# Purple Mania: How a Snail Created the Most Sought After Colour of All Time

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For thousands of years the colour purple has symbolized royalty, wealth, luxury, religious and social status and was the ultimate symbol of power; remaining so today. Names such as "royal purple" and "imperial purple" are often used to describe shades of this colour, and expressions such as "born to the purple" (meaning born into wealth) are still in use even though originating at the time of the Byzantine Empire. How did purple come to symbolize such wealth and status and how was the dye created? Astonishingly, it is all due to a particular snail, the Murex snail.

Murex snails contain a unique ingredient, a secretion found in their hypobranchial gland. Ancient dyers simply learned to pierce this gland and then to immediately smear the pale yellowish secretion onto whatever fibre or yarn they wanted to dye, and, within a few minutes, the colour magically turned into a brilliant purple.

It sounds incredibly easy, requiring no heat or additional ingredients, but this method does have drawbacks. Firstly, it is impossible to obtain an even colour, and, secondly, it is difficult to dye large quantities of fabric at one time as each snail produces only a few tiny droplets of secretion from its gland. The most serious shortcoming is that this method does not produce a stable and lasting colour.[1]

The point in time at which ancient dyers discovered a more complicated method that solved these problems is not known, but, with remarkable results, they overcame the initial technical challenges. Their efforts and expertise created the most coveted and expensive colour ever to be produced in the history of mankind. Not only did this colour pigment create vast wealth for the dyeing industry, but it also created immense wealth upon which nations themselves were built, the most famous being the Minoan and Phoenician empires. At certain times in history the pigment from these dye molluscs, ounce for ounce, exceeded the cost of gold by up to 20 times.[2] In fact, before the invention of coinage textiles were commonly used as a means to barter.

That textiles were such an important commodity

"Hexaplex trunculus," Murex trunculus purple dye sea snails from a fish market in l'Ametlla de Mar (Catalonia), Spain. Photograph by Hans Hillewaert, courtesy of Wikimedia Commons.

From left to right: Murex brandaris and Murex trunculus sea snail shells sitting on wool dyed imperial purple. Actual dye recipe unknown. John Edmonds Collection. Photograph by Mike Edmonds.

Purple dyeing Thais kiosquiformis sea snails found along the west coast of South America.

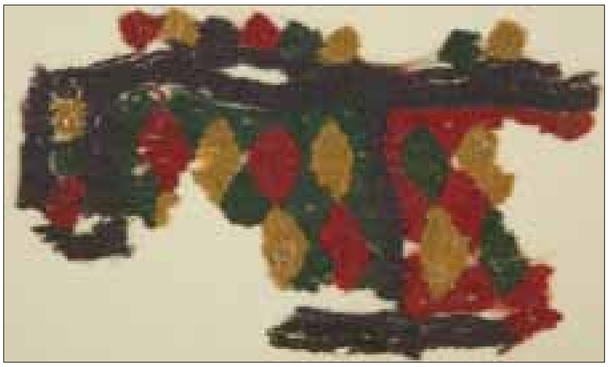
contributes to our fascination with ancient textiles and to our interest in trying to unravel the mysteries of how textiles and dye colours developed over time. Unlike pottery, textiles disintegrate in most climatic conditions over a relatively short span of time, making the study of ancient textiles rather difficult. Thankfully sea snails do not perish so readily, and the mountains of shells of Murex dye snails discovered by archeologists around the world have given great insight into the art of dyeing and also shed light on ancient trade routes and commerce.

One of the oldest known textiles dates back to 2500 BC; it is an Egyptian cloth that had been dyed with Indigofera tinctoria and was found wrapped around a mummy.[3] Textiles dating back to this time are extremely rare. By comparison, although dozens of ancient Murex dye sites are found around the world, the oldest site, on the Island of Crete, dates to 1600 BC, almost a thousand years later.

