

# The Story of $\pi$

from Harav Yitzchak Ginsburgh

## Introduction

Without a doubt, one of the most intriguing geometric questions lies in the age-old study of the circumference of a circle. In direct contradistinction to the elusive simplicity and perfection of its form, the circle’s circumference is impossible to measure. This highlights what is perhaps the most basic dichotomy between man and nature. As human beings, we love to measure and quantify. But, just as much as we love to measure, nature seems to detest it.

The basic reason for this dichotomy was already expounded by the wisest of all men, King Solomon, who wrote, “God made man straight, and yet he seeks so many machinations.”<sup>1</sup> The nature of the human mind is to think straight—hence our affinity for the straight edge ruler. But, the natural world, by its very nature, is curved. As the sages tell us, “there are no squares in nature”<sup>2</sup>—sorry, your straight edge simply does not cut it when it comes to quantifying natural phenomenon. So obviously, following this interpretation, the machinations sought are all meant to capture nature in its act.

And this is where the transcendental number  $\pi$  comes in.  $\pi$  represents the most basic intermediate spanning the gap between the human mind and nature’s curves.  $\pi$  allows us to within any degree of accuracy to translate a curve into a straight line. Take the circle with radius  $r$ . No squares in nature, in fact we can say that there are almost no regular polygons in nature.<sup>3</sup> So, regardless of how many sides in your regular polygon, you cannot use it to measure the circumference of the curved circle. But, you can come close. And approximating this relationship between the straight and the curved is indeed the story of the number  $\pi$ .

Histories can be told from a number of difference perspectives. The story of  $\pi$  has been told a number of times, but mostly from the perspective of discovery. Even the story of  $\pi$  from the perspective of traditional Jewish sources has been told.<sup>4</sup> Here we offer a fresh point of view, one that can only come from the psychologicistic and mystical



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2 Hausner St. • Jerusalem 96431 • tel.: 972.547.533770 • [gps@inner.org](mailto:gps@inner.org)

air of the inner dimension of the Torah. We are going to tell the story of  $\pi$  from the perspective of its remainder.

Geometrically,  $\pi$ 's remainder is the discrepancy between dividing the circumference by 3 and getting the value of its diameter. Numerically, it represents the part of  $\pi$  that runs on forever and ever after the decimal point.

In this article, we will tell the story of this remainder from the perspective of the basic transformational model described by the Ba'al Shem Tov, the 18<sup>th</sup> century founder of the Chassidic movement. Since we have covered this model and its particulars in many other articles and books,<sup>5</sup> we will for our present purpose limit ourselves to introducing its three general stages: submission, separation, and sweetening. In other words, we will see how the remainder is submitted (or suppressed), how it is separated, and finally how it is sweetened.

## Submission

In the Book of Kings,<sup>6</sup> we find the following description of the pool (literally, sea) made by King Solomon.

*And he cast the pool, ten cubits from edge to edge, round, five cubits deep, and the perimeter surrounding it thirty cubits.*

Based on this verse, Rabbi Refa'el Immanuel Chai Riki in his book *Choshev Machashavot*<sup>7</sup> on the Bible (written 1617-8) writes that,

*The width of a hexagon circumvented within a circle is exactly a third of the perimeter of the polygon, not more and not less.*

In the Hebrew text of the verse in Kings, the word "perimeter" (קו) is written and read differently. Such a variation between the way a word is read and the way it is written is one of the manifest mysterious phenomena of the Bible. In this particular case, the word is written קוה, but read קו. The obvious point, as highlighted in *Choshev Machashavot* is that for a circle with diameter 10 cubits, the circumference is not exactly 30 cubits. The additional letter ה that appears in the written form but is not read indicates the presence of a remainder that was suppressed.

Based on this same observation, it is well known that the Gaon of Vilna, some 100 years later, offered the following elaboration. If we take the numerical value of the written form of "perimeter" (קוה), 111, and divide it by the oral form (קו), 106 and then multiply it by 3 we get a very good approximation for  $\pi$ . Specifically,

$$3 \cdot 111/106 = 3.1415094\dots$$

The sages too make a statement similar to that of the *Choshev Machashavot*, “if something’s circumference is 3 cubits, its width is 1 cubit.” But, the manner in which it was described by the *Choshev Machashavot*—the circumference of the hexagon enclosed by a circle is exactly 3 times the circle’s diameter—highlights that the significance of suppressing the remainder entirely (using 3 for  $\pi$ ) reflects the secret of the Shabbat. The six sides of the hexagon enclosed in the circle represent the six weekdays. The remainder of  $\pi$ , reflected by the difference between the circumference of the circle and the circumference of the hexagon, represents the Shabbat. How so?

