

A Modern Miracle – Rediscovery of “Blue” Dye for Tallit Tassels



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Do you believe in miracles? Over twelve hundred years ago, the sea-snail that was used for dyeing the tassels of *tallit* prayer shawls was declared extinct. Modern scientific research has now rediscovered the elusive shellfish off the shores of Haifa, Israel.

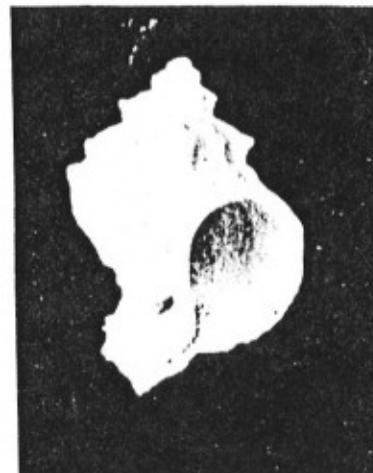
Nowadays only white *tzitzit* tassels are knotted to the corners of the *tallit*. In ancient Israel some of the cords on the *tzitzit* were dyed a blue-purple shade to contrast with the white cords. This arrangement was useful as a primitive indication of the time for reciting morning prayers, which was permitted as soon as one could distinguish between the colored and the white cords. The original biblical commandment is, in fact, still recited twice daily in our prayers as part of the *Shema*: “And the Eternal spoke unto Moses saying, Speak unto the children of Israel, and say unto them that make them a tassel on the borders of their garments, throughout their generations, and that they put upon the tassels of the borders a cord of blue-purple...”

In the original Hebrew text, this “blue-purple” is *tekhelet*, a dyed wool that was among the most precious treasures of the Near East in antiquity. It was manufactured by the Phoenicians using a special sea-snail that they fished in the shallow off-shore waters of the Mediterranean Sea. This shellfish uniquely yielded the prized textile dye that combined brilliant color with outstanding fastness and stability. The Talmud accordingly prescribes that, if not made from this snail, *tekhelet* is not kosher!

How the Dye Was Lost

When the Arabs conquered the Holy Land in 637 C.E., they destroyed the purple dyeing installations, and the manufacture of *tekhelet* ceased. Before long, the use of colored *tzitzit* had to be abandoned. As time passed, the identity of the special sea-snail was lost, and eventually even the authentic color of *tekhelet* was forgotten.

Scholars who inquired into the origins of purple dyeing began to confuse *tekhelet* with the red purple of antiquity, called Tyrian purple, which was also reputed to have been obtained from shellfish. Tyrian purple was soon identified with the biblical *argaman* dye. The source of *tekhelet* remained one of the fascinating mysteries of classical culture. The many proposals advanced regarding the nature of the dyestuff created much confusion. Was it of animal or vegetable origin? Colors mooted were green, violet, turquoise, yellow, blue and red! Could it have been obtained from worms, murex or cuttlefish, or from larkspur flowers? Was it made from the same murex as Tyrian purple? One Rabbi identified it as a cyanide salt of iron called Prussian blue, and even had his Hassidim dye their *tzitzit* with the synthetic pigment: this mix-up has tended to discredit further attempts to rediscover the elusive *tekhelet*.



Shell of the banded dye-murex,
from which *tekhelet* dye for *tzitzit* is obtained

Scientific Evidence

Travellers and archaeologists have discovered enormous mounds of seashells at the sites around the Mediterranean littoral, where the ancient Phoenicians manufactured purple dyes. Three particular species of snail were found: banded dye-murex, spiny dye-murex and the southern oyster-drill. Could one of these types have been the original source of *tekhelet*? At Sidon, in today's Lebanon, a vast bed of banded dye-murex shells has been identified, all broken open in a characteristic fashion as required for excising the dye-giving gland. Carefully separated from the main pile was a second pile, containing only shells of the other two species. Scholars saw this as an indication of two separate dyeing sites on the very shores where *tekhelet* had been manufactured in Talmudic times. Since banded dye-murex often dyed to a blue-purple while the other two species gave a red-purple, it was considered that the former was the source of *tekhelet* and the latter of *argaman*. However, variability in the shades given by banded dye-murex cast doubt on its designation as the *tekhelet* snail.



What the tzitzit with tekhelet-dyed cords will look like

Chemistry then provided cogent evidence. Red-purple made from spiny dye-murex and southern oyster-drill was analyzed to be a brominated indigo. The same substance is produced by other purple-snails from Britain, America, Japan, and Australia. In contrast, banded dye-murex is unique in giving a mixture of brominated indigo with plain indigo blue, together making a delicate violet that is thereby distinguished from Tyrian purple. An inappropriate technique of developing the dye from the colorless mucus in the hypobranchial glands of banded dye-murex can give different shades of color, exposure to sunlight being particularly conducive in creating the characteristic hue.

It has now been discovered that each of the two constituents of the banded murex dye is associated with the snails' sex: males typically yield plain indigo while the females give brominated indigo. Thus use of an unbalanced ratio of males to females in the dyeing will create a different color. The sex ratio is seasonal, males predominating in early spring and females in summer. Moreover, wool has a greater affinity for brominated indigo than for plain indigo: thus the first dyeing may give a different shade from a second batch of wool treated in the same dye bath. This, incidentally, may explain the Talmudic ruling that the fibers test dyed in a new dye bath are not kosher for *tzitzit*.

