

Tekhelet – Threads of Reason

R. Mois Navon

“And God spoke to Moshe saying: Speak to the children of Israel and bid them that they make for themselves tzitzit on the corners of their garments throughout their generations, and that they put on the tzitzit of the corner a thread of tekhelet.”

(Bamidbar 15:37-38)

With this statement, the Torah unequivocally commands the wearing of tzitzit with a thread of tekhelet.¹ And from the verse, “make for yourselves *gedilim* (tassels)” (Dev. 22:12), the Gemara (Men. 39b) learns that the tassel is to be composed of four strings. Of these four strings, some are to be white² and some tekhelet.³ In the event that either the white or the tekhelet is absent, the Mishna (Men. 4:1) explains that such lack does not mitigate the fulfillment of the mitzvah.⁴ Nevertheless, it cannot be stressed enough that the permit to use white alone is less than ideal, permissible only if one cannot avail himself of tekhelet to fulfill the mitzvah in its fullness.⁵ Tekhelet is not a “*bidur*” (enhancement) but an essential component of fulfilling the biblical command. Indeed, the essence – “*ikar*” – of the mitzvah of tzitzit is in the tekhelet strand itself.⁶

Given the great importance of fulfilling the mitzvah of tzitzit with tekhelet, the question is: where is one to obtain this coveted dye? The Gemara (Men. 42b, Men. 44a) reveals that the blue dye comes from the “blood”⁷ of a creature called the hillazon. And though

¹ R. M. Borstein, (*Ha-Tekhelet* [Jerusalem, 1988], p.93-4) explains that practically every halachic decisor concerned with counting the mitzvot (“*rubam k'kulam shel monei bamitzvot*” - see esp. ibid. n.51), enumerates the mitzvah of tzitzit with tekhelet as one singular mitzvah with two components.

² See my article “False Tekhelet” for a discussion on the color of the non-tekhelet strings (<http://tekhelet.com/pdf/false.pdf>).

³ There are three opinions as to how much tekhelet is to be used:

- (1) Rambam (Hil. Tz. 1:6) - Half of one string (when folded becomes one of the eight strings) is tekhelet.
- (2) Raavad (Hasagot on Hil. Tz. 1:6) - One full string (when folded becomes two of the eight) must be tekhelet (as Sifri Shelach 115).
- (3) Tosafot (Men. 38, s.v. *ha-tekhelet*) - Two full strings (when folded become four of the eight) are tekhelet (as Sifri Ki Tetzei 234).

⁴ Tosafot (Men. 38, s.v. *hatekhelet*) explain that one can fulfill the mitzvah either with white alone or tekhelet alone. The Rambam (Hil. Tz. 1:4) has a unique way of understanding this, such that if one has only white he fulfills the mitzvah, but the meaning of the statement, “the white does not mitigate the fulfillment with tekhelet”, means if the white was torn short the tzitzit are still valid (see R. H. Schachter, “Using Tekhelet in Tzitzit”, *Renaissance of a Mitzvah* [New York, 1996], pp.54-57).

⁵ R. Shmeul Ariel (Tekhelet in Tzitzit, *Techumin* 21, <http://tekhelet.com/pdf/muvchar.pdf>) argues that the white-only permit is applicable only under duress (i.e., when tekhelet is not available), otherwise it is forbidden to wear a four cornered garment with white only. This opinion is countered by R. Yehuda Rock (Definition of Nullifying a Mitzvah, *Techumin* 24, <http://tekhelet.com/pdf/bitulasei.pdf>) who explains that the white-only permit applies in any case when one can't wear tekhelet (not only under duress), however such fulfillment of the mitzvah is considered *bid'avad* – less than ideal. See also Borstein, p.97-8.

⁶ Rashi (Men. 40a *d"b b"sh potrin*); Ramban (Bam. 15:38); See list in Borstein, p.101, n.81.

