Tournaments Illuminated

Issue 191 • Third Quarter, 2014

Viking Age Dyes

QUEST ARTICLE: Hints for Metalcasters

Medieval Woodcarving • Pewtercasting Tokens

MUSEUMS OF INTEREST • MEDIEVAL DESTINATIONS • VILLAGE GREEN

ABOUT THE COVER

The yarns pictured on the cover were all dyed using Viking Age-appropriate dyes on a variety of wools and silk. All of the yarns were dyed by Kristina Gundersen | *Meave Douglass,* author of "Viking Age Dyes: An Overview", on page 11. The various shades of blue were achieved using a woad vat created with woad powder and using thiox as a substitute for a traditional fermentation vat. The lighter shades of blue are the result of an exhausted woad vat. Dried madder root was used to achieve the majority of the reds and the burnt orange. The color variation is a result of adjusting the pH using calcium carbonate, adjusting the time yarn was left in the dyebath, or grinding rather than soaking the roots. The bright orange yarn was achieved by using dried madder root without first soaking the root. For the deep red in the bottom left corner, a dyebath of crushed cochineal prepared by Ercil Howard | *Astridhr Selr Leifsdottir* (OL, OP) was used. For the yellows, a dyebath of weld extract with a touch of soda ash, to brighten the yellow, was created. Some of the yarns dyed in the weld bath were then overdyed with a woad exhaust, resulting in the greens. The pinks were achieved using a lichen dye which was the result of an ammonia fermentation vat by Tere Bruns | *Baroness Fionnghuala de Buchanan.* Lastly, the browns were dyed using fresh walnut hulls that were collected by the author at a local tourney.

The editor and the photographer would like to thank The Honourable Lord George Edward Archer for the (initially inadvertent) gracious loan of his chair for the photo session.

PHOTOGRAPHER

Andrew Nimrod *is currently found on the slopes of Big Bear snowboarding, when not participating in the SCA or on other photographic adventures*.

Ludwig Mahler von Koln (AOA) *is a 16th C German from the city of Koln, who can be found along the Rhine "painting" and brewing under the rock of the Lorelei. Most of the time though, he can be found on the battle field protecting the Crown alongside his fellow soldiers the Sons of the Lorelei.*

VIKING AGE DYES:

A BRIEF OVERVIEW

SO… WHO WERE THE VIKINGS?

When speaking about "Vikings", often a barrage of modern stereotypes come to mind. However, for purposes of this discussion I will focus on the dyes used by Scandinavian peoples who lived from approximately 800 to 1100 CE. Geographically, these peoples lived throughout Northern Europe in what we now call Norway, Sweden, Denmark, Finland, and Northern Germany. As time went on, Viking settlements were also to be found in Iceland, the Baltic region, and along the coasts and river-ways of the British Isles, including Ireland and Scotland. The settlements in northern and eastern England – including the city of Jórvík, modernly known as York – comprised the Danelaw, an area where, historically, Danish law prevailed. In general, settlers to the Danelaw originated in Denmark and Norway. In Ireland, they founded the city of Dublin. The Danes, along with the Swedes, also ventured east, trading and settling along the Baltic. It is generally accepted that the Rus have Swedish origins (Downham 5). Scandinavian traders during the Viking Age also had contact with Byzantium and the Mediterranean. Migration and trade throughout the Viking world was a complicated mixing of cultures that often resulted in hybrid ethnic identities. In the context of dyes and textiles, contact with such diverse populations spread over such a large geographic area meant they had access to a wider variety of ideas, materials, and techniques (Heckett 106).