In the early 1980s the archeology team "Mission Francaise Archeologiaque a Qatar" directed by Jacques Tixier went 80 kilometers south of Doha to a tiny Island, 400m x 200m, called Khor Ile-Sud where they excavated a shell midden (discarded heaps) measuring 10 x 15 metres. Beneath the top layer containing shells, fish bones and debris from hearths, they found almost 3 million shellfish. This was just one of many shellfish mounds discovered at the site. The archeologists conducted experiments on how long it might take to collect 3 million shellfish, and they concluded approximately 42,000 hours. The shells were identified as the Thais savignui mollusc, which produces a beautiful red dye, and were carbon dated to 1400 BC. Thick walled vats, thought to be dye vats, and pottery from the Kassite period were also discovered at this site. What is even more astonishing is that excavations on the island revealed the remains of a hearth dating back to 4500 BC.[4]

These discoveries created quite a sensation, not only because this was one of the oldest settlements to be found in the area but also because it was the first Murex dye site discovered in the Arabian Gulf and one of the oldest purple dye sites in the world.[5]

One of the earliest Murex dyed textiles was found in the famous Pazyryk burrows in Gorniy Altai, Russia. It is a wool fabric completely decorated with images of people and possibly temples and dates back to the 4th century BC.[6] During this same period dyers and weavers on the other side of the world in Peru, in the Paracas



North Africa, Egypt, woven tapestry using wool and linen, dated to 500-599 AD; purple yarns possibly dyed with Murex brandaris or Murex trunculus sea snails. Photograph courtesy of Textile Museum of Canada.

South American, Peru, woven tapestry using wool camelid hair, dated to 1000-1476 AD; purple yarns possibly dyed with Thais kiosquiformis sea snails. Photograph courtesy of Textile Museum of Canada.

North Africa, Egypt, woven tapestry using wool and linen, dated to 600- 899 AD; purple yarns possibly dyed with Murex brandaris or Murex trunculus sea snails. Photograph courtesy of Textile Museum of Canada.

Paracas Culture, 300 BC-100 AD, funerary wrap with fantastic zoomorphic figures. Archaeology Museum, Lima, Peru.
Photograph by Robert Frerck, courtesy of Odyssey/Robert Harding.

peninsula about a three hour drive south of Lima, were also creating spectacular dyed textiles. In the 1920s a Peruvian archaeologist, Julio Tello, noticed regular indentations on the side of a hill, known locally as Cerro Colorado, the painted hill, which turned out to contain 429 tombs.

Within the tombs were mummies, mainly elderly men, sitting upright on thick cotton pads in a squatting position with their knees pulled up to their chins. The initial layer covering the body was made from plain cotton textiles, while on top of that layer were many more layers of ponchos, tunics, cloaks and turbans. One mummy had so many layers he weighed 150 kilos. The garments were intricately woven and decorated with embroidered people, animals and supernatural beings made from yarn dyed in vibrant colours of red, yellow, blue and purple. Very likely the yarns that were dyed purple were produced from the Thais kiosquiformis sea snail which is found along the west coast of South America. These garments date from 900 to 400 BC and are considered the finest ancient textiles from this period.[7]

According to Takako Terada, a Japanese researcher and author of numerous papers about purple dye producing sea snails, approximately 300 mollusc dye producing species are found around the world of which 200 come from East Asia. In Japan, Terada has identified 13 species living along the coasts of Okinawa, Nagasaki and Sada.[8] Purple dye molluscs are also found in the South and East China Sea, the Indian Ocean, the Arabian Gulf, along the eastern Atlantic Irish coast and the western Atlantic coast from Florida down to Venezuela and Trinidad. They also live along the Pacific coast from Baja, California down to northern Peru.[9]

The art of vat dyeing with Murex purple snails was lost for 600 years. Much confusion, mystery and speculation has existed as to how ancient dyers produced this famous purple dye. This may seem surprising as the technique was used for over 2000 years, but dye recipes have always been guarded and in the past were rarely written down. Likely the dye master was the only person who knew the entire process while his dye assistants would not have. The technique and list of ingredients would have been passed on orally to the next dye master. Dye houses and guilds were generally set up to produce only one dye colour, and their knowledge of how to create that one dye was jealously guarded.

