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The Politics of Purple: Dyes from Shellfish and Lichens

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Dyes from shellfish ('murex') and lichens ('orchil') originated before 1500 BCE; by the Roman period they were synonymous with wealth and power. Wearing purple was indicative of status and privilege, and the dye industry was also politicized. Women were prevented from working at purple manufacture, and thus our research, as a female team, engages gender as well.³ Both murex and orchil were made according to 'secret' methods, but techniques we have developed are ethical, and also widely published. The junior author has devised 'akanishi' as a vernacular name for a Japanese shellfish dye. The senior author has also developed lichen dyes that yield purple. These two dyes are combined and they produce results that are fast to washing and light.

This project began as an experiment in replicating the 'combined' murex and orchil dyes mentioned in older texts. The research is political because murex has an almost sacred status among textile scholars who greatly admire its beauty and antiquity. Yet there was always a suspicion that shellfish and lichen dye combinations were an economic ruse rather than a legitimate dye. Murex requires more time to prepare than orchil, and the dyeing process is also more complex. Thus it would have been an economic advantage for orchil to be used as a ground colour, and thereby save on the amount of murex required. Murex and orchil yield identical colours so the subterfuge, if intended, was likely successful. This paper demonstrates, however, that there are other advantages to using murex and orchil together for one dye improves the quality of the other.

Project overview

The murex/orchil project has evolved over a number of years. The first stage of the research involved the following dye preparation:

1. SHELLFISH PURPLE. Shellfish dyes were prepared by the junior author according to methods she has established: 1. The *direct* dye method; 2. The *vat* dye method.⁴
2. ORCHIL DYEING. Orchil was prepared by the junior author according to a lichen dye method established by the senior author. The next stage in the study was to devise a method for the combined murex/orchil dyeing.
3. SHELLFISH AND LICHEN DYE COMBINATIONS.

The sequence of dyeing was as follows:

1. Shellfish *direct* dyeing followed by lichen dyeing.
2. Lichen dyeing *followed* by shellfish direct dyeing
3. Shellfish *vat* dyeing followed by lichen dyeing
4. Lichen dyeing *followed* by shellfish vat dyeing.

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³ Muthesius, *Op. Cit.*

⁴ Terada, 1995-2000.

4. SHELLFISH VAT DYEING AND LICHEN MORDANT DYEING. Sample dyeing here evolved as follows: 1. Shellfish *vat* dyeing with lichens in *one* dye bath; combined dye with alum; combined dye with copper; combined dye with iron.

The results of ‘Part 1’, and also ‘Part 2’, have been presented previously.⁵ This present work, ‘Part 3’, constitutes our paper at this Washington symposium.



*Figure 1. The hypobranchial gland of “akanishi.” (Terada 2006).
The hypobranchial gland is a dye precursor.*

Many species of shellfish can be used for dyeing purple. For this project we used *Rapana venosa*, collected in Japan by the junior author. The junior author has given the dye from this particular shellfish species a distinctive Japanese name, *akanishi*, which means ‘red (or red-purple) snail’. This gesture has political overtones, we note, because many scholars hold murex to be *inviolable* - that is, a dye so famous it is almost sacred. To apply a vernacular name to murex, and to create the dye using shellfish from a region of the world not previously associated with murex dyeing, is therefore also political.

The fluid secreted by the gland is the enzyme *purpuracea*. A dye precursor, it is soluble in water. It can be applied directly to a substrate which in this case is Japanese test fabric comprised of eight different fibers. Once the enzyme present in the fluid is subjected to oxygen and light, however, it is transformed into *dibromoindigo*, hereafter ‘DBI’. (The chemical structure above shows the biochemical diagram for DBI).⁶ As DBI is not water soluble, when murex dyeing uses the fluid already exposed to oxygen and light, it must be used as a vat dye.

The hypobranchial fluid is a dye precursor, soluble in water; this means it can be applied directly to fiber (we used Japanese standard multi-fiber test fabric). When the precursor is exposed to oxygen and light, the enzymes present convert to dibromoindigo, or ‘DBI’. Because DBI is not water-soluble, it must be used as a vat dye.

⁵ Dyes in History & Archaeology Vienna, 2007; DHA Istanbul, 2008.

⁶ Taylor, G. & P. Walton Rogers, 1983, p. 15.



Figure 2. Shellfish direct dyeing (Terada 2011).

