Gen. 1:31). ... From the beginning of the book [The Torah] until here, the glory of *The Lord* is

1 *Breishit Rabah*, Chapter 9.