The source of Shabbat and what it manifests in our physical reality is the highest part of the *sefirah* of crown called “the unknowable head” (רִישׁ אֵלֹהִים אֲתִידַע) or *Radla* (for its acronym, אֲרָדְלָא). The *Radla* is the faculty of faith in the soul. In Hebrew, the words for “faith” (אֱמוּנָה), “art” (אֲמִנוּת), and “craftsman” (אֲמֵן) stem from the same root, alluding to the craftsmanship needed to draw a perfect circle.

To fully understand the next point about the relationship between the remainder of  $\pi$  and the Shabbat, we need to quickly introduce the correspondence between suppression and thought. The central process described by the Ba’al Shem Tov in terms of submission, separation, and sweetening, is speech. Rectified and positive speech requires that the speaker first reflect in silence on his thoughts (silent thought is the suppression, of speech). Next, the speaker must sever and separate the words and content biased by the ego. Finally, rectified words can be spoken. These three stages are hinted to in the word *chashmal* (חֶשְׁמַל) that appears in Ezekiel’s vision of the Divine chariot, which the Ba’al Shem Tov divided into three two-letter words, *chash* (חש), *mal* (מל), and *mal* (מל). *Chash*, “silence,” is also the two-letter root of “thought” (מַחְשְׁבָה). The first *mal* is the two-letter root of “circumcision” (מִילָה), the essential act of separation. The second *mal* is the two-letter root of “word” (מִלָּה), or “speech” (מִלְלָה).<sup>8</sup>

Now, returning to the suppression of the remainder of  $\pi$ , the Shabbat represents the world of thought (corresponding to the first stage of suppression), whereas the six days of the week represent speech. This is clearly seen in the account of creation, where on the six weekdays God creates reality by speaking (the ten utterances). But, on Shabbat, He suppresses His speech; thereby nothing new was created on Shabbat.<sup>9</sup> As explained, the suppression of speech indicates thought. In the words of the sages, “silence surrounds wisdom”<sup>10</sup> and of course the inner aspect of wisdom in Kabbalah is selflessness (בְּטוּלָה), the foundation of all ability to submit. In addition, in the Arizal’s teachings, wisdom is considered the essence of the Shabbat. Indeed, selflessness too is rooted in the highest part of the crown, in the *Radla*, the place in the soul where self-reflection and self-knowledge are impossible, thereby giving rise to selflessness.

From this analysis, it becomes clear that the suppression of  $\pi$ 's remainder is not the result of either inaccuracy or ignorance, because we do find that in other places, the Torah does account for the remainder. Instead, it precisely reflects the act of submission in the psyche and the soul and by concealing the remainder points us in the direction of selflessness, the root of the Shabbat.

## Separation

One of God's Names, *Shakai*, normally translated as Almighty, is profoundly linked with  $\pi$ . The *gematria* of *Shakai* (שְׂכַי) is 314, easily suggesting  $\pi$ 's first 3 digits: 3.14. It is essential to note that the Torah uses base 10 numbering but does not use the decimal fraction. Therefore, a number such as 3.14 can only be suggested by its integer counterpart, 314. The two numbers are of course equivalent.

The sages explain that *Shakai* is an acronym for "He told His world, 'Enough!'" (שְׂכַי לְעוֹלָמוֹ דִּי לְעוֹלָמוֹ דִּי). As expounded in the *midrash*, the world was created by expansion, but the expansion was at first without limit, prompting God to limit it so that reality should have boundaries. This limiting process is the equivalent of the mathematical finite limit, whereby, through a series of infinite operations, we can come progressively closer to the value of  $\pi$ , but of course can never define it exactly.

The implication that  $\pi$  can be known through a limiting process is implied in the first verse of *parshat Va'eira*,

*I have appeared to Abraham, to Isaac, and to Jacob by the Name of Kel Shakai, but by my Name, Havayah, I was not known to them.*

In this verse, first, the 3 patriarchs are mentioned. Then the Name *Kel* (כֵּל) appears, whose numerical value is 31. Then, the Name *Shakai*, whose numerical value is 314.