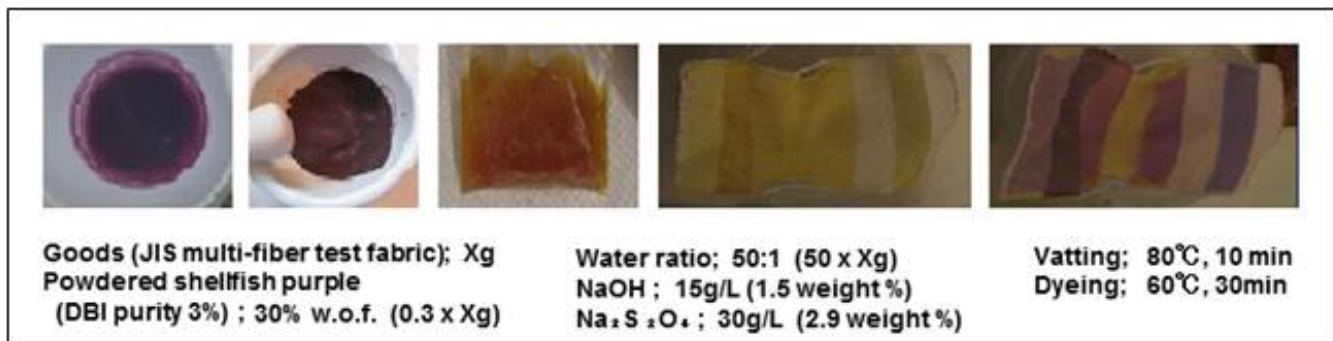


Figure 3. Shellfish vat dyeing (Terada 2011).

In Figure 3, the glands in the container are no longer green. They have been mixed with water (3:1 ratio glands to water), and exposed to oxygen and light. This combination is poured into dishes until the water evaporates, leaving a fine powder.

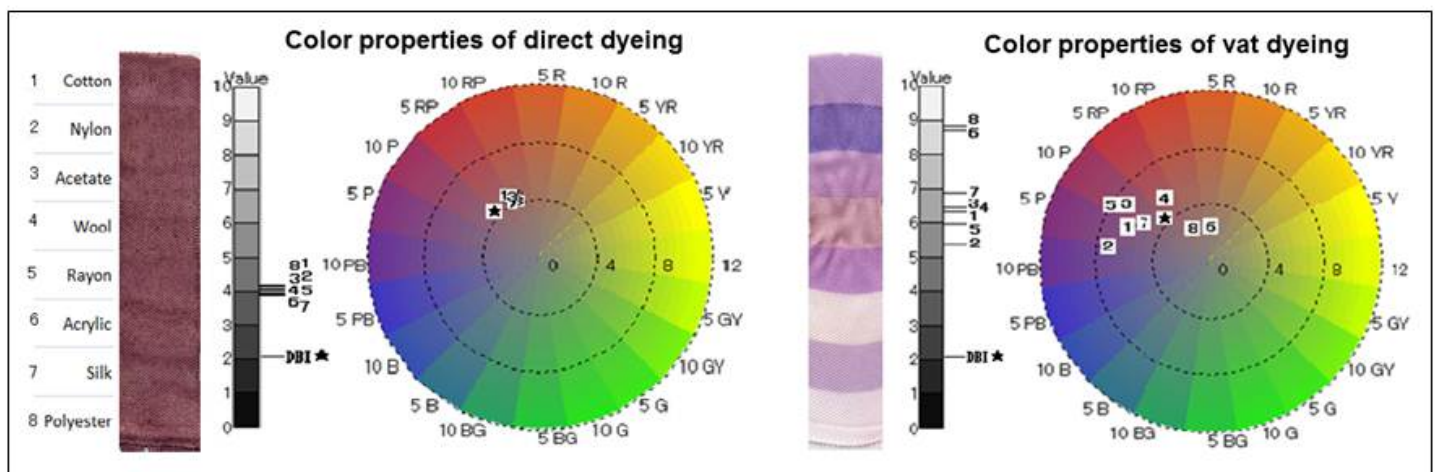


Figure 4: The Color Properties of direct dyeing and of vat dyeing. The test fabric shows results on cotton, nylon, acetate, wool, rayon, acrylic, silk and polyester (Terada 2006).

Notice in the 'hue' column that shellfish direct dyeing produces a narrow color range which is primarily RP (reddish purple). The 'star' symbol = synthetic DBI (a control). +

By comparison, vat dyeing produces a wider range of hues that are more strongly P (purple).