⁷ It is understood that “blood” is a general term which here actually implies “a secretion” (Tosafot, Shabbat 75a, s.v. *ki heichi*).

one might presume that the hillazon is but one of many valid sources, the Tosefta (Men. 9:6) states unambiguously that the hillazon is the sole source of the dye: “Tekhelet is valid only from the hillazon, otherwise it is invalid (*pasul*).”⁸

As such, since its disappearance some 1300 years ago,⁹ the yearning for the hillazon has been as deep as the blue sea to which it is compared.¹⁰ One of the most poignant expressions of this longing for tekhelet is found in R. Nachman of Breslav’s prayer on tzitzit: “May it be Your will that this mitzvah of tzitzit using white wool be considered before You as if we fulfilled it using tekhelet; for it is revealed and known to You that our will is to do Your will and we desire and yearn to fulfill the mitzvah of tekhelet in tzitzit. And if we were to merit finding tekhelet for tzitzit, we would spend a great fortune to fulfill the mitzvah in its fullness.”¹¹

This great yearning finally bore fruit in 1857 when the dye producing snail, *Murex trunculus*, was first discovered by French Zoologist Henri Lacaze Duthiers. However, it wasn’t until the early 1980s, when Professor Otto Elsner ascertained how to produce blue dye from the snail,¹² that the quest for tekhelet gained momentum. That is, having identified a strong candidate for the lost hillazon, still much effort was required to ascertain if indeed the physical evidence matched the references made in Judaic literature (i.e., Torah, Mishna, Gemara, Midrash, Halacha and commentaries).

Over the past decades much literature has been generated, and continues to be generated, showing that indeed the hillazon and tekhelet have been reinstated.¹³ In this paper I would like to review some of the more fundamental Judaic references in comparison with the *Murex trunculus* and its dye and then conclude with a look at the issue of Rabbinic support for the *Murex trunculus*.

Judaic References

The trappers of the hillazon are [located] from the Ladders of Tyre to Haifa.
(Shabbat 26a)

⁸ See also Mesechet Tzitzit (1:10). Though there are some few who hold that tekhelet may come from sources other than the hillazon, the overwhelming majority opinion is that it must come from the hillazon. See R. Bezalel Naor, “Substituting Synthetic Dye for the Hillazon,” *Journal of Halacha and Contemporary Society* (1992), pp. 97-107; Yehuda Rock, “Renewal of *Tekhelet* and Issues on *Zizit* and *Tekhelet*” (Hebrew), *Techumin*, Vol. 16 (website expanded version), pp.12-13; Borstein, pp. 25-27.

⁹ See my article, “On History, Mesorah and Nignaz” (<http://tekhelet.com/pdf/HistoryMesorahNignaz.pdf>).

¹⁰ “... its body is like the sea” (Men. 44a).

¹¹ Quoted in Borstein, p.139.

¹² O. Elsner and E. Spanier, “The Past, Present and Future of Tekhelet”, *The Royal Purple and The Biblical Blue* [Jerusalem, 1997], p.175.

¹³ Menahem Borstein, *Ha-Tekhelet* (Jerusalem, 1988); Yisrael Ziderman, “Reinstitution of the *Mizyah* of *Tekhelet* in *Zizit*”, *Techumin* 9 (1988): 423-46; Elyahu Tavger, “*Maamar ha-Tekhelet*”, *Kelil Tekhelet* (Jerusalem, 1993): 312-34; Yehuda Rock, “Renewal of *Tekhelet* and Issues on *Zizit* and *Tekhelet*”, *Techumin* 16; Rabbi Chaim E. Twerski, “Identifying the Chilazon”, *Journal of Halacha and Contemporary Society*, XXXIV (Fall 1997): 77-102. Shlomoh Taitelbaum, “*Lulaot HaTekhelet*” (Jerusalem, 2000).

Archeological digs dating to Joshua's conquest of Canaan (c. 1200 BCE) have revealed remnants of the Murex-based dyeing industry all along the northern coast of Israel through the southern coast of Lebanon.¹⁴ As such, archeological evidence corroborates the location of the tekhelet production given by the Talmud. That is, precisely where the Talmud say the tekhelet industry was located is where we find a plethora of evidence supporting Murex trunculus based dyeing.

One who traps a hillazon...

(Shabbat 75a)

Trapping, in the biblical sense, is not said to have occurred if one can simply pick up a creature like a snail. However, the Mishna (Beitzta 3:1) teaches that anyone who says, "bring a trap that we may trap it", is considered to have performed trapping in its biblical sense.¹⁵ In the case of the Murex trunculus, which lives burrowed in the rocks and sand at the bottom of the sea, one cannot simply pick it up; rather, one must lay traps – baited nets was the method of choice in ancient times as described by the Talmud.¹⁶ So indeed, biblical trapping is necessary to obtain the Murex trunculus.

