

36010 Tyrian purple

Tyrian purple was one of the most costly organic coloring matters of the ancients. It was prepared from several mollusks or whelks, including *Murex brandaris* and *Purpura haemostoma*, which are found on the shores of the Mediterranean and Atlantic coasts. Huge quantities of these mollusks were used for dyeing fabrics in classical times.

We produce Tyrian purple from the shellfish, *Purpura Lapillus*, which excretes the fluid from which the dye is won. Traditionally marking the dress of emperors, kings and chief magistrates, 1 gram of this dye is made from the secretion of 10,000 of these large sea snails.

This purple color is remarkably stable, resisting alkalis, soap, and most acids. It is insoluble in most organic solvents.

Tyrian purple was used in the preparation of a purple ink and in dyeing parchments upon which the codices of Byzantium were written. Whelks that produce the purple dye, are also found on the coasts of the British Isles, and they furnished the purple color for some of the early English, Irish and French manuscripts (Thompson).

The color went out of use about the 8th century, though it may have been used occasionally up until the 11th century.

Excerpts from: *Painting Materials* by Rutherford J. Gettens and George L. Stout

The History of Tekhelet, from Biblical to Roman Times

(we received the following information from Dr. Ari Greenspan, from www.tekhelet.com on June 05 2002)

Tekhelet

The history of color is as old as mankind. In the ancient world especially, colors and dyes were of paramount importance, both socially and economically. Three colors in particular - *tekhelet* (blue), *argaman* (purple), and *tolaat shani* (scarlet) -- were derived from living creatures in the eastern Mediterranean, and formed the basis of a major industry in this part of the world for well over 3000 years. The beautiful shades and permanence of these three dyes, in contrast to other existing plant-derived dyes, made them very desirable. Over time, possibly because of the high prices they demanded, these dyes became associated with the clothing of kings, caesars, and religious figures and hence, symbolic of leadership in general.

The dye that has left the richest record of its use in Eretz Yisrael and the surrounding region, is *tekhelet*. The questions of what exactly *tekhelet* is, why, when and how it was used and made, as well as how and why it disappeared will all be addressed in this paper.

The earliest references to *tekhelet* are in cuneiform tablets. A tablet from Ugarit (present-day Syria) which is dated to about 3500 years ago records the amount of "*takiltu*" i.e. blue wool, owed to a merchant. Recently discovered in the British Museum is a Babylonian tablet from the seventh century BCE that contains the earliest known instructions for dyeing wool with the colors "*takiltu*" and "*argamantu*".

In the biblical story of Joseph and his precious coat of many colors, we get our first inkling of the importance of color in the time of the bible. There are a multitude of biblical references to dyed cloths, and especially *tekhelet*. The Tabernacle and its vessels were covered with ornate cloths of *tekhelet*, *argaman*, and *tolaat shani*. Every Jew is commanded to wear a thread of *tekhelet*-colored wool on the corner of his garment, perhaps in order to instill a sense of grandeur in the simple believer, or as a constant reminder that he belongs to "a nation of kings and priests". [FOOTNOTE THIS REFERENCE]. The blue strand was tied together with strands of white wool to form "*tzitzit*", or ritual fringes.

According to Jewish tradition, the *tekhelet* dye is derived from a snail found on the Mediterranean coast, in the portion of land allotted to the tribe of Zebulun:

"Zebulun complained before the Holy One Blessed Be He: Lord of the Universes, to my brothers you have given fields and vineyards, but to me you have given mountains and hills. To my brothers you have given lands, but to me you have given seas and rivers"

God answered: They [your brothers] will need you, for the blessing of the tribe of Zebulun is "... those things buried in the sand". Rabbi Yosef taught, "those things buried" refers to the snails of *tekhelet*.