The ancient text that provides the most detailed account of Murex purple dyeing is Pliny the Elder's encyclopedic *Historia Naturalis* printed in 77 AD. Pliny describes how pale yellow liquid extracted from the molluscs was first macerated in heavily salted water for three days after which the rotting fish was then rinsed and heated in a lead or, depending on which translation, possibly tin, pot for ten days. The bath was then filtered, and a degreased sheep's fleece was immersed into the liquid and kept at a moderate temperature for 5 hours. The wool was then taken out, carded, and then re-immersed to obtain a darker and more even colour.

Not surprisingly, and unbeknownst to Pliny, he was not given the full dye recipe because these instructions fail to produce a purple colour. What Pliny did not realize was that once the hypobrancial gland is pieced and oxidizes with air the colourless soluble dye quickly transforms into a purple insoluable pigment. To turn this insoluble pigment back into a soluble dye more ingredients need to be added to the dye vat and a fermentation process has to take place.

In Israel in the early 90s there was renewed interest to re-discover how ancient dyers created a blue dye produced from purple dye molluscs. This blue was called tekhelet and is mentioned numerous times in the Hebrew bible. This colour holds great religious symbolism and was used primarily to dye a particular tassel on Jewish *tallit* prayer shawls. But it is not just the colour that is important for the religious ritual; how this colour was originally created from Murex dye molluscs is equally important. Many attempts to re-create this most ancient and revered colour failed. Then in Israel in 1995 Joel Guberman read an article about an ancient dye technique used to create a woad dye vat.[10] It occurred to Guberman that the chemistry for woad and the purple dye mollusc were similar and so a similar dye technique might produce the famous Tyrian purple or the tekhelet blue or even both. Guberman contacted John Edmonds in the U.K. as Edmonds was known for his research in duplicating ancient dye recipes; and his specialty was dyeing with woad.[11] Edmonds was delighted with this challenge and went to work testing different recipes.

Edmonds's first recipe started with the Hexaplex trunculus pigment that Guberman sent him, and he mixed it with chopped tissue of cockles. The cockles were needed as a fermentation medium in attempts to duplicate fresh dye molluscs. Edmonds then brought the pH up to 9 by adding ammonia. The temperature of the dye bath was kept at 47˚C for four days. The dye liquor throughout this process was shielded from sunlight in case the light might affect the final colour. The wool was then immersed in the vat for one hour. On March 3, 1996, Edmonds created a stunning dark purple; it was a eureka moment!

Wool dyed imperial purple using Murex trunculus sea snails by John Edmonds in 1996. Photograph by John Edmonds, courtesy of Mike Edmonds.

Wool dyed tekhelet blue using Murex trunculus and Murex brandaris sea snails by John Edmonds in 1996. Photograph by John Edmonds, courtesy of Mike Edmonds

Eight months later Edmonds tried another dye experiment using Hexaplex trunculus pigment from Israel which he combined with Hexaplex trunculus and Hexaplex bandaris chopped tissue from Spain. This time he fermented the mollusc tissue with a different alkaline, using wood ash and soda. The dye vat was kept at pH 9 and the temperature was 47˚C. The vat was left to ferment for ten days. The results gave a second eureka moment as the colour was a rich tekhelet blue![12]

All the alkalines that Edmonds used in these experiments were available to ancient dyers: ammonia made from aged urine, soda produced from burning certain woods or seaweeds and wood ash collected from hearths. Another important alkaline used in indigo dye is quick lime made from burning sea shells at high temperatures. Interestingly, several archaeological sites dating to 1300-1200 BC unearthed purple dye workshops located next to lime kilns. This seems to be a logical set up as purple mollusc dye sites certainly produced enough shells to warrant the making of quick lime. Quite possibly quick lime was another alkaline being used at this time in purple mollusc dye vats.[13]

One of the earliest references to a urine-vat used for dyeing wool with indigo is found on a papyrus dating to 2000 BC which compares the sorry lot of the dyer to that of a scribe: "His hands stink, they have the odor of rotten fish, and he abhorreth the sight of all cloth."[14] That indigo dye vats and purple dye vats were used at the same time in history and in the same locations makes it reasonable to hypothesize that the knowledge gained from the fermentation of indigo dye vats could have been transferred to the dye preparation of a purple mollusc dye vat or vice versa.

