

Contemporary Discourses on Techeiles:
***Is Murex Trunculus* the Chilazon?**

Mendel E. Singer, Ph.D.

Foreward

This collection of writings began with an article I wrote that was published in the *Journal of Halacha and Contemporary Society*. Prior to publication, I shared this article with the Ptil Tekhelet Foundation and requested their response. These two articles and my reply are reprinted here. This exchange prompted a letter by Rabbi Yechiel Yitzchak Perr that was published, and is also included here. Following these publications, I sought a teshuva about the *murex trunculus* “techeiles” from HaRav Shlomo Miller, Shlita. With some persistence on my part, and a lot from Dr. Yoel Ostroff, I did receive such a teshuva, and it has been published. It appears first in this collection. The last article to appear here is a feature article that was published in *Halacha Berura*. This article is remarkably well written and offers an excellent and concise review of the different opinions on the chilazon.

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* Reprinted from the *Journal of Halacha and Contemporary Society*

בס"ד יום ב' לפר' ויחי תשס"ד לפ"ק
לכבוד ידידי ר' מנדל זינגר שליט"א

אודות התכלת החדשה כבר הייתי שם במקום שעושים התכלת ולדעתי כל מש"כ בזה אין שום הוכחה שזהו תכלת, אדרבה יש ב' ראיות גדולות שאינה תכלת. א', דבגמרא ורמב"ם מבואר שיש בדיקה להבחין בין תכלת לקלא אילן, ומה שעושין תכלת החדשה הוא ממש קלא אילן אלא שעושים את זה ממין "מורקס" ומשנים הריר עד שיהא דומה ממש לקלא אילן ואין שום חילוק ביניהם באופן כימי וע"כ א"א להיות שום בדיקה להבחין ביניהם, וכל מה שדחו ראייה ברורה זו אין בו לא טעם ולא ריח.

ב', מה שעושין היום שאחר שבירת קצת מן הקליפה הם חותכין קצת מן החי וטוענים שכן מצאו הרבה כזה בחפירות מימים קדמונים, הנה בגמרא מפורש שמלבד איסור צידה ליכא שום איסור בפציעת חלזון ובנטילת הצבע, ובאופן שהם עושים הלא הוא גזיזת דבר מן החי שלכל הדיעות הוי מלאכה מן התורה בשבת כמו הסרת ערלה מן החי, וחייב או משום נטילת נשמה, או משום גזוז לפי"ד הש"מ בכתובות, וא"כ מפורש שמה שהם עושים אין זה באופן שעושים תכלת.

גם מפור' בגמ' שאופן פציעתו הוא באופן נטילת נשמה, אלא שאינו מכויין לנטילת נשמה והוי מקלקל או פס"ר דלנ"ל לגבי נטילת נשמה, והצבע שעושים הלא גם לדבריהם הלא הוא טוב ומועיל גם שעה או שעתים אחר המיתה, וא"כ גם מזה מוכח שאין תכלת שלהם תכלת של הגמ'.

גם יש להעיר מדברי תשובת ר"א בן הרמב"ם בברכת אברהם ליישב דעת אביו דחובל וחולב חייבים משום תולדות דדש, אף שאין דישה אלא בגדו"ק ומה"ט ליכא חיוב דישה בחלזון כמפורש בגמרא. וביאר דדישה ממש בעינן גדו"ק אבל תולדות דישה אי"צ גדו"ק. וכפי הנראה נטילת הריר מן החלזון אינו דישה ממש, ולכל היותר הוי תולדות דישה אשר אי"צ בהן תנאי גדו"ק לדעת הרמב"ם.

והנה יש מחלוקת הראשונים כמה חוטין בעינן לתכלת, א' משמונה או ב' משמונה [דהיינו א' מד' חוטין שבציצית], או ד' חוטין מח' [דהיינו ב' חוטין שלמים תכלת וב' חוטין לבן]. והנה לדעת הרמב"ם דבעינן פתיל א', ע"י אור שמח ריש הלכות ציצית שכתב בדעת הרמב"ם דחוט א' חציו תכלת וחציו לבן דלצובעו כולו תכלת א"א דפתיל א' ולא שנים. ונ' כוונתו דלהרמב"ם דפתיל הכוונה א' א"כ הוי כל תוסיף כשצובע ב' חוטין [מן הח' חוטין דהיינו חוט שלם], וא"כ אם התכלת כשרה ועושים יותר מחוט א' לדעת הרמב"ם אסור והוי כל תוסיף, אבל בזה שכתבנו שהתכלת פסולה הרווחנו שלא עברו על כל תוסיף לדעת הרמב"ם.

גם ראיתי שאחד מן המחזיקים בתכלת החדשה דחה דברי הגר"ח ז"ל שאמר דמצד סד"א לחומרא ליכא חיוב לעשות מעשה שהוא ספק מצוה. והיה סבור שסברת הגר"ח שבכל ספק מצוה ליכא חיוב סד"א לחומרא, ודחה דבריו מדברי הר"ן דגם בכהש"מ מחויב ליטל לולב ואתרוג אף דלא הוי אלא ספק מצוה. ולא הבין כלל סברת הגר"ח ואינו ענין כלל לדברי הר"ן. והי' לו לזכור הגמ' גברא רבה אמר מלתא אין

מזניחין אותו. סברת הגר"ח הוא במצוה שמחויב בתורת ודאי, ויש לפניו אופן לקיימו מספק, ואחר שיקיים מספק עדיין נשאר מחויב בדבר מדין סד"א לחומרא, א"כ ליכא חיוב מה"ת לעשות דבר שאף אחר עשייתו נשאר החיוב לעשות מוטל עליו. ואינו דומה כלל לדברי הר"ן דבכהש"מ יש חיוב מספק וע"י עשייתו הוא פוטר עצמו מן החיוב ולא נשאר שום חיוב עליו.

ובעיקר סברת הגר"ח נראה דתלוי בפלוגתא דרמב"ם ורשב"א אי סד"א מה"ת לחומרא או מדרכבן לחומרא, דלדעת הרשב"א דמה"ת לחומרא א"כ אם יטיל ספק תכלת בבגדו עדיין נשאר חיוב מצוה עליו מד"ת מדין סד"א לחומרא, וכיון דלא יפטר מחיוב על הטלת ספק תכלת ליכא חיוב עליו להטיל בבגדו ספק תכלת. אולם לדעת הרמב"ם דסד"א מה"ת לקולא, א"כ י"ל ע"י הטלת ספק תכלת נפטר מחיובו מה"ת ושפיר י"ל דחייב מה"ת להטיל ספק תכלת בבגדו לפטור חיוב תכלת שעליו. וידוע תשובת הר"ן לענין להתיר נדר בכיהש"מ של יום חלות הנדר דתלוי בפלוגתא הנ"ל דלדעת הרשב"א דסד"א מה"ת לחומרא כבר חל הנדר ויכול להתירו מה"ת, משא"כ לדעת הרמב"ם דמה"ת סד"א לקולא, א"כ בכיהש"מ עדיין מותר מה"ת וא"כ לא חל עדיין הנדר וא"א לו להתירו עדיין. אולם למש"כ החו"ד בסימן ק"י דהרמב"ם לא ס"ל דסד"א מה"ת לקולא רק בספק איסור, דמה"ת דוקא ודאי אסור, אבל לענין קיום מצות מחויב לקיים באופן ודאי וספק קיום מצוה גם לרמב"ם אינו פוטר חיובו. וא"כ אף לדעת הרמב"ם אם יטיל ספק תכלת עדיין נשאר בחיובו מה"ת, וא"ש סברת הגר"ח דליכא חיוב לעשות דבר שאף אחר עשייתו נשאר החיוב עליו, ואף שיש ראיות מכמה פוסקים דלא ס"ל כסברת הגר"ח, וגם האדמו"ר מראדזין ז"ל כבר דן על סברא זו, מ"מ עיקר הסברא סברא ישרה וא"א לדחותו בקל.

ומה שטוענים שמצאו מיני המורקס בחפירות, יתכן מאד שהיה צבע ארגמן אשר עד לפני כ"ד שנה לא ידעו שיש אופן לשנות הצבע ולעשותו קלא אילן ממש, א"כ י"ל גם בימים קדמונים לא ידעו מזה אלא שעשו מזה צבע אחר. ובפרט שכבר כתבתי שלפי הראיות שהביאו גם בימים קדמונים היו עושים באופן שהם עושים, וא"כ הוי מלאכה דאורייתא כמו הסרת ערלה מן החי. ועיין בן איש חי בספרו בן יהודע על ב"מ דף ס"א שכתב ע"פ קבלה מדברי האר"י ז"ל דגוון קלא אילן יש לסט"א אחיזה נורק בתכלת כשרה אין לו אחיזה, וע"ש שהאריך בזה, א"כ לדעתי שזהו קלא אילן יש קפידא על פי קבלה בדוקא שלא להשתמש בגוון זו שיש בו אחיזה לסט"א. מלבד הטעם ע"פ הלכה שאינו בגוון דכנף, דאם אינו תכלת בענין לכתחילה שיהיו הציצית כגוון הכנף ואין עושים רק ציצית לבנים וכמ"ש הרמ"א סימן ט' ס"ה אף בשאר גוונים של בגד ומה"ט מדקדקים לעשות טלית רק גוון לבן כיון דאין עושין ציצית רק לבנים.

והנה בעיקר מה שדוחקים המדעים בזה מפני שלא ידוע שום מין אחר וע"כ צריך להיות המורקס, אבל אין זה כלום לכל יודע דבר דתמיד מוצאים דברים שלא ידעו מתחילה, ובפרט חלזון שכבר אמרו עליו שאינו בנמצא עכשיו.

סוף דבר לדעתי יש קפידא בדוקא שלא להשתמש במין תכלת החדשה הבאה מן ה"מורקס".

ידידו,

שלמה אליהו מילר

Understanding the Criteria for the Chilazon

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Bio

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Background

The Torah commands us to wear a thread of blue, *techeilet*, in each corner of our *tzitzit*.¹ While *tzitzit* serve as a visual reminder to do the *mitzvot*, the blue thread reminds us of *Hashem*: “*Techeilet* resembles [the color of] the sea, and the sea the sky, and the sky the throne of glory”.² The Gemara informs us that the *techeilet* dye comes from a bodily fluid (lit: blood)³ of the *chilazon*.⁴ At some point it became forgotten which species is the *chilazon*. Exactly when *techeilet* ceased to exist is unknown. Though some have suggested this happened sometime between 500-700 C.E.⁵, there is evidence that *techeilet* continued to be dyed in some places for another several hundred years.⁶

In the 1880’s, Rabbi Gershon Henoch Leiner, the Radzyner Rebbe *zt”l*, set out to identify the *chilazon* species. Although widely known for his talmudic expertise (e.g. *Sefer Sedrei Taharot*), he had studied biology, chemistry and engineering, and practiced medicine as well.⁷ Guided by the *simanim* (signs) provided by the Talmud and the *Rishonim*, he traveled across Europe, studying at the famed aquarium of Naples. He decided that the long lost *chilazon* is *sepia officinalis* (the common cuttlefish), believed by some to be the opinion of Rambam.⁸ He wrote three books on *techeilet*, comprising nearly 500 pages. In the words of one of his present day dissenters, “These books still stand as the definitive works on the subject, and form the halachic foundation of any discussion of the topic”.⁹ Even today Radzyn produces *techeilet* from the cuttlefish.

Rabbi Dr. Yitzchak Herzog *z”l*, a brilliant talmudist, Jewish historian and the Chief Rabbi of Eretz Israel from 1936-1959, was fluent in numerous languages and *techeilet* was the subject of much of his doctoral dissertation. Rabbi Herzog rejected the Radzyner Rebbe’s position, and concluded that the *chilazon* was a member of the *Janthina* species.¹⁰ However, the dye produced by the *Janthina* turned brown, and was not permanent. It appears that Rabbi Herzog did not pursue this matter further, and no *techeilet* was ever produced from the *Janthina*.

In recent years there has been a movement in favor of the *murex trunculus* snail as the *chilazon*. Fueled by the work of Dr. Irving Ziderman, an academic scientist at the Israel Fiber Institute, followers of this theory formed an organization, *Petil Tekhelet Foundation*. Based largely on archeological and scientific evidence, they have been active in publishing, lecturing and electronic dissemination.¹¹ Their work has, for the most part, gone without critical appraisal. This article will attempt to elucidate the criteria for identification of the *chilazon*, clarify what is required to meet these criteria, and then evaluate the theory that *murex trunculus* was the *chilazon*. The criteria will be presented in 4 categories. The first section will discuss the primary criteria, based on statements brought by the Gemara for the purpose of describing the *chilazon*. This is followed by an analysis of the Gemara’s chemical tests for *techeilet*. Secondary criteria will deal with those characteristics of the *chilazon* which can be deduced from statements made for other purposes. Lastly, there is a section for other evidence which might be brought to lend further credence to, or discredit a claim.

¹ *Bamidbar* 15:38.

² *Menachot* 43b.

³ Hebrew: *dam*. The *chilazon* has two “bloods”, one that is the life blood, and another that is stored in its own sac. This other “blood” is the source of the *techeilet* dye (Rabbeinu Tam, *Tosafot, Shabbat* 75a)

⁴ *Menachot* 44a, *Masechet Ketanot Masechet Tzitzit* Ch. 1 Halacha 10, *Tosefta Menachot* 9:16.

⁵ Rabbi Isaac Herzog, “Hebrew Porphyrology”, in Ehud Spanier, ed., *The Royal Purple and the Biblical Blue: Argaman and Tekhelet* (Jerusalem, 1987), p.112. Baruch Sterman, “The Science of Tekhelet”, in Rabbi Alfred Cohen, ed., *Tekhelet: The Renaissance of a Mitzvah* (New York, 1996), p.70.

⁶ The Radzyner Rebbe bases this on the fact that *gaonim* did not write about *halachot* that were no longer applicable, and two of the *gaonim* wrote about the laws of *tzitzit* based on *techeilet* (Rav Natronei Gaon, Rav Shmuel bar Chofni). He also notes that Rambam explained in a responsum the practical application of the laws of *techeilet*, implying they were wearing *techeilet* in Luniel. (Rabbi Gershon Leiner, *Sefunei Temunei Chol*. Published in *Sifrei HaTecheilet Radzyn* (Bnei Brak, 1999), pp. 5-6. A nearly complete English translation of this *sefer* can be found at <http://www.begedivri.com/techelet/Sefunei.htm>)

⁷ Chapter on Rabbi Gershon Leiner in Frenkel, Rabbi Isser, *Yechidei Segulah* (Tel Aviv, 1967).

⁸ Ludwig Lewysohn, *Zoologie des Talmuds*. (Frankfurt, 1858), pp. 283-285.

⁹ Sterman *ibid.* p. 73.

¹⁰ Herzog *ibid.*

¹¹ The Petil Tekhelet Foundation maintains an excellent online library on their web site, <http://www.tekhelet.com>. This library was the source for many of the pro-*murex* arguments cited here. Their great efforts at publicizing the neglected mitzvah of *techeilet* is inspiring.

Primary Criteria

The strongest criteria for identifying the *chilazon* comes from the Gemara *Menachot*, where the subject of *techeilet* is discussed extensively.¹² There, the Talmud cites several sources in order to describe the *chilazon*. These statements are of the utmost importance because they were cited for the sole purpose of describing the *chilazon*. *Chazal*, knowing which species was the *chilazon*, chose these statements to describe it. As such, in order for a candidate species to satisfy these criteria, it is not sufficient to meet these criteria in a minimalist sense. It must be reasonable that *Chazal* would have chosen these statements to describe it. In evaluating whether a particular species is the *chilazon*, a strong case must be made for all of the primary criteria. The primary criteria for the *chilazon* come from the following statements: “*Chilazon zehu gufo domeh l’yam, ubriato domeh l’dag, v’oleh echad l’shiv’im shanah u’bdamo tzov’in techeilet, l’fichach damav yekarim*”.¹³ This establishes four primary criteria for the *chilazon*:

1. the color of its body is like the sea
2. its form is like a fish
3. it comes up once in 70 years, its “blood” is used for *techeilet*, therefore
4. it is expensive.

As Rabbi Herzog points out, the first requirement uses the *lashon gufo*, meaning body or flesh.¹⁴ It does not refer to the shell, which is usually rendered *nartik* or *klipah*. The *lashon* here, *gufo domeh l’yam*, is similar to the statement just a few lines earlier in the Gemara, *techeilet domeh l’yam*, where it is understood that the color of *techeilet* is similar to the color of the sea. There the comparison is extended to the sky and the sapphire, indicating that *techeilet* is blue.¹⁵ If, just a few lines apart, dealing with the same subject, we find the same expression, *domeh l’yam*, it is reasonable to conclude that the meaning is the same in both cases. If *techeilet* and the body of the *chilazon* are both *domeh l’yam*, then the color of *techeilet* and the color of the body of the *chilazon* must be similar, i.e. both blue. This is supported by the *lashon* of the *braita* of *tzitzit*, which states “*gufo domeh l’rekiah*”.¹⁶ The body of the *murex* does not resemble the sea. The Petil group argues that the shell of the *murex trunculus* is sometimes covered with a sea fouling. The color of these organisms will vary from place to place, but is sometimes blue or green.¹⁷ This argument fails on three counts. First, the requirement is for the body, not the shell. Second, the color of the sea fouling is only sometimes blue. Since it is usually not blue, the Gemara certainly would not choose to describe it as blue. Third, it is implausible that *Chazal* would choose to identify the *murex trunculus* by giving a description of the sea fouling, which is neither a part of the creature nor distinctive, since it covers everything else in the area, as well.¹⁸ Some have tried to argue that the Hebrew word *yam* can also mean seabed. However, only the shell is colored like the seabed, not the body. Considering that *yam* almost always means sea, and is used as such in regards to the color of *techeilet* in many places, it is hard to believe it could be used to mean seabed here. In fact, the requirement that the color of the body of the *chilazon* be like the *yam* is just a few lines after the Gemara’s statement that *techeilet* is the color of the *yam*, which everyone, including the *murex* supporters, agrees means sea.