Hence, this verse reveals the first three numbers in the infinite progression that is  $\pi$ :

3, 3.1, 3.14, ...

The identification of  $\pi$  with 3 made by the sages is itself an allusion to the 3 patriarchs, since the sages themselves denote the intrinsic connection between the patriarchs and the number 3, "Only three are called patriarchs, Abraham. Isaac, and Jacob." The ratio of 3:1 alludes to the clear-cut faith that the patriarchs bestowed unto the Jewish nation, the faith in one God.<sup>11</sup>

The numerical value of the three patriarchs (אַבְרָהָם יִצְחָק יַעֲקֹב) is 638, or the product of 22 and 29. If 638 is the circumference of a circle then the closest integer to its diameter would be 203, or  $7 \cdot 29$ . Indeed, this illustrates the closest ratio to  $\pi$  for integers under 100, which is  $22/7$ . 203 is also the value of just the first three letters of "Abraham" (אַבְרָם)

before the *hei* that God added to his name upon commanding him to circumcise himself. The literal meaning of these three letters is “limb” or “wing” (i.e., “arm”), suggesting the diameter of a circle. In addition, these three letters permute to spell *bara* (ברא), “create,” the first verb of the Torah, and indeed the first three letters of the Torah. If we then add the circumference to the diameter we get 841, or  $29^2$  or  $\square 21$  (which denotes the inspirational number of 21, or  $21^2 + 20^2$ ). Amazingly, the value of the words “to Abraham, to Isaac, and to Jacob” (אֵל אַבְרָהָם אֵל יִצְחָק וְאֵל יַעֲקֹב) is 737, the exact value of “He told His world, ‘Enough!’” (שָׂאֲמַר לְעוֹלָמוֹ דִּי). 737 is also the value of the words, “With all of your heart, with all of your soul, and with all of your all”<sup>12</sup> (בְּכָל לִבְבְּךָ וּבְכָל נַפְשְׁךָ וּבְכָל מְאֹדְךָ), whose three aspects, three levels of love of God, correspond to the three patriarchs.

The most important example of two words in the Torah that exhibit a circumference to diameter ratio (within integers) are the first two words of the Ten Commandments, “I am *Havayah* [your God]...”: The word for “I am” (אֲנִי) equals 81, while *Havayah* (יְהוָה) equals 26.

If we follow the same rationale for “Shabbat” (שַׁבָּת), 702 which we saw above corresponds to the suppression of the remainder of  $\pi$ , we find that its diameter would be 223, or “There is none but Him” (אֵין עוֹד מִלְבָּדוֹ), or “This is the thing,” (זֶה הַדָּבָר), both indicating a revelation of the *Radla*, as above. The latter, in particular, is the idiom that differentiates between the clarity of Moshe’s prophecy and the riddled nature of other prophets’ prophecies. Indeed, Moshe Rabbeinu received prophecy through his faculties of thought (particularly his wisdom), whereas all other prophets received it through their faculties of imagination.<sup>13</sup>

Returning to the finite limit of  $\pi$ , the next decimal fraction is 3.142 (this is the closest decimal approximation to 3.14159...) and its integer equivalent is 3142. Does 3142 also appear in this verse? If it does, we would expect it to appear in the words following the Name *Shakai* (314), “but by my Name, *Havayah*, I was not known to them.” *Rashi* writes that God is saying that by not revealing the Name *Havayah*, “I did not reveal to them my measure of truth.” In our context, God’s measure of truth refers to the secret of the true measure of  $\pi$ . In other words, what the verse is saying is that God’s Name *Havayah* (וְשֵׁמִי יְהוָה) contains the secret of the remainder of  $\pi$ . Let us see how.

