

**Sammanim – the Chemicals to Make Tekhelet**

Mois A. Navon, 5772 (original 5760)

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

(Menachot 42b).

This explanation of R. Shmuel bar 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, primarily the “*sammanim*” (chemicals) that were to be used with the hillazon blood.

**Rashi**

Commenting on the word “*sammanim*”, Rashi explains that, “it is the way of dyers to imbue the cloth with *tzrif* which is called *beitza*.” R. Herzog<sup>1</sup> identifies the compound ‘*beitza*’ as “alum-mordant”, which is a known chemical used to prepare cloth to accept dye.<sup>2</sup> Mordants are used - almost without exception - to treat the fabric first, after which the dye is applied to the fabric.<sup>3</sup> As such, this account of the *sammanim* comes at variance to the description in the Gemara (above) wherein R. Shmuel bar Yehudah stated unequivocally that the hillazon blood and the *sammanim* were boiled *together* to produce the dye.

The discrepancy can be reconciled by discerning the purpose of Rashi’s comment on the *sammanim*. It would be mistaken to understand Rashi as explaining the precise chemicals used in tekhelet dye, as he never saw the hillazon or its dyeing procedure.<sup>4</sup> Furthermore, there was no blue mordant dye known to the ancient world.<sup>5</sup> Rather, his account of the *sammanim* comes solely to answer the difficulty posed by the Gemara’s inclusion of substances other than hillazon blood,<sup>6</sup> since other references to the dye refer exclusively to its being from the hillazon blood.<sup>7</sup> As a result, Rashi explains that the *sammanim* were used

<sup>1</sup> R. Herzog, “Hebrew Porphyrology”, *The Royal Purple and The Biblical Blue* [Jerusalem, 1997], p.99.

<sup>2</sup> On use of alum see the Columbia Encyclopedia entry “mordant”.

<sup>3</sup> Personal conversation with dyer Y. Safri.

<sup>4</sup> The loss of tekhelet is placed somewhere between 638 C.E. and c.1000 C.E. In any case all agree that Rashi was not in possession of the dye. See my paper “On Mesorah, History and Nignaz” (<http://tekhelet.com/pdf/HistoryMesorahNignaz.pdf>)

<sup>5</sup> Personal correspondence with Prof. Zvi Koren, Edelstein Center for the Analysis of Ancient Artifacts at Shenkar College in Ramat-Gan.

<sup>6</sup> As R. Herzog (p. 99) explains, “The commentator’s objective is evidently to meet by anticipation the difficulty referred to in the Tosafot.” [See analysis of Tosafot further herein].

<sup>7</sup> “Tekhelet is valid only from the hillazon; if tekhelet was produced from other than the hillazon, it is invalid.” Tosefta (Men. 9:6). Mesechet T’zitzit, Halacha 20. Also Menachot 44a.

only to assist the dye-stuff to adhere to the wool and not to alter or contribute to the color.<sup>8</sup> He supplies – as an example of such chemicals – a mordant, quite probably because mordant dyeing was far more ubiquitous than vat dyeing in which the chemicals are boiled together with the dye-stuff.<sup>9</sup>

By a careful reading of Rashi's commentary on the Torah, R. Gershon Hanoch Leiner (the Radzyner Rebbe in his *Ein HaTekhelet* 1:22), found support for the notion that Rashi didn't necessarily hold tekhelet to be a mordant dye. 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 remains consistent with its final color when taken up in the fabric.<sup>10</sup> The Radzyner Rebbe explained that Rashi (Shmot 25:4) writes, "tekhelet is wool dyed from the blood of the hillazon and its *tziv'vo* (color) is 'green' [i.e., 'blue' in the Talmudic sense<sup>11</sup>]." 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 implies, according to the Radzyner, that though the final color of the dye is "green", the blood directly out of the hillazon is not necessarily so.<sup>12</sup>

While this last point is arguable, 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; (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 in order to make the dyestuff water soluble thus enabling it to bond into the wool.

## Tosafot

The Tosafot (*ibid.*, s.v. *sammanim*) express amazement that one could add chemicals to the hillazon blood since, as mentioned, other Talmudic references<sup>13</sup> bring only hillazon blood as the source of the tekhelet dye. Their question implies that they were of the opinion that the blood of the hillazon was the essential color of tekhelet.<sup>14</sup> To resolve their own quandary they explain that the tekhelet dye was composed of the dye-stuff from the hillazon blood together with the *sammanim*. R. Moshe Feinstein (*Iggrot Moshe*, Y.D. II, 133) understands their position to imply that the *sammanim* served to modify the dye such that they brought out the final color inherent in the dye-stuff. The Radzyner Rebbe emphasizes that,

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<sup>8</sup> See R. Herzog (p.99) writes, "The *sammanim*, Rashi holds, are simply mordants and have nothing to do with the production of the colour." See also R. Leiner, *Ein HaTekhelet* 1:22, p. 285; R. Twerski, *Identifying the Hillazon*, JOHCS (Vol. 34, Fall 1997), p.96.

<sup>9</sup> Vat dyeing was only used for *Isatis* and *Indigofera tinctoria* (personal conversation with dyer Y. Safri).

<sup>10</sup> This is notably true for Alum as opposed to other mordants which are said to have an effect on the final color (G. Sandberg, *The Red Dyes* [Lark Books, NC:1997], pp.178-179).

<sup>11</sup> See R. Herzog, p.92, 97.

<sup>12</sup> The Radzyner reconciles Rashi's comment (in *Hullin* 89a), "the blood is the color of the sea", by explaining that Rashi's intention was on the final dye.

<sup>13</sup> See fn. 7.