Tekhelet and *argaman* are enumerated among the booty captured in battle in the Book of Judges -- together with gold, silver and copper, indicating again the great value of these dyes. In a similar vein, when King Hizkiyahu had to pay obeisance to King Sennacherib in order to save himself and Jerusalem, the precious gifts he offered included *takiltu* and *argamannu*. The Book of Esther relates that as a reward for saving the king's life, Mordechai was publicly arrayed in the royal clothing of King Ahasereus, described as *tekhelet* and *argaman*. [FOOTNOTE Esther 8:15]

In fact, the entire region may have gotten its' name from the well-developed dye industry which once flourished here. In Akkadian, the word "Canaan" can be translated as "purple". According to this translation, the land in its earliest period was known for its most precious and prized item, purple dye, and so was called "the land of purple", or Canaan. The traditional Jewish commentators translate Canaan differently, to mean "merchants". It is possible that both translations relate to the same fact - that is, the Caananites' reputation as merchants of purple-dyed cloth. It is further interesting to note that *Phoinix* also means purple. In a later period, the Phoenicians, who spoke a different language but relied on the same industry, continued to call their country "the land of purple", or Phoenicia.

Where exactly did these dyes come from? The Talmud tells of an old man near Achziv, on the northern Israeli coast, who was asked, "What is your profession?" and answered "I am a *tekhelet* snail fisherman". Elsewhere, the Talmud relates that the dye-producing snails are found "between the cliffs of Haifa and Tyre". Israel had an active dye industry from the early Roman period through to the end of the Byzantine era.

The snail fishing was very plentiful on the coast of northern Israel and Lebanon, and eventually the Phoenicians, centered in the city of Tyre, became highly skilled in the production of *tekhelet* and *argaman*. With time, the prestigious dye industry became almost exclusively associated with Phoenicia.

Tyre's involvement in the industry is documented as early as about 970 BCE, when King Hiram and King Solomon signed a trade agreement. King Solomon dispatched ten thousand workers a month to Lebanon, in order to transport the supplies needed to build the temple in Jerusalem. King Hiram sent "vessels of gold and silver and sea-purple garments and many kinds of spices". King Hiram also supplied King Solomon with a skilled Tyrian artisan to help decorate the temple. The Book of Chronicles relates that this artisan, the son of a woman from the tribe of Dan and a man from Tyre, was an expert in working with gold, silver, bronze, iron, wood, stone, *argaman*, and *tekhelet*.

Josephus, in his praise of the unrivaled swiftness of Solomon's horses writes that:

"A further adornment for them (the horses) were their riders who, in the first flower of youth that was most delightful to see and of conspicuous height, were much taller than other men. They let their hair hang down to a very great length and were dressed in tunics of Tyrian purple".

Remnants of dye works and enormous accumulations of discarded snail shells, indicating the presence of a major industry, have been found in both Tyre and Sidon. The snail remains found in all of the archeological sites are from the Murexidae family, commonly referred to as the Murex family. The specific snails used were the *Murex trunculus*, *Murex brandaris*, and *Purpura hemastoma*. Both *tekhelet* and *argaman* were manufactured from these snails' extracts.

Evidence of the ancient dyeing industry - in the form of mounds of broken Murex shells and remains of the dye extract -- have also been uncovered in numerous other archeological sites along the Mediterranean. The Tyrians were sailors and businessmen who they set up colonies across the Mediterranean basin. Their most important colony was the city of Carthage. And again, heaps of broken Murex shells meters high bear witness to the dyeing center that flourished there. Some scholars have even suggested that the Tyrians' main motivation to search out new colonies was their desire to dominate the dye industry.

The Philistines may have had similar aspirations. When Sisro the Philistine general failed to return home from his war with the Jews, his mother became concerned. Although she feared that he might be dead -- which indeed he was, having been murdered by Yael with a tent peg -- Sisro's mother comforted herself with the thought that possibly his army had been delayed collecting the spoils of war, described as "colored woven cloth." Might not the entire war have been waged to control the dye works in northern Israel?

The dyeing industry was notorious for its' unpleasant by-product. In [DATES?] Strabo describes Tyre as having a very foul smell even though, he explains, the factories were not near living areas. Pliny asks "what is the cause of prices paid for purple shells, which have an unhealthy odor when used for dye?". The dyeing process, which involved exposing the dead snail extract to heat and chemicals and then letting the concoction ferment, was very malodorous. Modern attempts to re-enact the dyeing process have established that it remains as foul-smelling to modern noses as it did to ancient ones.

