TOPICS IN Perek HaTekhelet

DAF YOMI • MENACHOT PEREK 4

PTIL TEKHELET

The Common Thread that Unites our Jewish Past, Present, and Future

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DEDICATED BY RABBI DOVID AND ANITA FULD IN THE *ZECHUT* OF A *REFUAH SHELEIMAH* FOR HADASSAH RACHEL BAT CHANA GOLDA

DEDICATED BY MARC TOBIN L'ILUY NISHMAT DR. DODI FISHMAN TOBIN ע"ה AND IN HONOR OF MY DEAR CHILDREN: AMIEL & JULI TOBIN, GIDON & RONI TOBIN, MATAN & ADI TOBIN, AND MORIAH & SHIMMY GOLDSMITH

Techeiles Revisited (Abridged)

Rabbi Berel Wein z"l

One of the enduring mysteries of Jewish life following the exile was the disappearance of techeiles in tzitzis. Not only did Jews stop wearing techeiles—they apparently forgot how it was manufactured.

The Talmud identified techeiles as produced from a sea creature called chilazon, harvested along the northern coast of Israel from Haifa to Tyre.

Three main questions require study: (1) When and why did techeiles disappear? (2) Which sea creature is the chilazon? (3) Can we revive a "lost" commandment whose tradition has been broken?

THE DISAPPEARANCE

In the ancient world, the colors of purple and blue were reserved for royalty and the upper classes. The Romans were especially zealous about their governmental monopoly on dye production. The Talmud records the arrest of two rabbis from Israel who were smuggling techeiles into the Jewish community of Babylonia (Sanhedrin 12a).

Various dates have been proposed for techeiles' disappearance, ranging from the late fifth century to the fifteenth century. Rabbi Isaac Halevi Herzog assumed the manufacturing facilities were destroyed during the Muslim conquest of Israel around 638 CE. By the time of the great Geonim and Rishonim—including Mar Shalom Gaon (died 859), Rambam (died 1204), and others—techeiles was clearly unavailable and lamented as lost.

IDENTIFYING THE CHILAZON

In 1889, Rabbi Gershon Henoch Leiner, the Radzyner Rebbe, claimed the chilazon was a squid and produced thousands of techeiles strings. However, Rabbi Herzog's 1913 dissertation proved this incorrect and instead identified the Murex trunculus snail. Still, Herzog was troubled that this snail produced purple dye, not blue. This problem was solved in the early 1980s when Otto Elsner discovered that exposing the dye to direct sunlight during processing turns it brilliant indigo blue.

The seal of the Rebbe of Radzyn, Rav Gershon Henoch Leiner, z"l

THE HALACHIC QUESTION

Rabbi Yosef Dov Soloveitchik (Beis Halevi) discussed the Radzyner's techeiles and rejected it. Two versions of his reasoning exist: one presents his contention that since this squid was well known to the rabbis of all the ages, yet they did not regard it as being the chilazon, this in effect constitutes a negative tradition regarding equating the squid with the chilazon; the other requires a positive mesorah for identification, meaning techeiles must wait for Messianic times. This discrepancy has ramifications for techeiles obtained from the Murex trunculus. The Midrash's statement that techeiles was "nignaz" (hidden away) has been interpreted by Rabbonim such as Rabbi Yechiel Michal Tikutchinsky as meaning it became less common, not that it disappeared completely or that its future use was to be prevented.

While rabbinic opinions on techeiles vary, its use is spreading widely throughout the Jewish people. Techeiles has become a living practice, moving from academic study into the everyday life of tens of thousands of Jews worldwide.

Seated from left to right: HaRav Reuven Katz, HaGaon Rav Dov Weidenfeld of Tzivin, HaRav Shmuel Yitzchak Hillman, and Chief Rabbi Isaac HaLevi Herzog.

Rediscovering the Chilazon

By Rabbi Avrohom Gross

For more than a millennium, *techeiles* has remained a mystery. The identity of the chilazon—the creature from which *techeiles* is derived—was lost after the period of the Amoraim. Nevertheless, it is still possible to identify the chilazon through its *simanim*, its distinctive characteristics (Maharil, *Chadashos*, Responsa §5).

In recent decades, a promising candidate has emerged: the *Murex trunculus* snail. This article examines the information in Chazal about the chilazon and evaluates whether the Murex corresponds to the creature described in our sources.

The Chilazon: Murex trunculus

WHAT CHAZAL SAY

Talmudic and midrashic sources describe the chilazon as producing a blue dye (*Menachos* 43b) visually identical to plant-derived indigo (*kala ilan*), distinguishable only through chemical testing (*Menachos* 43a, *Bava Metzia* 61b). Besides blue, the chilazon yields a range of other colors (*Midrash* quoted by *R' Chaim Paltiel* on *Bereishis* 49:13). Its dye is exceptionally durable—even more so than indigo (*Menachos* 43a, *Rambam Tzitzis* 2:1)—and was extremely expensive (*Menachos* 43b, 44a).

THE MUREX MATCH

The *Murex trunculus* is the only creature known to yield a blue dye without modern chemicals. Its gland produces a blue dye visually indistinguishable from plant-based indigo. Recent experiments have recreated this blue dye using only materials available in ancient times, demonstrating that blue Murex dyeing is not a modern innovation.

The Murex dye gland contains three color-producing components, enabling it to produce a spectrum of hues: red, purple, blue, and green. The final color depends on variables such as sunlight, heat, and exposure time—virtually unparalleled in nature and matching the description in Chazal.

The durability of Murex dye is distinctive. As a vat dye, it bonds directly to fabric without binding agents and is nearly impossible to remove; recent reconstructions using ancient methods demonstrate durability exceeding that of indigo. Historically, it was the most expensive dye known—at times worth its weight in gold (Pliny, *Natural History* 9.63).

HISTORICAL FOOTPRINT

International Usage: Our sources depict *techeiles* as a royal fabric worn by nations across the ancient world—Assyrians, Babylonians, and Persians (*Yechezkel* 23:6; *Esther* 1:6, 8:15; *Shabbos* 26a). The Murex family are the only known marine source used for ancient dyeing, and *Murex trunculus* specifically was prized across the ancient world for producing vibrant, long-lasting blue and purple dyes.

Geographic Distribution: Chazal describe the portion of Zevulun as uniquely blessed with the chilazon (*Megillah* 6a), identifying Israel's northern coastline as the natural home of *techeiles* production. It is along this very coast that the Gemara relates that Nevuzaradan left Jewish chilazon collectors following the *Churban* (*Shabbos* 26a). Strikingly, archaeological remains of Murex dye-production installations spanning this period have been uncovered along the same shoreline.