One of the challenges of researching Society period dyes, especially from this early era, is that there is scant source material to work with. Contemporary depictions of textiles, such as representations of the valkyries, are stylized and generally not in color. Records were kept through oral tradition, so the only written descriptions are sagas recorded centuries later. These sources are problematic at best. Color is often used allegorically and symbolically in literature – and even if that were not the case, the authors of the sagas never actually saw which colors were worn during the Viking Age. Using the sagas as evidence of those colors would be similar to using a pre-Raphaelite painting to determine the construction of a *bliaut.* Two contemporary depictions of Viking Age Scandinavians do exist, in the form of the Anglo-Saxon Chronicle and Ahmad ibn-Fadlan's 10th C description of the Swedish Rus; however, neither source mentions textile colors. Even if they did, cultural bias and interpretation would have to be taken into account, since the authors are not Scandinavian. What we do have is some archeological evidence in the form of both preserved dyestuffs and textiles.

COLORANTS, AND MORDANTS, AND MODIFIERS OH MY!

Dyes were not new to the Viking Age, and there is evidence of purposeful dyeing dating back to some of the world's earliest textile finds (Barber 224). Israel's arid climate has contributed to the preservation of archaeological textile finds in the region such as a scrap of red woolen cloth from the early 4th millennium – that is thousands of years before even the Vikings! Newer analysis has even established that the majority of Scandinavian early Iron Age textiles that have been recovered from peat

VIKING AGE DYES: A GLOSSARY OF TERMS

Archaeobotanist: An archaeologist who studies plant remains.

Adjective Dye: Dye requiring the use of a mordant to bind the color to the fiber.

Alum (aluminum sulfate): A naturally occurring basic mordant widely used in the ancient world.

Chromatography: A collective term for a set of laboratory techniques for the separation of mixtures

Dermal Pattern: Unique patterns made by the growth of specialized cells forming the outer layer of a vascular plant; these patterns are used to identify the plant.

Dog Whelk *(Nucella lapillus)*: A species of predatory sea snail that can be used to produce both red-purple and violet dye.

Dye: Color-bearing organic compounds that can be dissolved in water or another liquid so that they will penetrate fibers.

Fugitive Dye: Dye colors that are prone to fading when exposed to sunlight – fugitive to light – or washing; as opposed to colorfast.

Gall: A tannin-rich growth on oak trees produced by an infection of the insect *Cynips gallae tinctoriae*, used as a dye and a mordant.

Kermes: A scale insect *(Kermes vermilio)* from which the crimson-colored dye kermesic acid is derived.

Lichen: Fungus and algae living in a symbiotic relationship, that in many cases will produce brightly-colored dyes.

Madder *(rubia tinctoria)*: This and other related plants of the Rubia family, whose roots are a source of good red dyes containing alizarin and purpurin.

Modifier: A chemical used with dyestuff to change the ultimate color result when dyeing.

Mordant: A chemical, usually a mineral, used in combination with dye to "fix" the color in the textile fibers. Different mordants will result in different colors from the same dye.

pH: A measure of the acidity or basicity of an aqueous solution. A pH measurement less than 7 indicates acidity; solutions with a pH greater than 7 are basic or alkaline. The pH of pure water is very close to 7.

Pigment: Insoluble color particles that may be attached to the surface of cloth using a binding agent.

Polish Cochineal: A scale insect *(Porphyrophora polonica)* from which the crimson-colored dye carmine is derived.

Stoma (pl. stomata): Minute pores on plants that allow for respiration, found typically on the outer leaf skin layer.

Substantive Dye: Dyes that produce color without the use of a mordant.

Tannin: A naturally-occurring yellow-to-brown acid compound found in many plants that is used as a mordant and a dye.

Wayside Plant: A plant occurring naturally in the wild; one not under human cultivation.

Wavelength: The distance over which a wave's shape repeats itself as light energy travels. Each color has a unique wavelength.

Weld *(Reseda luteola)*: A plant also called mignonette or dyer's rocket; it produces the flavonoid luteolin, the basis of a stable yellow dye.

Woad *(Isatis tinctoria)*: A plant whose leaves are a source for indigotin, which can be used to create a blue dye.

PICTURED ABOVE – TOP: *Woad Plant.*
BOTTOM: *Weld Plant.*

PAGE 6: *Dried Weld.*

bogs in fact were dyed (Vanden Berghe 1920). By the Viking Age, dyers had mastered some pretty sophisticated organic chemistry, all in the name of fashion.