Colour Fastness

Direct and vat dyeing methods produce colours that are very stable when exposed to sunlight and washing. The wide range of colors, on different fabrics, indicates suitability for protein substrates as well as man-made fibers.

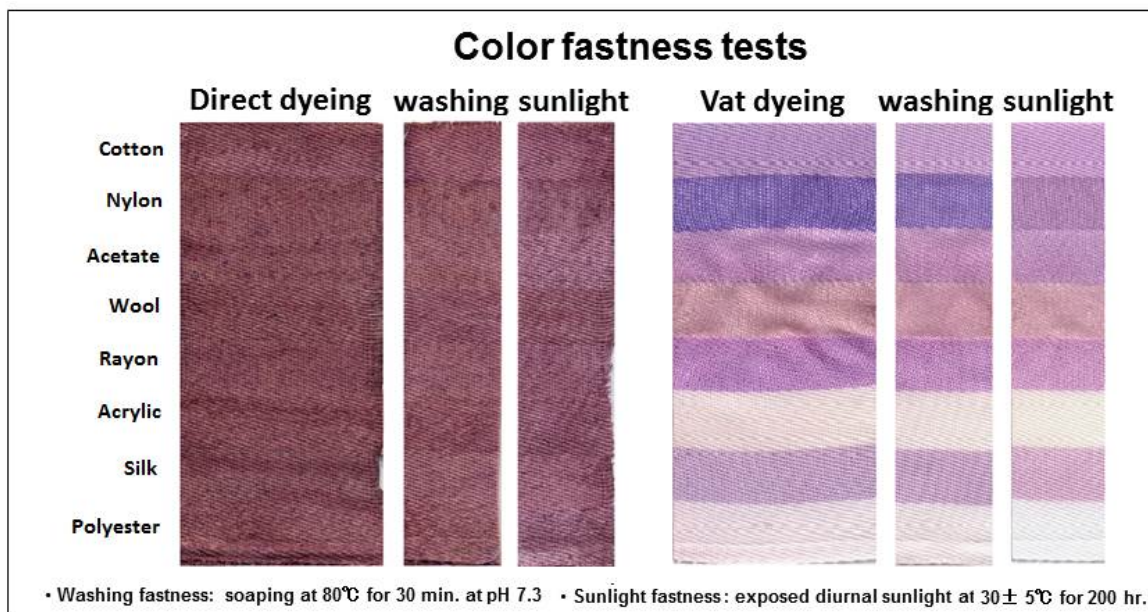


Figure 5. The direct dyed and the vat dyed test fabrics demonstrate the effectiveness of shellfish purple on wool and silk, which was known in the ancient world. The result on cotton, however, is stronger than expected for it was generally believed that shellfish dyes were unsuitable for cotton (Terada 2011).

Lichen Dyeing

Lichen dyes by a variety of vernacular names have a long history.⁷ For this project we used two dyes developed by the senior author: ‘orsallia’ derived from lichens of genus *Umbilicaria*. This genus is also found throughout North America, Europe, and also in Japan. We also used *Parmotrema tinctorum* collected in Japan; it also occurs on the same continents, and in the same countries, as *Umbilicaria*. We did not use the original orchil lichen, *Rocella* spp., because these lichens are generally unavailable beyond the Canary Islands, the Mediterranean coast, Mexico, and Baja California.

Regardless of the vernacular name, the chemistry of ammonia-processed or ‘AM’ lichen dyes is identical. Orcinol is the name for the lichen ‘substances’ contained in the organism. These ‘substances’ are complex acids which, when exposed to ammonia and water, in a fermentation vat, convert to the dye precursor ‘orcein’.⁸

⁷ Diadick Casselman, 1999, p. 32-33.

⁸ Diadick Casselman, 2001, p. 26.