Legal Restrictions: In Rava's time, imperial laws made possession or trade of *techeiles* dangerous (*Sanhedrin* 12a, *Rabbeinu Chananel*). This corresponds precisely with Roman criminalization of private Murex dyeing during this era. These restrictions escalated during the Rabbanan Savorai period (*Codex Justinianus* 4.40.1, 11.8.4), bringing Murex dyeing under imperial monopoly—in the same period that *techeiles* faded from practice.

HARVESTING THE CHILAZON

The chilazon is described as a shelled sea creature that burrows in sand (*Pesikta d'Rav Kehana* 11:21, *Megillah* 6a, *Lekach Tov Devarim* 33:19), caught using traps (*Shabbos* 74b). The *Murex trunculus* fits this description: a Mediterranean snail that buries itself in soft seafloor sediments, which is caught using baited nets (Pliny, *Natural History* 9.61).

A 3,500-year-old Egyptian textile dating to the period when Bnei Yisrael were in Egypt. The sky-blue threads in its fringes were dyed from Murex trunculus snails, indicating its use at this early stage. Identification based on Poulin et al., "Identification of Shellfish Blue on an Ancient Egyptian (Dynasty XVIII) Painted Votive Textile." © Government of Canada, Canadian Conservation Institute

Fresco from the House of Thiasus, Pompeii (buried in 79 C.E.), depicting a cluster of marine shells, including sea-colored Murex trunculus *snails in the middle. Courtesy of the MIC – Archaeological Park of Pompeii. Credit to R' Mordechai Honig for bringing it to the author's attention.*

The dye had to be extracted while the chilazon was alive to prevent spoilage (*Shabbos* 75a). Greek and Roman scholars describe the same requirement for Murex (Aristotle, *Historia Animalium* V:15; Pliny, *Natural History* 9.60). Modern science supports this: after death, the dye gland breaks down and the chemicals mix uncontrollably with surrounding tissue, leading to the spoilage of the color.

VISUAL CHARACTERISTICS

A *baraisa* (*Menachos* 44a) describes the chilazon as "resembling the sea" and "fish-like in shape." The *Murex trunculus* matches both: its shell is sea-green, "painted" by a layer of algae that bonds so tightly it cannot be removed even with harsh cleaning. This explains why the Murex was viewed in antiquity as sea-colored, as reflected in a Pompeii mural depicting it in aquamarine (see image above). Its curved body, with a pointed spire and flared base, closely resembles the shape of a fish (see image below).

THE SEVENTY-YEAR CYCLE

The *baraisa* states the chilazon "rises once in seventy years." Some opinions (*Chida* citing the Radvaz, *Pesach Einayim ad loc.*) explain this as a supernatural event that ceased with the exile of the tribe of Zevulun. If interpreted naturally, it could refer to rare "mass beachings"—a phenomenon documented among marine snails, including some species of Murex.

THE DYEING PROCESS

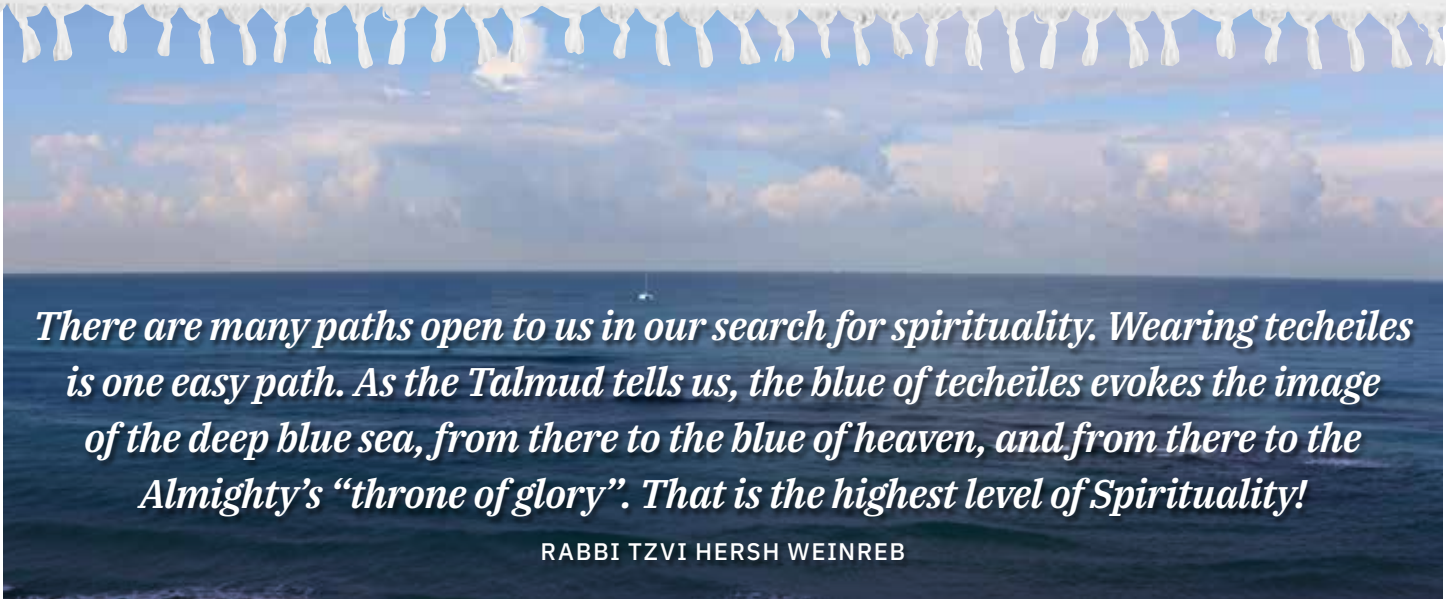
Chazal describe three steps to *techeiles* dyeing: placing the chilazon's "blood" with *samanim* into a vat, heating it, and testing a sample before applying (*Menachos* 42b). This testing requirement is unusual, as most dyes show their color immediately.

Murex dyeing follows these same steps, including this uncommon testing phase. Murex dye is translucent yellow in its reduced state, and its final hue only appears after exposure to air. Because the color varies based on conditions, testing is essential for achieving a specific hue. Roman accounts describe the same process (Pliny, *Natural History*, Book IX, Ch. 62).

CONCLUSION

The correspondence between the *Murex trunculus* and the chilazon spans multiple domains: halacha, biology, chemistry, history, and dyeing methodology. No other species matches the detailed descriptions in Chazal, nor can any other creature produce blue dye using methods available in ancient times. This compelling convergence indicates that the *Murex trunculus* is the authentic source of *techeiles*, making it possible to once again produce genuine *techeiles* after more than a thousand years.

