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## Threads of Reason

*A Collection of Essays on Tekhelet*

by Rabbi Mois Navon

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About the Book

This collection of essays is the result of research spanning more than a decade, motivated by nothing more than the desire to reach a clear understanding of the issues surrounding the rediscovery of *tebbelet* through the *Murex trunculus*. Is it possible to renew a biblical commandment without a *mesorah* (tradition)? Must religious objects, like *tzitzit*, be made from kosher substances? Does one violate the *melakhah* (Shabbat labor) of trapping when obtaining a snail on Shabbat? Bringing together biology and halakhah, chemistry and *aggadah*, archeology and theology – and applying careful consideration and logical reason – these essays seek to address the numerous questions that arise in the endeavor to revive this unique commandment. And as *tebbelet* is a commandment that has been forgotten for over 1300 years, each essay is colored with the marvel of a lost biblical commandment returned anew to the Jewish people. This collection of essays, then, can be seen as a group of threads – threads of reason – spun into a cord strong enough to bind a new generation in the fulfillment of an ancient commandment.

Sammanim – The Chemicals to Make *Tekhelet*

Abaye said to R. Shmuel bar R. Yehudah, “*Tekhelet* – how do we dye it?” He said to him: “We bring the blood¹ of the *hillazon* and chemicals (*sammanim*), put them in a pot and boil the mixture...”

Menahot 42b

This explanation of R. Shmuel bar R. Yehudah is the only source in our possession that discusses how *tekhelet* is to be dyed. Rashi, Tosafot and the Rambam grapple with the sparse details and their possible implications, especially the “*sammanim*” (chemicals) that were to be used along with the blood of the *hillazon*.

Rashi

Commenting on the word “*sammanim*,” Rashi explains that “it is the way of the dyers to imbue the cloth with *tzrif* which is called *beitza*.” R. Isaac Herzog² identifies the compound “*beitza*” as “alum-mordant,” which is a known chemical used to prepare cloth to accept dye. Mordants are used – almost without exception – to treat the fabric first, after which the dye is then applied to the fabric.³ As a consequence, this account of the *sammanim* comes at variance to the description in our Gemara in which R. Shmuel bar R. Yehudah stated unequivocally that the *hillazon* blood and the *sammanim* were boiled *together* to produce the dye.

The discrepancy, however, can be reconciled by discerning the purpose of Rashi’s comment on the *sammanim*. To begin with, it would be a mistake to understand Rashi as explaining the precise chemicals used in the *tekhelet* dye, as he never saw the *hillazon* or its dyeing procedure.⁴ Furthermore, there was no blue mordant dye

known in the ancient world.⁵ Rashi's account of the *sammanim*, then, comes solely to answer the difficulty posed by the Gemara's inclusion of substances other than *hillazon* blood,⁶ given that other references to the dye refer exclusively to its being from the *hillazon* blood.⁷ Accordingly, Rashi explains that the *sammanim* were used only to assist the dyestuff to adhere to the wool and not to contribute to the color.⁸ He supplies – as an example of such chemicals – a mordant, quite probably because mordant dyeing was far more ubiquitous than vat dyeing.⁹

Interestingly, through a careful reading of Rashi's commentary on the Torah, R. Gershon Hanokh Leiner, the Radzyner Rebbe, found support for the notion that Rashi did not necessarily hold *tekebelet* to be a mordant dye.¹⁰ One of the more prominent features of mordant dyeing (as opposed to vat dyeing) is that the color of the dye at the outset of the procedure in the dye bath is virtually the same as its final color when taken up in the fabric.¹¹ The Radzyner Rebbe explained that Rashi (Ex. 25:4) writes, “*tekebelet* is wool dyed from the blood of the *hillazon* and its *tziv'o* (color) is ‘green’ [i.e., ‘blue’ in the Talmudic sense¹²].” The Radzyner points out that Rashi did not say, “from the blood of the *hillazon* which is green,” but rather he stated, “...and its color is green.” This wording, according to the Radzyner, implies that though the final color of the dye is “green,” the blood directly out of the *hillazon* is not necessarily so.¹³