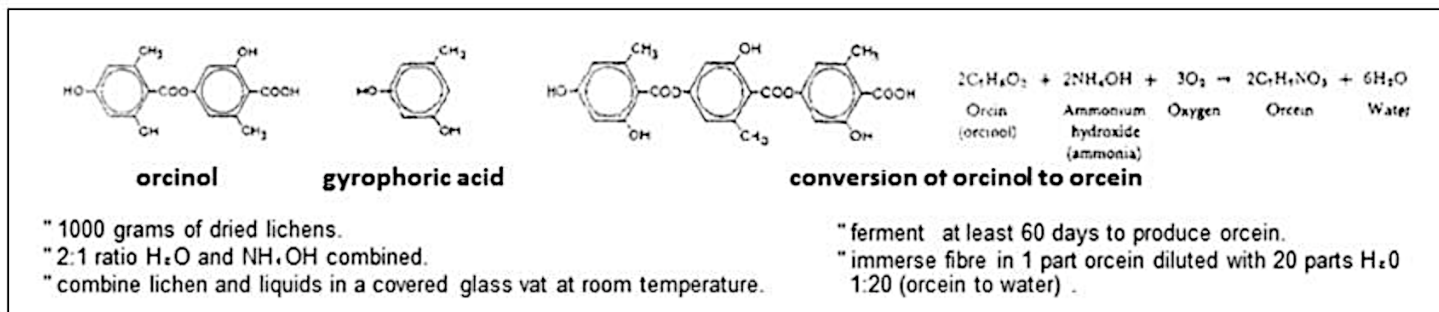


Figure 6. Gyrophoric acid is extracted from crumbled lichens, at room temperature, for a period of 60 days or more (Diadick Casselman 2006).

Orcinol is the dye precursor. The lichens are combined in a large glass vat with a solution of water and ammonia in a 2:1 ratio (2 parts H₂O: NH₄OH). As the lichens decompose, orcinol in the lichen medulla is transformed into orcein. Next the orcein is diluted with 20 parts water (or more). Prepared in this manner, the dye is very concentrated and not wasteful of lichens.⁹ Orcein is the dye precursor but the senior author has created the name ‘orsallia’ to describe orcein when it is made using lichens of the genus *Umbilicaria*. Orsallia is similar to ancient orchil, and it creates identical colors, but the name ‘orsallia’ signifies that is culturally unique.

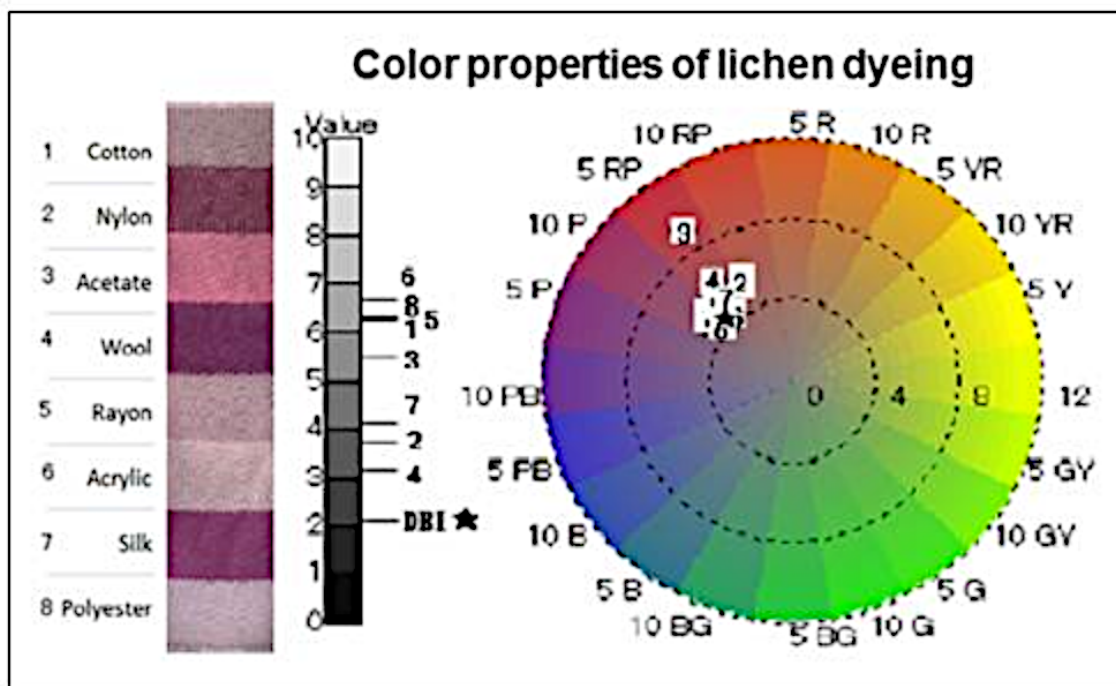


Figure 7. The color properties of lichen dyeing (Terada 2007).

Here the hues are clustered close to the DBI symbol, indicating the tests results are strongly red-purple. Lichen dyes have an affinity for wool and silk, as well as some additional fibers, in this case, rayon. (Terada 2011).