"Its form resembles a fish" Menachot 44a



There are many paths open to us in our search for spirituality. Wearing techeiles is one easy path. As the Talmud tells us, the blue of techeiles evokes the image of the deep blue sea, from there to the blue of heaven, and from there to the Almighty's "throne of glory". That is the highest level of Spirituality!

RABBI TZVI HERSH WEINREB

Principles Regarding Tying Tzitzis with Techeiles

Collected Sources

Although the method for tying white tzitzis is fairly standardized, the situation regarding tying tzitzis with techeiles is the subject of widespread machlokes. There are many aspects dealt with by the Gemara and Rishonim:

NUMBER OF STRINGS ON EACH CORNER

תנו רבנן: כמה חוטין הוא נותן? בית שמאי אומרים ד', ובית הלל אומרים ג'... מנחות מא:

The Rabbis taught, How many strings does one place [on each corner]? Beis Shammai say four and Beis Hillel say three... MENACHOS 41B

RATIO OF WHITE TO TECHEILES STRINGS

מכמה גדילים אתה עושה? אין פחות משלושה – דברי בית הלל. בית שמאי אומרים: שלושה של צמר ורביעית של תכלת. והלכה כבית שמאי. ספרי שלח (קטו)

How many strings must one place? Not less than three – this is the opinion of Beis Hillel. Beis Shammai say: Three [strings] of [white] wool and a fourth of techeiles. And the halacha is according to Beis Shammai. SIFRE SHELACH (115)

כמה גדילים נעשים? אין פחות משלושה חוטים כדברי בית הלל. בית שמאי אומרים: מארבעה חוטים של תכלת וארבעה חוטים של לבן... והלכה כדברי בית שמאי. ספרי כי תצא (רלד)

How many strings are placed? Not less than three strings according to Beis Hillel. Beis Shammai say: Four strings of techeiles and four strings of white. And the halacha is according to Beis Shammai. SIFRE KI TETZEI (234)

Note: The Vilna Gaon claims that the correct version of this Sifre is "בג' חוטין של לבן ורביעית של תכלת" – "With three strings of white and a fourth of techeiles." This change would harmonize the two quotes from the Sifre.

There are three different opinions of the Rishonim regarding the ratio of white to blue strings:

Rambam (הל' ציצית א':ו) – Half of one string (when folded becomes one of the eight strings) is techeiles. The Rambam understands the posuk in Bamidbar in the following manner: ונתנו על ציצת הכנף (= לבן) פתיל תכלת – put upon the fringe of each corner (= white) one thread of blue. Only the windings (פתיל) around the white core (כנף) must be techeiles.

Raavad (השגות הל' ציצית א':ו) and the Aruch (ערך תכלת) – Based on the Sifre in Shelach hold that one full string (when folded it becomes two of the eight) must be techeiles.

Tosfos -Rashi (מנחות לח. ד"ה התכלת) and Tosfos (שם וכן מא: ד"ה בית שמאי) – Two full strings (four of the eight) are techeiles.

ISSUES REGARDING THE WINDINGS (KRICHOS)

CHULYOS

וכמה שיעור חוליא? תניא, רבי אומר כדי שיכרוך וישנה. תאנא, הפוחת לא יפחות משבע, והמוסיף לא יוסיף על שלוש עשרה. הפוחת לא יפחות משבע – כנגד שבעה רקיעים, והמוסיף לא יוסיף על שלש עשרה – כנגד שבעה רקיעין וששה אווירין שביניהם. מנחות לט.

And what is the measurement of a chulya (link)? We learned in a Braisa, Rebbe says so that you can wind once, then again, and a third time. We learned in a Braisa, one who minimizes should not have less than seven, and one who maximizes should not exceed thirteen. One who minimizes should not have less than seven – this is analogous to the seven heavens, and one who maximizes should not exceed thirteen – this is analogous to the seven heavens and six spaces between them. MENACHOS 39A

According to the Gemara, when tying tzitzis, there is a concept of chulyos (literally, links or vertebrae). There is an argument as to what the numbers seven and thirteen refer. Most Rishonim explain that these numbers refer to the amount of chulyos (each of which is made up of three twists as Rebbe states). Some Rishonim explain that each chulya can have between seven and thirteen twists, and they explain Rebbe's three twists as referring either to the number of techeiles twists in each chulya (and the number seven includes both the white and the techeiles), or that Rebbe is talking about the absolute minimum required to fulfill the mitzva (bedieved deoraysa), but the best method (lechatchila derabanan) should have between seven and thirteen twists.

COLOR OF TWISTS

תנא, כשהוא מתחיל, מתחיל בלבן – 'הכנף', מין כנף, וכשהוא מסיים, מסיים בלבן – מעלין בקודש ולא מורידין. מנחות לט.

We learned in the Mishna, when one begins, he begins with white – "[the fringe of each] corner," the same kind as the corner [i.e. the same color as the garment]; And when one concludes, he concludes with white – one always increases holiness and never decreases. MENACHOS 39A

There is an argument as to the explanation of this passage:

- **Rav Amram Gaon** (גאוניקה ח"ב עמ' 330-331) holds that the first chulya is white, the next is techeiles, and so on alternating white and techeiles for seven or thirteen chulyos. These chulyos of alternating colors are termed l'sayrugin.
- **The Rambam** (הל' ציצית א':ב'-ג') holds that the first twist of the first chulya and the last twist of the last chulya are white, and all the other twists are techeiles.
- **The Raavad** (השגות הל' ציצית א': ז') holds that the twists of each chulya alternate between white and techeiles.

CHULYOS IDENTIFIED

Left to right: L'sayrugin, Yemenite, ARI z"l/Radzyn, Raavad.

THE KNOTS

KESHER ELYON

ואמר רבה שמע מינה קשר עליון דאורייתא. מנחות לט.

Rabbah says, this implies that the uppermost knot is required from the Torah. MENACHOS 39A

Rashi (מנחות לט. ותוספות שם) brings down two possibilities regarding the placement of the uppermost knot.

- Closest to the garment, in order to connect the strings to the garment
- At the end of all the twists, which adds stability to the windings

DOUBLE OR SINGLE KNOTS

There is an argument as to the nature of the knots of the tzitzis. The Geonim (גאוניקה ח"ב עמ' 331) hold that a knot can be one string tucked under itself. Rabbenu Tam (מנחות לט. ד"ה לא) compares the knots of tzitzis to knots in other laws like Shabbos, and therefore requires a double knot. According to Rabbenu Chananel, the knot is made by looping one string around the rest, whereas The Mordechai holds that all the strings are used (by looping four around the other four).