The *gematria* of the words in the verse up to this final phrase (וְאֵרָא אֵל אַבְרָהָם אֵל יִצְחָק) (וְאֵל יַעֲקֹב בְּאֵל שָׂדֵי) is 1292.<sup>14</sup> The remaining two words in the verse, “But, by my Name, *Havayah*” (וְשֵׁמִי יְהוָה) both have 4 letters. The secret here is that instead of just the regular *gematria* of these two words, we need to calculate the equivalent of their dot product (this is called “particular multiplication,” הַבְּנָאָה פְּרָטִית, in Kabbalah).

$$1 \cdot 1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot 8 \cdot 9 \cdot 10 = 10 \cdot 6 \cdot 300 \cdot 5 \cdot 6 \cdot 10 \cdot 10 \cdot 5 = 1850$$

And indeed,  $1292 \pm 1850 = 3142!$

Continuing the above logic, the next whole number to look for is 31416. To discover this number in our verse we need to divide it into two parts, 31 and 416.<sup>15</sup>

First note that the two-letter Name of God *Kel* (לֵאלֹהִים), 31, appears 3 times before in the verse as “to” (אֶל), “to Abraham, to Isaac, and to Jacob.”<sup>16</sup> In the final phrase of the verse these same two letters invert to spell *lo* (לֹא), “no” or “not,” “I was *not* known to them,” alluding to the unknowable remainder of  $\pi$ .

Now note that the first word of the verse (for which the Torah portion is named) is “I have appeared” (וַיֵּרָא) shares the same number, 208, as one of the three patriarchs mentioned immediately in the continuation: Isaac. This phenomenon is understood to mean that the Divine revelation to all of the three patriarchs was through the conduit of the soul-root of Isaac ( $208 = 8 \cdot 26$ , or 8 times *Havayah*). The sages teach us<sup>17</sup> that Isaac is the patriarch of the future. The light inherent in his soul and name will be the Divine revelation of the future.

The word after “I have appeared” is “to” (אֶל), whose value is 31. The word before “Isaac” is also “to” (אֶל). The word between the two “to” is Abraham, whose name equals 248, or 8 times “to” (אֶל), meaning that the three words between “I have appeared” and “Isaac” are equivalent to 10 times “to” (אֶל), or 310, which according to the logic of our present analysis is the same as 31! And the *gematria* of these two words, “I have appeared” (וַיֵּרָא) and “Isaac” (יִצְחָק) both equal 208 so their combined value is 416. So here we have discovered the two parts of 31416 in our verse! This is the beginning of the revelation of the future.

In the future the exact value of the transcendental number  $\pi$  will be known to all those who will connect to God in awe, as it is said, “the secret of *Havayah* is to those who fear Him, and His covenant He will make known to them.”<sup>18</sup> The secret of  $\pi$ 's remainder relates to name *Havayah*, as we saw, and this secret will be made known to those who fear Him. In Hebrew, the word used in reference to the patriarchs, “I did not make known [to them]” (נִדְרַעְתִּי) is the same as the word in this verse, “I will make known to them” (לְהוֹדִיעֵם). Furthermore, both verses refer to God’s covenant, implicitly implying that the secret of  $\pi$ 's remainder is the secret of God’s covenant with the Jewish people.

The finite limit approach to  $\pi$ 's remainder reflects the stage of separation. The very concept of a limit, a dividing line, is an expression of separation. In addition, the particular verse in which this approach to  $\pi$ 's remainder refers to God’s covenant, which was given to Abraham as the commandment of circumcision (itself separating between the Jewish people and all other peoples of the earth). We noted above that separation

corresponds to the first *mal*, as in circumcision. God's covenant refers specifically to the *sefirah* of foundation (in the human form, the procreative organs corresponds to foundation). God's Name that corresponds with foundation is *Shakai* and as learned from this verse, it is the Name associated with His covenant.

## Sweetening

The primary circle discussed in the Torah and the primary circle of human reality is the yearly cycle,<sup>19</sup> literally called the "circle of the year" (מעגל השנה) in Hebrew and the amount of time it takes the earth to revolve around the sun or for the moon to revolve around the earth 12 times. In Hebrew, the word for "year" (שנה) refers to itself, because its *gematria* is 355, the number of whole days in a full lunar (12 month) year.<sup>20,21</sup>

The first and primary measure of time in the Torah and in nature is the day—the time it takes the earth to revolve around itself. Interestingly, in the Torah the word for "day" (יום) is synonymous with year. Now, if we write out the filling of the word "day," we get: יוד ואו מם, whose *gematria* is 113.

In addition, there is an expression in the Torah, "a day or two days" (יום או יומים),<sup>22</sup> which the sages interpret to mean not two days but rather a full day, 24 hours. In this phrase, the words "or two days" (או יומים) have the same numerical value as the filling of the word "day" יוד ואו מם,<sup>23</sup> implying that a full day can indeed equal 113.