While this point is debatable, what is essential to understand from Rashi is that (1) the *sammanim* were used exclusively to facilitate the bonding of the dye to the wool, and (2) the *sammanim* did not, in and of themselves, directly contribute to the final color. Both of these criteria are met in the vat dyeing method used for the *Murex trunculus*, which employs chemicals only in order to make the dyestuff bond to the wool.¹⁴

Tosafot

The Tosafot (ad loc., s.v. *sammanim*) express amazement that one could add chemicals to the *hillazon* blood since, as mentioned, other Talmudic references¹⁵ bring only *hillazon* blood as the source of the *tekebelet* dye. Their comment clearly indicates that they were of the opinion that the blood of the *hillazon* was the essential colorant of *tekebelet*.¹⁶ To resolve the apparent incongruity of adding chemicals, they hint, according to R. Moshe Feinstein, that the definition of *tekebelet* dye is the combination of the *hillazon* blood together with the *sammanim*. R. Feinstein explains the statement of the Tosafot to imply that the *sammanim* served to modify

the dye such that they brought out the final color inherent in the dyestuff.¹⁷ In consonance, the Radzyner Rebbe interprets the Tosafot to have understood that, though the *sammanim* effected a transformation of the color, the *sammanim* did not, in and of themselves, contribute to the color.¹⁸

The Tosafot's explanation, that the chemicals help to transform the *hillazon* blood to achieve the final dye color, corresponds precisely to the vat dyeing process used in *Murex trunculus*-based dyeing. For the chemicals employed in this process are used to chemically reduce the dyestuff, which makes the dyestuff water soluble, thus facilitating its absorption into the wool and, at the same time, allowing the ultraviolet rays of the sun to act on the purple-blue dyestuff causing it to turn to the pure blue color that is *tekbelet*.¹⁹ And, it must be emphasized, the chemicals themselves do not contribute to the color of the dye.

Rambam

The Rambam (Hil. Tz. 2:2) explains that one is to clean the wool with chalk and then soak it in *ahala* “in order that the dye will be absorbed.” R. Herzog is of the opinion that this preliminary stage was done solely to clean the wool.²⁰ “Following this,” explains the Rambam, “one is to place the blood of the *hillazon* and *sammanim* into a dye-bath.” Clearly the Rambam does not consider the initial chemicals to be the *sammanim* which are boiled together with the *hillazon* blood. Indeed, he explains that the *sammanim* are “like *kamonia* and similar things as is the way of the dyers.” R. Herzog believed *kamonia* to be a cleansing substance.²¹ R. Kapach holds *kamonia* to be a salt (*melah alkali*).²² Now while a salt is the first element needed for vat dyeing, others maintain that this too was an element of a mordant dyeing process.²³

Be that as it may, the Rambam, by his own admission, did not have access to the *hillazon* nor did he have firsthand knowledge of the dye procedure.²⁴ He, like Rashi before him, did not give an account of the dye procedure but rather explained why *sammanim* were part of the process as detailed by R. Shmuel bar R. Yehudah. Note that both the Rambam and Rashi, when referring to the *sammanim*, use the phrase “as is the way of the dyers.” Their point is that it was common for chemicals to be used as part of the dyeing procedure. Indeed, R. Shlomoh Taitelbaum notes that if the specific chemicals were of import, the commentators would have used specific language to obligate their use and not the phraseology, “the way of the dyers.”²⁵

Radzyner

In discussing the chemicals used to produce *tekehelet*, it would be remiss not to mention the dye proposed by Rabbi Gershon Hanokh Leiner, the Radzyner Rebbe, which relied heavily on chemical additives. His most fundamental opinion on the subject of the *sammanim* was that the blood of the *hillaẓon* contained the essential color and the chemicals were used “only to purify and clarify the blood so it will achieve its proper color; however they are not part of the color.”²⁶