One who breaks open (*potzea*) a hillazon...

(Shabbat 75a)

R. Herzog explains the Talmudic use of the verb *potzea* to indicate breaking open something hard like a nut.¹⁷ As such, we expect the hillazon to have a hard shell; and indeed, the Murex trunculus is a hard shelled mollusk which must be broken open with something on the order of a rock or a hammer to obtain its dye stuff.¹⁸

Go and learn [about the clothes of the Jews in the desert] from the hillazon - all the time that it grows, its shell (*nartiko*) grows with it.

(Shir HaShirim R. 4:11)

In consonance with this Midrash, the Murex trunculus is a mollusk born with a hard protective shell that grows to accommodate its growing body.¹⁹

¹⁴ N. Karmon and E. Spanier, "Archaeological Evidence of the Purple Dye Industry from Israel", *The Royal Purple and The Biblical Blue* [Jerusalem, 1997], p.149-157.

¹⁵ And such is the halacha (see my article "HaZad Hillazon - Trapping the Murex trunculus", Torah U'Madda, July 2006 (<http://www.tekhelet.com/pdf/Trapping.pdf>)).

¹⁶ Shabbat 75a. Similarly the ancients of other cultures used the same methods, see: Aristotle, *History of Animals* (5:15); Pliny, *Natural History* (9:37).

¹⁷ R. Herzog, "Hebrew Porphyrology", *The Royal Purple and The Biblical Blue* [Jerusalem, 1997], p.57. For a discussion on this, especially regarding Rashi's opinion, please see my article "HaPotzo – Extracting the Dye from the Murex trunculus" (<http://tekhelet.com/pdf/Potzea3.pdf>).

¹⁸ E. Spanier and N. Karmon, p.180. Ziderman, *Techeumin* 9, p.430. Vitruvius explains, "After the shells are gathered they are broken into small pieces with iron bars; from the blows of which, the purple dye oozes out like tears, and is drained into mortars and ground" (Marcus Vitruvius Pollio, de Architectura, Book VII, Ch. 13, pt. 3).

¹⁹ Radwin and D'Attilio, "Murex shells of the world: an illustrated guide to the Muricidae", [Stanford University Press: 1976], p11.

The hillazon is this: its body is like the sea, its creation is like a fish, and it comes up once in 70 years and with its blood one dyes tekhelet - due to this it is expensive.

(Men. 44a)

While one might have thought this braitā to provide the key to identifying the hillazon, a closer examination reveals descriptions that are vague and ambiguous, making them ineffective for identifying a specific creature. However, upon noting that the structure of the braitā is divided into two by the word “therefore”, as in “therefore it is expensive”, it is readily understood that what came before this divider is simply the justification for the conclusion.²⁰ Indeed, R. Herzog writes that the declaration, “it is expensive”, is out of place in a formal halachic definition. It would however, explains R. Herzog, make sense as part of a justification to consumers far way in Babylonia curious as to the reason for its high price.²¹ This observation accords well with the *Murex trunculus* for it is an inherently expensive source of dye. The dye is expensive due to both the difficulty in obtaining snails as well as the minute quantity of dye each snail delivers – a set of four strings requiring approximately thirty snails.²²

One is more pleased that it should be alive, so that the dye should be successful.

(Shabbat 75a)

Rashi (ibid.) explains the Talmud to be teaching that the “blood” from the live hillazon is better than from a dead hillazon. To appreciate how this relates to the *Murex trunculus* it is important to understand the physiology of the snail. Inside the hypobranchial gland of the *Murex trunculus*, the precursors of the dye, along with an essential enzyme (i.e., purpurase), exist together as clear liquid.²³ The chemistry of the dye formation in the *Murex trunculus* is such that when this clear liquid is exposed to oxygen, effected by squeezing the gland,²⁴ the enzyme reacts with the precursors to produce the colored dyestuff. The purpurase, however, deteriorates soon after the snail’s demise²⁵ thus requiring that the dye extraction be done while the snail is alive, precisely as the Talmud explains.²⁶

²⁰ Rock, n.57.

²¹ Herzog, pp.66-7. For further discussion of this braitā see my article “The Hillazon Braitā” (<http://www.divreinavon.com/pdf/HillazonBraitā2.pdf>).