Coins of Tyre

Another fascinating connection between *tekhelet*, *argaman* and the city of Tyre, is the appearance of the Murex snail as a symbol of the city, on tens of Tyrian coins over a period of close to 650 years. The Tyrian mint was among the earliest and most important in the Greco-Roman world, and the snail icon served as a powerful publicity tool for the extensive dye works of Tyre.

It appears that the first coins minted in Tyre were small silver coins produced circa the year 450 BCE. The theme most commonly portrayed on those early coins is that of the ocean replete with dolphins riding the waves, and a prominently displayed Murex shell.

From the time of Emperor Caracala, 211 CE, through Galineus, 268 CE, the Murex shell was an almost constant feature of the Tyrian coins. The legend of the discovery of *tekhelet* and *argaman* was also a favorite of the Tyrian mint. According to legend, Hercules, the son of Zeus, had a dog. One day, this dog was frolicking in the ocean, foraging about for food. When the dog emerged from the ocean, his lips were colored bright purple from the snails he had consumed, and thus was the secret source of the beautiful dyes revealed to mankind.

Several hoards of these coins have been found in Israel, testifying to the widespread usage of Tyrian coins. The commercial relationship between Jerusalem and Tyre was intimate and of long duration. During the early years of the Second Temple, the prophet Nehemiah lamented the fact that Jews were doing business on the Sabbath in Jerusalem, and that:

"The Tyrians sit within it and bring fish and other items and sell them on the Sabbath to the children of Judah and Jerusalem"

So qualitative was the mint and so consistent was the silver content, that the Rabbis of the Talmud decreed that all obligatory payments prescribed by the Torah must be paid with Tyrian money. And so, the shekels brought to the Temple yearly from around the world were from the Tyrian mint despite the fact that many of these coins featured the face of Melkart, the god of Tyre on them. This presented an obvious problem, as it blatantly violated the Jewish laws against graven images and idol worship.

Why was it that the Rabbis not only permitted the use of the problematic Tyrian coins, but actually *required* that they be brought to the Temple? The answer lies in the need for exact amounts of silver to properly fulfill the biblical commandments. Over the course of time, most mints devalue their money by gradually changing the metal content - that is, for any specific coin minted, the amount of precious metal which was used in the original mint will slowly be decreased, and replaced by a higher percentage of cheaper metals.

The shekel is a weight measurement. If a so-called shekel coin has less than a shekel's weight of silver in it due to devaluation, it is no longer valid for use in the Temple. The Tyrian coins had an unparalleled 92% silver content for over 180 years, which is why they became the standard for Jewish ritual use.

The Role of Argaman in the Roman Empire

In later Roman times (DATES? ARISTOTLE) the value of colored cloth reached ten to twenty times its weight in gold. Pliny speaks of the “mad lust for purple”, and reports that “the best Asiatic purple comes from Tyre”. The dyed purple cloth became the royal garment of Rome:

“The official rods and axes of Rome [i.e. leaders -ed.] clear it a path, and it also marks the honorable estate of boyhood; it distinguishes the senate from the knighthood, it is called in to secure the favor of the gods, and it adds radiance to every garment, while in a triumphal robe it is blended with gold.”

By the fifth century heavy restrictions were laid down on the production and ownership of purple dyed garments.

“All persons of whatsoever sex, rank, skill, profession or family shall abstain from possession of that kind of material which is dedicated only to the Emperor and to His household...Garments of all purple must be surrendered to the Treasury and must be immediately offered.” (January 16, 424).

The Roman aristocracy was concerned about the possibility of fraud, and so another edict was issued:

“We command that every sixth man from the bureau of secretaries...shall be sent to the dye works of Phoenicia for a fixed period of time, so that by the astuteness of these officials all fraud may be prevented” (March 8, 436)

As late as the tenth century the emperor of the Byzantine Empire is referred to as Constantine VII porphyrogenitus, “born to the purple”.

The custom of reserving purple clothes exclusively for leadership continued well into the Middle Ages. Nachmanides, circa ??, comments “Even today no man would dare wear *tekhelet* - except the king of the Gentiles” [FOOTNOTE: Torah Commentary on Numbers 28:2]. Nachmanides seems to have been referring here to the Pope. Chemical analysis of papal robes from the Middle Ages [WHICH POPE? GOT ANY DATES? WHERE HAVE THESE RESULTS BEEN PUBLISHED?] reveals that they were indeed dyed using extracts from the Murex snail.