We have found therefore that the primary circle is constructed out of the days of the year, where day equals 113 and year equals 355. Indeed, the closest integer fraction to  $\pi$  for integers under 100,000 is known to be the ratio of these two numbers (the next best pair of integers for  $\pi$  are 33,102 and 103,993, whose ratio is 3.1415926...)!

$$355/113 = 3.141592920$$

The value of  $\pi$  as found using more complex methods has been calculated to begin with the numbers: 3.141592653.... Thus, this ratio gives us  $\pi$  to 1 part in a million! Note that this value for  $\pi$  is far more precise than the value (3.1415094...) discovered by the Gaon of Vilna, as described above. It has variously been reported that this fraction was known in the Far East long before it was discovered in the West.

Recall that the Gaon of Vilna's approximation was based on the ratio of 333/106. Above we mentioned that the closest ratio to  $\pi$  of integers less than 100 is 22/7. If we add 22 to 333 we get 355. Likewise, if we add 7 to 106 we get 113! Also, the addition of 7 to 106 is implied in the words "or two days" (או יומים) since the value of the first word "or" (או) is 7 and the value of the second word "two days" (יומים) is 106!

But the most remarkable finding regarding 355 and 113 presents itself when we look at the full verse from where the expression "a day or two days" is taken. The complete

verse reads, “But, if he continues to stand a day or two days, he shall not be penalized, for he is his money” (אֲךָ אִם יוֹם אֶוּ יוֹמִים יַעֲמֵד לֹא יִקָּם כִּי כֶסֶפוֹ הוּא). Almost every verse in the Bible is divided in two by a cantillation mark called an *etnachta*. In this verse, the *etnachta* divides the verse exactly where we have placed the comma in our English translation. If we calculate the *gematria* of the first half of the verse, “But, if he continues to stand a day or two days” (אֲךָ אִם יוֹם אֶוּ יוֹמִים יַעֲמֵד), we find that it is exactly 355! Thus, the first half of the verse contains both 355 and 113, or more precisely, 355 around 113!

In this case, the remainder is sweetened and can be expressed openly. In Kabbalah, time is considered the force that sweetens the severe judgments that emanate from the *sefirah* of understanding. It is specifically days that are described in the Bible as figuratively talking and expressing themselves.<sup>24</sup> Time itself emanates from the *sefirah* of kingdom, which is also known as the world of speech and expression.

Now, let us take a deeper look at these two numbers, 355 and 113.

113 is the inspirational number of 8, or  $8^2 + 7^2$ . But, if we add it to the two preceding squares and the two following squares, we will get  $5^2 + 6^2 + 7^2 + 8^2 + 9^2 + 10^2 = 355$ ! 355 is the sum of the 6 consecutive square numbers—from the 5<sup>th</sup> to the 10<sup>th</sup> square numbers. These two numbers 5 and 10 are the values of the letters of God’s Name, *Kah* (ה״י), which appears in the verse, “For with *Kah*, *Havayah* is the creator of worlds.” The sages explain that God created this world with the second letter of the Name *Kah*, the *hei* (ה), and that He creates the World to Come with the first letter, the *yud* (י). This too alludes to the craftsmanship needed to draw the circle and its diameter.

Put another way,  $355/113$  is the same as  $(5^2 + 6^2 + 7^2 + 8^2 + 9^2 + 10^2)/(7^2 + 8^2)$ , the sum of three inspirational numbers (of 6, 8, and 10) divided by the middle inspirational number.  $\pi$  is truly inspiring!

Note also that if we take the sum of the roots of the squares and divide, i.e.,  $(5 + 6 + 7 + 8 + 9 + 10)/(7 + 8)$ , we get  $45/15 = 3$ , the value for  $\pi$  given by the sages, as quoted above.