KNOTS ON EACH CHULYA

אמר רבא שמע מינה צריך לקשור על כל חוליא וחוליא מנחות לח:

Ravah says, this implies that one must tie a knot after each and every chulya. MENACHOS 38B

FIVE KNOTS

ציצית, שש מאות. שמונה חוטין וחמישה קשרים, הרי שש מאות ושלש עשרה. תנחומא, קרח י"ב

[The word] tzitzis is numerically equivalent to 600. 8 strings and 5 knots add up to 613. TANCHUMA, KORACH 12

RABBI MEIR WOULD SAY:

"What distinguished Techeiles from all other types of dyes? Because the techeiles is similar to the sea, and the sea is similar to the sky and the sky is similar to the throne of Glory."

MENACHOS 43B

THE LENGTH OF THE WINDINGS AND THE STRINGS

אמר רב הונא אמר רב ששת אמר רב ירמיה בר אבא אמר רב... ונויי תכלת שליש גדיל ושני שלישי ענף. מנחות לט.

Rav Huna said in the name of Rav Sheshes in the name of Rav Yirmiyah bar Abba in the name of Rav: The most ornate techeiles ought be one third windings and two thirds hanging threads. MENACHOS 39A

VARIOUS OPINIONS REGARDING THE KRICHOS FOR TZITZIS WITH TECHEILES

Disclaimer! *Very few Poskim define their shittah in complete detail. Often they discuss one issue (for example, alternating the colors of the chulyos), but leave another (e.g. the type of knot) unexplained. In the following list of shittos, some details are the result of speculation in order to determine a complete practical method of tying.*

The principles discussed above are applied differently by the Poskim. They correspond to the accompanying pictures. The following is an (incomplete) list:

Rav Amram Gaon – seven or thirteen chulyos alternating white then techeiles. A knot at the beginning and at the end (according to the Baal Haitur, a knot after each chulya). (These knots are not double, but rather the winding string tucked under itself. According to the Shaalos U'tshuvos Binyamin Zeev, the knots are double knots.)

Rav Natronai Gaon according to the Raava"d – five knots. Between each knot, seven to thirteen twists, with the twists alternating white then techeiles. Between the second and third knot, the amount of twists is not definite, but one may also alternate between techeiles and white.

Tosfos – first a double knot, then one chulya of white and one of techeiles, then a second double knot, again white then techeiles and a knot, then again white and techeiles then a knot, and finishing with one white chulya and a double knot. This has seven chulyos and five knots.

The Chinuch – thirteen chulyos, alternating white and techeiles distributed between five double knots. Between the first and second knot – three chulyos (white, techeiles, white). After the second knot another three chulyos, (techeiles, white, techeiles). After the third another three (white, techeiles, white), and after the fourth – four chulyos (techeiles, white, techeiles, white).

The Vilna Gaon – thirteen chulyos, alternating white and techeiles, distributed between five double knots. Between the first and second knot – four chulyos (white, techeiles, white, techeiles) and the same between the second-third, and third-fourth knots. Between the fourth and last knot – one chulya of white.

The Rambam – all twists are techeiles except the first and last. Seven or thirteen chulyos are tied with a knot between each that keeps them in place and separate from each other. The Yemenites have a tradition (even with white tzitzis) of tying each chulya into a special knot.

The Rambam according to the Ari z"l and the Radzyner – has all the twists techeiles except the first and last. There are five knots: between the first and second knot there are seven twists, between the second and third – eight twists, between the third and fourth – eleven twists, and between the fourth and last – thirteen twists (similar to the way we tie tzitzis without techeiles). Each group of three is separated by winding the techeiles around and inside to hold them together.

"Techeiles" for it is the essence (tachlis) of all the colors

PARDES RIMONIM 10:2

Kala Ilan

Rabbi Ari Zivotofsky

The Gemara in Menachos (41b) states:

ת״ר: טלית שכולה תכלת - כל מיני צבעונין פוטרין בה, חוץ מקלא אילן.

The Rabbis taught in a Baraisa: With respect to a garment that is made entirely of techeiles, threads of all colors satisfy the tzitzis obligation in it, with the exception of kala ilan.

Rashi explains the reason why the kala ilan dye is unacceptable:

דדמי לתכלת וזימנין דמזבן לה לאינש אחרינא וסבר דכל חוטיה תכלת וכי מצריך לטלית אחריתי שקיל תרי חוטים מהכא ונותן שם... ושדי קלא אילן עם לבן בציצית והוי כלאים בלא מצוה.

Since it is similar to techeiles and it may happen that the tallis is sold to another person who assumes all the strings are made of techeiles. And when he needs them for another tallis, he will take two strings from this [tallis] and put them on the other one... and he will have kala ilan with white on the tzitzis thus making kelaim without any mitzvah.

Kala ilan is a fraudulent dye which is visually indistinguishable from the more expensive techeiles. It is therefore imperative to ensure that one not substitute kala ilan for techeiles either maliciously or by accident. As the Gemara explains previously (Menachos 40a), the mitzvah of placing techeiles on one's tallis overrides the issur of shaatnez, and as such, one is obligated to put techeiles (which by definition is of wool, c.f. Yevamos 4b) on a tallis made of linen. This, of course, is true only when using authentic techeiles, but if the wool strings are dyed with the counterfeit kala ilan, the prohibition of shaatnez would remain intact, hence the injunction against any use of kala ilan was instituted in order to avoid any possible confusion. (See for example the Rosh, Halachos Ketanos [Menachos], Hilchos Tzitzis siman 1.)

Although the white (i.e. non-techeiles) strings of the tzitzis can theoretically be made of any color, the injunction against using kala ilan (instead of white) is so severe that Rav Moshe Feinstein felt that even if one had true techeiles strings that were afterwards dipped in kala ilan (to increase their luster), they would still be prohibited. (Iggros Moshe, Yoreh Deah, vol. 2:133) Since kala ilan was identical to the much more expensive techeiles, unscrupulous people might attempt to pawn off strings dyed with it in place of genuine techeiles. The Sifri (Bamidbar, 115) warns against this:

אני ה׳ אלקיכם אשר הוצאתי אתכם מארץ מצרים, וכי מה ענין יציאת מצרים לכאן אלא שלא יאמר הרי אני נותן צבעונים וקלא אילן והם דומים לתכלת ומי מודיע עלי בגלוי אני ה׳ אלקיכם דעו מה עשיתי להם למצריים שהיו מעשיהם בסתר ופרסמתים בגלוי.