Key Archeological Discoveries

Careful chemical analysis of dyes found in archaeological artifacts has now corroborated the banded dye-murex hypothesis of the source of *tekhelet*. A shroud fragment from fourth century Palmyra, Syria, was found to contain bluish violet wool yarn dyed with the unique mixture of brominated and plain indigotins that can nowadays be prepared from banded dye-murex. The same analytical result has now been reported in London's British Museum, for two 2000-year-old textile fragments from Enkomi, Cyprus. The same pigment mixture was also identified in a woolen fragment from the seventh century that was excavated at Ein Boqeq near Israel's Dead Sea.

Thus far, these four independent pieces of evidence of antique *tekhelet* dyeing with banded dye-murex have been uncovered. Archaeologists and curators are hopeful to find more examples of the ancient dye now that its outstanding stability has been proven. The ultimate verification of the scientific identification of *tekhelet* continues to elude us. Will its characteristic violet dye mixture ever be detected in the tassels of an antique *tallit*? Do the treasures stored in the catacombs beneath the Vatican in Rome conceal this forgotten relic?

Marine Biology Solves Talmudic Riddle

Off the coasts of Israel, Lebanon, and even Italy, hosts of banded dye-murex snails flourish in the shallow waters of the Mediterranean shore. Scientific observation of their ecological behavior has revealed that they are confined to the

water, but only if it is cool enough. Throughout the summer, divers cannot find them on the sea bottom. However, if traps are left overnight, they are full of banded dye-murex in the morning! During daylight they rest burrowed in the sand, but at night they come up to the sea floor to conduct their nocturnal activity. Only during the cold winter can the snails be observed by day.

This peculiar way of life is reflected in the Talmudic description of how to recognize the shellfish for *tekhelet*: its body is fishlike, its color is that of the sea and it only comes up once in seventy years! In other words, only divers can catch them and even then at short infrequent seasons in the spring and autumn, when the cold seas are not too stormy. While the shells are white after cleaning, they are colored turquoise and purple when gathered fresh from the sea, due to biological fouling – the tiny organisms that grow on the shells in the sea. Hence the Talmudic dictum: "Its color is that of the sea"!

Religious R&D

With the mystery of the historic source of *tekhelet* already solved, it is not surprising that enterprising scientists and developers are asking whether the time is not ripe to set up a new dyeing industry for reviving manufacture of the violet cords required for reinstating the biblical commandment of colored corner-tassels on the *tallit*. The obvious location is the Israel Oceanography and Limnology Research Company, located south of Haifa at Shikmona, by the very shores where the ancients gathered banded dye-murex and dyed *tekhelet* and Tyrian purple.

In conjunction with Jerusalem's Israel Fiber Institute, a three-year research and development program has been drawn up for piloting the breeding and raising of *tekhelet* snails in artificial ponds at Shikmona. The project will aim to discover the optimal environmental conditions of temperature, illumination, and so forth, for enhancing the yields of chromogenic mucus. The influence of various diets and nutritive additives on growth and development will be studied. Control of breeding will be investigated.

At the same time, chemical engineering research will be undertaken to develop an industrial process for dyeing *tekhelet*. Israel is fortunate in being able to call upon Professor Otto Elsner of the Shenkar College for Textile Technology and Fashion in Ramat Gan to participate in this venture. He is the foremost scholar engaged in purple dyeing research today.

The Israel Fiber Institute is affiliated with the Israel Ministry of Industry and Trade, and will contribute development of analytical testing of product quality and authenticity, to prevent marketing of synthetic imitations. It was the production of imitation *tekhelet* from plant dyes in Talmudic times that undermined the strict observance of this *mitzva*. The Fiber Institute will also be responsible for coordinating and directing the Tekhelet Program, through its Research Professor, Israel (Irving) Ziderman, a British immigrant who settled in Israel 29 years ago.

He is a foremost authority on antique purple dyes and was invited to contribute learned articles on this subject to the May 1986 issue of *Chemistry in Britain*, published by the Royal Society of Chemistry, and to the 1986 volume of *Review of Progress in Coloration*, published by the Society of Dyers and Colorists.

Rabbinical Sanction

Reintroduction of the *tekhelet* cords as an integral part of the *tallit* will be a revolutionary turning point in Jewish religious practice. The *halakhic* authorities approached have recommended that the revival be brought to the Chief Rabbinate of Israel for formal sanction. Both the Ashkenazic Chief Rabbi A. Shapira and the Sephardic Chief Rabbi M. Eliyahu have determined that the question be submitted to the Chief Rabbinical Council for decision. Observant Jews throughout Israel and the Diaspora await the outcome of these deliberations with pious excitement.

The Tekhelet Foundation

Implementation of the R&D program is now dependent on the donations expected from Jews throughout the world. A group of leading personalities representing various walks of life in the Israeli scene have taken the initiative in establishing the Tekhelet Foundation, whose aim is to sponsor an ambitious program for reintroducing the manufacture of *tekhelet* for religious observance.