Dyes in Early Northern Europe.

THEY WORE COLOR?

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So when exactly are we talking about?

- Roman Empire-
  - 753 BCE-Kingdom
  - 504 BCE- Republic of Rome
  - Empire-27 BCE
- Migration Period- Approximately 400-700
  - Visigoths 357-410
  - Vandals 406-439
  - Huns 370-451
- Viking Age- Approximately 800-1100

- Geographically, they lived throughout Northern Europe in what we now call Norway, Sweden, Denmark, Finland, and Northern Germany.

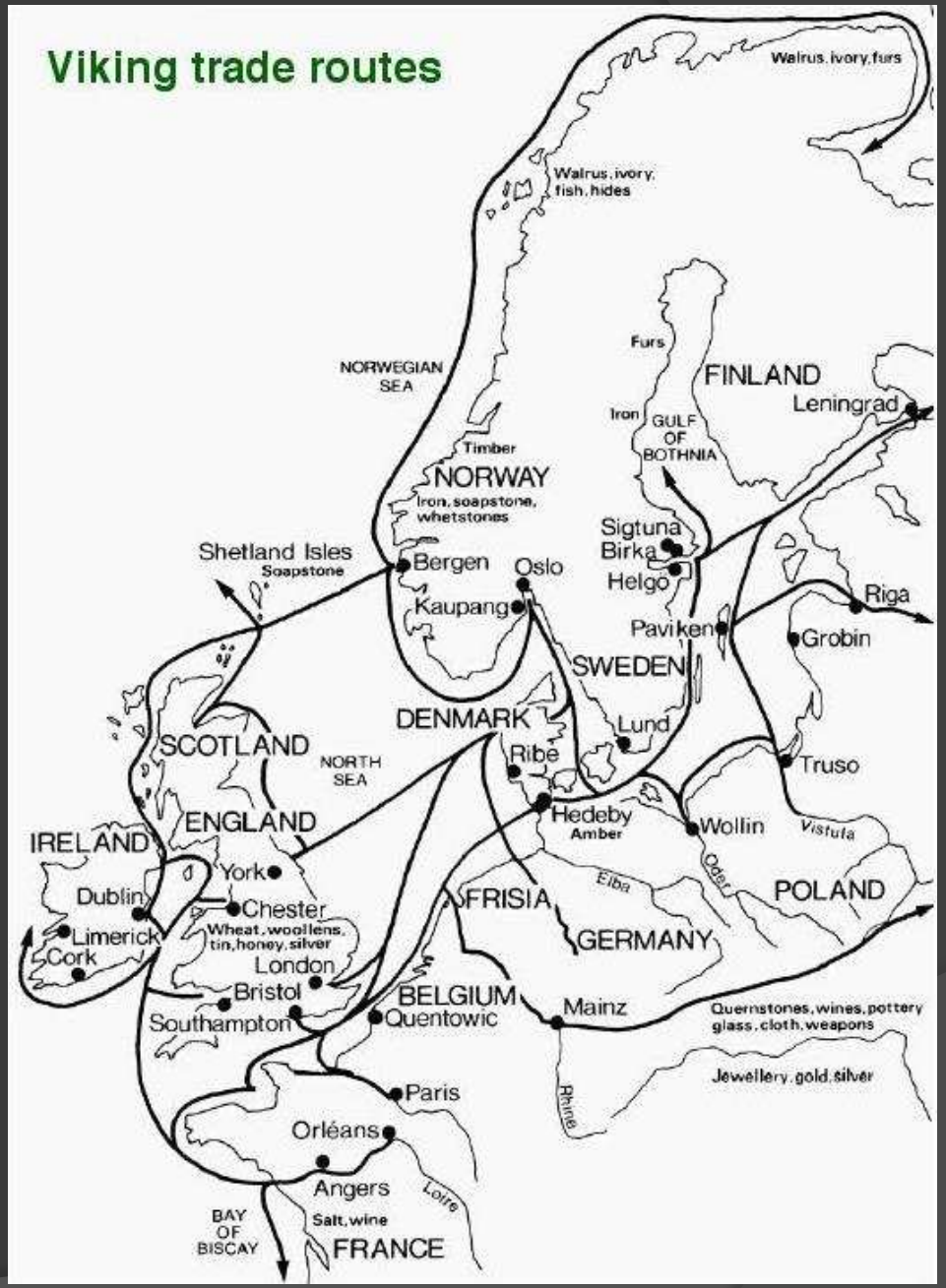
- Viking settlements were also to be found along the coasts and river-ways of Ireland, the British Isles, Scotland, Iceland, and the Baltic.

- The settlements in northern and eastern England (including the city of Jórvík, or modernly York) comprised what is known as the Danelaw. 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.

- We know Scandinavian traders during the Viking Age also had contact with Byzantium and the Mediterranean.



Colorants, and mordants, and modifiers oh my!