"I am Hashem your God who took you out of the land of Egypt." What does leaving Egypt have to do with this [parasha of tzitzis]? Rather one should not say, "Behold I put other dyes and kala ilan which are identical to techeiles and who can make this information public?" "I am Hashem your God." Know what I did to the Egyptians whose misdeeds were done in private and I advertised them in public.

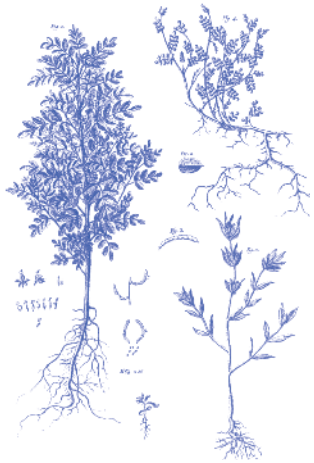
This idea is brought down in a number of additional places including Bava Metziah (61b), Rashi on the posuk in Shema (Bamidbar 15:41), and Sheiltos D'rav Achai Gaon (Vaera 43). These sources show that the similarity between kala ilan and techeiles was absolute, in that only Hashem can distinguish between them. Nevertheless, this assertion is challenged by the Gemara in Menachos (42b):

Isatis tinctoria – the woad plant

ת״ר: תכלת אין לה בדיקה, ואין נקחית אלא מן המומחה... ותכלת אין לה בדיקה? והא רב יצחק בריה דרב יהודה בדיק ליה, (סי׳ בגשם) מייתי מגביא גילא ומיא דשבלילתא ומימי רגלים בן ארבעים יום, ותרי לה בגווייהו מאורתא ועד לצפרא, איפרד חזותיה - פסולה, לא איפרד חזותיה - כשרה.

The Rabbis taught in a Braisa: Techeiles has no means of examination, and therefore it may be bought only from an expert... Does techeiles actually have no means of examination? But Rav Yitzchak the son of Rav Yehudah would test [techeiles] for authenticity. (BeGeSHeM is a mnemonic for the items that he used in his test.) He would bring alum, sap of fenugreek, and urine that is forty days old, and he would soak [the techeiles] in them from evening until morning. If its color faded, [the thread] was deemed unfit, for fading indicates that it is kala ilan, and if its color did not fade, it was deemed fit, for this indicates that it was genuine.

The Rambam (Hilchos Tzitzis 2:5) agrees that although the two are visually identical, chemical tests can distinguish between kala ilan and techeiles. It is generally agreed that the tests recounted here are difficult to understand and are therefore inconclusive (שו״ת שאילת יעבץ חלק א סימן נו).



Indigofera tinctoria – the indigo plant

Isatis tinctoria – the woad plant

Indigofera tinctoria – the indigo plant

KALA ILAN AND ISATIS

The Aruch defines kala ilan as indigo (פירוש אינדק"ו) and the Mosif adds "Binyamin said: That is its Greek name, it is a type of dye that is similar to techeiles." The Nemukay Yosef (לד, ע"א בדפי הרי"ף) also identifies kala ilan with indigo and the color blue. The Teshuvos Hageonim (גאוניקה לגינזבורג, כרך ב' עמ' 333) notes that in Arabic it is called nil (which is indigo).

Another dye mentioned by Chazal as similar to techeiles, and identified with the Arabic nil is isatis (איסטיס) (Kaftor Vaferach, ch. 48, Radvaz in Teshuvah 685, Rav Bartenura on the Mishnah in Kelaim 2:5, Pachad Yitzchak, vol. 4, p. 78 — see Rav Shlomo Teitelbaum in Lulaot Hatecheiles, pp. 235-240)

Although both isatis and kala ilan denote indigo and are both similar to techeiles, the terms are not used interchangeably. The Rambam (Hilchos Tzitzis 2:1) does seem to use isatis in place of kala ilan. Most probably the two were associated with different plants which both produced the same dye (indigo). Isatis referred to the woad plant (Isatis tinctoria) which is indigenous to the temperate regions of northern Europe, while kala ilan corresponded to Indigofera tinctoria which was cultivated in warmer climates (specifically China and India) and yields much higher concentrations of indigo.

KALA ILAN AS A BASIS FOR IDENTIFYING TRUE TECHEILES

Kala ilan and techeiles are impossible to tell apart (at least with the naked eye), and so one should be able to make use of this property when attempting to identify true techeiles. If one finds a candidate for the techeiles – producing chilazon, the most important test would be to see if the color of the dye is the same as that of indigo. In fact, the argument can be taken one step further, namely, that if one finds any marine organism that yields a dye which is permanent and the color of indigo, then that dye must be kosher for techeiles. This is the opinion of both of the greatest authorities on techeiles – Rav Gershon Henoch Leiner of Radzyn and Rav Yitzchok Isaac Halevi Herzog. The Radzyner writes:

אם אחר החיפוש נשיג ידינו למצוא דם איזה מין חלזון שיהיה שנוכל לצבוע בו צבע התכלת צבע עומדת ביפיה ולא תשתנה, ודאי יכול לקיים מצות תכלת בלא שום ספק. (שפוני טמוני חול, עמ' י"ד)

If, after searching we would be able to find the blood of any kind of Chilazon that would enable us to properly dye the color of techeiles which would retain its original beauty and would not fade, then certainly we would be able to fulfill the mitzvah of techeiles without any doubt. (SEFUNEI TEMUNEI CHOL, PAGE 14, 1999 EDITION)

Both Rav Herzog (*The Royal Purple and Biblical Blue*, Keter, 1987, page 73) and the Radzyner offer the same line of proof for this assertion. If there is another chilazon whose dye satisfies these criteria, but is not kosher for techeiles, then why would Chazal not warn us regarding its use? The only caution recorded in the Gemara is with regard to kala ilan – indigo derived from a plant source – but there is no admonition against using another sea animal that is not the chilazon shel techeiles. Therefore, either that species' dye is also kosher for techeiles, or there is only one species in the world (or in the Mediterranean) that satisfies both those criteria. In either case, any sea creature which produces a permanent dye the color of indigo must necessarily be kosher for use as techeiles.

ORIGIN OF THE TERM KALA ILAN

Rav Herzog (*Biblical Blue*, page 94) suggested a number of possibilities explaining the origins of the term kala ilan. Kala in Sanskrit means black or deep blue and nilam is indigo (similar to the Arabic nil). Kala ilan may mean the kala derived from trees (ilan in Hebrew) or perhaps it is a corruption of kala-nil(am). Rav Herzog also posits that the Chinese lan (= indigo) might be involved. This may be lent additional support by the fact that in ancient Chinese, the term for indigo was actually k'lan which is very similar to kala ilan (*Indigo Textiles*, Gösta Sandberg, Black, 1989).