The Radzyner proposed that the *hillaẓon* was a cuttlefish known as *Sepia officinalis*, and though its dye was black as ink, he believed that the added chemicals would allow for its inherent blue to be expressed. It has, however, been demonstrated that the dye he adjudged to be *tekehelet* was the well-known inorganic dye, Prussian blue, which obtains its blue color from the *Ferric ferrocyanide* added to the mixture, and not from the *Sepia officinalis* extract.²⁷ Upon discovering the chemical composition of the Radzyner dye, R. Herzog wrote, “The Radzin *tekehelet* thus stands self-condemned ... It would seem that the late Hasidic Chief was victimized by some fraudulent Italian chemist.”²⁸ Given this, it seems clear that the Radzyner would have gladly cast the *Sepia officinalis* back to the sea in favor of the *Murex trunculus* which inherently produces blue – the color of the sea, the sky, and God’s holy throne.²⁹

Conclusion

Given the discrepant opinions between Rashi, the Rambam, and Tosafot, the question has been asked, how can we make a decision? First, halakhah is full of great disputes, yet a final decision is made on how to act; a *mablokot* is no reason to remain idle. Second, I have demonstrated that the commentators come not to obligate a specific chemical or a specific method, but to explain the indispensable use of chemicals in the process of making *tekehelet* dye. Indeed, we must say that this is the case, certainly for those who implied that mordant dyeing was used, for it is a matter of historical record that no blue mordant dye was used in the ancient world.³⁰ Third, based on the Gemara’s non-identification of the *sammanim*, the Radzyner noted that *any* chemicals that will achieve the desired end without contributing to the color are acceptable.³¹

~ Notes ~

- ¹ It is important to note that the term “blood” here is non-specific, simply implying “a secretion” (Tosafot, Shabbat 75a, s.v. *ki heikhi*).
- ² R. Isaac Herzog, “Hebrew Porphyrology,” in *The Royal Purple and The Biblical Blue* (Jerusalem: Keter, 1987), p. 99.
- ³ Personal conversation with dyer Y. Safri.
- ⁴ The loss of *tekbelet* is placed somewhere between 474 and 1038, and it is agreed that Rashi (1040-1138) was not in possession of the dye. See my essay, “On History, *Mesorah*, and *Nignaz*” (herein, p. 18). See also R. Chaim Twerski, “Letters” *Journal of Halacha and Contemporary Society* XXXV (Spring 1998), p. 120).
- ⁵ Personal correspondence with Prof. Zvi Koren, Edelstein Center for the Analysis of Ancient Artifacts at Shenkar College in Ramat Gan. Similarly, dyer Y. Safri explained to me that vat dyeing was used only for indigo – either plant- or snail-based.
- ⁶ As R. Herzog explains, “The commentator’s objective is evidently to meet by anticipation the difficulty referred to in the Tosafot” (p. 99). See also my analysis of Tosafot further on in this essay.
- ⁷ “*Tekbelet* is valid only from the *hillazon*; if *tekbelet* was produced from something other than the *hillazon*, it is invalid” (Tosefta, Men. 9:6). See also Masekhet Tzitzit, Halakhah 20; Men. 44a.
- ⁸ Rashi (ad loc., s.v. *mishum*). R. Herzog writes, “The *sammanim*, Rashi holds, are simply mordants and have nothing to do with the production of the colour” (p. 99). See also R. Leiner, “Ein HaTekhelet,” in *Sifrei ha-Tekbelet Radzsyn* (Benei Berak: Mishor, 1990), 1:22, p. 285; R. Chaim Twerski, “Identifying the Chilazon,” *Journal of Halacha and Contemporary Society* XXXIV (Fall 1997), p. 96.
- ⁹ Indeed, vat dyeing was used only for indigo (see fn. 5).
- ¹⁰ “Ein HaTekhelet” (1:22).
- ¹¹ This is notably true for alum as opposed to other mordants which are said to have an effect on the final color (Gosta Sandberg, *The Red Dyes* [NC: Lark Books, 1997], pp. 178-179).
- ¹² R. Herzog explains that in Talmudic parlance, “green” was a category that included green, yellow and blue (p. 92); and he conjectures that Rashi may have intended a sea blue which included a “green tint here and there” (p. 97). See also Pri Megadim (Orah Hayyim, Eshel Avraham 9:6) who brings in the name of the Elijah Rabbah that “a green *talit* is ‘blue’ in the language of *Ashkenaz*.”