In order to understand the range of colors available historically, it is important to understand a little bit about how dyes work. There are several different types of natural dyes. Some are really just staining the fiber, in much the way dirt or grass can stain your hem. These dyes are temporary, a quality known to dyers as fugitive. Other dyes form a chemical bond with the fiber; these are more permanent. These more permanent dyes can be sub-divided into two main groups: substantive dyes and adjective dyes. Substantive dyes become chemically fixed to the fiber on their own, without the need for additional chemicals. Adjective dyes are not able to fully fix to the fiber without the assistance of another substance such as alum, iron, or tannin. These additional substances are usually metal-based and are called mordants.

The final color result can be tweaked depending on the mordants used or by changing the chemical reaction slightly, using substances like calcium carbonate, cream of tartar, and ammonia to adjust factors such as the dye bath pH. These substances are called modifiers. For example: use of an iron dye pot not only would act as a mordant, helping to fix the dye to the fiber when iron from the pot combines with the dyestuff, but also as a modifier, because iron typically "saddens," or dulls, the final color. Other modifiers can be used to brighten or deepen color. Temperature also can be a factor in the final color – many dyes need to stay within a certain temperature range for the colorant to be released. The range of colors produced also can be expanded through the use of over-dyeing. This involves first dyeing with one substance and then taking that newly-dyed fiber and dyeing it again with another color. Finally, the fiber itself can affect the color outcome. Not all fiber is white in its natural state. Grey or tan fibers will give a different result than one that begins white or off-white. Wools, silks, and linen also absorb dyes differently. Linen, for example, is notoriously difficult to dye – most likely a reason there are so few extant examples of dyed linen.

THEY WORE COLOR? BUT EVERYTHING LOOKS BROWN!

When looking at the archeological evidence, it is important to remember that this evidence is by no means comprehensive, and what we do have has in many cases been altered over time by environmental factors. Only a small sampling of textiles and dyestuff survived, and many of those textiles are stained and discolored by the soil in which they were found. Remember those mordants and modifiers? Soil can contain not only metals such as iron and aluminum, but other mordants such as tannins, which are found in plants such as oak trees. These substances will change the color of textiles over time. Tannins, in particular, will turn fiber shades of brown. Additionally, some dyes, especially the yellow ones, are almost impossible to identify using current techniques – or were fugitive and have long since disappeared from the textile (Taylor Identification 158, Walton-Rogers Wools 154). The Vikings almost certainly used wayside plants to create dyes we now are unable to identify. So with all of these challenges, how do we know what we do about which dyes were used?

FOR SCIENCE!

The dye identification process is actually some pretty cool science. Chemists used various types of chromatography to isolate the residual dye chemicals and then compared them to known dye sample spectrums (Taylor Identification 154-55, Walton-Rogers Summary 14-15). Basically, the individual atoms that make up the various dyes absorb light energy differently. This light energy travels in wavelengths, and only certain wavelengths are absorbed by each material. All of the others are reflected. This means that chemists are able to look at the patterns created by the wavelengths that are absorbed, and compare them to the patterns