The Chinese character for indigo (lan) is made up of three elements – an eye, a person, and a vessel with water. Taken together, this represents a reflection in the water (perhaps of the sky).

Dyeing Techeiles

Dr. Baruch Sterman

The Gemara in Menachos (42b) relates:

אמר ליה אביי לרב שמואל בר רב יהודה: הא תכילתא היכי צבעיתו להה? אמר ליה: מייתינן דם חלזון וסמנין ורמינן להו ביורה [ומרתחינן ליה], ושקלינא פורתא בביעתא וטעמינן להו באודרא, ושדינן ליה לההוא ביעתא וקלינן ליה לאודרא.

Abaye said to Rav Shmuel bar Rav Yehudah: This thread of techeiles, how do you dye it? [Rav Shmuel bar Rav Yehudah] replied: We bring the blood of the sea creature chilazon and certain herbs, and we put them in a pot and boil it up. Then, we take a little bit of the dye in an eggshell and test it with a wad of wool. Then we spill out the dye left in that eggshell and we burn the wad of wool that was dyed for the purpose of testing.

The dye process recounted here is similar to that brought down by the ancient Greek and Roman scholars. Aristotle (d. 322 BCE) and Pliny the Elder (d. 79 CE) describe the procedure used in dyeing with the porphyra. Pliny elaborates on the method:

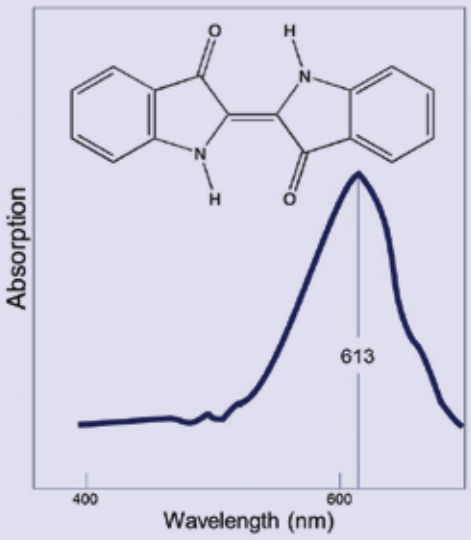
The vein of [the snail] is removed and to this salt has to be added... and it should be heated in a leaden pot, and with 50 lbs of dye to every six gallons of ---water kept at a uniform and moderate temperature by a pipe brought from a furnace some way off. This will cause it gradually to deposit the portions of flesh which are bound to have adhered to the veins, and after about nine days the cauldron is strained and wool that has been washed clean is dipped for a trial. (Natural History, Book IX. LXII. 133)

This procedure has been reenacted by researchers in Israel and England who have been able to produce beautiful blue dyed wool. With the advances in our understanding of dye chemistry, however, much more efficient methods can be used which yield results in a consistent and reliable manner.

Techeiles belongs to a group of colorants known as vat dyes. These must undergo specific chemical processing before they can be bound to fabric. One of the main characteristics of techeiles is its fastness – it does not fade with time or wash out of the wool. The Gemara (Menachos 43a) explains that even after chemical testing לא איפרד חזותיה – its color does not fade, or as the Rambam puts it (Hilchos Tzitzis 2;1), שעומדת ביפיה ולא תשתנה – it remains beautiful and does not change.

This trait of steadfast stability in a dye translates chemically into the fact that the dye pigment does not readily bind to water or soap or other substances that could serve to remove it from the fabric. However, if a dye is hard to get out of the wool, it is equally hard to get it into the wool, i.e. to dye the wool in the first place! Overcoming this obstacle is the major difficulty facing the vat dyes.

In order to dissolve the techeiles molecule in water and introduce it into the wool, it must undergo the chemical process known as reduction. In ancient times this was accomplished through fermentation, where the meat and dye-containing parts of the snail were heated on a low flame for a few days (as described by the Gemara and by the classical scholars). Bacteria that live on the snail meat ferment the dye and reduce it. In modern times, that same result can be accomplished much more quickly by adding a strong



The posuk in krias shema says that by looking at the tzitzis one will remember all of Hashem's mitzvos. Rashi explains that the word tzitzis is numerically equal to 600. Add to that the 8 strings and 5 knots, and you have 613, the number of mitzvos in the Torah. The Ramban and others disagree with Rashi and claim that it is the string of techeiles itself that serves as the reminder. The sky-blue thread evokes contemplation of the heavens and of God's throne, which leads one to remember the mitzvos.

Interestingly, work by Dutch scientists* regarding the properties of the techeiles dye molecule revealed a striking coincidence. The color of a substance is determined by way it reflects and absorbs light. No two molecules have the same pattern (called a wavelength absorption spectrum) which is measured in units called nanometers. Techeiles obtained from the *Murex trunculus* snail derives its color from a sharp peak in its spectrum at exactly 613 nanometers.

** J. Wouters and A. Verhecken, JSDC Volume 107, July/August, 1991.*

The chilazon after being broken open (petziah), showing the gland where the precursor to the dye is stored. PHOTO BY CHRIS ATKINS.

reducing agent (such as sodium dithionite). In this reduced state, two important things can happen. Firstly, the dye molecule dissolves in water, allowing wool to absorb the solution and take up the dye. Secondly, the chemical bonds are weakened so that exposure to sunlight removes the purple tint from the dye molecule (present when taken from the snail), and leaving it the beautiful sky-blue that is techeiles.

The effect of sunlight on the reduced dye was discovered only in 1985. Before then, all techeiles researchers (including the Radzyner Rebbe and Rav Herzog) believed as fact that sea-snails could produce only purple, which was the main obstacle to positively identifying them as the source of techeiles. Once it became known that the murex could also produce blue, it was only a few short years later that Rav Eliyahu Tavger produced the first authentic techeiles strings in over 1300 years.

When the dye is in the vat (יורה) in the reduced state, it does not have the same color that it will ultimately have in the wool. Rather the solution has a yellow-green hue, as can be seen in the accompanying picture. This may help us understand the second part of Rav Shmuel bar Yehudah's statement (echoed by Pliny) regarding the need to "test" the dye by pouring out some dye into an egg shell and dipping wool into it. Why not just look at the dye solution and see if it is the right color? Since the dye in its reduced state gives no indication of the color that the dyed wool will have, the only way to accurately determine this is to dye some wool which brings it out of reduction by exposing it to the oxygen in the air. In the picture one can see the lustrous blue techeiles of the wool in its final state, and the yellow-green of the dye solution.