What would it take to dye just one robe with the purple dye molluscs? It depends on what purple dye mollusc species is being used. From experiments, Takako Terada found that one Thais clavigera snail from the shores of Saga and Nagasaki in Japan dyes four square centimetres of cloth. In comparison, one Rapana venosa mollusc, commonly found in Japan, and in the western Pacific and the Indian Ocean, dyes 100 square centimetres of cloth.[15] Zvi C. Koren conducted dye experiments in the 1990s using the Mediterranean Hexaplex trunculus; it took 7 to 10 snails to dye one gram of wool. This means that 10,000 snails were needed to dye an ancient robe or toga weighing on average one kilo. The amount of work involved to produce just one garment is staggering.

While researching this topic I kept wondering about the possibility of purple cloth counterfeits, given the incredible amount of work and number of molluscs needed to dye just a single piece of fabric. The risks were high; at certain times in history it would have meant death if a dyer was caught replacing purple dye from molluscs with a cheaper ingredient. But the temptation must have been equally great; after all, people have been trying for millennia to turn base metal into gold, so why not find a cheaper alternative to create the colour purple? How difficult would it have been? Were there other dyes that could duplicate such a beautiful purple?

One researcher, Franco Brunello, writes that the Phoenician dye masters were expert in imitating mollusc dyed purples by first dipping the cloth in a Murex purple dye vat and then overdyeing it with inferior materials such as saffron, archil or kermes.[16] The resulting colour would have been a crimson shade, a shade still highly valued, but none of these dyes would have been colourfast. The roots of Alkanet (Alkanna tinctoria), native to southern Europe and the Middle East, make another dye used to imitate the Murex purple. Alkanna roots produce a vibrant rich purple, but, sadly the colour fades quickly so I doubt it could have been a reliable substitute.

My theory is that the most successful counterfeit purple dye would have been indigo, known for making all shades of blue and sea green but not rich purples. I would have thought it impossible until I actually succeeded in pulling out silk yarns and textiles from my indigo dye vats that instead of oxidizing and turning blue turned purple. Over a ten year period of experimentation, and with careful observation and copious note-taking, I have slowly come to understand how it might be possible to create a recipe that will consistently produce purple from an indigo dye vat.

Different species of indigo plants from around the world contain compounds such as indican, isatin and indigotin which, under the right conditions, can be transformed into a dye or pigment. Certain indigo dye techniques sometimes create a compound called indirubin that produces a purplish colourant, and this compound would account for why my indigo baths sometime created purple instead of blue dye.

One method of producing indirubin was patented in 1894 by a Mr. Coventry.[17] After his indigo leaves had steeped in water for a certain amount of time he would add quick lime as an alkaline. The quick lime would precipitate various impurities in the dye bath causing them to settle to the bottom. This liquid would then be oxidized. He claimed that indigo prepared in this manner was of superior quality.[18] What qualities made this indigo superior unfortunately are not mentioned.

I often prepare my indigo dye vat using a similar method which also creates a high concentration of indirubin. After the indigo leaves have been steeped I add quick lime, but I do not wait and let the lime settle to the bottom; I mix in the quick lime and immediately begin aerating the dye bath, which is the usual first step in making an indigo pigment. The second step is to turn the insoluble pigment into a dye. To do this an alkaline such as lime, wood ash, soda ash or aged urine is introduced as well as a fermentation medium such as un-refined sugar and bran. Over a period of days or weeks the indigo pigment will slowly convert into a dye. With this method I have succeeded on occasion to create the colour purple.

Ancient dyers would have been able to duplicate all these dye conditions, and they would have had access to all these dye ingredients. Therefore a good chance exists that they too created vivid purples from their dye vats. And if they did, would the temptation have been too great not to pass these yarns or cloths off as a true imperial purple? Until an ancient purple dyed textile is discovered and tests positive, not for bromine, the main chemical constituent from the Murex dye mollusc, but for indirubin we will never know!