As for criterion 2, the statement in the Gemara is “*briato domeh l’dag*”. *Briato* means “its form”, as explained by Rashi and Rabbeinu Gershom.¹⁹ *Murex trunculus* in no way resembles a fish. Supporters of the *murex trunculus* theory suggest *briato* could mean “its creation”, since *murex* spawn like fish. Aside from relying on an interpretation of *briato* that is contrary to the classical *mefarshim*, there is another difficulty. Since most mollusks spawn, it is unlikely that *Chazal* would have chosen this characteristic to distinguish the *chilazon* from other species.

Regarding criterion 3, the requirement of once in 70 years, the Radzyner Rebbe says this means that there are times when the *chilazon* is abundant.²⁰ Likewise, Rabbi Herzog, citing also the *braita* of *tzitzit* that says the *chilazon* comes up every 7 years, is of the opinion that there should be some cycle, though not necessarily 7 or 70 years.²¹ *Murex trunculus* has no known cycle or times of unusual abundance. Petil followers have tried to argue that the Hebrew *sheva shanim* in the *braita* could also mean seven-fold, and Pliny the Elder mentions an optimal seven-month cycle for harvesting *murex* snails.²² This not only ignores the Gemara’s expression of 70 years, but

¹² *Menachot* 41-44.

¹³ *Menachot* 44a.

¹⁴ Herzog *ibid.*, p. 70.

¹⁵ Although Rashi states that *techeilet* is green (*Shemot* 25:4), it should be pointed out that there were few color designations in the Gemara, and that green represented a color classification that includes blue (Herzog *ibid.* p.92). Indeed, elsewhere Rashi states the color of *techeilet* resembles the darkened sky at dusk (*Bamidbar* 15:41).

¹⁶ *Masechtot Ketanot Masechet Tzitzit* Ch. 1 Halacha 10

¹⁷ Serman *ibid.* p.69.

¹⁸ Serman *ibid.* p.69.

¹⁹ Rashi, Shita Mikubetzet and Rabbeinu Gershom, *Menachot* 44a; Herzog *ibid.* p.65.

²⁰ Leiner *ibid.* p.4.

²¹ Herzog *ibid.* pp. 69,73.

²² R.J. Forbes, *Studies in Ancient Technology* Vol 4, 2nd edition (Leiden, 1964), p.120.

also assumes that seven-fold means seven one-month periods. They do not suggest a reason why the base unit should be one month. Clearly the intention of the Gemara and the *braita* is that it is unusual for there to be an abundance, and every seven months is hardly unusual or noteworthy.

Purple dye from all species of *murex*, including *trunculus*, was exceedingly expensive. This was because each snail possessed so little dye that it took about 8,000 snails to make one gram of dye!²³ In criterion 4, Rashi explains that the *techeilet* dye was expensive because of the *chilazon's* rare appearance, and not because of the minute dye quantity.²⁴ This follows from the language of the Gemara where the statement that the dye is expensive is introduced with the word *lefichach*, “therefore”, and the preceding statement was about the once in 70 year appearance of the *chilazon*. Rabbi Herzog indicates that this requirement implies that the quantity of dye in the *chilazon* was not very small, which is inconsistent with *murex trunculus*.²⁵

Chemical Tests

In ancient times, there were unscrupulous individuals who would substitute an imitation *techeilet* dye known as *k'la ilan*, for the real *techeilet*. *K'la ilan* is widely understood to be indigo, traditionally derived from a plant.²⁶ Indigo was the predominant source of blue dye in ancient times, and was both readily available and relatively inexpensive. This counterfeit *techeilet* was virtually identical to the color of the real *techeilet*. Accordingly, the Rabbis proposed chemical tests that could distinguish between the chemical that made up the authentic *techeilet* and the chemical that made up the counterfeit *techeilet*.²⁷ These tests are based on subjecting the dyed wool to a fermentation process²⁸ and ruling it *k'la ilan* if the color worsens. Fermentation processes were used in the traditional method of dyeing indigo, and causes the blue indigo to change to a yellow solution.²⁹ Chazal used this knowledge to design tests that indigo would fail. The chemical test proposed by Rav Yitzchak the son of Rav Yehudah describes a fermentation vat typical of what was used in ancient dyeing of indigo. The main ingredient was fermented urine, *mei raglayim*.³⁰ Though the Gemara's *lashon* of “*ben arba'im yom*” could mean the *mei raglayim* had to be 40 days old (thereby sufficiently fermented), or it could mean the *mei raglayim* had to be from someone 40 days old, as Rashi notes³¹, the *mei raglayim* must be fermented.³² *Mei raglayim* of babies under 6 weeks old consists mostly of water, making it a poor choice for fermentation. Thus, the Gemara's use of “*ben arba'im yom*” could reasonably be understood either way. Regardless, it is clear that the Gemara's chemical tests were based on the chemical properties of indigo and were designed so that indigo would fail the test.

The Petil group uses mucus from the *murex trunculus* snail, and through a process creates indigo, chemically identical to plant indigo. In other words, Petil is saying that real *techeilet* and imitation *techeilet* are the same chemical, just made from different sources.³³ This position is untenable. Obviously, if the Gemara gives chemical tests to distinguish *techeilet* from *k'la ilan*, they cannot be the same chemical! Dr. Allen Kropf, a retired professor of pigment chemistry familiar with the Petil dyeing process, writes in a personal communication, “There should absolutely be no chemical difference between plant and snail indigo. Thus, any chemical test that posits a difference, is not valid, in my opinion”. Therefore, the Gemara's chemical tests cannot possibly be testing plant indigo vs. snail indigo. This leaves two possibilities: plant indigo is not *k'la ilan* or snail indigo is not *techeilet*. Given the wide acceptance of indigo as *k'la ilan*, and the corroboration afforded by the Gemara's tests which are clearly based on detecting indigo, the only conclusion would seem to be that *techeilet* is not snail indigo. Nonetheless, Dr. Roald Hoffman, a Nobel-prize winning chemist does reach a different conclusion. Recognizing the

²³ P. Friedlander, “Über den Farbstoff des antiken Purpurs aus *murex brandaris*”, *Berichte der Deutschen Chemischen Gesellschaft*. 42(1909):765-770.

²⁴ Rashi on *Menachot* 44a.

²⁵ Herzog *ibid.* p. 70.

²⁶ Aruch on *k'la ilan*; Nimukei Yosef *Baba Metzia* 34a; Herzog *ibid.*, pp.94-96, Responsa Ridbaz v2, 685.

²⁷ *Menachot* 42b-43a.

²⁸ Herzog *ibid.* p.102.

²⁹ Indigo, to be able to penetrate wool, must first be converted (oxygen removed) into its chemically reduced form, known as “indigo white” (which is really more of a yellow, or yellow-green). After wool is dipped into “indigo white”, it is removed from the solution and turns blue upon exposure to the oxygen in the air. The chemical reduction of indigo into “indigo white” was done by immersion into a fermentation vat. The first of the two tests in the Gemara describes such a fermentation vat, which should reduce the indigo, thereby fading the blue color and failing the test. Descriptions of fermentation vats can be found in: Edmund Knecht, Christopher Rawson, and Richard Loewenthal, *A Manual of Dyeing*, Eighth edition, (London, 1925), and J.N. Liles, *The Art and Craft of Natural Dyeing*, (Knoxville, 1990).

³⁰ The ingredients of the test, fermented urine, juice of the fenugreek plant and alum, seem puzzling at first glance. It would not appear to be a convenient test if it involves waiting many days for the *mei raglayim* to ferment. However, knowing that this is merely describing a typical fermentation vat used for dyeing indigo the matter becomes clear. *Techeilet* dyeing was probably done at or near the dye houses. Anyone wishing to test *techeilet* could merely walk over to where indigo was being dyed and put it in a fermentation vat and check it in the morning. The second test uses a hard, leavened dough that has fermented as much as possible (Rabbeinu Gershom, *Menachot* 43a).

³¹ Rashi on *Menachot* 44a.

³² Rambam, *Hilchot Tzitzit*, Ch. 2, Halacha 5; Tosafot on *Menachot* 43a; Tosafot on *Nidah* 63a.

³³ The Petil writings and web site boast (bold print) of how their *techeilet* is chemically equivalent to indigo.

impossibility of distinguishing plant indigo from snail indigo, he clings to the conclusion that *murex* indigo is *techeilet*. He writes of the Gemara's chemical tests, "These tests don't work, because the chemical is the same".³⁴ Since the Gemara's tests were clearly based on sound scientific knowledge and the tests were actually used ("Rav Yitzchak the son of Rav Yehudah used to test it thus..."³⁵), it would seem rather presumptuous to doubt the veracity of the Gemara's tests. It is the scientist's conclusion that *murex* indigo is *techeilet* that needs to be re-examined. Even Dr. Irving Ziderman himself, the chemist whose work led to the creation of the Petil group, acknowledges that *murex* indigo is guaranteed to fail the Gemara's chemical tests and therefore rejects the theory of *murex* indigo as genuine *techeilet*.³⁶ Petil writings have suggested that the chemical tests might be designed to detect impurities that might be found in plant indigo, but are not found in snail indigo. This logic demonstrates a lack of understanding of the nature of the chemical tests. It is clear from the above discussion that the Gemara's tests are based on the chemical nature of indigo, and not any remaining impurities. Thus, the *murex*-indigo used by Petil for *techeilet* will fail the Gemara's tests, rendering it invalid. However, a distinction must be made between evaluating whether a species is the *chilazon* and assessing whether a particular dye is *techeilet*. Even though *murex* indigo cannot be genuine *techeilet*, this does not by itself preclude the possibility that *murex trunculus* is the *chilazon*. There may be an as of yet undiscovered, alternative process that creates a different blue dye (i.e. not indigo) from the *murex trunculus*. Therefore, it is still necessary to evaluate whether *murex trunculus* meets the criteria for the *chilazon*.

An interesting side-note: the process used by Petil to make indigo from *murex trunculus* would also work for the other species famous for their use in ancient purple dyeing, *murex brandaris* and *purpura (thais) haemastoma*.³⁷ Indeed, none of the arguments presented in Petil writings appear to uniquely identify *murex trunculus*.

Secondary Criteria

There are other sources from which additional information about the *chilazon* can be deduced. These criteria can lend valuable support to a theory postulating a particular species as the *chilazon*. However, care should be taken in determining the weight placed on these criteria. These criteria were not brought for the purpose of identifying the *chilazon*, as was the case with the primary criteria discussed above. As such, it may be that a particular statement should not be understood literally or exactly. Unlike the primary criteria, meeting secondary criteria should only involve a plausible explanation, and does not have to bring out the uniqueness of the *chilazon*, and may be difficult to understand without already being familiar with the species. There is also the complication that it is not always clear when the Gemara's use of the word *chilazon* is speaking specifically of the *chilazon shel techeilet*. In some of these cases the classical *mefarshim* clarify this, in other cases it remains ambiguous.

Shell grows with it: The Midrash says about the *chilazon*, "its shell (*nartiko*) grows with it".³⁸ This would rule out hermit crabs, for example, since they do not grow shells but rather move into shells they find. This would also rule out species like the lobster that when outgrowing their shell, discard it and grow another. Elsewhere, the Midrash *Rabbah* says "when it grows, its *malvush* grows with it".³⁹ *Malvush*, garment, would appear to be some form of growth on the exterior of the *chilazon*. The term *malvush*, garment, seems to imply that it is not merely attached, but covers the body of the *chilazon*, or surrounds it. *Murex trunculus* has a shell of its own, but doesn't seem to have anything else that could be termed a *malvush*. It may be that the Midrash is using *malvush* as a synonym for shell. This would make sense in the context of the Midrash, which discusses the issue of whether the Jews in the desert outgrew their clothes. The *chilazon* is brought as an example to suggest that the clothes grew with the wearer. Referring to the shell as *malvush*, garment, would be consistent with the context. Based on this understanding of *malvush*, *murex trunculus* would appear to meet this criterion.

Hard shell: The Gemara discusses the case of someone who extracts the dye from the *chilazon* on *Shabbat*.⁴⁰ The verb used by the Gemara in describing the action of the person extracting the dye is *potzea*. *Potzea* is usually understood to mean to crush or crack open.⁴¹ This would imply that the *chilazon* has a hard shell, though this could be an external or an internal shell. Rashi says that the person squeezes (*docheik*) the *chilazon* in his hand to get out

³⁴ Hoffman, Roald. "Blue as the Sea". *American Scientist*, 78 (July/August 1990):308-9.

³⁵ *Menachot* 42b.

³⁶ I.I. Ziderman, "On the Identification of the Jewish Tekhelet Dye", *Gloria Manis* [Antwerp] 24(4): 77-80.

³⁷ P.E. McGovern, "Ehud Spanier: The Royal Purple and the Biblical Blue (*Argaman* and *Tekhelet*): The Study of Chief Rabbi Dr. Isaac Herzog on the Dye Industries in Ancient Israel and Recent Scientific Contributions", *Isis* 81:308 (September 1990):563.

³⁸ Midrash *Shir HaShirim Rabbah* 4:11.

³⁹ Midrash *Devarim Rabbah* 7:11.

⁴⁰ *Shabbat* 75a.

⁴¹ Leiner, *ibid.* p.27. Herzog *ibid.* p.57.

the blood (dye secretion). From Rashi's comment we can only infer that squeezing the *chilazon* can make the dye come out. Rashi's use of the word "squeeze" is difficult to understand since it seems to imply a soft substance, not a hard shell. This difficulty in understanding Rashi might be resolved if the *chilazon*, while being held in the hand, has a shell on one side, and flesh on the other. Thus, the person squeezes the fleshy side of the *chilazon*, and in the process may crack open, or crush, the hard shell on the other side. *Murex trunculus* has a hard, external shell that is cracked in order to get the dye out. The shell almost completely encloses the body. This would be consistent with the usual understanding of *potzea*, but not with Rashi's *docheik*.

Dye is better while chilazon is alive: We learn in the Gemara that people try not to kill the *chilazon* when extracting the dye because the dye is better if extracted while the *chilazon* is alive.⁴² From this Gemara we learn that there is a significant difference in the dye when extracted while the *chilazon* is alive and when it is extracted just moments after its death. Petil followers argue that the *murex* secretion (mucus) loses its dyeing power a few hours after the snail's death. This doesn't help since the Gemara is speaking not of a few hours, but mere moments after death. Another problem is Pliny's statement that the *murex* discharges its dye upon death.⁴³ If so, the reason not to kill the *murex* when removing the gland containing the dye is because otherwise the precious few drops of dye will be lost!

Hidden in the sand: The Gemara in Megilah states that the verse in Devarim 33:19, "*sefunei temunei chol*" ("hidden treasures of the sand"), refers to the *chilazon shel techeilet*.⁴⁴ It is not clear how restrictive this criterion is. It might only mean that the *chilazon* is considered to be a creature of the sand and that it is hidden. In this case, it would seem to be sufficient to be hidden by its own shell, and that it would not be necessary to bury itself in the sand. On the other hand, it might mean that it is hidden because it is buried in the sand. This is the understanding of the Radzyner Rebbe, citing the *Sefer HaKaneh (Hilchot Tzitzit)* as stating that the *chilazon* buries itself in sand with its head sticking out.⁴⁵ The *murex trunculus* lives on the sand, and simply by virtue of hiding its body in its shell could be considered hidden. There are times when it buries itself in the seabed, which might satisfy the general requirement of burying itself in the sand. Given that this is a secondary criterion, *murex trunculus* would seem to reasonably meet this criterion, though not in the manner described by the *Sefer HaKaneh*.

Color of the blood: Rambam states that the "blood" of the *chilazon shel techeilet* is black like ink.⁴⁶ Rashi states that the appearance of the "blood" of the *chilazon shel techeilet* is like the color of *techeilet*.⁴⁷ The Radzyner Rebbe reconciles the apparent contradiction between Rashi and Rambam by explaining that when Rashi says *maris damo*, "appearance of its blood", he is referring to the "blood" after it is prepared for dyeing, while Rambam refers to the original color of the "blood".⁴⁸ Supporters of the *murex* theory follow the lead of Rabbi Herzog who, unable to find a source to support Rambam's statement, speculated that Rambam was basing this on an erroneous statement of Aristotle, and dismissed this statement of Rambam.⁴⁹ However, it is not clear that the Petil group's *techeilet* meets the description of Rashi, either. The *murex* secretion is essentially clear. Left in the sun it turns purple-blue. When it is placed in a chemical solution it turns yellow. It is then exposed to ultraviolet radiation, after which the wool threads are dipped in the solution. The wool turns blue when it is removed from the solution and exposed to the air. Thus, the *murex trunculus* dye is never blue as a liquid, only turning blue after it is already on the garment. This might be reconciled by saying that when Rashi refers to the appearance of the blood of the *chilazon*, he means the dye as it appears on the *tzitzit* after the dyeing is completed. As a secondary criterion, this would seem to be an acceptable explanation of Rashi, although there is still the problem of dismissing the Rambam on a matter of science.

Treatment for hemorrhoids: The Gemara also tells us that the *chilazon* was used to treat hemorrhoids.⁵⁰ Rabbi Herzog states that modern pharmaceuticals knows nothing of the use of a mollusk to treat hemorrhoids.⁵¹ Rabbi Herzog's comments are a bit puzzling. Given that this treatment was from the times of the Gemara, it would be likely that mention of this would be found now only in non-traditional medical sources, what might be deemed today to be "alternative medicine". Additionally, the Radzyner Rebbe had already written that cuttlefish ink has

⁴² *Shabbat* 75a and Rashi ad loc.