TABLE 1: VIKING AGE DYES*

Dyestuff	Common Name	Chemical Colorant	Color/Colors Given	Archeological Evidence Found	Geographic Location
Isatis tinctoria	Woad	Indigotin	Blues, Greens	Seeds, Wool, Linen, Silk	Norway, Denmark, York, Sweden, Dublin
Reseda luteola	Weld, Dyer's Rocket	Luteolin	Yellows, Golds	Seeds, Silks	York, Sweden
Rubia tinctorum	Madder	Alizarin, Pseudopurpurin, Purpurin	Oranges, Reds	Plant Remains, Wool, Silks, Linen	Norway, York, Denmark, Sweden, Dublin
Galium boreale, Galium verum, Galium aparine	Bedstraw, Lady's Bedstraw	Alizarin, asperuloside	Reds, Yellows	Wool	Norway, Denmark
Juglans regia	Walnut	Juglone, Tannin, Plumbagin	Browns, Tans	Wool, Plant Material	Norway, Denmark
Xanthoria parietina, Rocella tinctoris	Wall Lichen	Orecin	Yellows, Tans, Reds, Purples	Wool, Silk	Dublin
Ochrolechia tartarea	Orchil Lichens	Orecin	Purples/Pinks	Wool	York, Northern Germany, Dublin
Calluna vulgaris	Heather		Yellow	Plant Material	York
Genista tinctoria	Broom, Dyer's Greenwood, Woadwaxen	Genistein	Yellow	Plant Material	York
Nucella lapillus	Dog Whelk	Dibromoindigo	Tyrian Purple	Silks, Shells in Dye Workshop	Norway, York
Kermes vermilio	Kermes	Kermesic Acid	Reds	Silks, Wool Tunic	Norway, York, Denmark, Sweden, Dublin
Porphyrophora polonica	Polish Cochineal	Carminic Acid	Reds	Silks	Norway, Sweden
Yellow X – always found with indigotin	? Dyes eliminated include: Weld, Broom, and Heather	?	Green & Yellow (In all but one instance found with indigotin. Dye itself produced a yellow.)	Seven Textiles (fiber composition was unspecified)	Norway, Denmark, Dublin

Mordants and Modifiers most likely used	Alum:	We have archeological evidence for clubmoss (*Diphasium complanatum, Lycopodium complanatum*) which is a likely source of alum.
	Iron:	Most likely through the dyepot
	Copper:	Most likely through bronze dyepots
	Tannin:	Perhaps from Oak Galls
	Calcium Carbonate:	(Think shells or Coccolithophores)

**This table is a work in progress.*

PICTURED ABOVE – TOP: *Madder dyepot.*
BOTTOM: *Yarn dyed with weld and woad.*

created by known substances. They are even able to draw conclusions about the shades based on the level of dye chemical found (Walton-Rogers Wools 153-54)! The chemistry surrounding the identification of these dyes is also detailed enough that subtle differences between the dye resulting from kermes and cochineal can often be pinpointed (Koren 276). Mordants are a bit trickier to identify because they can be confused with minerals from soil deposits. Their position and density in the soil around the finds would need to be analyzed to positively identify common modifiers such as iron (Taylor Identification 154). A great deal of research has been done recently trying to both develop new methods of dye identification that will allow those more elusive dyes – such as the yellows – to be identified, in addition to the development of component identification methods that do not destroy textile samples (Vanden Berghe 1914-1915). Currently this research is focused on textiles dating just prior to the Viking Age, but hopefully this will result in even more data becoming available in the future!

In addition to the dyes identified on extant textiles, archeologists have also discovered plant material in contexts such as workshops that suggest their use as dyestuffs. Seeds, roots, flowers and stems from a variety of dye plants including woad, weld, madder, walnut, heather, and broom have been discovered at a variety of Viking Age sites (Walton-Rogers Textile Production 1767-69). The plants were identified by archaeobotanists using a variety of methods including chemical analysis and even observation of distinctive plant dermal patterns, such as arrangement of the stomas that plants use for respiration, observed under a dissecting microscope (Tomlinson 270). Woad plant remnants were actually found in a manner that suggests they had been fermented – evidence that lends extra credence to the remains being found in a dye context (Tomlinson 278). Also of interest is the discovery of a non-native variety of clubmoss at Jórvík. Clubmoss actually absorbs aluminum making the plant a great mordant in the absence of alum. (Taylor Reds 40, Duff and Sinclair 29). The variety of clubmoss found is not native to the British Isles, and is, in fact, native to parts of Scandinavia (Hall Evidence 25, Tomlinson 275). From this it can be inferred that the clubmoss was imported specifically to be used in a textile dye context. Having evidence that aluminum-based mordants were used further supports the use of adjective dyes such as weld and madder during this period.