Tekhelet in Jewish Tradition

The Torah commands “you shall put on the fringes on the corner of your garment a blue (*tekhelet*) thread”. The Rabbis commented, “*tekhelet* is wool” i.e. the halachic definition of *tekhelet* is blue-dyed wool. Maimonides qualified that the wool must be permanently dyed, in a blue “the color of the sky.”

The dyed wool, so prized and expensive in the secular world, was no less so when needed for ritual use. The Talmud explained, “It (the snail) comes up once every seventy years, therefore it is expensive”. Clearly, the extensive Mediterranean dyeing industry could not have been built around a rare resource that surfaced only once every seventy years! The Talmud frequently uses the number seventy as a kind of stylized exaggeration, a non-literal expression meaning “a lot” or “many”. Here, the metaphor is meant to describe the relative rarity of the snails, coupled with the need for large numbers of them, which resulted in the high cost of *tekhelet*.

Possibly due to price considerations, an imitation dye of plant origin, Kala Ilan, was produced, that was practically indistinguishable from *tekhelet*. Kala Ilan is translated by the Aruch, an 11th century dictionary of the Talmud, as “Indiko” i.e. the indigo or woad plant, which has been in use for close to 5000 years and yields an exceptionally permanent dye. There are ancient Egyptian textiles extant today which still sport their original indigo coloring, clearly visible to the naked eye.

The imitation dye was so similar to the original that the Talmud relates that just as only God was able to distinguish between the firstborn Egyptian and Jewish babies, so only He can discern “who places Kala Ilan on his garment and calls it *tekhelet*”. The Rabbis cautioned their students to “only buy *tekhelet* from an expert” as a way of ensuring its authenticity. They further recommended using 40-day-old urine (i.e. the reducing agent ammonia) as part of a chemical test to see if the false color diminishes.

The Dyeing Process

How exactly were *tekhelet* and *argaman* produced?

Pliny relates that "The Murex...has the famous flower of purple, sought after for dyeing robes, in the middle of its throat. Here there is a white vein of very scanty fluid from which that precious dye, suffused with a dark rose color, is drained". And, "people strive to catch this fish alive because it discharges its juice with its life". [FOOTNOTE: "fish" is used here as a general term, referring to all sea creatures] The Talmud also states that "when it is alive it is better, so that the color will be good".

In other words, after the Murex snail was captured and broken open, the hypobranchial gland that holds the dye was removed from the snail while it was still alive. The liquid retrieved from the snail looks fairly innocuous; it is clear and colorless. But in a chemical process initiated by oxygen and sped up by light, the fluid undergoes an enzymatic reaction that causes a spectacular color transformation. The clear liquid, after passing through various shades of yellow, green, aqua, and blue, dramatically turns a deep dark purple, consonant with the "dark rose color" mentioned by Pliny, and the "blood of purple hue" mentioned by Homer.

Rabbi Meir of the Talmud used to say, "Why is *tekhelet* different from all other colors? Because *tekhelet* is similar to the sea, and the sea is similar to the sky and the sky is similar to God's throne". This statement is ubiquitous in the Talmud; it appears eight separate times, each time modified by the addition of another color - "similar to the grass", "similar to the sapphire", and even "similar to the colors of the rainbow".

While many psychological and symbolic interpretations of these passages are possible, one wonders how the entire spectrum could really be used to describe a single shade of blue? Rabbi Meir may have been describing a physical phenomenon familiar to anybody living on the Mediterranean coast in those times i.e. that the color *tekhelet* is derived from the snail whose extract displays all the colors of the rainbow when exposed to the sun.

The molecule of the purple-colored dye (*argaman*) is called dibromoindigo - that is, an indigo molecule with two bromine atoms attached to it. This molecule can form a chemical bond with wool, which is the definition of a permanent color. If no such bond exists, the color will wash out. But in order for a permanent molecular bond to be created, a series of chemical reactions must take place.