⁴³ Aristotle, *Historia Animalium*, Book V, Ch. 15; Pliny the Elder, *Naturalis Historia*, Book 9, Ch. 60.

⁴⁴ *Megilah* 6a and Rashi ad loc. See also Midrash *Bamidbar Rabbah* 13:16.

⁴⁵ Leiner, *ibid.* p.29.

⁴⁶ Rambam, *Hilchot Tzitzit*, Ch.2, Halacha 2.

⁴⁷ *Chulin* 89a, Rashi.

⁴⁸ Leiner *ibid.* pp. 28-9.

⁴⁹ Herzog *ibid.* p.77.

⁵⁰ *Avodah Zarah* 28b.

⁵¹ Herzog *ibid.* p.59.

been used as a treatment for hemorrhoids since ancient times.⁵² Indeed, it is still sold today for this purpose.⁵³ As for *murex trunculus*, in ancient times it was considered to be bad for the bowels.⁵⁴

Tentacles bent like hooks: The Mishnah describes a chain hanging on the wall, with something called a *chilazon* attached to the head of the chain.⁵⁵ The *mefarshim* say it was called this because it was shaped like the *chilazon shel techeilet*⁵⁶, and *Tiferes Yisroel* explicitly states that this was an iron hook attached at the end which was used to hang the chain on a wall. The Radzyner Rebbe understands this to mean the *chilazon* has long tentacles that are bent like hooks.⁵⁷ No part of a *murex* snail would fit this description.

Snake-like extensions: The Gemara speaks of red flesh-like warts, forming a snake-like shape in the eye.⁵⁸ This disease is called both snake and *chilazon*. The Radzyner Rebbe states that the *chilazon* must have snake-like limbs or extensions, and have red warts.⁵⁹ This description does not fit *murex trunculus*.

Other Evidence

Aside from establishing criteria to identify the *chilazon*, it may be possible to find evidence to corroborate an opinion regarding the identity of the *chilazon*. The following paragraphs discuss this type of evidence in the context of the *murex trunculus* theory.

Archeological evidence: There can be little doubt that *murex trunculus* was used in ancient dyeing. It has long been accepted that *murex trunculus* was used for dyeing purple in ancient times.⁶⁰ There is significant archeological evidence to support this. However, all of the evidence suggests it was used for purple dyeing. There is absolutely no evidence to suggest that *murex trunculus* was used to dye blue. In fact, as Dr. Ziderman himself points out, it would be absurd to think that non-Jews would use *murex* to make indigo blue when they could make the same thing easier and cheaper using plants, as was done all over the world.⁶¹ One might argue that *murex*-indigo was used to make *techeilet*, while the identical but inexpensive plant indigo was used for all other blue dyeing. However, piles of *murex trunculus* shells have been found at many ancient dyeing sites, not just in the vicinity of the Jews. Certainly at those other sites they would only have used *murex trunculus* for purple. The notion that *murex trunculus* was used for making indigo is both illogical and groundless. Let us examine the archeological evidence.

Mounds of *murex trunculus* shells (as well as two related species, *murex brandaris* and *purpura haemastoma*) have been found at ancient dye sites in many locations. These shells were cracked in the exact spot to get the dye. This is solid proof that *murex trunculus* was used in ancient dyeing, but does not imply it was used for dyeing blue. A 13th century B.C.E. potsherd from Sarepta has a stripe of dye that is believed to be from the *murex trunculus* – it is a purple stripe, with no detectable blue (indigo) content.⁶² A vat from a dig at Tel Shikmona has purple *murex* dye on it, not blue as previously described in a brochure from the Petil Tekhelet Foundation (from the picture it is obviously purple, but the text erroneously said blue). Pliny speaks in great depth about dyeing with *murex*; different shades of purple, red and violet, but not blue. Petil followers point out that at one site the shells of *murex brandaris* and *purpura haemastoma* were together, but the *murex trunculus* shells were in a different area. They leap to the conclusion that *murex trunculus* must have been used for dyeing blue. They are ignoring Pliny (among others), who states that the famed Tyrian purple shade was produced by double-dyeing with *murex brandaris* and *purpura haemastoma*.⁶³ Thus, it was logical that those two species were found together, and apart from *murex trunculus*. How does that suggest *murex trunculus* was used for dyeing blue? In fact, it is hard to see how chemical analysis of archeological finds could ever support the idea that *murex trunculus* was used for dyeing blue. If the chemical is purely indigo, the natural assumption would be that the source was plant indigo, which was

⁵² Rabbi Gershon Leiner, *Ein HaTecheilet in Sifrei Techeilet Radzyn*, pp.292-3. That this was known in the times of the Gemara can be confirmed in three 1st century texts: Pliny the Elder, *ibid.* Book 32:1; Celsus, *De Medicina*, Book 2:29; Dioscorides, *De Materia Medica*, Book 2:23.

⁵³ Sepia, cuttlefish ink, is sold in tablet form as a treatment for hemorrhoids. One such store is Vitamin USA of Findlay, OH (www.vitaminusa.com/pharmacy/03-06960-67713.html).

⁵⁴ Celsus *ibid.* Book 2:30.

⁵⁵ *Keilim*, ch. 12, Mishnah 1.

⁵⁶ *Idem*, Rav Ovadiah MiBartenura, *Meleches Shlomo*.

⁵⁷ Leiner, *Sefunei Temunei Chol* p.27.

⁵⁸ *Bechorot* 38a-b.

⁵⁹ Leiner *ibid.* p.27.

⁶⁰ P.E. McGovern, and R.H. Michel, "Royal Purple Dye: Tracing Chemical Origins of the Industry", *Analytic Chemistry* 57(1985):1514A-1522A.

⁶¹ Ziderman *ibid.*

⁶² McGovern *ibid.*

⁶³ Pliny *ibid.* Book 9, ch. 62.

used around the world. If indigo was found with traces of purple, it might be suggestive of *murex trunculus* dye. *Murex trunculus* dye is naturally a mix of purple and blue, and has to be irradiated to induce a photochemical reaction from which blue dye results. If this process were not completed, the dye would be mostly blue with traces of purple. However, *murex trunculus* produces dyes with varying mixtures of indigo and purple (brominated indigo). Some batches of dye may turn out to be almost all indigo, and other batches might turn out to be all purple. Thus, even when the intention is to use the natural purple-blue of *murex trunculus*, a particular batch could turn out to be almost pure indigo. Also, mixing of dyes was common. A mix of blue and purple might be the product of *murex trunculus*, or it might be the mixture of plant indigo with purple dye from other *murex* species. Not only is there no archeological support for the notion that *murex trunculus* was used to dye blue, it may be that it is not even possible for archeological evidence to accomplish this through chemical analysis alone!

It has been suggested that the image of a *murex* shell on a Bar Kochba coin is “apparently irrefutable evidence” that *murex trunculus* was the source of *techeilet*.⁶⁴ Why else would a non-kosher species appear unless it was used for a mitzvah? *Murex* dyeing was a major industry, with some regions employing half their population in *murex* fishing.⁶⁵ Moreover, the *murex* was a status symbol, associated with wealth and royalty. Bar Kochba was not original: *murex* images showed up on coins from many places, both before and after Bar Kochba’s time.⁶⁶ It would appear that Bar Kochba used the *murex* image either for the same reason as others did (i.e. status symbol, commercial importance), or, perhaps, to give his government the appearance of more legitimacy by following the lead of other governments that printed coins with *murex* images.

Linguistic Proofs: Petil followers offer some linguistic arguments in attempting to support their position. The word *chilazon* is a general term for snail, not only in modern Hebrew but in some other languages as well. Aside from not pointing specifically to *murex trunculus*, it is not clear which species *chilazon* referred to at the time of the Gemara. It may have been a general term for mollusk. Did it only include gastropods, or could it have included cephalopods such as octopus and squid? This is unclear.

Petil writings also mention the Septuagint’s Greek translation of *techeilet* as *porphyros* (word used for purple or *murex*). Rabbi Herzog raises this issue and dismisses it rather handily.⁶⁷ He points out that everywhere else (including that same chapter) the Septuagint uses *iakinthos* for *techeilet* and *porphyra* for *argaman*, and shows how the Hebrew text they must have been given could not have matched our Masoretic tradition, and that the translation was probably given for *argaman*, not *techeilet*.

Some have suggested that Raavya (*Berachot* 9b *Siman* 25) equates *techeilet* with *porphyrin*, the Greek word for *murex*, though they do not supply a full explanation of this statement by Raavya and do not mention that in both Greek and Latin the word for *murex* and the word for purple are the same. Let us examine the passage in question. Raavya quotes a *Yerushalmi* (a part that is no longer extant) explaining the time for reciting the morning *shema*: “[from the time when one can distinguish] between *techeilet* and *karti*, between *porphyrin* and *parufinen*, which is a coat that is called in Latin *purpura*”. A logical explanation of this missing *Yerushalmi* is that the second comparison *bein porphyrin bein parufinen* is a color distinction that would be as hard to tell apart in the dark as blue (*techeilet*) and green (*karti*). *Porphyrin* is from the Greek word meaning purple. *Parufinen*, from the Raavya’s description, appears to be from the Greek *parufaino*, meaning “a robe with a hem or border of purple”,⁶⁸ which is consistent with the *hagahot* where this color is equated with *argaman*. Thus, *bein porphyrin bein parufinen* might mean to distinguish between the purple border of a robe and the rest of the garment.

Petil suggests that this *Yerushalmi* is equating *murex* with *techeilet*. Obviously they cannot mean that *techeilet* is the *murex*, but rather the source of *techeilet* is the *murex*. However, this logic would render the *Yerushalmi* as “between *techeilet* and *karti*, between a *murex* snail and a purple coat”. Aside from sounding bizarre, it is difficult to see how a purple coat could be the source of *karti*. *Karti* is usually understood to be green, like a leek.⁶⁹ There is a minority view that *karti* is not green, but a different color close to *techeilet*.⁷⁰ However, even if you rely on this view, which is based on a citation from *Aruch* which is no longer extant, to explain a *Yerushalmi* that is no longer extant, the wording still doesn’t work. Additionally, this would require equating *karti* with *argaman*, which does not fit with any opinion. There does not appear to be a way to interpret Raavya’s statement as equating *murex* with *techeilet*.

⁶⁴ Rabbi Norman Lamm, “New Discoveries and the Halakhah on Tekhelet” in Rabbi Alfred Cohen, ed., *Tekhelet: The Renaissance of a Mitzvah* (New York, 1996), p.23.

⁶⁵ Franco Brunello, *The Art of Dyeing in the History of Mankind*, translated by Bernard Hickey (Venice, 1973), pp. 91-92.

⁶⁶ Found on Corinthian and Tyrian coins (Brunello *ibid.*, p.92; Serman *ibid.*, p.64). Also found on a coin from Taras (Taranto), minted hundreds of years before Bar Kochba (Brunello *ibid.* p.105) - see coin at <http://www.geocities.com/~dougsmit/feac50tar.html>.

⁶⁷ Herzog *ibid.* p.78.

⁶⁸ Liddell-Scott-Jones Lexicon of Classical Greek, <http://www.perseus.tufts.edu>.

⁶⁹ See, for example, *Targum Onkelos Bamidbar* 11:5, *Sukkah* Ch. 3 Mishnah 6.

⁷⁰ Rabbeinu Yonah on *Berachot* 9b.

Proof by Omission: There is a simple logic that argues against *murex trunculus* as *chilazon*. At the times of the Gemara, purple dyeing with *murex* snails was pervasive throughout the region. This may explain why the Gemara does not mention the source of the *argaman* (red-purple) dye – everyone knew! *Murex* snails were famous: *Murex* dye sold for more than its weight in gold, its shell appeared on many governments' coins, royal edicts were issued to monopolize use of the dye, and Pliny wrote about the *murex* dyeing process. There was even a well-known term for the *murex* that was the same in Greek and Latin (*porphyra*, *purpura*). If this species was the source of *techeilet*, why didn't the Gemara tell us this? Why didn't the Gemara say that the *chilazon* was from the family of purple-giving snails? Wouldn't this have been simpler and clearer than the signs provided by the Gemara?⁷¹ It is implausible that the Gemara would choose to ignore a well known classification term, opting instead to describe the *chilazon* through a set of characteristics from which someone might be able to determine the correct species.

Summary

The identity of the *chilazon* was lost for many centuries. Without a tradition as to the correct species, and without a sample of ancient *techeilet*, it might not be possible to identify the *chilazon* with certainty.⁷² However, there are minimum requirements that can be expected to be met in order to seriously entertain the possibility of a particular species being the *chilazon*. Chazal, knowing the identity of the *chilazon*, chose several distinguishing characteristics to describe it. For a species to be considered as the *chilazon*, these criteria would have to be clearly met in such a way that it would have been reasonable for Chazal to have chosen these statements to describe this species. The Gemara also provides chemical tests to distinguish between genuine *techeilet* and *k'la ilan*, imitation *techeilet*. Any *techeilet* that would clearly fail this test could be rejected with certainty. It would also be reasonable to expect the species under consideration to fit most of the characteristics of the *chilazon* that can be deduced from sources outside of the *sugya* of *techeilet*.

Murex trunculus does not meet any of the primary criteria. Arguments brought in favor of the *murex trunculus* depend on new interpretations of the Gemara that contradict the classical *mefarshim* and even the precise language of the Gemara. Even with these explanations, it could not be reasonably stated that Chazal would have chosen these statements to describe the *murex trunculus*.

The *techeilet* dye produced by the Petil Tekhelet Foundation must fail the chemical tests provided by the Gemara since it is the exact same chemical as *k'la ilan*. Additionally, the Gemara's tests were designed to make indigo fail the test, and Petil's *techeilet* is indigo. Thus, *murex*-derived indigo as *techeilet* is an utterly untenable position. This is acknowledged even by the chemist whose work led to the Petil group's formation.

Murex trunculus meets few of the secondary criteria, and archeological evidence provides no support whatsoever for the proposition that *murex trunculus* was used in the ancient dyeing of blue in general, let alone *techeilet* in particular.

Since *murex* snails were famous for their purple dyeing and there was a well-known term for *murex*, it would seem rather odd that the Gemara chose not to use this term, instead providing descriptive statements that have failed to provide a consensus opinion for many centuries.

In summary, the case for *murex trunculus* as the *chilazon* has little merit. Indeed, the evidence against *murex trunculus* as the *chilazon* is overwhelming.

⁷¹ Herzog *ibid.* p.60.

⁷² The archeologist Yigael Yadin believed he found *techeilet* from the Bar Kochba era (circa 135). The unspun, purple wool that he found was subjected to chemical analysis and found to be made of indigo and kermes, a common red dye made from an insect. This combination was a common, inexpensive substitute for the expensive *murex* purple. It is puzzling why Dr. Yadin thought this was *techeilet*. The wool was just beginning to be spun. It was not attached to a garment. No white threads were intermingled. Despite Dr. Yadin's imaginative drawings of how this wool was actually partially completed *tzitzit*, any connection between this wool and *tzitzit* is pure speculation. See Yigael Yadin, *Bar-Kochba: The rediscovery of the legendary hero of the Second Jewish Revolt against Rome.* (New York, 1971).

A response to Dr. Singer's review of *murex Trunculus* as the source of *tekhelet*
Baruch Stermán, Ph.D.¹

We would like to thank Dr. Singer and Rabbi Cohen for allowing us to respond to the article, “*Understanding the Criteria for the Chilazon*.” The primary goal of the P’Til Tekhelet Foundation is to encourage and promote interest in the topic of *tekhelet*. Dr. Singer’s article would probably never have been published in a contemporary *halachic* journal a few years ago. We would certainly take this as an indication that the awareness within the *halachic* community has grown, and that the perception of *tekhelet* as an issue to be addressed is taking root within widening circles of Torah debate, and for that we are grateful.

We would like to divide our response into two parts. The first part will attempt to examine Dr. Singer’s main objections one by one and provide our understanding of each point. The second part will focus on the more general issue of which criteria are actually the most critical in determining the halachic acceptability of a specific *tekhelet* dye. For this, we will primarily rely on the Torah giants of past generations, and in particular, the objections that were raised by them against the Radzyner’s proposed *tekhelet*.

Objections raised by Dr. Singer

Dr. Singer makes a sweeping statement at the beginning of his article that cannot go unchallenged. He states that “the strongest criteria for identifying the *chilazon* come from the *Gemara Menachot*” and specifically from the *braita* found in Menachot 44a. This assertion is very difficult to reconcile with the fact that most *rishonim*, in their discussion of the topic, do not quote this *braita*. Both the Rif and the Rosh, who quote many other statements about *tekhelet* do not mention these criteria at all. Both the Rambam and the Smag selectively choose from among the criteria in the *braita*, ignore one of those criteria (i.e., that it rises once in seventy years), and add or alter the other *simanim*. The Maharil, when stressing how easy it should be to reintroduce *tekhelet* based on finding the *chilazon*, refers to the *simanim* brought in the Smag, and not those of the *braita*. Clearly the *rishonim* did take the criteria of the *braita* at face value. They treat these statements as general descriptive identifiers and not as distinct and essential of the *chilazon*. With this in mind, let us examine the arguments in detail.

1. The *murex Trunculus* is not the color of the sea.

First of all, Dr. Singer’s assertion, that the term *gufu* means the soft body of the mollusc, is not compelling. As mentioned, the *braita* provides general descriptive information regarding the *chilazon*. It would make most sense to describe the outward appearance of the organism before going on to its internal appearance. This, especially given that internal examination requires painstaking procedures (e.g., carefully breaking open the shell and extracting the snail). Moreover, the general description would most naturally be that of the *chilazon in situ* – covered in its characteristic sea-fouling (and not after it has been assiduously polished).² The *murex Trunculus* snail has a greenish color when it is alive in the ocean, and anyone who has seen it underwater is struck by its camouflage and resemblance to the sea. This fact is a perfect explanation of the term “*domeh l’yam*.” Indeed, this interpretation is not new; the commentary on the *Sefer Yitzirah* attributed to the Raavad similarly understands this passage.³

Furthermore, the word “*domeh*” implies similarity and not absolute equivalence. When something is identical in property, the *Gemara* states it explicitly. For example, when the *Gemara* explains that the color of *tekhelet* is identical to the color of *kala ilan*, it states that only Hashem can distinguish between the two⁴. The term *domeh* is not used. The *Chacham Zvi*⁵ states clearly that the term *domeh* implies a certain “similarity” in a property and nothing more.