The chilazon stores the techeiles inside a gland. (These dye compounds are actually formed as the snail digests its food.) In order to become the dye, two additional things are necessary; an enzyme called purpurase which is also present in the snail, and air. The enzyme decomposes quickly after the snail dies, so the dye must be extracted and exposed to air while the snail is alive or shortly after its death. This accords well with the sugya in Shabbos (75a) which discusses whether breaking open a chilazon and extracting its dye should make one liable for the trangression of taking a life on Shabbos, since killing the snail is actually detrimental to the dyeing process.

דכמה דאית ביה נשמה - טפי ניחא ליה, כי היכי דליציל ציבעיה.

The more life it has, the more it pleases, so that the dye will be clear.

Mareh Sheni in Dyeing Techeiles

The Gemara (Menachos 42b) cites a *machlokes*:

טעימה פסולה משום שנאמר (שמות כח, לא) כליל תכלת דברי ר׳ חנינא בן גמליאל רבי יוחנן בן דהבאי אומר אפילו מראה שני שבה כשר משום שנאמר (ויקרא יד, ד) ושני תולעת

Dye used for a test is disqualified since it is written: kelil techeiles (completely techeiles). Theseare the words of R' Chanina Ben Gamliel. R' Yochanan Ben Dahavai says: even the second appearance (mareh sheni) is fit, since it is written: and a thread of red (shani) wool.

RABBI SHIMON BAR YOCHAI SAID:

Anyone who is diligent in this mitzvah of tzitzis merits receiving the Shechinah (Divine Presence)

MENACHOS 43B

R' Chanina ben Gamliel's opinion was accepted by the Amoraim, as can be seen by R' Shmuel bar R' Yehuda's description of the dyeing process on that same daf and as brought down by the Rambam (Hilchos Tzitzis 2:3). The Rambam explains the reasoning behind this ruling as a question of intention – צביעה לשמה – and by dipping wool in the vat to test the dye's quality as opposed to dipping wool for the sake of dyeing Techeiles for a mitzvah, one invalidates the entire vat. According to this understanding, if one were to dye a batch of wool with the proper intention there would be no problem with dipping a second batch of wool into the same vat, since nothing had been done which would invalidate the remaining dye. Tosafos say this explicitly,

דאפילו מאה פעמים לשמו משמע דכשר... אבל כשטעם הרי יש צבע שאינו ראוי לתכלת ולכך קרוי מראה שני (תוספות מנחות מב: ד״ה משום)

Even if one dyed a hundred times [in the same vat, each time] with the proper intention, it would apparently be acceptable... But if one tested [the dye], that would result in dye that is unfit for Techeiles, and therefore it is called "mareh sheni".

Rashi formulates a different opinion:

משום שנאמר כליל תכלת – כל תכלת בעינן (כליל) שיהא כל עיקר מראה החלזון בצמר שלא יהא דבר אחר צבוע בה מתחילתה (רש״י מנחות מב: ד״ה משום)

Since (the Torah) states "completely techeiles"– All-techeiles is required (kelil). Such that there be the entire essential part of the appearance of the [dye obtained from the] chillazon within the wool, that nothing else shall be dyed with it beforehand.

Rashi seems to be clear in stating that dipping a second batch of wool in the dye vat would be considered Mareh Sheni and that would be pasul

(Tosafos explicitly state that this is Rashi's opinion). R' Gershon Henoch Leiner of Radzyn, however, argues that the only possible understanding of Rashi's requirement – כל עיקר מראה – must relate to the strength of the dye color. The problem is a physical deficiency in the appearance of the dye (חסרון ממשות מראה הצבע) and "thus when something else has been dyed in it (the vat) beforehand, the potency of the dye (color) is weakened".[1] Drawing on his own experience in dyeing, the Radzyner Rebbe writes:

בצבע חמה נראה בחוש שאינו מושך וקולט הצבע בפעם הראשונה ואפילו בפעם שניה ושלישית צובעת במראה יפה וחזקה כפעם ראשונה ולא הוכהה מראיתה כלל ואיך שייך לומר דלא הוי כליל תכלת?

With a hot dye (vat) we see empirically that the first batch (of wool) does not absorb (all the dye), and even the second and third times the wool obtains as beautiful and fast an appearance as the first time, and does not look lighter in any way. How is it possible to say (regarding the second and third batches) that this is not kelil techeiles?[2]

Based on this reasoning, the Radzyner paskens that it is permissible to dye multiple times in the same dye vat as long as all immersions of the wool are done לשמה, to meet the requirement of the Rambam and Tosafos, and the dye color remains strong and beautiful (to meet Rashi's requirement of כל עיקר מראה). To this day, Radzyn dyers (who still use the dye obtained from the cuttlefish), follow R' Gershon Henoch's psak halacha and dip multiple times in the same vat.

R' Eliyahu Tavger suggested another way to understand Rashi's opinion, namely that the first wool dipped into the dye vat carries an enhanced quality in terms of prestige and not merely in terms of dye strength. Only the first dip is worthy, similar to the olive oil for the Menorah, the bikkurim, and the first-born. Techeiles, as the most precious of dyes, is meant to elicit a sense of eminence and nobility, the aspect of Malchut (as Mordechai's Techeiles is described Megillat Esther 6:8). One can suggest that this idea is in fact alluded to by R' Chanina ben Gamliel's drasha from the text, basing it on the words kelil techeiles. The word kelil in context means fully, completely. But in Mishnaic parlance, the word had a second meaning, as in the phrase from the Shabbat Amidah, כליל תפארת בראשו נתת – "a crown of glory You placed on his head" – hinting that the dyeing must adhere to the highest standards befitting a king. Rashi's words – כל עיקר מראה החלזון – are understood to mean the full potential of the chillazon, since anything less would diminish the dye's stature.[3]

Based on Rav Tavger's interpretation, we at **Ptil Tekhelet** adopt a stringent position and uses each dye vat only once for one batch of wool. A further stringency held by Ptil Tekhelet is based on the same reasoning. Only tufts of wool or fine threads are dyed in the techeiles vat, but not fully 8-fold plied strings (after *shezira*). The tightly wound strings do not fully absorb the dye throughout, and a core of white remains. This could be a violation of *kelil techeiles* on two counts. Firstly, understanding *kelil* as 'completely', the techeiles dye does not permeate the string thoroughly. Secondly, following the notion of techeiles as representing the highest level of prestige, such strings would certainly be considered inferior. One might be tempted to call them techeiles-plated, and indeed, such strings could hardly be described as fit for a king.