In its initial state, the dye is insoluble in water, much like oil is insoluble in water. The process of creating a solution with dibromoindigo is called reduction, and reduction can only happen if the water is basic, and not neutral or acidic. The dyer must first create a basic environment before he can reduce the dye. Maimonides lists several chemicals which were routinely added to the dye mixture, including a very basic plant called kimoria, and limestone, a strong base.

Once a basic environment has been created, the reduction can be accomplished in a number of ways. Pliny writes that heat and urine were used in the process. Old urine is ammonia, a potent reducing agent. Methyl mercaptan, a by-product of the enzymatic color transformation process, is a reducing agent, too. In other words, there is a reducing agent built into the snail itself. Methyl mercaptan is responsible for the terrible odor of the dyeing process mentioned previously.

Whatever method is used, something surprising happens when the dye is reduced - it becomes clear and colorless again, due to lack of oxygen in the solution. The wool is then placed in the clear solution and allowed to absorb the clear liquid. Once the wool is removed from the dyeing vat and exposed to air, the absorbed dye slowly re-oxygenates and, almost magically, a deep purple color materializes on the wool.

One major puzzle remains, though. Namely, this method of extracting dye from the Murex snail yields only purple dye, or *argaman*. What of the blue *tekhelet* mentioned in Jewish sources? Somehow, this knowledge was lost for centuries, not to be recovered until a chance laboratory accident in the 1970's.

Loss and Rediscovery

How were the identity of the *tekhelet*-producing snail and knowledge of the dyeing process lost to the Jewish People? Essentially, the destruction of the Second Temple and the resulting exile meant that, within a century or two, the majority of Jews were living in Babylon. They no longer had access to the Mediterranean or to the Murex snails that live in it. And so, it seems that with time they lost the technical expertise required to manufacture the dye. Around when did this knowledge disappear?



PIGMENTE

“Abaye said to Rav Shmuel bar Yehuda: That *tekhelet*, how do you dye it? He answered: You bring the blood of the *chilazon* (snail) and chemicals and you put it in a vat and boil it”

Rav Shmuel bar Yehuda’s familiarity with details of the dyeing process would seem to indicate that at least some Jews still had access to *tekhelet* at this period in time. This particular conversation can be dated fairly accurately -- Rav Shmuel bar Yehuda emigrated to Babylon around 337 CE, and Abaye died in 338 CE. The Talmud also tells us that Mar of Mashki brought *tekhelet* in the time of Rav Achai (d. 506 CE). Apparently at this late date it was still possible to purchase *tekhelet* imported from Israel - although it must have been a rare occurrence, as it was noteworthy enough to be singled out for mention. It is possible that by this time, imperial edicts prohibited trading in *tekhelet*. The Talmud relates:

“A pair (of people) came from Reket (Tiberias) and the eagle (Roman soldiers) caught them, and they had in their hands items made in Luz, but by the virtue of God’s mercy and their own merits, they escaped safely”

What was this city of Luz, and what items came from there?

“This is the same Luz where *tekhelet* is dyed, it is the same Luz whose inhabitants Sennacherib could not deport, which Nebuchadnezer could not destroy, nor can the Angel of Death pass through it. However, when the old men and women of the city grow weary of life, they go out of the walls of the city and die”

It seems that in the Tanaitic age this city was regarded as a sort of terrestrial paradise, a Forbidden City to the Angel of Death. What idea were the Rabbis trying to express with the tale of Luz? I would like to suggest that they are praising a group of people that were willing to endanger themselves in order to fulfill, and help others fulfill, the mitzvah (commandment) of wearing *tzitzit* with *tekhelet*. Even during a time when edicts prohibited the use of royal blue outside of the imperial house, the violation of which resulted in military action against those caught with *tekhelet* in their possession, these brave people continued a tradition of dyeing going back to the time of Sennacherib. The Rabbis suggest that as a result of their righteousness, the residents of Luz were granted immunity from punishment, and even immortality.