The sum of 355 (the circumference) and 113 (the diameter) is  $468 = 18 \cdot 26$  where 18 is the value of *chai* (י״ח, meaning alive) and 26 is the value of *Havayah*. 468 is also the product of 3 times “Joseph” (יֹסֵף). This is a most interesting result. If we take a step back and look at what we have done, we can see that we have taken temporal concepts (year and day) and used them to describe spatial concepts (circumference, diameter, and  $\pi$ ).<sup>25</sup> Joseph is described in the Torah as the soul with the power to translate between the spatial and temporal dimensions. This is most clearly seen in his interpretation of Pharaoh and Pharaoh’s ministers’ dreams. They dreamed of spatial objects (3 vines, 3 baskets of bread, 7 cows, and 7 stalks of wheat) and Joseph translated them into temporal objects (3 days, 3 days, 7 years, and 7 years, respectively).<sup>26</sup>

In more conceptual terms, the words for “year” and “day” in Hebrew are feminine and masculine respectively. This is true conceptually as well. Thus, the relationship of the circumference (represented by the year) and the diameter (represented by the day) is conceptually that of the feminine to the masculine. This is beautifully captured in the verse, “The female will surround the male.” The transcendental secret behind  $\pi$  is thus the secret of the unification of masculine and feminine. The particular word denoting the unification of male and female is “coupling” (זויג). Numerically, this word’s *gematria* is 22, and its initial is the letter *zayin* (ז) whose value is 7. The ratio of 22:7 (3.1428...) is the closest to  $\pi$  for integers under 100. Spiritually, there is no greater source of sweetening than the coupling between male and female. In fact, in Kabbalah the circle represents nature while its straight diameter represents human reason. The source of all hardship and stern judgment in the world is nature, which acts coldly and without compassion. Man is entrusted with sweetening nature by connecting with it in a constructive manner.

Let us now conclude with a bit more on the male-female relationship that lies at the heart of  $\pi$ . The feminine aspect, the circumference is also represented by “Pharaoh” (פֶּרַעִי), whose name equals 355. 355 is also the value of the word *sefirah* (סְפִירָה), indicating that there is indeed something round about the *sefirot*. This also provides some basis for the proposed etymology of the word “sphere” in English, that it is somehow related to *sefirah*.

In the Bible, Pharaoh is the feminine half of the pair of great serpents that God created on the fifth day of creation. They are described in the prophets as “the snake-like round leviathan” (לִוְיָתָן נָחָשׁ עֵקֶלְתוֹן) and “the snake-like straight leviathan” (לִוְיָתָן נָחָשׁ בָּרֵחַ), clearly a metaphor for the circumference and the diameter, respectively. Indeed, the *gematria* of “round” (עֵקֶלְתוֹן) is 656, which would give a diameter (to the closest integer) of 209, 1 less than the value of “straight” (בָּרֵחַ).<sup>27</sup>

When God sent Moshe to Pharaoh he told him,<sup>28</sup>

*You shall take this staff in your hand and with it you will perform the signs.... Moshe took the staff of God in his hand.*

Moshe used the staff of God to perform signs that would subdue Pharaoh and prove to him that God is omnipotent. Since Pharaoh represents the circumference of the circle as above, it follows that the staff of God should function as his diameter. Allegorically, if Moshe could show Pharaoh—the circle—that he knows the secret of  $\pi$ , this would be like subduing Pharaoh’s greatest source of power, his mastery of nature and the natural world. Moshe’s straightness, his staff, represents the Divine soul of man that comes to subdue that natural world and sweeten its harsh judgments. Now, in the verse just

quoted, the word “staff” appears twice in two variations, once as “the staff” (הַמֵּטֶה) and once as “staff” (מֵטֶה). The *gematria* of these two instances of “staff” together equal 113! So, indeed, Moshe’s staff acted to subdue Pharaoh’s (355) circumference by revealing the secret of  $\pi$ .

When Moshe and his brother Aaron performed the signs for Pharaoh, we find the following description,<sup>29</sup>

*If Pharaoh speaks to you saying, “Make yourselves some sign,” you shall tell Aaron, “Take your staff, cast it before Pharaoh, and it will become a serpent.” Moshe and Aaron came to Pharaoh and they did so, as God had instructed. Aaron cast his staff before Pharaoh and before his servants and it became a serpent. Pharaoh called his wise men and his sorcerers and they did the same with the wizardry of the Egyptians. Each cast his staff and they became serpents; then Aaron’s staff swallowed their staffs.*

In this section of the Torah the word “Pharaoh” appears 5 times and their value is 1775 (5 times 355), and the *gematria* of the words “it will become a serpent” (יְהִי לְתַנִּין) is 565, or 5 times 113. Of course, their ratio is then the same as 355/113! Thus, we have another illustration of how the staff as a serpent (the diameter) subdued Pharaoh (the circumference).