⁹ Ibid., p. 37-39.

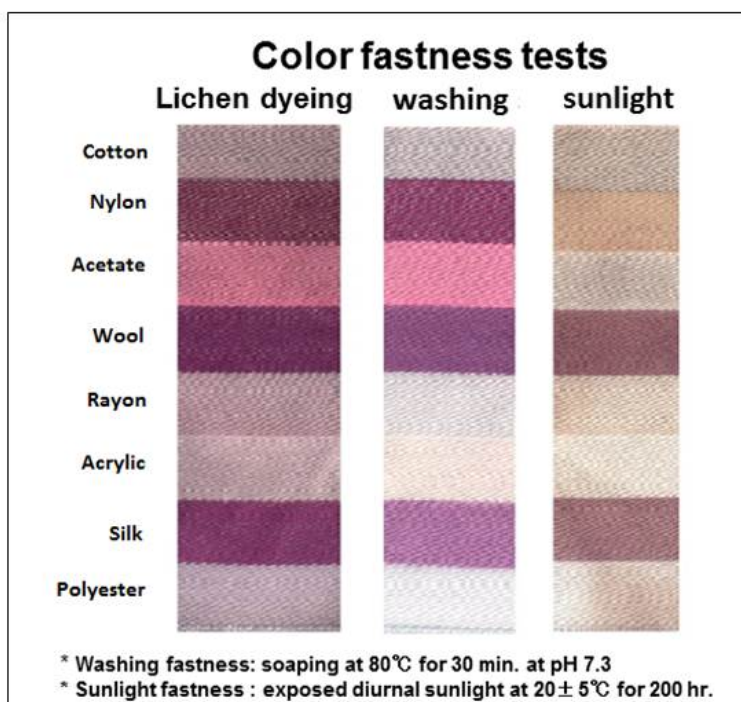


Figure 8. Color Fastness Tests (Terada 2011).

Lichen dyes on wool, silk, and rayon are fast to washing. However, many writers believe that lichen dyes are not fast on any fibre.¹⁰ These results indicate that lichen dyes prepared for this project (and aged more than three months, a significant difference possibly) are reasonably fast to sunlight when exposed for 200 hours.

Orchil and Murex Combinations	Source (see References)
orchil used to duplicate murex	<i>Papyrus Holmiensis</i> c. AD200
orchil used to duplicate murex	<i>Plictho</i> (Rosetti 1548)
orchil used to improve murex	Bancroft 1814; Lindsay 1856
orchil used as a ground colour for murex	Kok 1966
orchil used to adjust murex colours	Perkins 1986
orchil extended the amount of murex required	Walton Rogers 1988

Table 1. Historical Background for Shellfish and Lichen Combination Dyes

We began this project with the objective to investigate the numerous historical references to murex and orchil as *combined* dyes (Table 1). We discussed whether it was possible to devise a method to replicate the dyes used in sequence, and/or together, to produce a purple that was superior in some way (e.g. more fast, improved colours, etc.) This was a political decision on our part because murex is an illustrious dye, one held in high regard, and yet the process of preparing it remains almost a mystery. By contrast, lichen dyes are treated with less respect for historians believe that orchil faded and was therefore an

¹⁰ Grierson, Duff & Sinclair 1985, p. 221, 225.

inferior dye. We approached this project not knowing precisely what techniques to use because none had been published - there was simply speculation. The junior author devised original techniques and results demonstrate the combined dyes are possible, they are effective, and there were considerable aesthetic and practical advantages as well.

Purpose and Structure of the Study

Our goal was to reproduce ancient purple dyes based on murex and orchil; to use ingredients available in the ancient world; to establish the best technique for the combined dyes; to achieve maximum color and fastness; and to establish a baseline for further studies on the combined dyes. Our results show that shellfish and lichen purple

dye combinations were not simply a myth; they can be replicated. From earliest times, purple dyeing was highly-politicized because Roman laws prevented ordinary citizens from wearing the color. Because murex manufacture was complicated and more labour- intensive than orchil dyeing, there were times when lichen dyes were substituted in shellfish purple. Was this a ruse? Historians believe that using orchil with murex was a duplicitous act, and the resulting dyes were thus 'fraudulent' or 'fake' purples.¹¹ But we believe it made sense to combine the two because both dyes yield identical shades of reddish-purple and purple, and the combined dyes do not create an inferior product.