Nowhere in the Talmud (redaction approximately 570 CE) is there any indication that the practice of using *tekhelet* had been discontinued, yet the Sheiltot de Rab Achai, a book on ritual practice circa 760 CE, makes no mention of its use. In the first century or two of the last millenium, statements begin to appear to the effect that “we have no *tekhelet* in the present day” or “and for many days we have not heard of anyone who has merited to wear *tekhelet* on his garment.” Yet seeds of hope were planted by Rabbi David ben Zamra (b. 1423), who wrote, “It is possible that the species is still to be found, but it is not known how it can be fished.”

In 1683, William of Cole, on a sea mission to uncover the secrets of nature for the Phil. Society of Oxford, claimed to have found the "purple fish", a snail producing the color. He wrote in his report, "There is no doubt but that it is a species of that kind...the best of all were found in the Tyrian seas near that Island on which that renowned city of Tyre was built, now called Sur." William hoped to perform a dyeing demonstration before His Royal Majesty but "a stop was put to this by a calamity too great and too public to mention." -- that is, the murder of the King by Oliver Cromwell .

In the late 19th century, Rabbi Gershon Chanoch Henoah Liener, the scion of the Chasidic Radziner dynasty, set off across Europe in an attempt to find the source of the lost *tekhelet*. In a series of three brilliant books, Rav Liener proceeded to organize all of the Jewish sources on *tekhelet* in a truly comprehensive manner, and publish his own findings. In a seaquarium in Naples in 1888, he found what he thought to be the source of the lost dye. He identified the elusive snail as *sepia officianalis*, an animal better known as the squid.

Rabbi Liener announced to religious Jewry that he had rediscovered the source of *tekhelet*, and after some initial difficulty with the actual dyeing, he produced 10,000 sets of *tzitzit* as gifts for his followers on the first day of Chanuka, 1889. The vast majority of rabbinical authorities did not accept Rabbi Liener’s thesis as correct, and it soon became a highly charged and emotional conflict. A book condemning the Radziner *tekhelet* was published in 1901 It was called “Ptil *Tekhelet*”and vociferously attacked the usage of the religious innovation. As part of his cynical approach , he referred to the new *tekhelet* as “psil *tekhelet*”or “invalid *tekhelet*”, a clever play on words with the biblical phrase “psil *tekhelet*”, a “string of *tekhelet*”.



PIGMENTE

The modern scientific rediscovery of the Murex as a source of dye is due to a chance meeting between French zoologist Lucaze-Duthiers and a local fisherman off the coast of Italy. Lucaze-Duthiers noticed the fisherman painting his shirt with the yellow juice of a freshly broken snail, and saw that the stain soon turned a reddish-purple color. Through subsequent study, he found that three mollusks in the Murex family were the source of the ancient dyes. In 1909, German chemist Paul Friedlander discovered that the chemical structure of the dye extracted from the snail is dibromoindigo.

Rabbi Issac Halevi Herzog, who later became the first Chief Rabbi of the State of Israel, wrote his doctoral thesis on the topic of *tekhelet* in 1913, and coined the term "Hebrew Porphorology" for its title. While trying to recover the lost source of *tekhelet* after almost two thousand years, Rabbi Herzog was forced, contrary to the evidence of his research, to reluctantly propose the less likely *Janthina* mollusk as the source of *tekhelet* because the Murex, a more likely candidate, seemed to produce only a purple dye.

Professor Otto Elsner, of the Shenkar Institute in Tel Aviv, accidentally re-discovered the secret of *tekhelet* in the early 1970's. One day while dyeing, he unintentionally left the reduced solution of dibromoindigo sitting in the sunshine for a few minutes before immersing the wool in it. Unbeknownst to him - or anyone else at that time-- the dye solution is susceptible to the sun's radiation. The sun causes the bond between the bromine atoms and the indigo molecule to break down, leaving only indigo active in the solution. Professor Elsner placed his wool into the colorless solution as usual, but when he pulled it out into the air and waited for the usual purple color to appear, he was amazed to see a vibrant blue shining on the wool instead. The serendipity of his discovery has reawakened our understanding of how *tekhelet* was produced.

Since the early 1990's there has been a rekindling of interest in reintroducing the use of the original *tekhelet* string in the tzitzit worn by all Jews. A group called Ptil Tekhelet was formed in order to do just that. Today, murex is collected in various ports around the Mediterranean and the dying of the strings is once again being done in Israel as it was done 2000 years ago.