*I would like to give special thanks to Mike Edmonds for his generosity in sharing photos of wool dyed imperial purple and tekhelet blue, taken by his late father, John Edmonds; as well for his original photo of Murex trunculus and Murex brandaris sea shells. I would also like to thank Roxane Shaughnessy, Curator at the Textile Museum of Canada, for her invaluable help in supplying photos from their collection of ancient textiles.*

**References**

**1** The Israeli dye researcher, Otto Elsner, experimented with dyeing wool by using the "direct" dye method with the dye mollusk Stramonita haemastoma. His results showed that the colour was less bright and less colourfast than that achieved by using a "vat" dye process. Cardon, D. *Natural Dyes*. Archetype Publications Ltd, London, 2007.

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**3** Forbes, R.J. "Chemical, Culinary, and Cosmetic Arts", in Singer, C., E.J. Holmyard, and A.R. Hall (eds.) p.247, *A History of Technology.* Oxford University Press, 1956.

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**7** Reid, H. *In Search Of The Immortals*. Headline Book Publishing, London, 1999.

**8** Terada, T. *Sea Snail Purple in Contemporary Japanese Embroidery*. Textile Society of America Symposium Proceedings, 2008.

**9** The most famous dye mollusc is from the Mediterranean Sea and is a medium to large carnivorous snail; they use their tongues to make holes in other shell fish to feed on their meat. Fishermen harvest them by using little crabs and mussels as bait.

Esme Living Colour silk textiles and yarn dyed purple with Indigofera suffruticosa. Cotton yarn dyed fuchsia with Onosma echinionides (Alkanet) roots. Photograph by Esme Hedrick-Wong.

Making Indigo paste. Photograph by Esme Hedrick-Wong.

**10** "Mr. Guberman" cited in Edmonds, J. *Tyrian or Imperial Dye.* Little Chalfont, Bucks. U.K. Historic Dyes Series No. 7, 2000.
**11** Woad is a dye plant that contains a compound called isatis. Under the right dye conditions this compound creates a blue dye.
**12** Edmonds, J. *Tyrian or Imperial Dye.* Little Chalfont, Bucks. U.K. Historic Dyes Series No. 7, 2000.
1**3** Cardon, D. *Natural Dyes.* Archetype Publications Ltd., London, 2007. It is clear that more dye experimentation is needed using all these alkalines to see what range of colours they produce.
**14** Forbes, R.J. "Chemical, Culinary, and Cosmetic Arts," in Singer, C., E.J. Holmyard, and A.R. Hall (eds.), *A History of Technology,* p.249. Oxford University Press, 1956.
**15** Terada, T. *Sea Snail Purple in Contemporary Japanese Embroidery.* Textile Society of America Symposium Proceedings, 2008.
**16** Brunello, F. *The Art of Dyeing in the History of Mankind.* Neri Pozza, 1973.
**17** "Mr. Coventry" cited in Perkin, A.G. and Arthur Ernest Everest, *The Natural Organic Coloring Matters.* Longmans Green and Co., London, 1918.
**18** Perkin, A.G. and Arthur Ernest Everest. *The Natural Organic Coloring Matters.* Longmans Green and Co., London, 1918.

*Working professionally with textiles for the last 33 years, Esme started as a fashion designer in Toronto selling collections under her own label, "Esme Designs." She then co-founded a fashion boutique called "Esme & Nolan." In 1992 she followed her dream to live and work in India, followed by Bangladesh, and then Singapore, where she lived for 15 years. Esme was exposed to the rich cultural traditions of natural dyes which led her to begin designing natural dye handloom silks and silk hemp textiles working with weavers in Bangladesh and Thailand; these collections were sold internationally. Since 2002 Esme has been conducting full time research on Asian natural dyes and collecting information on 500 natural dye plants and trees. Traveling extensively over a 20 year period, she has met with natural dyers in remote villages in over a dozen countries to study and understand how ancient dye practices have developed over centuries. Esme has created dye gardens in Singapore, Thailand and Canada, growing different kinds of dye trees and indigo plants and in the process has formulated over 800 natural dye recipes without the use of toxic additives all tested for colourfastness. This research is presently being compiled into a four volume book series.*

Esme Living Colour silk chiffon shawl dyed purple with Indigofera suffruticosa. Photograph by Esme Hedrick-Wong.

Esme Living Colour silk chiffon shawl and hand woven organza silk shawl dyed purple with Indigofera suffruticosa. Photograph by Esme Hedrick-Wong.