Phase 1 and 2 of the project (see Project Overview, above) involved shellfish dyeing and lichen dyeing, done separately. Phase 3, Part 1, Shellfish direct dyeing and lichen dyeing, was presented to Dyes in History & Archaeology in Vienna, 2007; Part 2, Shellfish vat dyeing with lichen dyeing, was presented to DHA at Istanbul, 2008.¹²

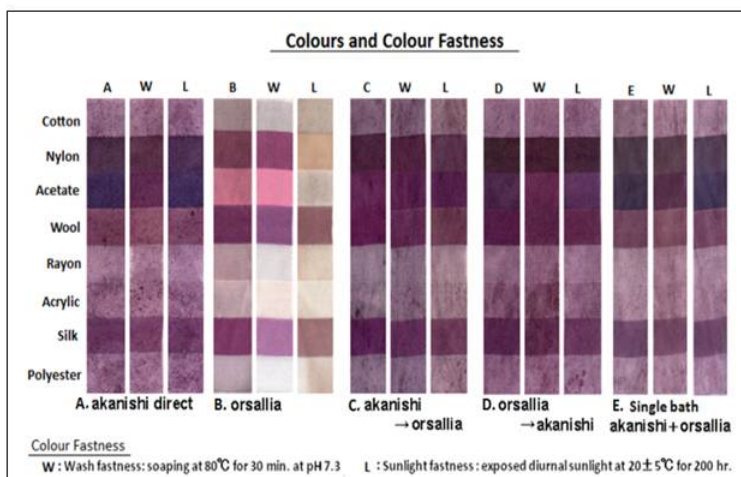


Figure 9. Color and fastness results from Part 1 (direct dyeing) demonstrate that direct dye methods show good fastness to washing and also to light exposure (Terada 2010).

The combined dye techniques above illustrate that a lichen ground color followed by shellfish dyeing gives optimum fastness. These results validate the historical references. We also believe that by combining the two dyes, it was possible to obliterate the strong odor of murex when used alone. Murex was famously odoriferous and the two-dye strategy may have targeted this problem that is apparent to

¹¹ Sandberg 1994, p. 36-38.

¹² See note 5.

those who have worked closely with murex.¹³

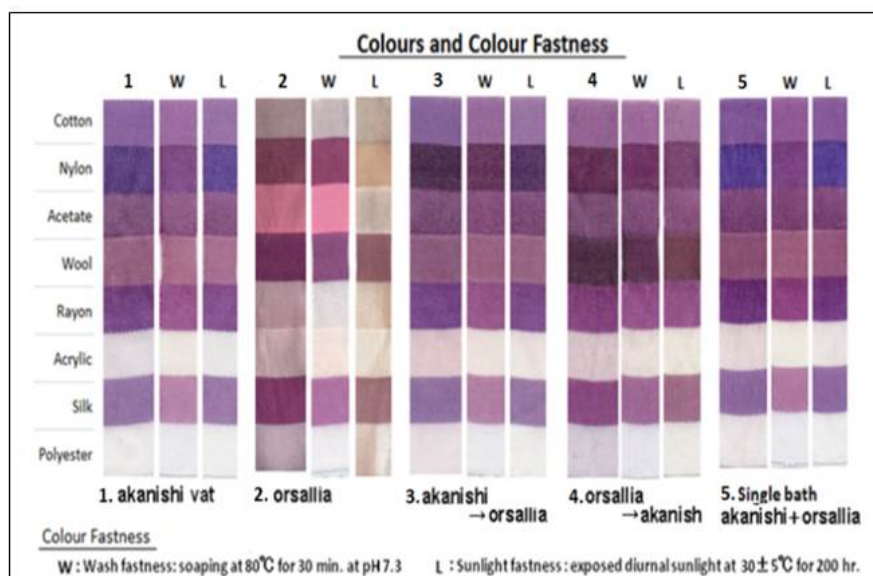


Figure 10. Color and fastness results from Part 2 (vat dyeing).

From the results in Figure 10 we conclude that shellfish (akanishi) and lichen dyes have a strong technical affinity, and they are particularly compatible. Optimum colors are achieved when a lichen ground color is over-dyed with shellfish vat dyes. This technique produces even colors and optimum fastness. There is also no odor. The colors are also successful on wool, silk, and cotton. This is interesting because many historians believe that murex, and also lichen dyes, will not dye cotton.