²² This is our empirical observation in the factory today. See "Coordination Chemistry of Pigments and Dyes of Historical Interest" (American Chemical Society, 1994), which records that it took 12,000 mollusks for 1.5 grams of dye.

²³ E. Spanier and N. Karmon, pp.180, 183, 188; Ziderman, *The Royal Purple and The Biblical Blue*, p.214.

²⁴ Today the gland is cut out and squeezed, in ancient times the entire snail was simply smashed, thus squeezing the gland in the process. See my article “HaPotzo – Extracting the Dye from the *Murex trunculus*” (<http://tekhelet.com/pdf/Potzea3.pdf>), especially notes 18 and 19 there.

²⁵ B. Sterman, “The Science of Tekhelet”, *Renaissance of a Mitzvah* [New York, 1996], p.68.

²⁶ Note this is also what Aristotle (History of Animals, Book 5, part 15) explained about the *Murex*: “the Fishermen are anxious always to break the animal in pieces while it is yet alive, for, if it die before the process is completed, it vomits out the bloom [i.e., purges its dye]; ...” (See: http://classics.mit.edu/Aristotle/history_anim.5.v.html)

God said: I distinguished in Egypt between the drop of [semen that was to become] a firstborn and that of a non-firstborn, I will exact retribution from he who attaches *kela ilan* to his cloth and claims it is tekhelet.

(Baba Metzia 61b)

The Rabbis who articulated this statement, though known for their acute ability to distinguish between various colors, were nevertheless compelled to state that only God can distinguish between “*kela ilan*” and “tekhelet”. This fact, explains R. S. Rappaport, stands as powerful testimony to the great degree that the two dyes were visually equivalent.²⁷ Now *Kela Ilan* has consistently been identified as indigo,²⁸ the blue dye coming from, most ubiquitously, the *Indigofera tinctoria* plant.²⁹ Amazingly, the blue dye obtained from the plant source is not only visually indistinguishable but molecularly equivalent to the dye obtained from the *Murex trunculus* snail³⁰ - so indeed, only God can distinguish between the two dyes.³¹

How is tekhelet made? One places the blood of the hillazon and chemicals (*sammanim*) in a pot to boil.

(Men. 42b)

Rashi, Tosfot and Rambam all grapple with the use of the chemicals given that tekhelet is, by definition, from the hillazon. That is, though one might expect the tekhelet dye to consist solely of the extract from the hillazon, the Talmud notes that chemicals were added. In account for the use of additives, the commentators explain that chemicals were necessary to fix the dye into the wool but not to give color itself.³² This is indeed true of the process used to produce the dye from *Murex trunculus* which consists of the following steps. The hypobranchial gland containing the dye stuff is removed and boiled together with a strong base which is used to dissolve the snail meat and to create the chemical environment for reduction. The solution is then reduced to make the dye water-soluble enabling it to take to the wool (i.e., typical vat dyeing).³³ An acid is then added to neutralize the basic solution in order to prevent the dye solution from damaging the wool. From this description it should be clear that the chemicals are used only to

²⁷ R. S. Rappaport, “Simanim, Mesoret, and Identifying Tekhelet” [Hebrew] (<http://www.tekhelet.com/doc/ra01.doc>), p.2.

²⁸ Aruch, s.v., *kela ilan*; Radvaz Responsa 2:685.

²⁹ See Borstein, p.75, A. Zivotofsky, “Kela Ilan” (<http://www.tekhelet.com/DafYomi/EnglishDaf.pdf>).

³⁰ O. Elsner and E. Spanier, p.175.

³¹ It bears mentioning that the Gemara (Men. 42b) proposes chemical tests in order to distinguish between the two dyestuffs by causing the plant dye to fade. The question is then posed as to how such tests would be effective if the dyes are molecularly equivalent. Professor Roy Hoffman explains that the plant-based procedure called for merely soaking the wool in crushed leaves thus not allowing the dyestuff to bond as well snail-based dye which used a proper vat dye procedure. For further information see my article: “Chemical Testability” (<http://tekhelet.com/pdf/ChemicalTestability.pdf>).

³² For a detailed discussion on this issue, see my article “Sammanim – the Chemicals to Make Tekhelet” (<http://tekhelet.com/pdf/Sammanim1.pdf>).