- Fugitive- really more of a stain
- Permanent- chemically bond with the fiber
  - Substantive- chemically fixed to the fiber on their own
  - Adjective- need some help from another substance such as tannin or alum. These are called *mordants*, and are usually metals.
  - They actually have found non-native clubmoss, an aluminum absorbing plant, at York. It was most likely imported as a mordant.

Color Variations

- Depending on the *mordant* you use, the color will change. For example, iron will *sadden*, or dull, the color.
- Factors such as pH can also be adjusted using *modifiers* such as calcium carbonate and will change the color. For example, soda ash will brighten the yellow weld gives.
- All wool is not white.
- The length of time and amount of fiber to dyestuff ratio in a pot will change the color.
- The range of colors possible is also increased with overdyeing.

They wore color? But everything looks brown!

Challenges

- There are no contemporary written descriptions that describe textile color.
- Contemporary art tends to be representational and not in color
- Extant textiles have been damaged and altered by soil and excavation methods
- Soils tend to be rich in mordants such as tannin, which turn things brown
- Some dyes are fugitive, and have long since faded from the textiles.
- Dye identification methods can be destructive.

For Science! (Or how we know what we think we know.)

- Dye Identification by Chemists
  - TLC (Thin Layer Chromotography)
  - HPLC (High-Pressure Liquid Chromotography)
  - FTIR (Fourier Transform Infrared Microscopy)
- Identification of botanical remains by archeobotanists
  - Seeds
  - Stems and leaves

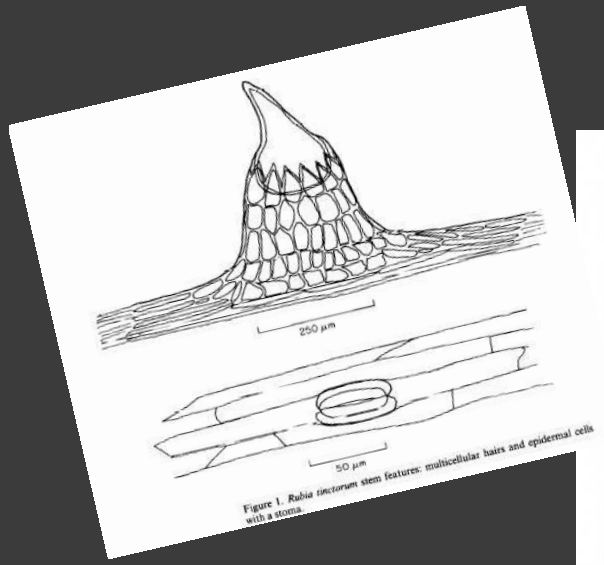


Figure 1. *Rubia tinctorum* stem features: multicellular hairs and epidermal cells with a stoma

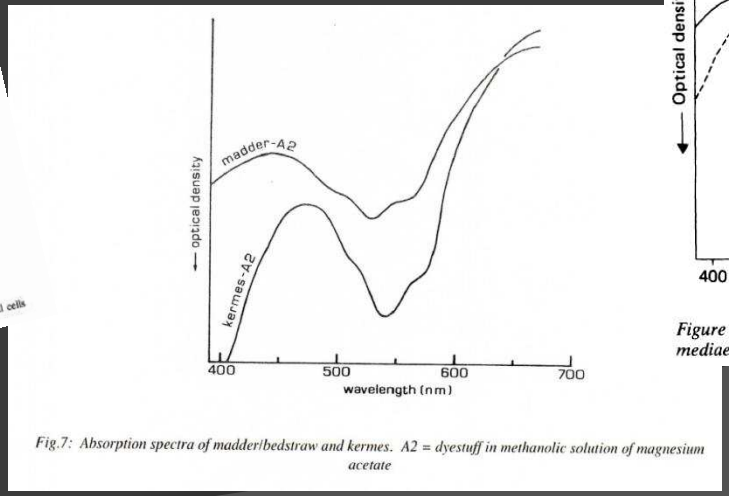


Fig.7: Absorption spectra of madder/bedstraw and kermes. A2 = dyestuff in methanolic solution of magnesium acetate

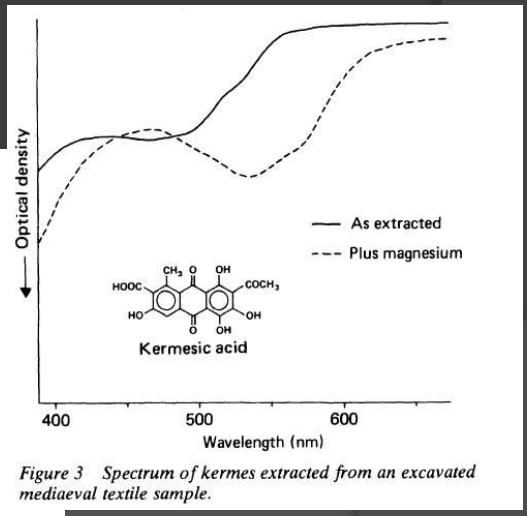


Figure 3 Spectrum of kermes extracted from an excavated mediaeval textile sample.