Some have even suggested that all the criteria enumerated in the *braita* come to explain the conclusion, namely why

¹ I would like to thank the members of P’Til Tekhelet for their comments and especially Rav Shlomo Taitelbaum and Mois Navon for helping to prepare much of this response. Rav Taitelbaum’s recent book, *Lulaot Tekhelet* deals with many of these issues, and is available from P’til Tekhelet (info@tekhelet.com).

² Dr. Yisrael Ziderman, “Reinstitution of the Mitzvah of Tekhelet in Zizit” (Hebrew), *Techumin*, Vol. 9 (1988), p. 430.

³ Commentary on *Sefer Yitzirah* attributed to the Raavad, Introduction, *netiv* 8

⁴ Bava Metzia, 61b.

⁵ *Shaalot U’tshuvot Chacham Tzvi*, responsum 56

tekhelet is expensive.⁶ The fact that the snail resembles its surroundings would then explain why it is so difficult to obtain - since it would require highly trained fishermen or divers to search for it. This would make sense only if the outward appearance of the snail resembled the sea; the color of the hidden body would be irrelevant.

2. The *murex Trunculus* is not a fish.

Sea snails are *halachically* fish. The opinion of the *rishonim*, including the Rambam in some places⁷ is that all sea creatures are fish. Furthermore, in *Hilchot Ma'achalot Asurot*⁸ where the Rambam distinguishes between sea animals, fish, and sea *sh'ratzim*, shellfish fit in to the more focused subdivision of fish. The examples he gives of sea animals are all larger creatures that have limbs for leaving the water (seal, frog, sirens); the *sh'ratzim* are the likes of worms and leeches. Sea snails do not fit either of these— and thus fall into the remaining category of “fish”.⁹

And so they were called for centuries. Oxford Dictionary in the first entry under Fish defines it:

In popular language, any animal living exclusively in the water; primarily denoting vertebrate animals provided with fins and destitute of limbs; but extended to include various cetaceans, crustaceans, molluscs, etc. In modern scientific language (to which popular usage now tends to approximate) restricted to a class of vertebrate animals....”

After the definition there is a note: “Except in the compound shell-fish, the word is no longer commonly applied in educated use to invertebrate animals.” To say that *murex/chilazon* is not a fish, is an anachronism. As such, the *murex* mollusc fits neatly into the description “*briato domeh l'dag*”.

3. The *murex* does not have a 70 year cycle.

Both the Radzyner and Rav Herzog dealt with this problem and did not feel that it was a sufficient reason to disqualify their candidates for the *chilazon*. As previously mentioned, the Rambam does not bring it when citing the *braita*. As Rav Herzog himself puts it, “Science knows nothing of such a septuagenarian ‘appearance’ of any of the denizens of the sea.”¹⁰ Rav Herzog and the Radzyner suggest that the cycle mentioned refers to periods of greater or lesser availability or accessibility, but that the animal itself is always obtainable¹¹.

Though no intrinsic characteristic of the *murex* would explain this cyclic property, the archeological evidence may offer a clue. At the sites where ancient dye installations have been found, the crushed shells were often used as part of the walls of adjacent buildings. (It is not clear if this was to strengthen the matrix of the material, or as an adornment.) One finds that the size of the snails decreases over time. This fact indicates that the snails suffered from over fishing, and that they became increasingly hard to obtain over time. This extrinsic feature might explain the periodicity, that due to over fishing, the *murex* population would need time to replenish itself before a new expedition could reasonably hope to procure a sufficient amount.

Interestingly, the Rambam replaces this criteria with the phrase, “and it is found in the salty sea”, which most interpret as the Mediterranean. Perhaps the Rambam understood the phrase, “and it comes up once in seventy years,” in terms of its compliment – namely, if you can find it on land very infrequently, then the rest of the time it is found in the sea.

4. The amount of dye in each *murex* is too minute.

How minute is too minute? Approximately two tons of snails will provide enough dye for ten thousand sets of *tsitsit*. A small village in Greece consumes that amount for snacks in one week. Is that too much or too little?

⁶ Y. Rock, “Renewal of *Tekhelet* and Issues on *Tzitzit* and *Tekhelet*” (Hebrew), *Techumin*, Vol. 16 (website expanded version), p.15, n.57.

⁷ See *Hilchot Tumat haMet* 6,1 and compare to *Hil. Keilim* 1, 3.

⁸ 2, 12.

⁹ *LT*, 126-36.

¹⁰ Herzog, *The Royal Purple*, page 69.

¹¹ I should point out that there are those who explain that this is referring to a supernatural exodus onto land (Chida, Ptach Aynayim, Menachot 44a).

5. The chemical tests to determine true *tekhelet*.

Based on discussions with scientists and Talmudists it is clear that no one completely understands the chemical tests brought by the *Gemara*, and interpreted by the Rambam and Rashi, to distinguish between *tekhelet* and *kala ilan*. One thing is clear though: a sample subjected to the described procedures that does not fade, passes the *tekhelet* test. We have tested *tekhelet* dyed with *murex* according to the analysis described by both the Rambam and by Rashi, and it did not fade. Therefore, there is no challenge that arises from this criterion to *murex tekhelet*.

The fact is, however, that indigo (*kala ilan*) dyed wool also passed the chemical tests. To reiterate, this is not a problem as far as *murex tekhelet* is concerned, but rather an academic problem in understanding the Rambam and the *Gemara*. I personally have proposed that although there may be no difference molecularly between the two, and therefore according to the methods currently used to dye wool, there is no discernible difference in quality between them, historically, this was not always the case. When dyeing according to natural methods in the ancient world, *tekhelet* was dyed in a completely different manner than indigo. The former was fermented together with the meat from the snail. Current research by John Edmonds in England has shown that bacteria present in the snail meat plays an active part in the reduction of the dye. On the other hand, indigo was chemically reduced in an entirely different manner. Consequently, it is quite reasonable that the quality and fastness of wool dyed with *tekhelet* according to the method employed in vat dyeing with snails, would have differed from that of *kala ilan*. This may have been the basis for tests that attempted to distinguish between the two. Nobel Chemist Prof. Roald Hoffman has told me that he finds this proposition to be plausible.

It should also be stressed that regardless of one's opinion as to the efficacy of these tests in differentiating between *tekhelet* and *kala ilan*, one incontrovertible fact must be understood: *tekhelet* and *kala ilan* are visually indistinguishable.¹² And since the blue dye from the *murex* is molecularly equivalent (and needless to say – visually equivalent) to *kala ilan* dye, the *murex tekhelet* is undoubtedly the exact color of the *tekhelet* of *chazal*. This fact is a sufficient condition for the determination that *murex tekhelet* is kosher - even if there may be another *tekhelet* which would also be kosher. This will be explained more fully in the discussion of the 8th criterion.

6. *Tekhelet* comes from a live *chilazon*.

This is one of the more powerful proofs supporting the *murex* as the *chilazon*. The enzyme required for dye formation quickly decomposes upon the death of the snail, and so the glands that hold the dye precursor must be crushed while the snail is alive or soon after. In experiments, we have seen that as soon as two hours after death, the quality of the dye is severely degraded. Dr. Singer's assertion that "the *Gemara* is speaking not of a few hours, but mere moments after death" is totally arbitrary. That assertion is even more implausible considering that this property is mentioned by both Pliny and Aristotle specifically regarding the *murex*. Since the *murex* loses its dye quality a few hours after its death, and those scholars express that fact by saying that the dye must be obtained from live snails, it follows that the *Gemara's* use of the same terminology would certainly sustain a two hour *post mortem* limit.

7. Equating *tekhelet* with *purpura* and the color of *purpura*.

The *Chavot Ya'ir* in his *M'kor Chayim*¹³ states clearly that the *chilazon* used for dyeing *tekhelet* is the *purpur*. The *Shiltei haGiborim* also states explicitly that it is the *purpura*¹⁴. The *Musaf la'Aruch* defines *purpura* as the "Greek and Latin word for a garment of *tekhelet*". The *Midrash haGadol* from Yemen¹⁵ quotes Rav Chiya as saying, "the *purpura* of the kings is made out of *tekhelet*", and the *Aruch* suggests that the word "Tyrian" (apparently Tyrian purple) is Latin and Greek for the color *tekhelet*. The *Ramban*¹⁶ also says that in his time only the king of the nations (i.e. the Emperor) was allowed to wear *tekhelet*, thus equating it with *purpura*. The Radzyner Rebbe notes¹⁷ that the

¹² *ibid.*

¹³ 18, 2.

¹⁴ Ch. 79; see *Lulaot Hatechelet*, Shlomo Taitelbaum, *P'Til Tekhelet*, Jerusalem, 2000 page 100 for more information about this work.

¹⁵ *Bamidbar* 4, 5.

¹⁶ *Sh'mot* 28:2.

¹⁷ *P'til Tekhelet*, Introduction.

ancient chroniclers frequently mention *tekhelet* as a most precious dyestuff, perfected in Tyre. Obviously, he too believed *tekhelet* was *purpura*.

The other points raised by Dr. Singer regarding the identification of *purpura* with *tekhelet* are simply not accurate. Vitruvius specifically states that one of the shades that can be obtained from the *purpura* is blue (*lividum*).¹⁸ Moreover, we have noticed that one can obtain a blue color from *murex Trunculus* without even exposing it to sunlight – simply by steaming the wool immediately after the dyeing. It is hard to believe that we amateurs, who have been dyeing for less than a decade, would know more than the ancient dyers who made their livelihood working with these dyes for more than 2,000 years. Furthermore, one would not expect to find anything but purple archeological stains since while the glands are being stored for dyeing, and during the fermentation process, the vat color is purple. Only during the very short dyeing stage itself (and possibly, not until after the dye process was completed, if steaming was used), would the dye turn blue.

In addition, Dr. Singer's question as to why the ancients would have wanted to dye blue with *murex* when indigo was more readily available is anachronistic, since *murex* dyeing in the Mediterranean dates back to the time of Avraham whereas indigo reached the region only 1,500 years later. (Though ancient Egyptians used a blue coloring for eye makeup, there was no blue dyeing of garments with any material other than the *murex*.)

8. The equivalence of *murex tekhelet* with *kala ilan* - indigo

As stated previously in the introduction, the primary *halachic* guides for any discussion of *tekhelet* are Rav Gershon Henokh Liener and Rav Herzog. Both of them are unequivocal in their assertion that *tekhelet* was the color of the mid-day sky. Rav Herzog clearly identified the color of *tekhelet* as identical to indigo and claims that this is also the opinion of the *Rambam*¹⁹. The *Gemara* itself explains that only Hashem can distinguish between *tekhelet* and *kala ilan* (i.e., indigo).²⁰

Furthermore, both the Radzyner and Rav Herzog state that if one finds a candidate for the *chilazon* that satisfies these two criteria - that the color of the dye is sky-blue, and that its dye is fast and strong - then that organism **must be acceptable as a kosher source for *tekhelet***. To quote the *Radzyner*:

If after searching, our hands will obtain the blood [secretion] of any kind of *chilazon* from which we may dye a color similar to *tekhelet*, a dye that retains its beauty and does not change, we will surely be able to fulfill the *mitzvah* of *tekhelet* without any doubt.²¹

Both Rav Herzog and the Radzyner offer the same line of proof for this assertion. If there were another *chilazon* that satisfies these criteria, but is not kosher for *tekhelet*, then why would the *Gemara* not warn us regarding its use? The *Gemara* cautions us only of *kala ilan*, a plant substitute for *tekhelet*, but never mentions any alternative sea creature that might mistakenly be used for *tekhelet*. Either that hypothetical species is also kosher, or there is only one species in the world (or in the Mediterranean) that satisfies both those criteria.²² *Murex Trunculus* provides a dye which is the color of *tekhelet*. Its dye is among the fastest dyes that exist.²³ It was well known throughout the ancient world and is found off the coast of Israel. There can be no doubt, then, that according to Rav Herzog and the Radzyner, this species must be a kosher source for *tekhelet*.²⁴

¹⁸ *Vitruvius*, De Architectura (ed. H. L. Jones), Loeb Classical Library, Cambridge, London 1930) Book VII, c. VII-XIV, p. 113-129

¹⁹ *Ibid*, page 94.

²⁰ Bava Metzia, 61b.

²¹ *Sefuny T'muney Chol*, page 14, 1999 edition

²² Herzog, *ibid*, page 73

²³ Personal correspondence with the late Prof. Otto Elsner, professor of Ancient Dye Chemistry at the Shenkar College of Fibers.

²⁴ Though Rav Herzog studied the *murex trunculus*, he provisionally rejected it; primarily because the process for obtaining blue dye visually equivalent to *kala ilan* was not then known. The process was not discovered until 1980 by Professor Otto Elsner of the Shenkar College of Fibers. I should also point out that there is no other species other than the *muricae* currently known that produces a dye similar in color to indigo and neither is there any archeological evidence for other species being used in the ancient world for dyeing. In order to assume that the *chilazon* of *chazal* is different than the *murex*, one would need to accept both the fact that knowledge of that

Let us not forget the fact that *tekhelet* has been lost for 1,300 years and therefore much of what has been written is based on assumptions and conjecture. It is highly doubtful that any and every statement regarding *tekhelet* or the *chilazon* will suitably apply to any candidate. Nevertheless, it is our opinion that the *murex Trunculus* fits the descriptions of *chazal* in an overwhelming majority of instances.

Criteria for determining kosher tekhelet.

There are numerous descriptions found throughout the *Gemara*, Midrash, Zohar and other Judaic sources regarding *tekhelet* and the *chilazon*. In order to begin to apply them it is important to understand, first and foremost, that it is essentially impossible to reconcile all of those sources with any candidate, or, for that matter, with each other. For example, the *Gemara* asserts that the *chilazon* is found in the Mediterranean²⁵, the Zohar claims that it is found in the Kinneret²⁶, while the Rambam states that it is to be found in the “*yam hamelach*.”²⁷ Needless to say, there is no species that lives in all three habitats.

Secondly, it is essential to distinguish between *aggadic* statements versus *halachic* statements. For as with every issue in Jewish thought, though we must strive to understand the *aggadic* material, we are bound in deed by the *halachic* instruction. One method to determine if a statement is *halachic* in nature is to find its use as the basis for an actual *halacha*. Conversely, if a statement is never used in a formal *halacha*, it quite often remains in the realm of a non-binding *aggadic* statement. For example, the *Gemara* relates that the *chilazon* and the proficiency in *tekhelet* dyeing were a special gift to the tribe of Zevulun. Nevertheless no certificate of *yichus* proving descent from that tribe is required before accepting *tekhelet* from a dyer! In this case, the “criterion” lies clearly within the *aggadic* realm.

On the other hand, the following are a number of statements relating to *tekhelet* and the *chilazon* which do find their way in to formal *halacha*, and these must be related to with due rigor.

1. ***Tekhelet is the color of Kala Ilan.***

All of the laws regarding *kala ilan* are based on this fact including the *sugyot* in *Bava Metzia* (61b) and *Menachot* (40a and 43a).

Tekhelet obtained from *murex Trunculus* is identical in color to *kala ilan*.

2. ***Tekhelet is a fast dye that does not fade.***

The *Gemara* bases its chemical tests on this fact (*Menachot* 43a) – “*lo ifrid chazute, keshayrah* - if it does not change its appearance, it is kosher [for *tekhelet*].” The Rambam states this explicitly “*tzviyah yeduah sheomedet b'yafya* - a dye which is known to be steadfast in its beauty” (*Hilchot Tsitsit*, 2:1).

Murex tekhelet has been tested by independent fabric inspectors at the Shenkar College of Fibers and received excellent marks for fastness. I can personally testify to my own *tekhelet*, worn every day for the past ten years, that has not faded or changed color at all.

3. ***Tekhelet dyes on wool, but does not take to other fabrics.***

The well-know *halachic* principle of “*assay docheh lo'tassay* - a positive commandment takes precedence over a negative commandment” is based on the fact that the *tekhelet* dye adheres to wool but not to linen (*Yevamot* 4b – “*tekhelet amra hu - tekhelet is [dyed] wool*”).²⁸

Murex tekhelet binds exceedingly tight to wool, but not to cotton or synthetic fibers.

organism eludes modern science as well as the fact that the detailed archeological survey of the Mediterranean has not uncovered any hint of such an animal.

²⁵ Shabbat 16a.

²⁶ Zohar, II, 48b.

²⁷ Hilchot Tsitsit, 2:2

²⁸ Rashi does not follow this reasoning. On the other hand, the Yerushalmi Kelim (9:1) says “*Ma pishtim k'briata af tsemer k'briato*” just as linen remains its own color, so to wool (only can become *tamei nigei b'gadim*) in its natural color (and not dyed).” We see from there that only wool is dyed, not linen.

4. ***The dye from the chilazon is more potent when taken from a freshly killed chilazon – but one must kill the animal in order to extract the dye.***

The *Gemara* in *Shabbat* (75a) bases one of the fundamental principles of *hilchot shabbat* on this fact, namely *p'sik reisha d'lo nicha lei*- an inevitable act [lit. cutting off a head] that is undesirable.

As mentioned previously, the enzymes responsible for transforming the precursor of the dye into actual dye upon exposure to oxygen, do not survive long after the death of the snail. Consequently, within a few hours after death, the *murex* can no longer be used for dyeing.