Phase 3, Part 3

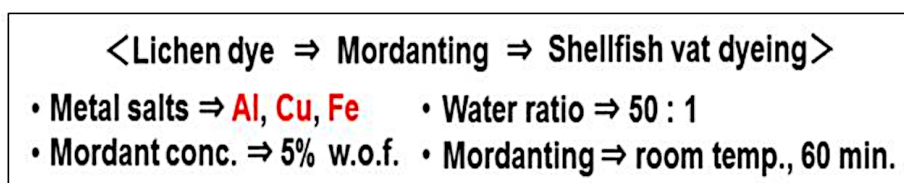


Figure 11. The technique for shellfish vat dyeing and lichen dyeing (Terada 2010).

Part 3 comprises the junior author's experiment in combining shellfish vat dyeing with lichen dyeing according to the sequence shown in figure 11. (Figure 12). Although lichen dyes do not require a mordant, alum (NH_4OH), copper ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$), and iron (FeSO_4) mordants were tested comply with historical references to alum used with lichen dyes. We were also interested to see if any mordants made a difference to color quality or fastness. The lichen used was *Parmotrema tinctorum*, a Japanese species, and the lichen to water ratio is the same as when dyeing with *Umbilicaria*.¹⁴ Mordanting was done after

¹³ Murex experiments conducted by the authors at Hyderabad, India (2008) were sufficiently odiferous to escape the hotel bathroom (our 'lab') into the hallways where the smell was noticeable to staff.

¹⁴ Diadick Casselman 2001, p. 26-27.

the lichen dyeing, and before the test fabric was dyed with Japanese murex.

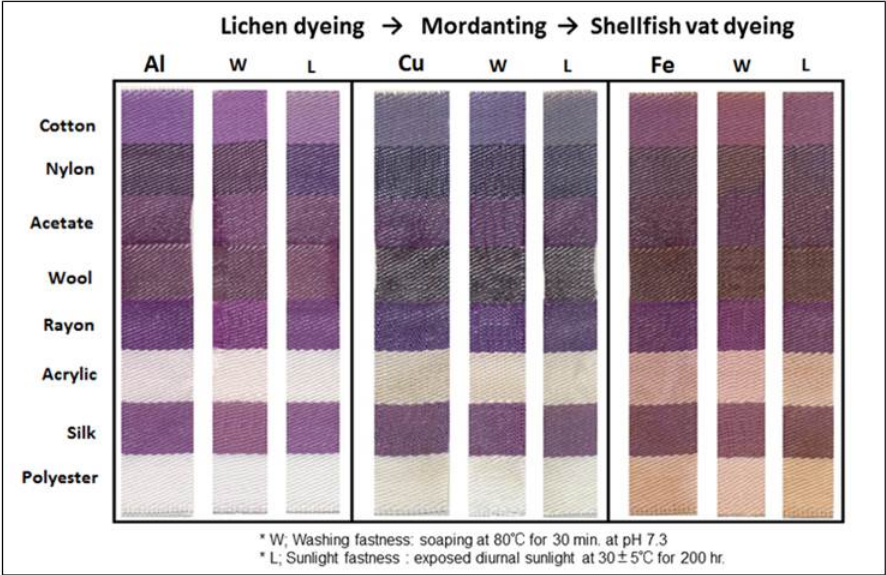


Figure 12. Color and fastness results from part 3 (Terada 2012). After washing and exposure to light, the most successful technique appears to be lichen dyeing followed by an alum mordant, and then the shellfish vat dye. This sequence produces colors that are very stable.

The use of a copper mordant, by comparison, downgraded the aesthetic quality of the colors as it moved the colors away from the DBI symbol. Similarly, An iron mordant also moved the colors away from the DBI symbol.

