

Sammanim

Mois A. Navon, 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).

Rashi

Chemical Function

Commenting on the word “*sammanim*”, Rashi explains that, “it is the practice of dyers to imbue the cloth with *tzrif* which is called *beitza*.” Implicit in this explanation is Rashi’s opinion that the *sammanim* were used only as an agent to affix the dye in the wool and not to alter or contribute to the color.¹ R. Herzog (p.99) identifies the compound ‘*beitza*’ as “alum-mordant”, which is a known chemical used to prepare cloth to accept dye.² Mordants are used - almost without exception - to treat the fabric first, after which the dye is applied to the fabric.³ As such, this account of the *sammanim* comes at variance to the description in the Gemara wherein R. Shmuel bar Yehudah stated unequivocally that the *hillazon* blood and the *sammanim* were boiled *together* to produce the dye.

This 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.⁴ Rather, his account of the *sammanim* comes solely to answer the difficulty posed by the Gemara’s inclusion of substances other than *hillazon* blood,⁵ since other references to the dye refer exclusively to its being from the *hillazon* blood.⁶ Consequently, Rashi explains that the *sammanim* were used only to assist the dye-stuff to adhere to the wool. 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 “cooked” with the dye-stuff.⁷

Dye-stuff Color

¹ See R. Herzog, *The Royal Purple and the Biblical Blue*, p.99; R. Twerski, p.96; R. Leiner, *Ein HaTekhelet* 1:22, p. 285.

² On use of alum see the Columbia Encyclopedia entry “mordant”.

³ Personal conversation with dyer Y. Safri.

⁴ R. Herzog places the end of the *tekhelet* dyeing industry at 638 C.E., the time of the Arab conquest of the land of Israel. R. Leiner believed that the Gaonim were the last to merit *tekhelet*. In any case all agree that Rashi was not in possession of the coveted dye.

⁵ 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]

⁶ “*Tekhelet* is valid only from the *hillazon*; if *tekhelet* was produced from other than the *hillazon*, it is invalid.” Tosefta (Men. 9:6). Mesechet Tzitzit, Halacha 20. Also Menachot 44a.

⁷ Vat dyeing was only used for isatis and indigoferra tinctoria (personal conversation with dyer Y. Safri).

As previously mentioned, given that the *sammanim* do not contribute to the color, the simplest inference is that the color of the final dye is identical to that of the “blood” as it comes from the *hillazon* (i.e., blue). However this is certainly not the only possible understanding. One could just as easily hold that the dye goes through various transformations before arriving at its final color while still maintaining that the *sammanim* do not contribute or directly alter the color (e.g., color changes being due to exposure to oxygen and/or sun). This was the Radzyner’s understanding, and through a precise analysis of Rashi’s comment on the Torah (Shmot 25:4), he demonstrated that Rashi in fact held that the color out of the *hillazon* was different from the final dye color.⁸

In conclusion, we derive from Rashi’s comment 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.

Tosafot

The Tosafot (s.v. *sammanim*) express amazement that one could add chemicals to the *hillazon* blood since other references⁹ state only *hillazon* blood as the source of the *tekhelet* dye. They explain that the *tekhelet* dye was composed of the dye-stuff from the *hillazon* blood and *sammanim* together. Their question implies that they were of the opinion that the blood of the *hillazon* was the essential color of *tekhelet*.¹⁰ Given this position, their resolution can be understood in the following ways: (1) the *sammanim* served to modify the dye such that they merely brought out the final color inherent in the dye-stuff, but didn’t contribute to the color in any way;¹¹ (2) the *sammanim* served to facilitate adhesion of the dye-stuff to fabric.¹²

Conclusion

The dye produced by the *Murex trunculus* is described as follows:

Inside the hypobranchial gland of the snail, only the precursors to the dye exist as a clear liquid. ... When the precursors are exposed to air and sunlight in the presence

⁸ The Radzyner (Ein HaTekhelet 1:22), though agreeing with the simplest understanding of Rashi, provides an interesting explanation wherein he deduces that Rashi could have been of the opinion that the chemicals changed the final dye color, though certainly **not** by adding color. Rashi (Shmot 25:4) comments that, “*tekhelet* is wool dyed from the blood of the *hillazon* and its *tziv’o* (dye/color) is ‘green’ [‘blue’ in the Talmudic sense (see Herzog, p.92, 97)].” The Radzyner points out that Rashi did not say, “from the blood of the *hillazon* **which is green**” or “from the blood of the *hillazon* **whose blood is green**”, rather he stated “...and **its color** is green”. These words imply, 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. 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.

⁹ See fn. 6.

¹⁰ For otherwise they would have no reason to be so incredulous at the idea of additives. See Radzyner (Ein HaTekhelet 1:22), Twerski, p.96, n.53.

¹¹ Radzyner (Ein HaTekhelet 1:22, p. 288) explains that the blood contained the essential color and the chemicals were used “only to purify and clarify the blood so it will reach its clear color, however they are not part of the color.” This statement clearly indicates that the Radzyner was duped as to the nature of his own dye; for it has been demonstrated (see Herzog, p. 117, Elsner, p.172, Ziderman, p.208) that his dye, Prussian Blue, obtains its blue color from the ferric ferrocyanide added to the mixture, and not from the Cuttlefish extract.

¹² See R. Twerski, n.53.

of the enzyme purpurase which also exists within the gland, they turn into the dye material. ... In the *trunculus*, these reactions result in a mixture of dibromindigo (purple) and indigo. The dye must be put into solution (usually accomplished by reducing the dye molecule) in order for it to bind tightly to wool. In this state, if dibromindigo is exposed to ultraviolet light, the bromine bonds will be broken and it will transform to indigo, turning the *trunculus* colorant from purplish-blue to pure blue.

(Baruch Sterman, *The Science of Tekhelet, Tekhelet*, YU Press, p.76)

Both Rashi and Tosafot agree: (1) that the *sammanim* were used to facilitate the bonding of the dye to the wool and (2) that the color came from the *hillazon* “blood” (not the *sammanim*).¹³ This accords well with *Murex* dye:

- (1) The chemicals are used solely to affix the dye-stuff to the wool by bringing the *hillazon* blood into a reduced state (i.e. and thus water soluble), as per common “vat” dyeing procedure.
- (2) The chemicals do not directly alter the color of the final dye-stuff. Rather, the chemicals indirectly allow the dyestuff (which inherently contains the complete chemical composition necessary to make blue) to discard its bromine atoms, and subsequently oxidize in wool as pure blue.¹⁴ The chemicals do not in any way add or modify the color of the dye. The change of color is due simply to the action of the sun, or more precisely, the ultraviolet rays of the sun. The chemicals merely reduce the dye 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 oxidizes in the wool it is blue. Once again, the chemicals do not modify the color in any way.

As an interesting aside, based on the Gemara’s non-identification of the *sammanim*, the Radzyner (Ein Ha*Tekhelet* 1:22, p. 288) concluded that *any* chemicals which will achieve the desired end without contributing to the color are acceptable.

¹³ The primary differences between the two were that (1) Rashi made reference to a mordant (something explained herein as an example and not a demand; Tosafot explicitly maintain that the chemicals are mixed with the dye-stuff (as per vat dyeing). (2) Tosafot leave more room to interpret that the original color was not the final color, though there is room to view Rashi similarly.

¹⁴ Given this understanding, it seems clear that the Radzyner would have joyfully rejected the *Sepia officinalis* in favor of the *Murex trunculus*.