5. ***Tekhelet was not “hidden” until the days of Mashiach, but rather can be obtained at any time***

The *Maharil*²⁹ rules that even though *tekhelet* is no longer available, one is still prohibited from wearing a linen *begged* for *tsitsit*. This is because *tekhelet* is “easily available” and one need only find the proper *chilazon* in order to reinstate the *mitzvah* of *tekhelet*. There is nary a *posek* who argues with the *Maharil* in practical terms and allows a linen *begged* for *tsitsit*.

Finally, it is instructive to mention two not commonly referred to sources which provide an important perspective on this discussions. Both were written in the early 1890's as critiques of the Radzyner's *tekhelet*. The first is an article entitled “*Tekhelet me'Iyay Elisha*” by Mordechai Rabinovits and the second is a book called “*P'til Tekhelet*” by Hillel Meshil Gelbshtein³⁰. Both of these works discuss the various sources and measure the Radzyner's *tekhelet* against them. Both are highly critical of the Radzyner's *tekhelet*.

Although numerous challenges to the Radzyner's *tekhelet* are raised, the most forceful objections are based on the fact that Radzyn *tekhelet* did not meet the “*halachic*” criteria enumerated above. The authors of these works contend that (a) Radzyn *tekhelet* is not the color of the sky, (b) that it fades when washed with soap, and (c) that the material from the dye can obtained from dead *sepia Officinalis*, (and not exclusively from live organisms). On the other hand, as has been demonstrated herein, *murex tekhelet* would indeed be acceptable precisely according to all these criteria.

It is our hope that these and other issues relating to *tekhelet*, to the identification of the *murex Trunculus* as the *chilazon*, as well as the investigation of other candidates, will continue to spark discussion within the walls of *batei midrash* all over the world. Any argument that is for the sake of Heaven has great merit and will serve to unite *klal yisrael* in its search for truth and proper *kiyum hamitzvot*.

²⁹ *Shu”t Maharil HaChadashot* (M'chon Yerushalayim), #5, 2.

³⁰ Hillel Meshil Gelbshtien, Introduction to *P'til Tekhelet*, printed in *Abir Mishkenot Yaakov* by the same author. The Gelbshtien family is currently reprinting the entire book which should be available by January, 2001.

Author's Reply

I would like to thank Dr. Sterman for agreeing to respond to my article, thereby affording the readers both sides of the story. I would also like to thank the editor, Rabbi Cohen, for devoting so much space to this issue. In fairness to the editor I will endeavor to be brief, while trying to cover most of the essential points.

Criteria from the sugya of techeilet

Dr. Sterman prefaces his comments with the rather startling assertion that we can essentially ignore the descriptions brought by *Chazal* in *Menachot*(44a) because many *Rishonim* do not cite these criteria or omit one of them. There is only one *sugya* in the entire Talmud that deals explicitly with the details of *techeilet*. Nowhere else in the Talmud do *Chazal* cite statements for the primary purpose of describing the *chilazon*. How can these statements of *Chazal* not be important? Dr. Sterman has said that the writings of the Radzyner Rebbe and Rabbi Herzog must form the foundation of any halachic discussion of *techeilet*. These criteria are the heart of Rabbi Herzog's criteria, essential to the Radzyner Rebbe's criteria, and have been considered of unquestioned importance even in most, if not all prior writings by supporters of the *murex trunculus* theory. How can Dr. Sterman now claim they are not essential? While horns are not essential to the *halachot* of the burnt offering brought by the Kohen Gadol on Yom Kippur, that animal must be a ram, and would, therefore, have horns. Similarly, it is not surprising that when writing about *techeilet*, some *Rishonim* may mention that *techeilet* must come from a *chilazon* without describing the *chilazon*. Nonetheless, the *chilazon* must possess the characteristics that *Chazal* have ascribed to it. Rashi brings down all of these criteria in multiple places, and it would be presumptuous to assume that those who omit one ("rises once in seventy years") did so because they felt it could be ignored. Indeed, the Radzyner Rebbe explains why some omit the seventy year criterion.¹⁰³ Let us briefly examine these criteria.

"*Its body resembles the sea*": Dr. Sterman's argument as to how *murex trunculus* meets these criteria is based on three false premises, namely, that the expression *domeh l'yam* can mean green, that the expression *gufo* ("its body") can refer to external organisms living on the shell of the *chilazon*, and that the resemblance is to the living organisms in the sea and not the sea itself. Regarding *domeh l'yam*, the same expression is used just a few lines earlier in the *Gemara* to refer to the color of *techeilet*. Dr. Sterman is asserting that "resembles the sea" can mean blue in one phrase and a few lines later, dealing with the same subject, mean green. This is both illogical and groundless. Rambam clearly indicates otherwise since he writes that the *chilazon* itself resembles *techeilet*, i.e. blue.¹⁰⁴ Similarly, the *braita* of *tzitzit* states that the color of the body of the *chilazon* is similar to the sky.¹⁰⁵ Dr. Sterman suggests *gufo* cannot mean the soft body since it would be impractical to describe the color of the body which can only be viewed by the careful breaking of the shell and extraction of the soft body. Of course, this presupposes the *chilazon* is completely enclosed by a hard exterior shell. Also, it would only be necessary to check the color of the body to identify the correct species. It would not be necessary to check every animal that is used. While Dr. Sterman's claim that *gufo* could refer to the shell is not entirely unreasonable, it is quite a different matter to say that "its body" means the external organisms covering the shell. Whereas it would indeed make sense to describe the outward appearance, it would hardly be helpful to describe the external sea fouling if it looks like everything else. While *murex trunculus* does blend in with its surroundings due to the greenish sea fouling, this means it resembles the sea fouling and plant life living in the sea, but not the sea itself.

"*Its form is like a fish (dag)*": Dr. Sterman's response is that according to *halacha*, *murex trunculus* is a fish, therefore this statement is true by definition. This renders meaningless the statement of *Chazal*. Why would *Chazal* say "the *chilazon*, which is a fish, resembles a fish"? Clearly the intent is to inform us that the form of the *chilazon* has some similarity to what is characteristically true of fish. No such argument can be made for the *murex trunculus* snail.

"*Comes up once in seventy years*": Dr. Sterman admits that there is no characteristic of the *murex trunculus* that would meet this criterion. Dr. Sterman's unfounded speculation about the replenishing of the snail population suggests a steady pattern of increase in the population and not an unusual abundance. Rabbi Herzog cites a 3-6 year cycle for his candidate species.¹⁰⁶ As for the Radzyner Rebbe's choice of *sepia officinalis*, since the Rebbe's death a periodicity has been noted and there have been rare reports of mass "invasions" and "strandings" of cuttlefish.¹⁰⁷

¹⁰³ Rabbi Gershon Leiner, *Eyn HaTecheilet*, published in *Sifrei HaTecheilet Radzyn* (Bnei Brak, 1999), p.387.

¹⁰⁴ *Hilchot Tzitzit* 2:2.

¹⁰⁵ *Masechtot Ketanot Masechet Tzitzit* Ch. 1 Halacha 10.

¹⁰⁶ Herzog *ibid.*, p. 73.

¹⁰⁷ David H. Tompsett, *Sepia* (Liverpool, 1939), p. 143, citing the work of Grimpe; *Transactions of the Royal Society of Edinburgh*, Vol. 61, Part I, 1943-1944. (No. 9), pp. 247-260.

“*It is expensive*”: The Gemara states the dye is expensive because of the lack of abundance (“comes up once in 70 years”). One of the reasons Rabbi Herzog rejects *murex trunculus* is because of the minute dye quantity it produces.¹⁰⁸ The Gemara clearly states that the reason *techeilet* is expensive is because of its infrequent appearance or abundance and not because of the minute dye quantity. Dr. Sterman’s answer that a small village in Greece consumes 2 tons of snails in a week, enough for 10,000 sets of *techeilet*, is amusing, but merely underscores my point. That small village in Greece is eating the snail, not extracting the dye. *Murex* dye was not expensive due to scarcity but due to the work involved in extracting the dye from exceedingly large quantities of snails to produce small amounts of dye.

Chemical test for *k’la ilan*

Rabbi Herzog, with the aid of renowned dye chemist Dr. A.C. Green, recognized that the Gemara’s tests have the aim of chemically reducing indigo. In this state indigo is yellow, thus the Gemara’s stipulation that if the color fades it fails the test and is suspected to be *k’la ilan*. Since snail indigo and plant indigo are the exact same chemical, *murex* indigo should also fail this test. Indeed, *murex* indigo would be expected to fail *any* chemical test that plant indigo fails, let alone the Gemara’s test which is clearly designed to detect indigo. Dr. Sterman posits that it is theoretically possible that some snail meat remaining in the *murex* indigo could keep it from failing the test. Since the Gemara’s test only requires the color to fade, not to be entirely reduced, the snail meat would have to completely inhibit the chemical reduction in order to pass the test. Dr. Sterman offers no reason why the snail meat might have this effect. In fact, the one statement he makes is that snail meat may have played an important role in aiding reduction. Dr. Sterman suggests that Nobel chemist Dr. Roald Hoffman has deemed his explanation plausible. I contacted Dr. Hoffman, and he merely maintains that the presence of bits of snail meat makes it theoretically possible to develop chemical tests to distinguish snail indigo from plant indigo, not that it was at all likely for the snail meat to have any impact in the chemical test of the Gemara. Even Dr. Irving Ziderman, the chemist who did so much of the pioneering work on the *murex trunculus* theory, acknowledges that snail indigo would fail this test. Although Dr. Sterman says that he has recreated the Gemara’s tests and *murex* indigo passed, he then acknowledges that regular indigo also passed, thereby proving that he had not recreated the test correctly. It is my hope to accurately reproduce these tests and report the findings on my web site.¹⁰⁹ Thus we are left with sound scientific reason to suggest *murex* indigo would fail the Gemara’s tests versus the unfounded speculation that it is a theoretical possibility it would pass.

Other statements of Chazal regarding the *chilazon*

There are a number of descriptive comments made by *Chazal* which clearly do not describe *murex trunculus* and were not addressed by Dr. Sterman. Rambam, the Midrash HaGadol and Philo (who was alive when *techeilet* was made) state that the color of the blood of the *chilazon* is black, while Rashi states that the appearance of the blood is blue.¹¹⁰ When dyeing *techeilet* with *murex* indigo the dye solution is never blue. After wool is dipped in the dye vat, removed and exposed to air, the dyed wool turns blue. The Gemara also tells us that the *chilazon* was the source of a treatment for hemorrhoids, yet *murex trunculus* was known in ancient times to be bad for the bowels.¹¹¹ The Mishnah in *Keilim* tells us that a metal hook attached to the “head” (*roshoh*) of a chain was called *chilazon* because of its shape, which the Radzyner Rebbe understands to mean that the *chilazon* has hook-shaped tentacles coming out of its head.¹¹² Again, *murex trunculus* does not fit this description. Finally, we have the problem of why the Gemara, when choosing to describe the *chilazon* did not say that it was *purpura*? The species and its name were famous. Further, according to Josephus and others, it appears that *murex* snails were the source of *argaman*.¹¹³ If so, why didn’t the Gemara state that the *chilazon shel techeilet* was from the same family of snails as that used for *argaman*?

Equivalence of *murex techeilet* with *k’la ilan*(indigo)

Dr. Sterman notes correctly that since *murex techeilet* is the same chemical as *k’la ilan*(plant indigo), its color is visually indistinguishable from plant indigo. He then makes the assertion that both the Radzyner Rebbe and Rabbi Herzog are of the opinion that if one finds a candidate for the *chilazon* that produces a dye that is sky-blue and is a

¹⁰⁸ Rabbi Isaac Herzog, “Hebrew Porphyrology”, in Ehud Spanier, ed., *The Royal Purple and the Biblical Blue: Argaman and Tekhelet* (Jerusalem, 1987), p. 70.

¹⁰⁹ www.chilazon.com

¹¹⁰ Rambam *Hilchot Tzitzit* 2:2; Midrash HaGadol *Shemot* 25:4; Philo, *De Congressu*, as cited by Herzog, *ibid.*, p.87; Rashi *Chulin* 89a.

¹¹¹ *Avodah Zarah* 28b; Celsus *ibid.* Book 2:30.

¹¹² Leiner, *ibid.*, *Sefunei Temunei Chol*, p. 27; *Keilim* 12:1 and *Tiferet Yisroel ad loc.*

¹¹³ Flavius Josephus, *Antiquities of the Jews*, Book 3 Chapter 7.

fast dye, then it is automatically kosher *techeilet*. The statement from the Radzyner Rebbe is taken out of context. The Rebbe concludes that section with the comment that it will be further explained in the following section, where the Rebbe states that the statements of *Chazal* must be satisfied, but if they are all satisfied and the dye meets the requirements then it is definitely kosher.¹¹⁴ As for Rabbi Herzog, he places great importance on the criteria from *Menachot*. Rabbi Herzog states that the inquirer equipped with knowledge of the secular sources “will go to the Talmud only for a confirmation of the identification of the *techeilet*-species with *murex trunculus*. But there is a surprise in store for him”.¹¹⁵ Rabbi Herzog then dismisses *murex trunculus* because it fails to meet any of the criteria from the *sugya* in *Menachot*.¹¹⁶ As for the problem with the Gemara needing to warn us about *murex* indigo like it did for *k’la ilan*, this poses no difficulty for several reasons. First, the Gemara doesn’t need to warn us about anything that did not happen. Whereas counterfeiting *techeilet* with *k’la ilan* was a real problem, counterfeiting with *murex* indigo is a theoretical problem with no indication that *murex trunculus* was ever used to dye blue in any context. Even if the ancients did make *murex* indigo, why would people have used it to counterfeit *techeilet* when they could achieve the same results more cheaply with readily available plant indigo? However, there is an even stronger answer. Since *murex* indigo is equivalent to plant indigo, it would also fail the Gemara’s tests, so there was no need for a special warning. However, the Gemara’s need to warn us of other counterfeit dyes does pose a problem for P’til. The process used by P’til will produce indigo from any of the purple giving mollusks. If *murex trunculus* indigo was true *techeilet*, why doesn’t the Gemara warn us of the perfect imitations that could be produced by related species?

Dye is superior if extracted from a live *chilazon*

The Gemara speaks explicitly about the case where a live *chilazon* is squeezed or crushed to get the dye out, and the person tries not to kill the *chilazon* in the process because the dye is better, or clearer, if taken while the *chilazon* is still alive.¹¹⁷ How long does it take to extract the dye from the *chilazon*? Seconds? Minutes? Yet, if the *chilazon* dies during this short process, the dye will not be as effective. Dr. Sterman’s argument that *murex* dye loses its power over several hours hardly satisfies this condition. This time frame ignores the fact that the Gemara speaks of the *chilazon* dying during the extraction process, a matter of minutes, not hours. Even more troubling is Dr. Sterman’s misrepresentation of Pliny and Aristotle. In my article I correctly state, as Rabbi Herzog also does, that Pliny and Aristotle warn that the dye should be extracted from the *murex* while it is alive because it discharges its dye when it dies.¹¹⁸ Dr. Sterman cites the first half of their statements, but then ignores the reason they explicitly state and instead supplies his own reason. In fact, these classical sources do not say anything about the dyeing power of the *murex* diminishing after death, their reason being at odds with the Gemara’s explanation regarding the *chilazon*.

Ancient blue dyes

Dr. Irving Ziderman states that it would be absurd to think the ancients would use *murex* indigo when they could make the same dye cheaper and easier by using plant indigo.¹¹⁹ Dr. Sterman responds with a series of unsupported statements claiming that Egyptians used *murex* for blue dyeing but not indigo, that *murex* dyeing in the Mediterranean dates back to the days of *Avraham Avinu* whereas indigo reached the region only 1,500 years later. There is a good reason Dr. Sterman fails to provide references for these statements – they aren’t true. There is absolutely no record of *murex* being used to dye blue in ancient times. All of the archeological evidence cited in P’til writings merely demonstrate it was used for purple dyeing, as is well known. In the classic work, *The Art of Dyeing*, by Franco Brunello, we find four sources of blue dye in ancient Egypt – none of them are *murex*.¹²⁰ On the other hand, Brunello and others cite sources that conclude that indigo was used in Egypt over 1,000 years before *Yosef’s* arrival there, long before shellfish dyes were ever used.¹²¹ As for Dr. Sterman’s claims, they might be based on the work of late 19th/early 20th century Austrian Egyptologist, Alexander Dedekind, of whom P’til speaks highly. Dr. Dedekind’s claims about Egyptian use of shellfish dyes has been completely refuted and even ridiculed

¹¹⁴ Leiner, *ibid.*, pp. 14-17.

¹¹⁵ Herzog, *ibid.*, p. 65.

¹¹⁶ Herzog, *ibid.*, p. 70.

¹¹⁷ *Shabbat* 75a and Rashi ad loc.

¹¹⁸ Herzog *ibid.*, pp. 74-75; Aristotle, *Historia Animalium*, Book V, Ch. 15; Pliny the Elder, *Naturalis Historia*, Book 9, Ch. 60. For a picture of a *murex* snail discharging its dye upon death, see Nira Karmon, “The Purple Dye Industry in Antiquity” (hebrew), in Chagit Sorek and Etan Ayalon, eds., *Colors from Nature: Natural Colors in Ancient Times* (Tel Aviv, 1993), p. 85.

¹¹⁹ I.I. Ziderman, “On the Identification of the Jewish Tekhelet Dye”, *Gloria Manis* [Antwerp] 24(4): 77-80.

¹²⁰ Franco Brunello, *The Art of Dyeing in the History of Mankind*, translated by Bernard Hickey (Venice, 1973), p. 43.