- ¹³ The Radzyner reconciles Rashi's comment (Hullin 89a), that "the blood is the color of the sea," by explaining Rashi's intention to pertain to the final dye.
- ¹⁴ The *Murex trunculus* dye method involves employing a base to dissolve the snail meat containing the dyestuff and create the chemical environment necessary for reduction, which is then effected through a reducing agent (or through fermentation), after which an acid is introduced to neutralize the solution in order to prevent the dye solution from damaging the wool. Of import here is that the chemicals in no way contribute to the color, but merely facilitate the bonding of the dyestuff from the snail to the wool.
- ¹⁵ See fn. 7.
- ¹⁶ Otherwise they would have no reason to be so incredulous at the idea of additives. See Radzyner, "Ein HaTekhelet" 1:22; R. Twerski, "Identifying the Chilazon," n.52.
- ¹⁷ *Iggrot Moshe*, Yoreh Deah II, 133.
- ¹⁸ This, because their whole question is based on the impossibility that the chemicals alter the color from the *hillaẓon* ("Ein HaTekhelet," 1:22, esp. p. 288).
- ¹⁹ Otto Elsner and Ehud Spanier discovered that, in the reduced dye solution, the ultraviolet rays from the sun break off the bromine atoms in the dibromoindigo (i.e., purple-blue) molecule from the snail dye, thus leaving a pure indigo (i.e., blue) molecule to be bonded into the wool upon oxidation (Otto Elsner and Ehud Spanier, "The Past, Present and Future of *Tekhelet*," in *The Royal Purple and The Biblical Blue* [Jerusalem: Keter, 1987], p. 175).
Interestingly, this change in color fits with Rashi's distinction, as noted by the Radzyner, between "the blood of the *hillaẓon*" versus "its color green" in the final dyed fabric, for the blood is dark purple, yet its dye is pure blue.
- ²⁰ R. Herzog, p. 99. Though one could argue that the words, "in order that the dye will be absorbed," imply that *abala* was a mordant.
- ²¹ Ibid.
- ²² See R. Menachem Burstein, *Ha-Tekhelet* (Jerusalem: Sifriyat, 1988), p. 54, n. 67.
- ²³ R. Shlomoh Taitelbaum, *Lulaot Tekhelet* (Jerusalem: Ptil Tekhelet: 2000), p. 258.
- ²⁴ Responsa v.1, #138; also comm. on Mishnah Menahot 4; Hil. Tz. 2:9.
- ²⁵ See R. Taitelbaum, p. 254.
- ²⁶ "Ein HaTekhelet," 1:22, p. 288. Similarly the Radzyner wrote, "And with the help God it has come to my hands to extract, from the blood [of the cuttlefish which is] black as ink, the color *tekelet* in a manner which nothing affects the color other than the blood of the *hillaẓon*; and the chemical additives are colorless and only work to extract the color from the bloods" ("Ptil Tekhelet," p. 168).

²⁷ R. Herzog, p. 117; Otto Elsner and Ehud Spanier, p. 172; I. Ziderman, “Halakhic Aspects etc.,” in *The Royal Purple and The Biblical Blue* (Jerusalem: Keter, 1987), p. 208.

²⁸ R. Herzog, p. 117.

²⁹ As noted, the chemicals used in the *Murex trunculus* dye procedure do not, in and of themselves, contribute to the color of the dye – see above fn. 14 and fn. 19.

³⁰ See fn. 5.

³¹ “Ein HaTekhelet,” 1:22, p. 288.