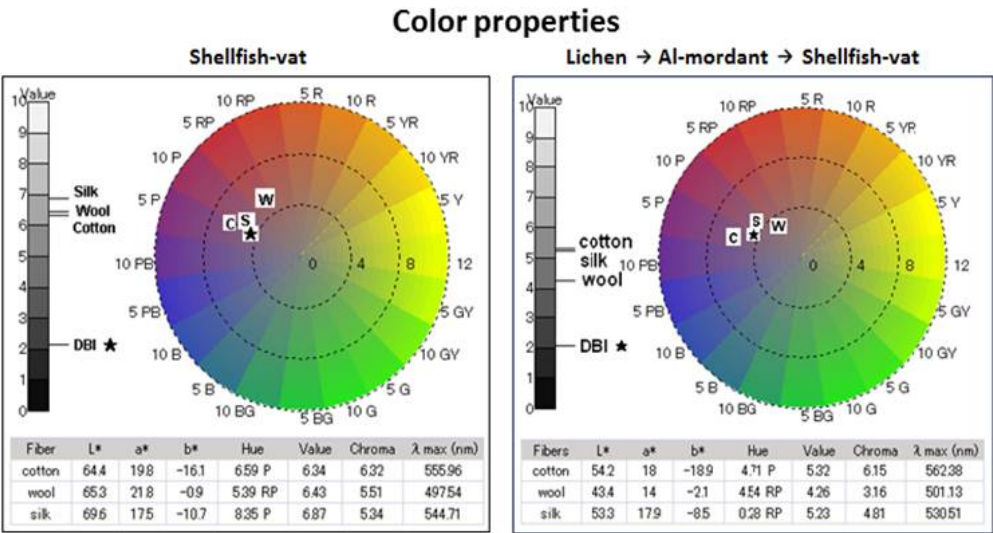


Figure 13. This experiment indicates that the color produced on cotton is almost as saturated as it is on wool and silk.

One interesting result of the shellfish vat and lichen combined dyeing is how well the color holds on

cotton (figure 13). As noted, it has long been thought that cotton was not compatible with murex or with orchil.¹⁵ By comparison, both murex and orchil are known to produce maximum results on wool and silk.



Figure 14. We conclude there were various benefits to these combined dyes. As the progression from left to right indicates, each dye is improved by the addition of the other.

Results in Figure 14 appear to validate the historical references to alum used in lichen dyeing *when* the result is top-dyed with purple from the shellfish vat. The combined dye colors are darker, more intense, and thus aesthetically superior. This is particularly interesting because lichen dyes are considered by some authorities to fade significantly.¹⁶ Alum therefore appears to stabilize the lichen ground color when followed by shellfish dyeing.

To refer back to Table 1, therefore, it would appear that the historical references are entirely valid. There are, however, two remaining questions: aside from our project, is there any *other* evidence to support our discovery about the compatibility of murex and orchil as two dyes that technically improve one another? Secondly, why did the technique appear not to have survived into the present day? Had this knowledge been maintained among dyers, surely others would have taken advantage of these aesthetic benefits. It may be that politics has played a role in a reluctance to incorporate anything with murex, given its legendary reputation. Our study is intended to alert other scholars to the possibility that some of the ‘unknown’ purples found in textiles may have been produced in this historical manner.

¹⁵ Sandberg 1994, p. 28.

¹⁶ Diadick Casselman 2009, p. 9.

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References

Bancroft, E. 1814. *Experimental Researches Concerning the Philosophy of Permanent Colours*. Philadelphia: Thomas Dobson.

Diadick Casselman, K. 2009. Praxis & paradox: the culture of natural dyes. *Textile: Journal of Cloth & Culture* 7: 8-26.

Diadick Casselman, K. 2001 *Lichen Dyes: The New Source Book*. New York: Dover.

Diadick Casselman, K. 1999. Etymology and biology of European lichen dyes. *DHA* 18: 31-36.

Grierson, S., D. Duff & R. Sinclair. 1985. The colour and fastness of natural dyes of the Scottish highlands. *J. Society Dyers & Colourists* 101: 220-227.

Hofenk de Graaff, J. 2004. *The Colourful Past: Origins, Chemistry and Identification of Natural Dyestuffs*. London & Riggisberg: Archetype & Abegg-Stiftung.

Kok, A. 1966. A short history of orchil dyes. *The Lichenologist* 3: 248-272.

Lindsay, W.L. 1854. Dyeing properties of lichens. *Edinburgh New Philosophical Journal* 42: 228-250.

Muthesius, A. 1993. The Byzantine silk industry. *J. Medieval History* 19: 1-67.

Papyrus Holmiensis. AD200.

Perkins, P. 1986. Ecology, beauty, profits: trade in lichen dyestuffs. *JSDC* 102:221-227.

Rosetti, G. 1548. *The Plictho*. Facsimile edition. Cambridge & London: MIT Press.

Sandberg, G. 1994. *The Red Dyes*. Lark Books, Asheville, USA.

Taylor, G. & P. Walton Rogers. 1983. 'Lichen purples', *DHA* 2, pp. 14-19.

Walton Rogers, P. 1988. Dyes and wools in Iron Age textiles. *Danish J. Of Archaeology* 7: 144-158.