OK, SO WHAT COLORS DID THEY USE?

As laid out in Table 1, there is evidence that reds, blues, yellows, purples, pinks, oranges, greens, and browns could be achieved using dyestuffs that have been identified archaeologically either as plant material found in a dye context, or on an extant Viking Age textile using chromatography. There is also some positive chemical evidence of the use of mordants, and this greatly widens the available color palette (Walton-Rogers Cordage 401). Fibers that were naturally brown or grey would also give a greater variety of achievable colors, and the chromatography process has positively identified several examples of over-dyeing, textiles dyed with more than one dye (Pritchard 98). The unidentified dye referred to as Yellow-X, for example, was only detected because the indigotin – the principal colorant matter in indigo – came off of the textile differently in some instances (Walton-Rogers Wools 154, Summary 17). This happened because in addition to the indigotin, a mordanted dye was applied to the cloth as well – the textile had been overdyed. The Vikings were creative in their color use too. There are examples of woad blue stripes being dyed over madder, and diamond twill being woven with a heavily saturated wood-blue warp and an off-white weft – thus giving the effect of blue diamonds on an off-white field (Walton-Rogers Dyes and Wools 153-4). The starting color differences between natural fibers also were employed to create patterns in the fibers' un-dyed state, when woven together.

Because Viking settlements and trade routes covered such a wide geographic area, they had access to dyes that are not native to Scandinavia – both in the form of pre-dyed imported textiles and imported dyestuffs (Walton-Rogers Wools 156). Some dyes, such as Polish cochineal and kermes, were found only on textiles whose contexts suggest that they were imported (Heckett 105-108). This widespread geographical distribution of Viking Age Scandinavians also meant that the variety of native dyestuffs to which they had access differed depending on where they lived.

There is also evidence to suggest regional differences in color usage. For example, the Anglo-Scandinavians lived in a climate where madder could be grown rather than simply imported, and proportionally a larger number of items dyed with madder were found there. Thus, Anglo-Scandinavian finds tend towards reds and oranges (Walton-Rogers Textile Production 1769). Norwegian and Danish examples tend towards blues from woad, and Irish examples tend towards purples from lichens (Walton-Rogers Summary 18-19). The regional differences may stem from incomplete data – especially since the textile finds as a whole are not from consistent contexts. Overall, the finds from Scandinavia tend to be from wealthier burials, and that is not the case for the Anglo-Scandinavian and Hiberno-Norse textiles (Walton, Summary 19).

In conclusion, there is archaeological evidence establishing a strong tradition for dyed textiles throughout Scandinavian settlements during the Viking Age. There appear to have been regional preferences in the choice of dyestuffs, but this picture may be incomplete. Items dyed with lichens, weld, woad, and madder have been found throughout the Scandinavian settlements. The availability of the three primary colors as well as the use of over-dyeing and the textiles' natural color variations would have given Viking Age dyers a large palette to choose from, and the import of exotically dyed silks would have added to those color choices. The evidence points to the chromatic fashion choices of Scandinavians throughout Viking settlements during the Viking Age being as colorful as their history.

SELECT BIBLIOGRAPHY

Barber, E. J. W. *Prehistoric Textiles: the Development of Cloth in the Neolithic and Bronze Ages with Special Reference to the Aegean.* Princeton, N.J.: Princeton University Press, 1991. Print.

Downham, Clare. "Viking Ethnicities: A Historiographic Overview." *History Compass* 10.1 (2012): 1-12. Print.

Duff, D.G., and R.S. Sinclair. "The Use of Aluminum in Clubmoss as a Dye Mordant." *Dyes in History and Archaeology* 7 (1989): 25-31. Print.

Hall, A.R. "Evidence of Dye Plants from Viking Age York and Medieval Beverly." *Dyes in History and Archaeology* 2 (1983): 25. Print.

Hall, Allan R., and Philippa Tomlinson. "Archaeological records of dye plants—an update with a note on fullers' teasels." *Dyes in History and Archaeology* 8 (1989): 19-21. Print.