1 פתיל תכלת, דף עו במהדורת ספרי קודש מישור 1990
2 Ibid, דף עז
3 Rav Tavger sees this idea in the Rambam as well, who chooses the word "pagum" to describe the vat contaminated by teimah. See פירוש לפרק ב מהלכות ציצית לרמב"ם, הרב אליהו טבגר, והיה לכם לציצית - קונטרס בענייני התכלת, שנה שתים עשרה, פתיל תכלת

Unearthed at the archeological dig on Har Tzion in Jerusalem, this specimen dates from the first century C.E. – the years before the churban Bayis Sheni (destruction of the Second Temple). The area has been identified as the houses where the Kohanim lived. A few dozen Murex trunculus shells were found.

Rav Achai's Dilemma

The Gemara (Menachos 43a) tells of the strange results of some chemical tests to determine the authenticity of some techeiles strings in the days of Rav Achai.

מר ממשכי אייתי תכלתא בשני רב אחאי, בדקוה בדרב יצחק בריה דרב יהודה ואיפרד חזותיה, בדרב אדא ואישתנאי למעליותא, סבר למיפסלה. אמר להו רב אחאי: אלא הא לא תכילתא היא ולא קלא אילן היא.

Mar from Mashkhei brought sky-blue wool in the time of Rav Achai. They tested it in the manner described by Rav Yitzhak, son of Rav Yehuda, and its color faded. They then tested it in the manner described by Rav Adda and the color changed for the better. They thought to deem the wool unfit [because it did not pass the first test]. Rav Achai said to them: But how could it be that this wool is not techeiles, [as it failed one of the tests], and is also not kala ilan [as it passed the other]?

In ancient times there were only two sources that could produce a sky-blue dye, techeiles, which came from a sea-snail, and Kala Ilan which was derived from a plant (and is identified with indigo – see previous article). The two produced virtually identical colors – indistinguishable to the naked eye – and so Chazal proposed two different chemical tests to try and determine if a string was authentic techeiles based on the theory that snail-techeiles was a more durable dye than its vegetable counterpart, Kala Ilan. Rav Achai was surprised when the two tests unexpectedly gave differing results, the strings "failed" the first but "passed" the second. Ultimately, the Gemara explains that they are not two different tests, but rather, are two stages of a procedure.

Rav Achai's words imply that there could be no third option for the blue strings before him, either they were dyed with techeiles or with Kala Ilan. That assumption is borne out by the archeological record we have of that period. Fabrics generally don't last very long; it is rare to find any more than a few hundred years old, let alone thousands of years. For a textile to last that long it requires very special environmental conditions, the kind that just happened to be found in the Judean Desert along the Dead Sea, and many of the oldest surviving fabrics have been found there.

The three pictures here show fabrics dating back to the end of the Second Temple period through the first and second century – the times of the Tanaim. The first picture is of a fabric from King Herod's palace at Masada. The second is a scrap of cloth found not far from there, in a cave that was used as a hideout by Bar Kochba's soldiers. Both of those fragments contain blue threads dyed from murex snails. The third picture shows a cloth from the same time period, found in Ein Rachel in the Arava Desert, but that was dyed with plant-based indigo. No blue-dyed fabric from that period has ever been found that came from a source other than the murex or the indigo plant. Historians, archeologists and scientists do not believe there were or could have been any third source for blue dyes, precisely as Rav Achai maintained.

Although in ancient times it was difficult to distinguish between techeiles and Kala Ilan, modern chemical analysis tools are sensitive enough to detect the very low concentrations of trace molecules that exist only in samples from one source as opposed to the other. This allows researchers to unequivocally determine if a blue thread was colored with murex-dye, and even to determine the exact species of murex.

Wool – Murex-dyed | Masada, Israel | First century BCE-first century CE

PHOTO BY CLARA AMIT, COURTESY OF THE ISRAEL ANTIQUITIES

Wool – Murex-dyed | Murabba'at Caves, Israel | The Bar Kokhba Revolt, 132-136 CE

PHOTO BY CLARA AMIT, COURTESY OF THE ISRAEL ANTIQUITIES

Wool – Indigo-dyed | Ein Rachel, Israel | First century BCE-first century CE

PHOTO BY CLARA AMIT, COURTESY OF THE ISRAEL ANTIQUITIES

The beautiful coin of Tyre (above) shows the eagle representing the Roman government, and between its legs is the valuable Murex shell.

The Coins of Techeiles

Dr. Ari Greenspan

During the 3rd century the Roman government severely restricted the wearing of techeiles and argaman, and use of these colors was limited to the ruling class. At some point, this most expensive of dyes became worth a fortune, as the Gemara states, "therefore [Techeiles] is expensive" (Menachos, 44a).

Most techeiles and argaman came from the coast of northern Israel and Lebanon, and we are told in the Gemara that the snails are found from "Haifa to the ladders of Tyre" (Shabbos 26a).

Tyre was also renowned for being the most important Roman coin mint east of Rome. So unadulterated was the silver of Tyre, and of such high quality were its coins, that Chazal tell us that for any mitzvos aseh that requires money, the coin to use is the "Tyrian Shekel" (Kiddushin, 11a). The Tyrian Shekel was widely used throughout the entire Roman Empire; it was the dollar of its day. It is no wonder that for a period of 70 years or so, these coins were used to publicize the most important commodity and industry of the city – the famous dyes of techeiles and argaman.

Numerous coins with a predominantly depicted Murex shell, the ancient source of the dyes, have been discovered.

Perhaps the most interesting intersection of these elements is the following elusive story (Sanhedrin, 12a):

והא שלחו ליה לרבא: זוג בא מרקת, ותפשו נשר, ובידם דברים הנעשה בלוז, ומאי ניהו - תכלת, בזכות הרחמים ובזכותם יצאו בשלום.

"It was sent to Rava: a pair came from Reket, the eagle caught them, and in their hands they had things made in Luz. What were they? Techeiles, by the mercy of heaven and their merits they escaped in peace."

Two people came to Rava who was in Bavel. They had items made in Luz, a city known for its techeiles manufacture (Sota, 46b). Reket is the city of Teveria, the seat of the Sanhedrin in those days. Some suggest that these two individuals were shluchei sanhedrin trying to smuggle techeiles into Bavel for mitzvas tzitzis. The eagle is the symbol of Rome, and as Rashi says, Roman soldiers caught them. A great miracle happened and they were released and made their way successfully to Bavel.

Techeiles... A Seal of Gold

(MENACHOS 43B)

Just as a slave is sealed with the sign of his master, and as a lover adorns a symbol and reminder of the love, so we carry the tzitzis of techeiles, the royal thread which resembles the Kisei Hakavod, as a symbol of our connection to Hashem.

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