¹²¹ Brunello *ibid* p.43; Helmut Schweppe, “Indigo and Woad”, in Elisabeth West FitzHugh, ed., *Artists’ Pigments: A Handbook of Their History and Characteristics*, vol. 3 New York, 1986), p.83.

at length.¹²² Dr. Gillian Vogelsang-Eastwood is probably the world's leading expert on Egyptian textiles and has analyzed ancient Egyptian clothing from many eras, including those found in the tomb of King Tutankhamun. In a personal communication she confirmed that the only blue dye she has found on Egyptian clothing is indigotin (from the indigo or woad plant), and that she has not found any evidence of purple shellfish dye in Egypt until the Roman era, about 1,000 years after the exodus from Egypt. There has been evidence of rare use of purple dye in Pharaonic Egypt, but this was found to be a mixture of indigo(blue) and alizarin(red).¹²³

Techeilet, purpura and the color of purpura

Dr. Sterman brings an assortment of different sources that purportedly equate *techeilet* with *purpura*. Some of these statements make no mention of *purpura*, such as the statement he cites from the Radzyner Rebbe. The Ramban's statement that even in his time only the King was allowed to wear *techeilet* hardly equates *techeilet* with *purpura*.¹²⁴ In fact, during the Ramban's lifetime (Middle Ages), there were efforts in several countries to restrict the use of blue to royalty and the very wealthy much like *murex* dyes during some periods of the Roman empire.¹²⁵ One must also be careful when dealing with the word *techeilet* since it may at times indicate a color with no specific origin. This is clear from the cited Ramban, since there was no kosher *techeilet* in the Ramban's lifetime, yet he used the word *techeilet* to discuss contemporary blue dye. Other statements cited by Dr. Sterman are merely examples of *purpura* being used to connote Royal attire, as is commonly found in the Midrashim, and is used to refer to Mordechai's royal clothing of *techeilet*, where the color of *techeilet* is implied, but not necessarily *chilazon* origin.¹²⁶ This is the simple explanation of Dr. Sterman's quotes from the Aruch and Midrash HaGadol. Since the Midrash Hagadol, like Ramban, says that the color of the blood of the *chilazon* is "black like ink", it would not make sense to suggest that it supports the notion that a *murex* snail is the *chilazon*.¹²⁷ Dr. Sterman cites the *Makor Chaim* (by the author of the *Chavot Yair*) and the *Shiltei HaGiborim* as explicitly stating that the *purpura* is the *chilazon shel techeilet*.¹²⁸ There are several problems with this. Both of these *seforim* are from *kitvei yad* that were discovered hundreds of years after they were supposedly written. Aside from possible issues concerning authenticity, and the more likely problem of the integrity of every word, in both cases the statements about *purpura* appear in isolation, i.e. there is no discussion of *chilazon* and *techeilet*, just a single statement. Both of these sources, especially the *Baal Chavot Yair* ("dam *chilazon* is not blue, but purple"), seem to be of the opinion that *techeilet* is purple, hence their conclusion as to the origin. Unfortunately, there is no discussion of how this species fits *Chazal*, or how the color of the blood contradicts the writings of Rashi and Rambam. Could there be errors in transcription? The *Baal Chavot Yair* seems clear, but the *Shiltei HaGiborim* would read quite naturally with *argaman* instead of *techeilet*. Seeing as how the notion of *argaman* coming from a mollusk was not well known, could an editor or copyist have inserted the word *techeilet* after seeing the word *chilazon* used in conjunction with dyeing?¹²⁹ In light of the fact that at the times they would have been written it was not known that blue dye could be made from *murex* snails, the simplest explanation is that they held the position that *techeilet* is purple and then made the natural corollary that the source was the famous purple-fish. Unfortunately, there is no evidence that either sage ever pursued their hypothesis in treatise or practice.

In my article I refuted efforts by P'til to demonstrate that *murex* snails were used to dye blue in antiquity. Dr. Sterman has not responded to my refutations, but instead offers another possibility. Vitruvius writes that depending on the location, *murex* purple could come out one of four different shades: black, red, blue and violet.¹³⁰ From the context it is clear that he is speaking of shades of purple, and is not suggesting that *murex* was used to dye blue or black. This is consistent with modern writings citing this work, as well as with Rabbi Herzog's understanding of Vitruvius' remarks.¹³¹ Rabbi Herzog also demonstrates that Vitruvius was not speaking about *murex trunculus*, but

¹²² Meyer Reinhold, *History of Purple as a Status Symbol in Antiquity*, (Bruxelles, 1970), pp. 13-14.

¹²³ Gillian Vogelsang-Eastwood, "Textiles", in Paul T. Nicholson and Ian Shaw, eds., *Ancient Egyptian Materials and Technology* (Cambridge, 2000), p. 279.

¹²⁴ Ramban *Shemot* 28:2.

¹²⁵ Daniel V. Thompson, *The Materials of Medieval Painting* (New Haven, 1936), p. 127.

¹²⁶ *Esther* 8:15; Midrash *Esther Rabbah* 10:12; Chidushei Radal *Bamidbar* 13:18.

¹²⁷ Midrash HaGadol *ibid.*

¹²⁸ *Makor Chaim* 18:2; *Sefer Shiltei HaGiborim* ch. 79.

¹²⁹ Josephus *ibid.*

¹³⁰ Vitruvius, *De Architectura*, Book 7 Chapters 7-14.

¹³¹ Thompson *ibid.*, p. 156-158; Herzog *ibid.*, p. 26.

of other *murex* snails.¹³² Additionally, according to Vitruvius, the shade of purple associated with Tyre and Israel is red, not blue.

Dr. Sterman's new set of criteria

Dr. Sterman proposes a new set of criteria. As stated earlier, Dr. Sterman says that Rabbi Herzog and the Radzyner Rebbe form the basis of any *halachic* discussion of *techeilet*. Their writings, as well as virtually all prior P'til writings, were based largely on the *sugya* in *Menachot* and other Talmudic sources. Dr. Sterman now dismisses those sources as *aggadata* and offers his own set of four criteria (the fifth "criterion" merely states that *techeilet* is not hidden and can still be found). As we will see, they not only form a peculiarly small and arbitrary set of criteria, but two of these criteria are not even valid.

"*Techeilet* is the color of *k'la ilan*": Dr. Sterman seems to be unaware that there is no single shade of color produced from indigo. Indigo was used in ancient times to produce a wide range of blues, from light to dark blue. The fact that indigo can imitate *techeilet* does not tell us the color of *techeilet*. It merely tells us that one of the many colors produced by indigo is that of *techeilet*.

"*Techeilet* is a fast dye that does not fade": Dr. Sterman's quotation from the Rambam is appropriate and merely states that the dye is fast. The Radzyner Rebbe discusses this issue and understands it to mean that the mere passage of time in and of itself will not cause the dye to fade, though certain chemicals or repeated prolonged exposure to the sun could cause the dye to fade.¹³³

"*Techeilet* dyes on wool, but does not take to other fabrics": Dr. Sterman's sources do not support this statement. The Gemara deduces from *p'sukim* about the garments of the *Kohen Gadol* that *techeilet* must be wool, but does not say or imply that *techeilet* dye cannot dye other fabrics.¹³⁴ That *techeilet* can dye linen is clear from the Ibn Ezra who states that *techeilet* can be wool or linen.¹³⁵ Why Dr. Sterman proposes this criterion is especially surprising since indigo can dye linen, so *murex* indigo should also be able to dye linen.

"The dye from the *chilazon* is more potent if taken from a freshly killed *chilazon*, but one must kill the animal in order to extract the dye...": This is puzzling. The Gemara states that the dye is better if extracted from the *chilazon* while it is still alive, as discussed earlier. The *chilazon* may die from being crushed, but the desire is to extract the dye while it is alive. As demonstrated earlier, *murex trunculus* fails to meet this criterion. Since the classical commentaries do not explicitly state that this *sugya* is speaking of the *chilazon shel techeilet*, and this property of the *chilazon* was not brought for the purpose of description, it is not clear why Dr. Sterman gives such prominence to this criterion over other references in *Shas* where the purpose is to describe the *chilazon shel techeilet*.

Objections to the Radzyner Rebbe's position

Dr. Sterman cites two obscure *seforim* in raising three objections to the Radzyner Rebbe's *techeilet*. Since neither my article nor his response treated the issue of the Radzyner's position it is not clear why he chose to include these points, but since he took the liberty of raising these objections, I will take the liberty of rejecting them.

"Radzyner *techeilet* is not the color of the sky": Prussian Blue, the pigment formed by Radzyner *techeilet*, can be either royal blue or sky blue depending on the proportions of the ingredients.¹³⁶ Further, it is hardly obvious what the color of *techeilet* should be. It is likened to the color of the sea, the sky and the sapphire. Dr. Sterman himself states that the term "*domeh*" only indicates a similarity in property. Indeed the Ibn Ezra says the color of *techeilet* slightly resembles the sky.¹³⁷ It is interesting to note that in artist pigments, indigo can be so similar to Prussian Blue, that a chemical test is required to distinguish the two.¹³⁸

"It fades when washed with soap": While this sounds at first like a strong criticism of Radzyner *techeilet*, this appears to be a known characteristic of true *techeilet*! As cited by Rabbi Herzog, Rabbeinu Gershom states

¹³² Herzog *ibid.*, p. 34.

¹³³ Leiner *ibid.*, *Sefunei Temunei Chol*, p. 10, written before he produced his first batch of *techeilet*.

¹³⁴ *Yevamot* 4b.

¹³⁵ Ibn Ezra, HaPeirush HaKotzeir, *Shemot* 25:4.

¹³⁶ J.N. Liles, *The Art and Craft of Natural Dyeing*, (Knoxville, 1990), p. 49.

¹³⁷ Ibn Ezra *ibid.*

¹³⁸ Schweppe, *ibid.*, p. 94.

explicitly that *techeilet* fades in the wash.¹³⁹ The Radzyner Rebbe also quotes the *Tosafot* who state that *techeilet* fades in soap, and that *k'la ilan* does not.¹⁴⁰

“The dye can be obtained from dead *sepia officinalis* (and not exclusively from live organisms)”: This is confusing. First Dr. Sterman cites the Gemara as stating that the dye is better, or clearer, when taken from a live *chilazon*. Then, in his new set of criteria, he says that it must be taken from a freshly killed *chilazon*, implying that it is taken from a dead *chilazon* and not a live one. Now, he says that it is impossible to get dye from a dead *chilazon*. The Gemara merely states that the dye is superior if taken while the *chilazon* is alive. The fact that it is possible to extract cuttlefish ink from *sepia officinalis* after it is dead is irrelevant. The issue is how effective it is in dyeing when it is extracted after death. The Radzyner Rebbe explains that when the cuttlefish ejects its ink it ejects the best of the dye and leaves behind the undesirable parts.¹⁴¹ Italian chemist Dr. Rodolfo Nicolaus is one of the pioneers of sepiomelanin (cuttlefish ink) research, and in addition to the vast amounts of information on his web site, he was kind enough to provide scientific explanations of the Rebbe’s answer in a personal communication.¹⁴² When cuttlefish ink is ejected it has more mature melanosomes, and is the purest representation of natural sepiomelanin. When the ink is extracted from the sac, it is likely to be in contact with other components that cause transformations and degradation of the melanin. When the cuttlefish dies, this transformation takes place and the resultant ink is chemically very different from natural sepiomelanin.

Conclusion

Murex trunculus meets virtually none of the known characteristics of the *chilazon*. There is no evidence that *murex trunculus* was ever used to dye blue until recent times. P’til writings have suggested that people wear *murex* indigo based on the principle of *sofeik d’oraita l’chumra*. Given the overwhelming evidence against *murex trunculus*, there appears to be little *sofeik*.

Addendum (not published)

Tosafot (*Shabbat* 75a) suggest that the reason a person is not *chayiv* for trapping a *chilazon* on *Shabbat* is because when it is caught it jumps about, thereby hastening its death. As Rabbi Mordechai Kornfeld, Rosh Kollel of Kollel Iyun HaDaf, points out, a snail does not fit this criterion of *Tosafot* (see <http://www.shemayisrael.co.il/dafyomi2/shabbos/insites/sh-dt-075.htm>).

Above, it was argued that it is meaningless to claim the color of *techeilet* is the color of indigo since indigo can be used to make a vast spectrum of blues depending on the dipping technique. This is supported by *Tosafot* (*Chulin* 47b) where it is stated that indigo, which resembles the sky, only slightly resembles (*domeh k’tzat*) *techeilet*, and that one can distinguish between indigo and *techeilet* some time before sunrise. This suggests that the true color of *techeilet* is not the shade of blue most commonly associated with indigo, though indigo can be made to imitate *techeilet*.

¹³⁹ Rabbeinu Gershom, *Menachot* 43a.

¹⁴⁰ Leiner *ibid.*, *P’til Techeilet* p. 82; *Baba Kama* 93b; *Tosafot Zevachim* 95a; *Nidah* 62a.

¹⁴¹ Leiner *ibid.*, *P’til Techeilet* p. 54.

¹⁴² www.tightrope.it/nicolaus

Appendix

Letter to the Editor

Rabbi Yechiel Yitzchok Perr

Bio

Rosh Yeshiva, Yeshiva Derech Ayson, Far Rockaway, NY

Having spent much spare time over the past several years studying murex trunculus *techelet*, I was most gratified to find that I had arrived at the same conclusion, and for many of the same reasons, as Dr. Mendel E. Singer; namely that murex trunculus is not the *chilazon*.

Although the space of a letter does not permit some of the other arguments against murex trunculus, nevertheless, allow me to add some points to Dr. Singer's essay.

On page 11, Dr. Singer writes about the small amount of dye produced by a single murex snail, only 4 or 5 drops. It should be pointed out that the discussion about the culpability for *disha* in *Shabbat* 75a is thus completely without basis, since the minimal volume required for culpability is that of a *grogrit*, a dried fig. And clearly, the Gemara is discussing extracting the mucus of a single *chilazon*.

On page 16, Dr. Singer assumes that the "*nartik*" or *malvush* of the *Midrashim* is a shell. Despite the fact that we lack an adequate explanation for these words, there is only the one opinion, that of Rabbi Binyomin Mosufa, that *nartik* means a shell. All the other *Rishonim* and *Acharonim* refer to the *chilazon* as a fish, ignoring the word *nartik*. No doubt this is because there is a perfectly good word for snail in the Mishnah *Shabbat* 77b, "*shavlul*". This is also used in an Aramaic form in the Gemara *Menachot* 42b, "*shavlulita*". The contention that the Sages of the Talmud held the *chilazon* in their hands, and did not use the word snail for it, but chose to call it a fish, is completely untenable.

On page 17, Dr. Singer discusses the meaning of the word "*potze'a*", and he accepts Rabbi Herzog's understanding that there is a connotation in *potze'a* of cracking a hard shell. Sad to say, Rabbi Herzog was inexplicably mistaken in this understanding. In both biblical and mishnaic usage, *potze'a* carries no connotation of a hard object. One of numerous such examples is the Mishnah *Ketubot* 43b, "*Patza'a Bifaneha*", "he wounded her face". According to the Radak's *Sefer Hasharoshim*, *Potze'a* refers to incising a smooth surface, splitting, cutting, wounding, or causing a fissure. See also Rashi, *Shemot* 21:25 and *Shir Hashirim* 5:7. It is the usage of "splitting", that is found in *Shabbat* 122b, "*Liftzo'a Egozim*", to split, not to crack, nuts.

A small experiment demonstrates why the Gemara there speaks of using a *kurnos*, a blacksmith's hammer, for opening nuts. When a walnut is struck smartly with a light ¼ lb. Hammer along the seam where the halves join, the shell at the contact point is crushed. But when it is merely tapped with a heavy 1 ¼ lb. Hammer, it splits in half all the way around.

In other places *potze'a* is used for splitting the limbs from a tree or splitting a stretched string.

On page 19, Dr. Singer discussed the color of the "blood". The murex mucus is not blood, neither biologically nor in color. P'til advocates attempt to cope with this problem by writing the word thus, "blood". The implication here is that the "ancients" were imprecise in their use of language. However, there happen to be excellent words used in the Talmud for mucus: *Rir*, *Leicha*, and *Maya* are some of them.

On page 22, Dr. Singer quotes Dr. Ziderman that it is absurd to think that non-Jews would use murex dye, when indigo was available. IN this reasoning Dr. Ziderman was already preceded in the response of the Radbaz. But the most trenchant proof is from the prophet Yechezkel, who informs us in chapter 27 verse 7 that in the sixth century B.C.E., at the height of the Tyrean commercial hegemony over the Mediterranean Basin, Tyre was importing, not manufacturing *techelet*.

On page 27, Dr. Singer writes of the silence of the Gemara about the murex. The *Beit HaLevi* of Brisk, quoted in the forward to *Ein Hatechelet* page 13, rejected the Radzyner's *techelet* based on a most penetrating question. He asked, how is it possible that the *mesorah* (tradition) could have been lost, that this commonly available squid is in fact the fabulous *chilazon*? And since it is common, the *Beit HaLevi* continued, then there is a *mesorah* that the squid is not the *chilazon*!

Tyrean dye faces even more severe objections, since it was massively produced throughout the Middle East, and continued to be produced in Constantinople until May 29, 1453. Beside the omission from the Talmud, there is not one hint by Rashi, the Rambam, or any other *Rishon*, that Tyrean purple manufactured in the sunlight was actually the much sought-after *techelet*. The proposition that the sages of the Talmud and the *Rishonim* were

ignorant of facts on a subject of deep concern to them, facts that were commonly known in the world around them, is a proposition that is impossible to accept.

In note 11, Dr. Singer pronounces P'til Techelet's efforts as "inspiring". I find their efforts rather distressing. P'til is attempting to foist on an unexpert public a halachic practice through marketing methods and thereby establish the precedent of a *Minhag*. At the same time, their stand ignores the words of the *Rishonim* and exhibits a cavalier attitude towards the Gemara itself. The Gemara *Menachot* that gives the description of the *chilazon* is dismissed by P'til as "homiletic". If P'til succeeds, they will have contaminated the halachic process.