Heckett, Elizabeth. *Viking Age Headcoverings from Dublin.* Dublin: Royal Irish Academy, 2003. Print.

Koren, Z.C. 1994. HPLC analysis of the natural scale insect, madder and indigoid dyes. *Journal of the Society of Dyers and Colourists* 110, pp. 273–277.

Pritchard, Frances. "Aspects of the wool textiles from Viking Age Dublin" pp.93-104. *Archaeological Textiles in Northern Europe* 4 (1992): 93-104. Print.

Taylor, G.W. "Detection and Identification of Dyes on Anglo-Scandinavian Textiles." *Studies in Conservation* 28 (1983): 23-26. Print.

Taylor, George W. "Reds and Purples: from the Classical World to Pre-Conquest Britain", *Textiles in Northern Archaeology: NESAT III: Textile Symposium in York, 6-9 May 1987*, edited by Penelope Walton and John-Peter Wild (London, 1990), p. 37-46

Tomlinson, Philippa. "Use of Vegetative Remains in the Identification of Dyeplants from Waterlogged 9th-10th Century AD Deposits at York." *Journal of Archaeological Science* 12 (1985): 269-283. Print.

Vanden Berghe, I., Margarita Gleba, and Ulla Mannering. "Towards the identification of dyestuffs In Early Iron Age Scandinavian peat bog textiles." *Journal of Archaeological Science* 36.9 (2009): 1910-1921. Print.

Walton-Rogers, Penelope. "Dyes and Wools in Iron Age Textiles from Norway and Denmark." *Journal of Danish Archaeology* 7 (1988): 144-158. Print.

Walton-Rogers, Penelope. "Dyes of the Viking Age: A Summary of Recent Work." *Dyes in History and Archaeology* 7 (1989): 14-20. Print.

Walton-Rogers, Penelope. *Textiles, Cordage and Raw Fibre from 16-22 Coppergate.* London: Published for the York Trust by the Council for British Archaeology, 1989. Print.

Walton-Rogers, Penelope. *Textile Production at 16-22 Coppergate.* York: Published for the York Archaeological Trust by Council for British Archaeology, 1997. Print.

For a complete bibliography, please contact the Member Services Offices at (408) 263-9305; Monday–Thursday 9 am–4 pm PT and reference this article title.

AUTHOR AND PHOTOGRAPHER

Kristina Gundersen *has been an elementary and science educator for 14 years. She currently resides in Southern California with her husband and a small zoo. (Don't ask about the snails. They're for science.)*

Meave Douglass (THL) *is a 14th C Scot living in the Lanarkshire region. Her interests include research, natural dyes, weaving, and embroidery.*

SCA PUBLICATIONS

THE SCA PRODUCES TWO PUBLICATIONS: *The Compleat Anachronist* and *Tournaments Illuminated*. *The Compleat Anachronist* is a monograph series that extensively covers one topic per 50-60 page volume and is published each quarter. A few of the 150-plus topics printed to date have included *Making Medieval Mead, or Mead Before Digby; Unveiling the Truth: Medieval Women's Hairstyles, Volume I: Hairstyling Tools and Easy Hair Fashions from 600 to 1500;* and *The Basic Craft of Turnshoes: Basic Skills Used to Make Common Turnshoes.*

Tournaments Illuminated is the SCA's quarterly magazine. It contains four to five articles with topics on how to thrive in the Society, as well as works of research, and a good portion of the articles include "how-to" instructions. It also features a humor column, book reviews, listings of major SCA events, an occasional interview column with history professionals, SCA announcements, select advertisements, and a column featuring medieval destinations.

Both publications are available by subscription, which you can purchase with your membership or at any time during your membership year through the Member Services office (membership@sca.org). Some of the articles are also available online free of charge, and back-issues of many issues of both publications can be purchased through the Stock Clerk.

So where do you find all this treasure?

Start at www.sca.org and look for Publications and/or Shopping!