³³ Today a reducing agent is used, however in ancient times reduction was effected by long term boiling of the snail meat – see Dr. Zvi Koren, “The First Optimal All-Murex All-Natural Purple Dyeing in the Eastern Mediterranean in a Millennium and a Half”, p. 142, http://www.tekhelet.com/pdf/-KOREN_DHA20_2005.pdf and Dr. Roy Hoffman, “Identifying Tekhelet: New findings” (The BaDaD Journal, Vol. 27, 2012, <http://tekhelet.com/pdf/naturaldypaper3.pdf>).

enable the dye-stuff to absorb into the wool and are not part of the color itself – just as the commentators defined.

How is tekhelet made? ... then we take out a little in an egg shell and test it on a piece of wool.

(Men. 42b).

Ancient dyes are classified into three categories: vat dyes, mordant dyes, and direct dyes.³⁴ In vat dyeing, as opposed to mordant and direct dyeing, the final dye color is not discernible while in the vat but only upon removal from the vat. Now, regarding the Murex trunculus dye, it is a vat dye which produces colors ranging from blue to purple, depending on how much ultraviolet light it receives when in the vat.³⁵ Therefore, while the Murex dye solution is in the vat it appears yellowish in color and only upon removal from the vat does it take on its final color in the wool. Since the resultant color can range from purple to blue, the dye must be tested to determine if it has been sufficiently exposed to ultraviolet light which is what turns the dye from purple-blue to pure blue. As such, the Gemara's requirement to sample the dye fits well with the vat dyeing procedure used for the Murex trunculus.³⁶ Indeed, the fact that the Gemara indicates vat dyeing for tekhelet production accords well with historical record, for the only blue dye known to the ancient world was the indigo vat dye (either plant or snail based).³⁷

If its color is permanent then it is valid.

(Men. 43a)

The Rambam explains that tekhelet “is well known for its steadfast beauty and does not change” (Hil. Tzitzit 2:1). Due to the chemical process whereby the dyestuff is first reduced and then oxidized in the wool, the Murex trunculus dye binds very tightly to wool. Indeed, indigo dyes are well known to be the fastest dyes known to the old-world.³⁸ Anecdotally, R. Chaim Twerski noted that soaking the dyed strands for three days in strong bleach had no effect.³⁹

“Treasures buried in the sands” (Dev. 33:19) refers to the hillazon.

(Megilla 6a)

In consonance with this statement, the Murex trunculus indeed burrows itself into the sands and sediment on the sea floor.⁴⁰ Concerning the verse “*sfunei temunei hol*”, though it is true that the Gemara explains each term of the verse as applying to a different item

³⁴ *The Real World of Chemistry* 6th ed by Lois Fruen Kendall/Hunt Publishing, see <http://realscience.breckschool.org/upper/fruen/files/enrichmentarticles/files/ancientdyes/ancientdyes.html>

³⁵ See fn. 30.

³⁶ R. Gershon Bess, in a personal conversation.

³⁷ Personal correspondence with Prof. Zvi Koren, Edelstein Center for the Analysis of Ancient Artifacts at Shenkar College in Ramat-Gan. See also fn. 34.

³⁸ John Edmonds, *The History of Woad and the Medieval Woad Vat*, John Edmonds Publisher: 1998.

³⁹ Twerski, p.91.

⁴⁰ E. Spanier and N. Karmon, p.181, p.190; Ziderman, *Techumin* 9, p.429; Twerski, p.85).

(i.e., *sefunei*: hillazon, *temunei*: tuna fish, *bol*: glass), many commentators explain the verse as a whole to refer to all three. The Radzyner Reebi, in his book by the same name, “Sefunei Temunei Hol” states that, “the verse includes all three things together for it is their way to be found in the sand” (Siman Bet, Het). And though some express reservation as to how three items could be intended, the Sforno seems convinced that the statement does apply at least to the *hillazon*: “‘covered and buried in the sand’ is the blood of the *hillazon*...” (on Dev. 33:19). The point here is that the *hillazon* lives on the sea floor, which is corroborated by the braita (Men. 44a) “Comes up once in...” – Rashi explains means comes up “from the earth”, upon which Yavetz clarifies, “that means to say: from the seabed.”