הלכה ברורה Halacha Berurah

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The Search for Techeiles

EMAIL
EDITION

Reviewed by
Horav Shlomo Miller

In recent times there have been several attempts to discover and revitalize this most precious *mitzvah*. None, however, has been met with universal acceptance. It is our intention in this article to provide a number of the criteria mentioned by *Chazal* in the identification of the *chilazon*, discuss tests that *Chazal* used to determine the authenticity of the *techeiles* dye, present a historical overview of the disappearance of *techeiles* and the

attempts to rediscover it, and analyze the different suggestions that have been offered over the years.

When Did the Identity of the *Chilazon* Become Unknown?

It is unclear exactly when the identity of the *chilazon* and the manner of producing *techeiles* became unknown. *Techeiles* was definitely available after the destruction of the second *Bais Hamikdosh* (70 C.E.) as there are references in the *Gemara* of *Amoraim* having it.

The latest reference to the possession of *techeiles* in the *Gemara* is a reference to Rav Achai having it.⁸ Rav Achai was one of the heads of the *Rabbonon Savorai*, the post-amoraic *chachomim* who were the final editors of the *Gemara*. The *Gemara* was completed in the year 475 C.E. Rav Achai, who was *niftar* around the year 510 C.E., is quoted very often in the *Gemara* in an explanatory context.⁹

The *Medrash Tanchuma*, which was completed around 750 C.E., states that

The Mitzvah of *Techeiles*

The *Torah* states in *Parshas Shelach*: ועשו להם ציצת על כנפי בגדיהם לזרתם ונתנו על ציצית הכנף פתיל תכלת—*They are to make themselves tzitzis on the corners of their garments throughout the generations, and they are to place upon the tzitzis of each corner a thread of techeiles.*¹

The *Gemara* explains this *posuk* to mean that the *tzitzis* on a garment should consist of white thread and *techeiles* thread. *Techeiles* is wool that has been dyed with blue dye produced from the 'blood' of a sea creature known as the *chilazon*.²

On each of the four corners of the garment, four *tzitzis* threads are inserted into a hole and the threads are folded over, thereby making eight strings. There is a *machlokes Rishonim* as to how many of these eight strings should be dyed. The *Rambam* maintains one, the *Ravaad* two, and *Rashi* and *Tosafos* four.³

Chazal state that the color of *techeiles* is similar to the color of the sea, the color of

the sea is similar to the color of the sky, and the color of the sky is similar to the color of the *kisei hakavod*.⁴ The *Torah* states that by performing the *mitzvah* of *tzitzis* one will remember all the *mitzvos* of *Hashem*. The *Ramban* explains that the reminder is provided by the color of the *techeilis* which is ultimately similar to the *kisei hakavod*.⁵

For many centuries, the identity of the *chilazon* and the manner in which *techeiles* is produced has been lost. Consequently, *tzitzis* have generally consisted only of white threads which *halacha* recognizes as acceptable in the absence of *techeiles*. The *mitzvah* of *techeiles* according to most opinions is not an independent *mitzvah*, but an aspect of the *mitzvah* of *tzitzis*. Therefore, in its absence, by substituting white threads, one fulfills the *mitzvah* of *tzitzis*, though not in the preferred manner.⁶

It has been said in the name of various *rebbe*s that the discovery of *techeiles* is one of the stepping stones for the coming of *Moshiach*, as the *techeiles* dye will be used to color the *bigdei kehuna*.⁷

Please Note: Due to the intricacy of the material discussed in each issue, and the brevity of its treatment, a *Rov* should be consulted for a final *psak halacha*. In addition, this publication does not intend to be מכריע on issues that are a *machlokes haposkim*. Although we have usually brought the dissenting views in the footnotes, we have selected for simplicity sake to incorporate into the main text the views of the *Mishnah Berurah*, R' Moshe Feinstein, R' Shlomo Zalmen Auerbach and several other preeminent *poskim*. Please send all questions and comments to 1341 E. 23rd Street, Brooklyn, NY 11210 or email to hbinfo@thekosher.net

nowadays all we have are white threads because the source of *techeiles* has been concealed.¹⁰ The *Ramban* postulates that *techeiles* became lost due to governmental decrees that prohibited commoners from possessing it as it was marked a royal color.¹¹ Others claim that it was a result of the persecution of the Jews under the Byzantine Empire and the Moslems during the seventh century. The Jews were forced to wander from place to place, and in the interim, the tradition of the *chilazon* and the way it is processed became lost.¹² Some speculate that during the following few centuries there were select individuals - including the *Rambam*, perhaps - who had *techeiles*.¹³

Historical Overview of Rediscovery Attempts¹⁴

The Radziner Rebbe, Rav Gershon Henoch Leiner, was well-known for his revolutionary masterpiece *Sefer Sidrei Taharos*, which gathers *divrei Chazal* from all over *Torah* and places them with the appropriate *mishnayos* of *Seder Taharos*, thus forming somewhat of a *Gemara* on these *masechtos* on which we do not have any written *Gemara*. The *sefer* received the approbation of the leading *gedolim* of the nineteenth century, who all recognized the sheer brilliance involved in the writing of such a work. In addition to his proficiency in *Torah*, the Radziner Rebbe was also very fluent in secular studies including medicine, chemistry and engineering.

In 1887, the Radziner Rebbe got the intuition to place all his efforts into rediscovering *techeiles* and revitalizing this long-lost *mitzvah*. He published a *sefer* that year discussing all the references in *Chazal* that allude to the *chilazon* and the *techeiles* dye that is produced from it.

In the *sefer*, the Radziner Rebbe pieced together these references to develop all the possible indications as to how the marine creature called the *chilazon* is supposed to appear. He also spent much effort clarifying whether it is possible to reinstate the *techeiles* nowadays, and indeed concluded that the source was forgotten only due to the political events of past generations and not because it was concealed and taken away from us until *Moshiach* comes.

At the end of the *sefer*, the Radziner Rebbe writes that he sent all the information he compiled to marine experts, and although they speculated as to what type of fish the *chilazon* is, they were not successful in con-

verting the dye into the color *Chazal* describe the *techeiles*. He concludes by mentioning his determination to pursue the matter on his own and with *Hashem's* help reinstate this *mitzvah*. He sent the *sefer* to many *gedolei Yisroel* of that generation.

In 1888, the Radziner Rebbe traveled to Italy and spent the greater part of that year at the world-famous aquarium in Naples, studying all the different types of marine creatures housed there in surroundings resembling their natural habitats. He concluded that the cuttlefish (*Sepia Officinalis*), a squid like creature, also known as the tint fish, which exudes a black ink when in danger, fits the description of the *chilazon* as indicated by *Chazal*, albeit with some slight modifications.

The Radziner Rebbe returned to Poland with a significant amount of blood from the cuttlefish and was determined to devise a method to convert it to the color blue. In fact, he was very pleased to discover that the blood was black, since the *Rambam* describes the *chilazon* as possessing black blood. This obviously comes across as puzzling in light of the fact that *Chazal* indicate the color of the *chilazon's* blood as being blue. The Radziner Rebbe explained that the *Gemara* mentions that *techeiles* is produced by heating up the blood with the addition of a few herbs. He reasoned that the natural blood is probably black as the *Rambam* puts it. Only after it is heated up with some other chemicals does its color change to blue.

After consulting with many chemists and using natural compounds that were available in the times of *Chazal*, the Radziner Rebbe successfully converted the blood to a bluish color. Pleased with his findings, he published another *sefer* clarifying the issue and publicizing that he had discovered *techeiles*.

In 1889, the Radziner Rebbe began mass-producing the *techeiles*, following the opinion of the *Rambam* and dyeing only one of the eight strings on each corner of the *bege*. All of his *chassidim*, as well as many others, began wearing the *techeiles*, with close to fifteen-thousand people wearing it on their *tzitzis*. This included many *Breslover chassidim* who also started wearing it, but accepted the *Raavad's* view which requires two strings to be dyed. The *Breslover chassidim* had a *kabbalah* from Rav Nachman of Breslov that the year 1888 was marked for the *geulah*. Since nothing happened in the

year 1888, they interpreted it to refer to the discovery of the *techeiles*, which, as mentioned, is one of the signs of the *geulah*.

Although thousands of people began wearing the newly discovered *techeiles*, the Radziner Rebbe had expected many more people to do so. He was very taken aback that most of the *gedolim* of his time did not offer any comment on the matter, not in support of his discovery nor in opposition to it. He questioned the silence of these other *gedolim*, and said that those who agree with his findings should support him and those who disagree should notify him of their opinion as well. If he was in error, he said, he was willing to retract his stance.

There were actually a few *gedolim* who did write to the Radziner Rebbe explaining why they did not advocate wearing the *techeiles* he had discovered. The Radziner Rebbe published many letters clarifying and defending his position, but was taken from this world shortly thereafter, at a relatively young age, and a collection of these letters was first published posthumously in 1891. It is said that the *Maharsham*, amongst some other *gedolim*, privately put on a *tallis* that had the Radziner Rebbe's *techeiles* and requested to be buried with it.

During the years of World War II, the Radziner Rebbe's exact method of producing the blue dye was seemingly lost. It was later discovered that Rav Yitzchok Isaac Herzog, the former chief rabbi of Israel, had in his possession a letter outlining the exact details as to how the Radziner Rebbe's *techeiles* dye was produced. At that time, Rav Yitzchok Isaac Herzog was working on writing a thesis about *techeiles* for his doctorate and exposed the letter. He rejected the Radziner Rebbe's *techeiles* for reasons which we will discuss below, and postulated that the *chilazon* is a snail called the *Janthina*.

In recent years, there has been a renewed interest in determining the true identity of the *chilazon* and *techeiles*. Rav Herzog's *techeiles*, which had never really been accepted, was officially rejected. Some postulated that the *chilazon* is a different snail called the *Murex Trunculus*. Although many people began wearing *techeiles* made from the *Murex Trunculus*, it was far from universally accepted and was openly rejected by many reputable *talmidei chachomim*.

Prior to analyzing each of these particular opinions and suggestions, it is imperative to be familiar with some of the basic

aspects of the *mitzvah* mentioned by *Chazal* and in the *poskim*.

Substituting the *Chilazon* Dye

One of the first questions that must be analyzed is whether there is a need to locate the *chilazon* and remove its blood to make it into dye or if any dye suffices, provided that it is of the same shade of blue.

During the times of *Chazal*, *techeiles* was quite expensive due to the *chilazon's* rare appearance, as will be explained below. There were many counterfeiters who would color *tzitzis* with a dye extracted from an indigo plant which looked similar to the color of *techeiles* and would falsely market it as such.

Aware of this problem, *Chazal* devised chemical tests to differentiate between the genuine *techeiles* and the forged one. One test determined whether certain specific chemicals were able to make the color fade. The other test determined whether subjecting it to a certain procedure would improve its color or not. If the color faded from the first test and did not improve from the second test, it was clear that it was dyed with the indigo plant and not with genuine *techeiles*.¹⁵

The *Tiferes Yisroel* postulated a very novel approach. He maintained that *techeiles* does not have to come from the *chilazon*, and as long as a dye possesses these qualities, it is kosher even if it originates from plants. Virtually all *poskim* disagreed with this suggestion.¹⁶

Though the *Radziner Rebbe* disagreed with the *Tiferes Yisroel's* approach on a practical level, he agreed with it on a theoretical level. He maintained that no plant dye would be able to blend in and retain its color as steadfastly as animal dye. In order for the dye to be completely absorbed and retain its color in the wool which comes from an animal, it, too, has to originate from an animal. He offered a detailed scientific rationale for this, and thus maintained that if there are indeed marine creatures other than the *chilazon* from which one can produce a dye that possesses these qualities, the dye can be used for *techeiles*. He writes that in order to be certain that it possesses these qualities, the plant or animal dye would have to pass the exact tests used by *Chazal*. Alternatively, if one does find a marine creature that has the physical features *Chazal* use to describe the

chilazon, one may assume that it is indeed the *chilazon* and the dye does meet these qualifications.¹⁷

At present time, no one is familiar with the exact procedures *Chazal* used in conducting their tests. Tests which were thought to be on target have been questioned based on the fact that the indigo plant passed as well, which clearly disproves the functionality of the test as we know it. Consequently, it is imperative to be familiar with the criteria for the *chilazon* in addition to the chemical properties of the dye.

Physical Features of the *Chilazon*

There is a *Gemara* in *Maseches Menachos*, which, although written in a seemingly cryptic manner, sheds some light on the actual physical appearance of the *chilazon*. It states that: 1. The coloration of its body is similar to that of the sea. 2. Its anatomy is similar to that of a fish. 3. It emerges once in seventy years. The *Gemara* then states that one dyes *techeiles* from its 'blood'. The *Gemara* further mentions that since the *chilazon* is so rare, the cost of *techeiles* is so exorbitant.¹⁸

Anatomy

The *Medrash* implies that the *chilazon* has a shell that grows with it,¹⁹ which could mean that the *chilazon* is a type of snail. This fits well with the understanding of *Rashi* who generally refers to the *chilazon* as being similar to a fish - implying that the *chilazon* is a marine creature - although, in one place, he describes it as a worm.²⁰ A snail fits both descriptions. Alternatively, the *Medrash* could refer to an internal shell. The cuttlefish has an internal cartilage shell. It is similar to a fish in that it is a marine creature which can swim in the ocean.²¹

Location and Frequency

The *Gemara* in *Maseches Shabbos* mentions that there were fishermen whose occupation was hunting the *chilazon* in the Mediterranean sea between Tyre and Haifa (i.e. northern Israel and southern Lebanon - and in ancient times, Phoenicia).

The *Radziner Rebbe* claimed that when the *Gemara* states that the *chilazon* emerges once in seventy years it cannot mean that it is inaccessible except for that time, for how could these fishermen have made a livelihood from doing this? Thus,

he concluded, it seems that *chilazons* were always available in certain waters, albeit with some difficulty. He maintained that once every few decades *chilazons* would swim out of the water on to land, and during those times they were numerous and easily accessible.²²

Blood Type

The *Gemara* in *Maseches Shabbos* states that if one traps a *chilazon* on *Shabbos* and squeezes out its blood, he is only liable for trapping it. *Tosafos* comment that even though one intends to squeeze out the blood, he is not liable for this, because the blood that is extracted from a *chilazon* is not its lifeblood, but rather an inky secretion stored in a cavity within the creature.²³

Additionally, the *Gemara* mentions that even though the *chilazon* will inevitably die in the process, it is not intentional and is not desired, for the longer the *chilazon* is alive, the clearer the dye it secretes becomes. Consequently, one is not liable *Mideoraisa* for the *chilazon* dying, even though it is inevitable, as it is considered a *pesik reisha d'lo nicha leih*.

The Recent Attempts to Identify the *Chilazon*

I. Cuttlefish - *Sepia Officinalis*

The *Radziner Rebbe* maintained that although there are many marine creatures that have inky secretions, the *Sepia Officinalis* subspecies of the cuttlefish species possesses basically all the features he was looking for. Its skin color changes so that it can camouflage itself in its natural surroundings. Thus, it resembles the color of the sea. It possesses an inner shell and has a separate ink sack that contains black ink, which is mentioned by the *Rambam* in his description of the *chilazon*. *Chazal* imply that coming out of the *chilazon's* head is something which appears similar to hook-like threads that are put on chains which can be hung on a wall and that it has or-



The cuttlefish

gans or fringe-like extensions that resemble a snake. The cuttlefish has eight arms and two tentacles protruding from its head which would seem to satisfy this feature.

As mentioned earlier, although thousands of people began wearing the *techeiles* discovered by the Radziner Rebbe, it was not universally accepted. From the several objections put forward, one of the most notable ones was from the *Bais Halevi*, who stated that in order to proclaim a certain species as being the *chilazon*, one has to be certain that the species was unknown for ages and the manner of making the blue dye was not either known. Otherwise, it would be considered as if we have a negative *mesorah* stating that this particular species is not the *chilazon*.²⁴

Additionally, the *Ran* explains the *posuk* referring to *Klal Yisroel* as “*Am k’shei oref* - a stiff-necked nation” to mean that *Klal Yisroel* is very skeptical when it comes to changing its practices based upon new discoveries, and unless something is conclusively proven, *Yidden* will not modify their ways. Once it is proven, however, *Yidden* will act accordingly, accepting the practice at all costs.²⁵

While working on his doctoral thesis on *techeiles*, Rav Yitzchok Isaac Herzog sent the Radziner Rebbe’s *techeiles* to three independent laboratories in three different countries to investigate its chemical breakdown. The results astonished him. All three laboratories came to the same conclusion: it had the identical chemical makeup as a well-known synthetic dye known as Prussian blue.

Rav Herzog began investigating the matter and realized that the Radziner Rebbe had added chemicals into the dye to change its color from black to blue. Although the *Gemara* does mention the insertion of chemicals into *techeiles*, according to *Rashi* the chemicals are added only to function as a processing agent but not to serve as a basis for the coloring of the resultant dye. In this case, however, the chemicals added to the mixture were iron, potash, ammonium, chloride, muratic acid, sulfuric acid, and tartaric acid, which served as the essence of the dye.

Furthermore, even according to *Tosafos* who postulate that the chemicals were in fact part of the dye, Rav Herzog maintained that it seems clear that the *chilazon* blood must be a unique substance which

would be needed to furnish the dye and not merely serve as a supplier of an organic compound which can easily be obtained from an array of organic substances. In the case of the Radziner Rebbe’s *techeiles*, the only ingredient which the chemicals did not supply was an organic compound needed to supply carbon and nitrogen. Any organic compound would suffice. In fact, the original Prussian blue was made by using ox blood. Rav Herzog speculated that the Radziner Rebbe assumed that since the added chemicals had no intrinsic color, the blue dye must have been inherent in the black ink. This, however, was not the case.