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1. Ecclesiastes 7:29.

2. *Yerushalmi Nedarim* 3:2.

3. The one notable exception is crystals, e.g., salt crystals. They do have straight edges and may approximate a regular polygon.

4. Albeit, in a very limited manner, excluding many of the most important sources on the subject. See for example, Elishakoff and Pines, “The Number Pi: Are the Bible and Mathematics Compatible?” in *B’or Hatorah* vol. 17 (2007).

5. See especially *Transforming Darkness into Light*.

6. I Kings 7:23.

7. Chapters 19-20.

8. See Psalms 106:2.

9. In fact, the sages write that “hardly is a person permitted to speak on Shabbat,” referring of course to speech other than prayer and Torah study and teaching.

10. *Avot* 3:13.

11. 3 is the 3<sup>rd</sup> prime number (counting 1 as a prime). Most interesting is the fact that the 31<sup>st</sup> prime is 113, whose relationship with  $\pi$  will be explained in the next chapter. The 314<sup>th</sup> prime is 2081. If we add these three together, we get 2197 or  $13^3$ .

12. Deuteronomy 6:5.

13. *Rambam Hilchot De’ot* 7:6. For a wide and deep explanation see Malbim to

14. The *gematria* of “I was not known to them” (לֹא נִדְעָתִי לָהֶם) is 646, which is exactly half of 1292, an example of a whole and a half, as explained elsewhere.

<sup>15</sup>. 31 is the value of God's Name, *Kel* (אֵל). 416 is 16 times the value of God's essential Name, *Havayah*.

<sup>16</sup>. Note that the average value of "to... to... and to..." (אֵל אֵל וְאֵל) is 33 or "by [the Name of] *Kel*" (בְּאֵל).

<sup>17</sup>. *Shabbat* 89b.

<sup>18</sup>. Psalms 25:14.

<sup>19</sup>. In Kabbalah, the geometric metaphor used to describe creation is of a primordial circle permeated by a "line," a ray of Divine light, acting as either its radius or diameter.

<sup>20</sup>. A simple-full year has 355 days. In such a year, the months of Cheshvan and Kislev are both 30 days long. As explained in length on our website, the Jewish year can have 353, 354, 355, 383, 384, or 385 days. The average value of all the years within the 19 year cycle (see next footnote) approximates 365 days, the number of days in the solar year. The diameter of 365, to the closest integer, is 116, which when added to 365 gives 481, the 16<sup>th</sup> inspirational number, 13 times 37 (the 13<sup>th</sup> prime) and the value of the word "ring" (טבעת), which in Hebrew is the root for the word "nature" (טבע).

<sup>21</sup>. Because the Jewish year is based both on the moon and the sun, the cycle of the Jewish year depends on another unsolvable mystery, the three body problem (the sun, the moon, and the earth). The solution to this problem too depends on the God's Name *Havayah*, a topic for another article. The practical solution for accounting for both the lunar and solar years, which differ by about 11 days per annum, is to add a 13<sup>th</sup> lunar month to the year in 7 out of every 19 years. This solution is known as the secret of the pregnancy. When the year has an additional lunar month, it is considered pregnant.

<sup>22</sup>. Exodus 21:21.

<sup>23</sup>. The entire phrase "a day or two days" equals 169, or 13<sup>2</sup>, where 13 is the value of "one" alluding to the first day of creation, "And it was evening and it was morning, one day" (Genesis 1:5).

<sup>24</sup>. See Psalms 19:3 and in many other places.

<sup>25</sup>. Note that we made a similar translation between the temporal and the spatial in the submission treatment of  $\pi$  above (the six weekdays and Shabbat). Thus, the first and last stage bear a conceptual resemblance to one another, as per the idiom that, "the end is enwedged in the beginning."

<sup>26</sup>. This point was expanded on in length in our Hebrew seminar on space, time, and energy.

<sup>27</sup>. Early Kabbalists, especially the Arizal, employed the use of the *kollel*, a *gematria* technique by which 1 can be added to the *gematria* of a word to account for the word itself. Though there is evidence for the objective validity of this technique in the Torah, we seldom make use of it. Here we have used it because the relationship is indeed very beautiful.

<sup>28</sup>. Exodus 4:17-20.

<sup>29</sup>. *Ibid.* 7:9-12.