Rabbinic Support

A final point which needs to be addressed is that of Rabbinic support. For, while every Jew is enjoined to learn Torah and discover its truths, such enterprises are often complex, requiring overarching perspective and complete devotion, such that even after a review of the issues, as has been provided herein, one still rightly wonders if something hasn’t been overlooked. As such, the task of deciding difficult halachic issues is submitted to the Rabbis who have dedicated their lives to such endeavors.

The Rabbis of great stature have, to date, absented themselves from this discussion. That is, they have not come out unequivocally on the issue. In 1998 R. Elyashiv put out a statement on the subject in which he raises a number of concerns regarding the acceptance of any candidate for the hillazon. When I met with R. Shlomo Fischer, he asked me what was R. Elyashiv’s opinion on the matter – I handed him the printed statement which he read and without hesitation concluded, “He is avoiding the issue.” However, in 2011 R. Elyashiv did give his blessing to his disciple, R. M. M. Karp, to issue his own letter stating that, though due to his own lack of knowledge which prevented him from giving a decision on the matter, “those who have verified the issue must fulfill it ... and anyone who desires to fulfill it ... will have great reward.”⁴¹

Now while it is true that the Rabbis considered the generation’s “gedolim” have absented themselves, in one way or another, from the discussion, there are in fact many Rabbis of prominence in the modern orthodox world, in the *dati leumi* world, as well as a growing number in the *hareidi* world, who have come out in support of the identification of the *Murex trunculus* as the hillazon of chazal, and that is not to mention all the Rabbis who, for various reasons, choose to keep their decision private.

In any case, though it might have been nice to publish a long list of well known names who wear *Murex trunculus tekhelet*, this is really not necessary for one to decide in favor of wearing tekhelet. First of all, while there is a principle that we are to follow the majority, this does not apply when the two sides have not debated face to face, but rather only expressed their opinions in writing.⁴² Second, there is an accepted principle that on decisions of *d’oraita* law, we follow the stricter opinion regardless of the stature of the

⁴¹ www.tekhelet.com/approbations/KarpApprobation.pdf

⁴² Yabia Omer (Even HaEzer, Helek 8, Siman 12): “The poskim have already written that in a case when poskim did not debate face to face but only wrote their opinions individually, then the rule of “follow the majority” does not apply.” See also Sefer HaHinuch (78:1).

Rabbis involved.⁴³ In the case of tzitzit, strictness would argue for fulfilling the words of the Torah in their fullness.⁴⁴ Third, R. Avraham Shapira explained that “Klal Yisrael” has the power to decide (*psak*) more than even a thousand Rabbis, and the Rabbis today are simply waiting for Klal Yisrael to decide to wear to tekhelet so that they will not have to quarrel over the issue.⁴⁵

R. Meir famously teaches that tekhelet is magnificent because it is like the sea and the heavens (Men. 43b, Sot. 17a). Is it not more than coincidence that precisely these similes are the ones employed by the Torah to exhort us to action?

For this commandment which I command thee this day, it is not hidden from thee, neither is it far off. It is not in *heaven*, that thou shouldest say, Who shall go up for us to *heaven*, and bring it unto us, that we may hear it, and do it? Neither is it beyond the *sea*, that thou shouldest say, Who shall go over the *sea* for us, and bring it unto us, that we may hear it, and do it? *But the word is very nigh unto thee, in thy mouth, and in thy heart, that thou mayest do it.*

(Dev. 30:11-14)

⁴³ Kesef Mishna (Hil. Mamrim 1:5): “Even if one is greater than his peer in wisdom and age, in a case of Torah law once goes according to the stringent.” So also Tosfot (Avoda Zara 7a). Though Rashba (Avoda Zara 7a), Meiri (Avoda Zara 7a) argue that the superior authority is followed, and only in case of a disagreement of authorities of equal stature over a Torah law does one follow the more stringent authority.

⁴⁴ When weighing what it means to be strict versus what it means to lenient in a positive commandment, being strict would mean going out of ones way to fulfill the mitzvah, like the Vilna Gaon who paid every Cohen for his own pidyon bechorot until he found a Cohen meyuhas. So too with tekhelet, one should make every effort to fulfill it.

⁴⁵ See http://www.yk8.org/artsfl/mamar_147.pdf, footnote 19.