It may be possible to produce a blue dye from the cuttlefish in a different manner than the way the Radziner Rebbe produced it with the aid of his chemists; however, no such method has been discovered as of yet.²⁶

There were some other minor objections put forward including the fact that the color in the Radziner Rebbe’s *techeiles* can be washed off with soap. The Radziner Rebbe himself countered this and other minor objections. He brought proofs that the condition that the dye be steadfast is only when it is subject to normal wear and tear, and not when toxics are used remove its color. However, Rav Herzog’s objection remains the most significant one.²⁷

II. *Janthina*

Rav Hertzog concluded his thesis with an open suggestion that perhaps the *chilazon* is the *Janthina* snail, whose shell possesses a violet color. The *Janthina* snail secretes a violet dye, and its species often live in large groups that are attached to one another. On rare occasions, they have been known to wash ashore by the millions. This may be what the *Gemara* refers to when it says that the *chilazon* emerges once in seventy years.

Modern researchers have rejected the suggestion of the *Janthina* snail as the *chilazon*. Amongst their objections is their claim that even though it does secrete a blue liquid, it does not produce a dye that can be used to color cloth, for the fluid turns

brown after a few minutes. Additionally, it is water soluble and its color does not remain steadfast in the cloth.²⁸

III. *Murex Trunculus*

In recent times, an organization in Israel asserted that the *Murex Trunculus* snail is the lost *chilazon*. This organization now markets blue woolen strings to be placed as *techeiles* on *bigadim* of *tzitzis*.²⁹

The belief that the *Murex Trunculus* snail is the *chilazon* stems mostly from the location where it was discovered. We mentioned above that *Chazal* say that there were fishermen who would hunt the *chilazon* between Tyre and Haifa. This was the ancient Phoenician area, which is presently northern Israel and southern Lebanon. It is documented that the center of the dye industry in the ancient world was Phoenicia.

The most famous dye was the Tyrean Purple. This color was used by many noblemen and was quite pricey. There are archeological findings of a vast amount of broken *Murex Trunculus* snail shells near the cities of Sidon and Tyre. Each was broken opposite the hypobranchial gland - the location where

the dye is released from.

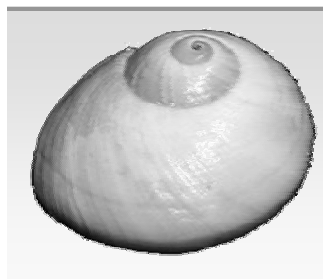
Indeed, Rav Herzog contemplated at one point that the *Murex Trunculus* is the *chilazon*. However, he rejected it on several accounts. Firstly, *Chazal* state that the color of the *chilazon*’s body is similar to the sea. The actual body of the *Murex Trunculus*

has a whitish color which does not resemble the sea, and its shell is light brown. Additionally, it produces a purple dye, not a blue one.

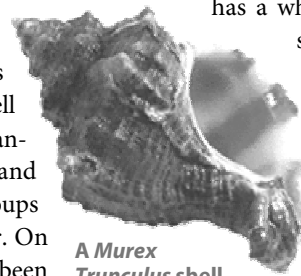
In an attempt to defend their findings, researchers claim that when *Chazal* stated that the color of the *chilazon*’s body is similar to the sea, they

referred to the color of the seabed which is brown. In addition, they claim, even if the *Murex Trunculus* is brown, in its natural habitat its shell takes on a blue-green color due to algae that become attached to it.

These defenses are difficult to comprehend, since the *Gemara* uses the same terminology in defining the color of the *chilazon*’s body and the color of *techeiles*.



Janthina



A *Murex Trunculus* shell

(The *Gemara* states that it is “*domeh liyam*,” similar to the sea.) It is highly unreasonable to say that regarding the color of *techeiles* the *Gemara* refers to the sea, and just a few lines later, regarding the color of the *chilazon*, the *Gemara* refers to the seabed.

Furthermore, the straightforward interpretation of the term “*gufo*” is the creature’s actual body. Even if one were to argue that it can also refer to the shell since this is what first meets a person’s eye, it is unreasonable to extend this untenable idea to also include foreign organisms, such as algae, that become attached to it. *Chazal* would not refer to that as “*gufo*”, but would have been more descriptive, especially if this is the primary *Gemara* in *Shas* that deals with the *chilazon*’s physical features. Moreover, algae would not be distinctive at all, since it also covers everything in that area of the sea as well. This is all in addition to the fact that in most cases, the color of algae is green, not blue.

As far as the color of the *Murex Trunculus* dye is concerned, the color pattern is as follows. The gland exudes a clear liquid, and when affected by oxygen it changes colors. First it changes to yellow, then to green, then to blue, and finally to purple. If it is left for a while, it dries out and turns black. Thus, the suggestion was made that perhaps this can fit well with the *Rambam*’s explanation that the blood of the *chilazon* is black. However, a straightforward reading of the *Rambam* would imply that the natural color of the blood is black and not after it is dried out. The bigger question is the fact that the resulting color must be blue, not purple. In the early 1980s it was discovered that if the purple liquid is exposed to direct sunlight or artificial sunlight, the color of the dye changes from purple to blue.

In order for the color of a dye to remain steadfast on a cloth, the dye has to be water soluble at first to allow it to get fully absorbed. Once absorbed, it must be insoluble so that it won’t get washed off. The liquid that is secreted from the gland of the *Murex Trunculus* is naturally insoluble. In order to make it soluble, it must undergo a process which causes it to be chemically reduced. This is performed by adding chemicals which deoxidizes it (i.e. removes oxygen components from it). The resultant color has a yellowish-green shade. If ex-

posed to direct sunlight in its reduced state, the bromine (purple) molecules become unbound from the blue molecules, and after it is placed on a cloth and re-oxidized it returns to an insoluble state, with a blue color.

The excitement of this discovery intensified when these researchers realized that the resulting blue dye had the exact same chemical composition as the indigo plant. This fit very well with *Chazal*’s statement that the indigo plant was used to forge the genuine *techeiles* due to the similarity in color.

However, many *poskim* and chemists brought this exact point to refute the authenticity of the *Murex* dye. *Chazal* devised chemical tests to differentiate between the indigo plant and genuine *techeiles*. If the *Murex* dye possesses the exact same chemical composition as the indigo plant, then naturally any test performed on one of them would result in the same exact results when performed on the other. Thus, the *Murex* dye is clearly not *techeiles*. This objection was the most profound of those offered.

In attempt to defend their view, researchers put forth various hypotheses which state how things may have been different in the times of *Chazal*. One theory suggests that whenever *Chazal* made the *techeiles* dye, some snail meat would get mixed in with the dye, which changed the result. This argument fails from both *halachic* and scientific standpoints.

Firstly, it is highly unreasonable that *Chazal* would make a test that was based on impurities, as the test would be dependent on something that will vary from batch to batch. A particularly good batch, pure from any impurities, would then fail the test. Moreover, any outside ingredients that would have caused the test to pass could have been maliciously added, by the forgers, into the plant indigo dye as well, which would imply that it was something inherent in the *techeiles* dye that would make it pass the test. In our case, both dyes have the exact same chemical composition.

Additionally, it appears that the purpose of the test used by *Chazal* was not to determine whether or not the dye itself remains absorbed in the wool, but to see whether the color remains and is not reduced to a different color. All the items used in *Chazal*’s test are recognized by

modern chemists as fermenting ingredients. Historically, these ingredients were placed in the fermentation vats that were used in dying indigo to enable it to become water soluble. This observation was made by Rav Herzog himself.

If, in fact, it was snail meat that was mixed into the dye, this would seem to be at odds with what scientists claim that snail meat is actually beneficial as a reducing agent. This would not jive with this understanding of *Chazal*’s test. Also, the *Rambam* mentions the insertion of snail mucus into the vat that was used for the test. In conclusion, since the blue *Murex* dye has the identical chemical makeup as indigo, it would fail any type of test that indigo would fail, let alone the *Gemara*’s test as just described.

There are several additional facts indicating the fallaciousness of the *Murex techeiles*.

Chazal mention that although it is inevitable that the *chilazon* will die right after secreting the dye, nevertheless, the longer it stays alive, the more beneficial it is, since the dye will become clearer. The advocates of the *Murex techeiles* claim that the *Murex Trunculus* contains an enzyme in its glands that is necessary for dye formation and this enzyme decomposes several hours after the snail’s death. From the *Gemara*, however, it is clearly implied that the dye begins to degrade at the moment of death. This is precisely the value in it remaining alive a bit longer; it provides enough time to efficiently process a clear dye. If the dying effect would not be impaired right away but would first be impaired a few hours later, there would be more than enough time to process the tiny amount of dye inherent in a snail, and there would be no value in it remaining alive any longer.

The Recent Discovery of Literary References

Despite the clear indications that neither the *chilazon* nor *techeiles* have any connection to the *Murex Trunculus*, supporters of the *Murex Trunculus* have purportedly misinterpreted a *Yerushalmi* quoted by the *Ravya* as indicating that *techeilis* is *Purpura*, which in Greek languages refers to either the color purple or the *Murex Trunculus* snail.³⁰ Additionally, these individuals found *kisvei yad*, old

manuscripts, from the *Chavos Yair*, which mention this as well. The *Chavos Yair* concludes that the color of *techeiles* is actually purple.³¹ The same is implied in a *sefer* attributed to the *Shiltei Hagiborim* on the *klei mikdosh*, which was found with *kisvei yad*.³²

However, as the Radziner Rebbe himself points out, the implication from *Chazal* and all the *Rishonim*, and what seems to be the *mesorah* in *Klal Yisroel*, is that the color of *techeilis* is blue. The Radziner Rebbe writes that this is a basic concept that even young school children are aware of. Additionally, it is somewhat problematic to base a *halacha* on isolated writings. If there was indeed a *mesorah* that the *chilazon* is the *Purpura*, it should have been mentioned elsewhere in other *seforim* from the past thousand years. None of the *gedolim* during the times of the Radziner Rebbe ever discounted his arguments based on this claim. It is therefore clear that no one was aware of such a *mesorah*. Quite possibly, the *Chavos Yair*, who was under the impression that *techeiles* is purple, came to this conclusion on his own, based on the fact that the basic dye of the *Murex Trunculus* is purple.

Passing *halachic* rulings based on *kisvei yados* discovered long after the author lived is itself quite dubious in the eyes of the *poskim*, as the authenticity and integrity of each word is questionable.³³ This is even more so in a situation such as ours where such a *mesorah* ought to have been mentioned elsewhere. Thus, the fact that the physical features of the *Murex Trunculus* do not resemble the *chilazon* as described by *Chazal*, and the fact that its chemical properties are identical to indigo, would lead one to believe that the *Murex techeiles* is not authentic.

The Conclusion

As we stated, this article is merely a brief overview of this most difficult, challenging and enigmatic topic. There are many more details, particulars, and other pieces of information and minutia that have been discussed by the many *rabbonim*, *poskim*, scientists and researchers who have devoted

themselves to this matter. We have tried to present the major issues.

The most recent proposal of the *Murex Trunculus* has not been met with universal acceptance to any extent. None of the signs mentioned by *Chazal* are clearly inherent in the *Murex Trunculus*. In fact, the impetus to find grounds for support of the *Murex techeiles* was based on archeological findings and not on the similarity of features mentioned by *Chazal*. Only after it was recognized that the *Murex Trunculus* had been discovered in the ancient Phoenician area where the *chilazon* had originally been hunted centuries ago, did these researchers attempt to reconcile their findings with the descriptions found in *Chazal*.

It is quite possible that all the archeological findings were linked to the purple dyeing industry well ascribed in literature to that ancient area and not the blue *techeiles* which involves great effort to produce. The fact that marine experts cannot identify the genuine *techeiles* can be due to either insufficient knowledge of the marine wildlife or the general extinction or migration of the *chilazon* creature, which will definitely return only when *Moshiach* arrives.

It is interesting to note that the supporters of the *Murex Trunculus* have been busy conjugating speculative arguments to defend their approach, making it seem like it is the duty of their antagonists to disprove them, when they have never pre-

sented any concrete proof that the *Murex techeiles* is genuine.

Performing a Mitzvah With a Questionable Item

Quite a number of *poskim* maintain that there is no requirement to perform a *mitzvah* with an item regarding which there is a doubt whether one can fulfill a *mitzvah* with it.³⁴ Even those who disagree with this principle in general would most likely agree to it with respect to the so-called *Murex techeiles*, where the available evidence overwhelmingly demonstrates that there are numerous questions regarding each of the various proposals.³⁵ Additionally, *halacha* mandates that *lechatchila*, unless genuine *techeiles* is used, *tzitzis* should be the same color as the garment. Obviously, if the *techeiles* being used is not authentic, the *tzitzis* do not conform to this *halacha*.

It is mentioned in the name of the *Arizal* that according to *kabbalah* one should refrain from wearing *techeiles* made from the indigo plant. Since the *Murex Trunculus techeiles* is quite convincingly considered indigo, there is definitely a reason to refrain from wearing it.³⁶

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| 28. מדישה אצל מומחים. | שבסוף ספרי התכלת מראדזין, ומהספר גופא. | 1. במדבר טו:ח. |
| 29. כל הדברים שנכתבו לקמן הם מדישה אצל מומחים וממה ששמעתי מפוסקי זמנינו. עי' ראב"ה במס' ברכות דף טו. סי' כה שהביא ירושלמי שפירוש זמן משיכיר ודל' וגרסינו בירושלמי בין תכלת לכרתי בין פורפירין ובין פריפנין, והוא מעיל שקורין בלשון לעז' פורפירא ויש שדומה לו קצת, עיי'ש. וידוע ששמו של דג המיוקס הוא פורפירין ביונית, ממ אין לפרש שמשכ' הירושלמי אח"כ הוא פירוש על מה שכתוב לעיל בין תכלת לכרתי אלא הוא סימן שני לידע זמן משיכיר, והמעין הטיב ביין האמת. | 15. עי' מס' מנחות דף מב. ומג. | 2. עי' מס' מנחות דף מב. ומד. |
| 30. עי' מקור חיים סי' יחג. | 16. עי' תפארת ישראל בהקדמה לסדר מועד, ויש שרצו לדייק כן מדברי הרמב"ם ריש הל' ציצית שבהלכה א' מפרק ב' מהל' ציצית לא זכר שהוא מהחלזון רק שתהיה צבעיה ידועה שעומדת ביופיה, אכן עי' משנה למלך בהל' כלי מקדש ח"ג, ועי' ספרי התכלת מראדזין שהאריך בזה, ואכמ"ל. | 3. עי' רמב"ם הל' ציצית אג, ועי' השגות הראב"ד שם, ועי' רש"י ותוס' במס' מנחות ריש פרק התכלת. ועי' טור בסי' יא שפסק כרש"י ותוספות, ועי' מב' טו' סק"ז, וסי' יא סק"ג נ"ח. |
| 31. עיי' שם בסי' עט, ועי' ספר לולאת תכלת עמוד ק' שהביא לשונו. | 17. שם. | 4. עי' מס' מנחות דף מג. |
| 32. עי' קובץ אגרות חז"א, וכן איתא בשאר פוסקים. | 18. מס' מנחות דף מד. | 5. עי' רמב"ן, במדבר טו:ח. |
| 33. כן אומרים בשם הגר"ח מבריסק זצ"ל, ועי' בחוות דעת ביד' סי' קי, ועי' תשובה שפירסם הגר"ש מיללער שליט"א על ענין התכלת ומה שהאריך שם בענין זה, ועי' בספרי התכלת מראדזין. | 19. עי' שיר השירים רבה ד"א. | 6. עי' במס' מנחות ריש פרק התכלת בענין אם תכלת מעכב את הלבן, ועי' רמב"ם ריש הל' ציצית. |
| 34. עי' בתשרי הנ"ל, וכך שמעתי מכמה פוסקי זמנינו. | 20. מס' סנהדרין דף צא. ד"ה חלזון. | 7. עי' ערך חידוש התכלת שבסוף ספרי התכלת מראדזין. |
| 35. עי' שרע' ורמ"א בסי' טו' סע' ה' ומשכ' במ"ב שם. | 21. עי' בספרי התכלת מראדזין. | 8. עי' מס' מנחות דף מג. |
| 36. עי' בן יהוידע על מס' ב"מ דף טא. | 22. עי' מס' שבת דף כו. ועי' ספרי התכלת מראדזין. | 9. עי' תולדות תנאים ואמוראים ערך רב אחאי, ועי' אגרות רב שרירא גאון, אכן עי' תוס' במס' כתובות דף ב. שהיה מאמוראי בתראי. |
| | 23. עי' מס' שבת דף עה. ועי' תוס' שם. | 10. עי' מדרש תנחומא פר' שלח פרק טו, ועי' במדבר רבה ז"ה. |
| | 24. עי' ספרי התכלת מראדזין וערך חידוש התכלת בסופו. | 11. עי' רמב"ן שמות כחב. מובא בספרי התכלת מראדזין עמוד ו. |
| | 25. עי' דרשות הר"ן. | 12. עי' בספרי התכלת מראדזין וגם בספר שהוציא הרב הרצוג על ענין זה. |
| | 26. עי' ספר של הרב הרצוג, ובענין שיטות תוס' עי' שר"ת אג"מ יו"ד ח"ב סי' קל"ג באריכות. | 13. עי' ריש ספר שפוני טמוני חול מראדזין, והוכיח זה ממה שנתן הרמב"ם סימנים שלא מצינו בחז"ל כגון שהיו שחור. |
| | 27. עי' בספרי התכלת מראדזין, ועי' רבינו גרשום במס' מנחות מא. בענין רב יהודה כשמסר גלימא עם תכלת לקצרא ומפייסו שיהיה שלא יקלקל מראה התכלת. | 14. הרבה מהדברים בא מערך חידוש התכלת |