<sup>14</sup> For otherwise they would have no reason to be so incredulous at the idea of additives. See Radzyner (*Ein HaTekhelet* 1:22); Twerski, n.52.

notwithstanding the *sammanim*'s affect on transforming the color, the *sammanim* did not contribute to the color in any way.<sup>15</sup>

The Tosafot explanation, that the chemicals help to transform the hillazon "blood" to achieve the final dye color, fits well with the vat dyeing process used for the Murex trunculus. This because the chemicals employed are used to reduce the dyestuff, which makes the dye water soluble to allow its absorption into the fabric, and at the same time allows the ultraviolet rays of the sun to act on the purple-blue dye causing it to turn to the pure blue color that is tekhelet.<sup>16</sup> Interestingly, this fits with Rashi's distinction, as noted by the Radzyner, between "the blood of the hillazon" versus "its color green" in the final dyed fabric – for the "blood" is dark purple yet its dye is pure blue.

## 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.<sup>17</sup> "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.<sup>18</sup> R. Kapach holds *kamonia* to be a salt (*melach alkala*).<sup>19</sup> A salt is the first element needed for vat-dyeing, though others hold this too was an element of the mordant dyeing process.<sup>20</sup>

Be that as it may, the Rambam did not have access to the hillazon nor did he have first hand knowledge of the dye procedure.<sup>21</sup> He, like Rashi before him, was not giving an account of the dye procedure but rather explaining why *sammanim* were part of the recipe provided by R. Shmuel bar 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 being that it was common for chemicals to be used as part of the dye procedure, be they what they may be. Indeed, R. S. 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 of "the way of the dyers."<sup>22</sup>

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<sup>15</sup> This because their whole question was at the outset based on the impossibility that the chemicals alter the color from the hillazon (Ein HaTekhelet 1:22).

<sup>16</sup> Otto Elsner and Ehud Spanier discovered that, in the reduced dye solution, the ultraviolet rays from the sun break the bromine atoms off of the dibromo-indigo (i.e., purple-blue) molecule from the snail thus leaving a pure indigo (i.e., blue) molecule to be bonded into the wool upon oxidation.

<sup>17</sup> Herzog, p.99; one could argue that the words "in order that the dye will be absorbed" imply that the *ahala* was a mordant.

<sup>18</sup> Herzog, p.99.

<sup>19</sup> See R. M. Borstein, *Ha-Tekhelet* (Jerusalem, 1988), p.54, n.67.

<sup>20</sup> R. S. Taitelbaum, *Lulaot Tekhelet*, p.258.

<sup>21</sup> He himself says so in *Shu"t* v.1,#138; also comm. on Mishna Menachot 4; Hil. Tzitzit 2:9.

<sup>22</sup> See R. S. Taitelbaum, *Lulaot Tekhelet*, p.254.

## Radzyner

In discussing the chemicals used to produce tekhelet it would be remiss not to mention the dye proposed by the Radzyner which relied heavily on chemical additives. His most fundamental opinion on the subject of the *sammanim* was that the blood of the hillazon 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.”<sup>23</sup> This statement clearly indicates that the Radzyner was duped as to the nature of his own dye, for it has been demonstrated that his dye, Prussian Blue, obtains its blue color from the *Ferric ferrocyanide* added to the mixture, and not from the *Sepia officinalis* (a.k.a, cuttlefish) extract.<sup>24</sup> Given this understanding, it seems clear that the Radzyner would have joyfully cast the *Sepia officinalis* back to the sea in favor of the *Murex trunculus* which inherently provides the blue dye.<sup>25</sup>

## Conclusion

The question has been asked: given the discrepant opinions between Rashi, the Rambam, and Tosafot, how can we make a decision? First of all, halacha is full of great disputes, yet a final decision is made on how to act – a *mabloket* is no reason to remain idle. Second, I believe that we have demonstrated that the commentators are not coming to obligate a specific chemical (or specific method) but to explain the mere use of chemicals in the process of making tekhelet 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.<sup>26</sup> Third, based on the Gemara’s non-identification of the *sammanim*, the Radzyner concluded that *any* chemicals which will achieve the desired end without contributing to the color are acceptable.<sup>27</sup>

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<sup>23</sup> Ein HaTekhelet 1:22, p. 288. Similarly he 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 tekhelet in a manner which nothing affects the color other than the blood of the hillazon; and the chemical additives are colorless and only work to extract the color from the blood” (Ptil Tekhelet, p.168).

<sup>24</sup> R. Herzog, p. 117, O. Elsner and E. Spanier, “The Past, Present and Future of Tekhelet”, *The Royal Purple and The Biblical Blue* [Jerusalem, 1997], p.172, I. Ziderman, “Halakhic Aspects etc.”, *The Royal Purple and The Biblical Blue* [Jerusalem, 1997], p.208.

<sup>25</sup> The chemicals used in the *Murex trunculus* procedure do not directly alter the color of the final dye-stuff. The chemicals merely “reduce” the dye (i.e., remove the oxygen and make it water soluble) so that it can affix to the wool. When the dye is in the reduced state, exposure to ultraviolet light modifies the chemical composition of the dye such that when it is removed from the dye-bath and oxidizes in the wool it is blue. Once again, the chemicals do not in any way add or modify the color of the dye. The change of color is simply due to the action of the sun, or more precisely, the ultraviolet rays of the sun when the solution has been reduced with the help of the chemicals.

<sup>26</sup> Personal correspondence with Prof. Zvi Koren, Edelstein Center for the Analysis of Ancient Artifacts at Shenkar College in Ramat-Gan.

<sup>27</sup> Ein HaTekhelet 1:22, p. 288.