Walton, Penelope. 1988. "Dyes of the Viking Age: A Summary of Recent Work." *Dyes in History and Archaeology* 7, pp. 14-19.

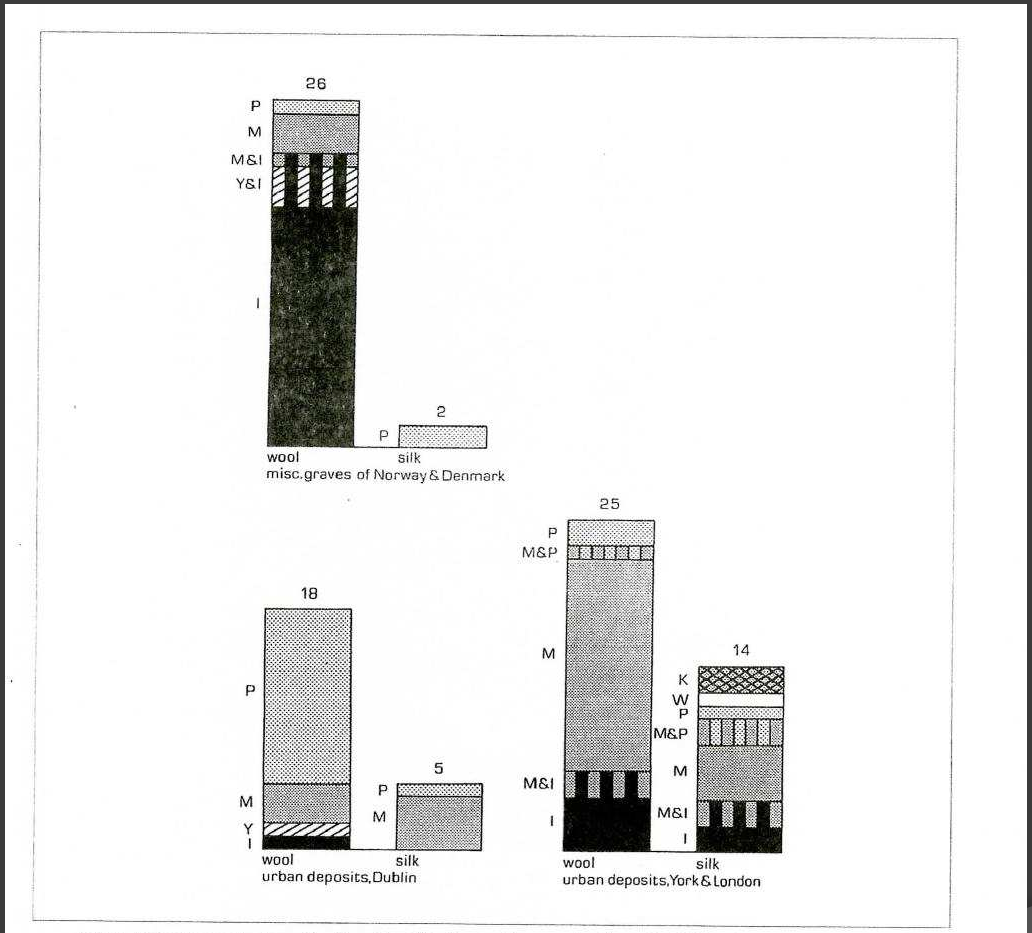


Fig.9: Bar-graphs to show the dyes identified in textile samples from the Viking Age. I = indigo/woad (indigotin); M = madder/bedstraw; P = lichen purple; Y = 'yellow X'; W = weld; K = kermes

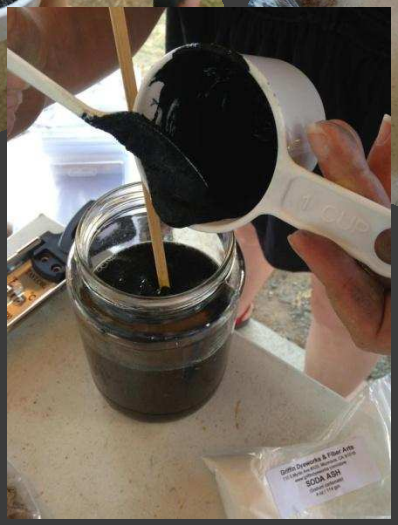
Ok, so what colors did they use?

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	Flavonols: Quercetin & Myricetin	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	Ireland
Kermes vermilio	Kermes	Kermesic Acid	Reds	Silks, Wool Tunic	Norway, York
Porphyrophora polonica	Polish Cochineal	Carminic Acid	Reds	Silks	Norway, Sweden
Yellow X- found with indigotin in all but 1 case	? Dyes eliminated include: Weld, Broom, and Heather	?	Green & Yellow (In all but 1 instance found with indigotin. Dye itself produced a yellow.)	7 Textiles (fiber composition was unspecified)	Norway, Denmark, Dublin
Mordants & 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**				

Woad

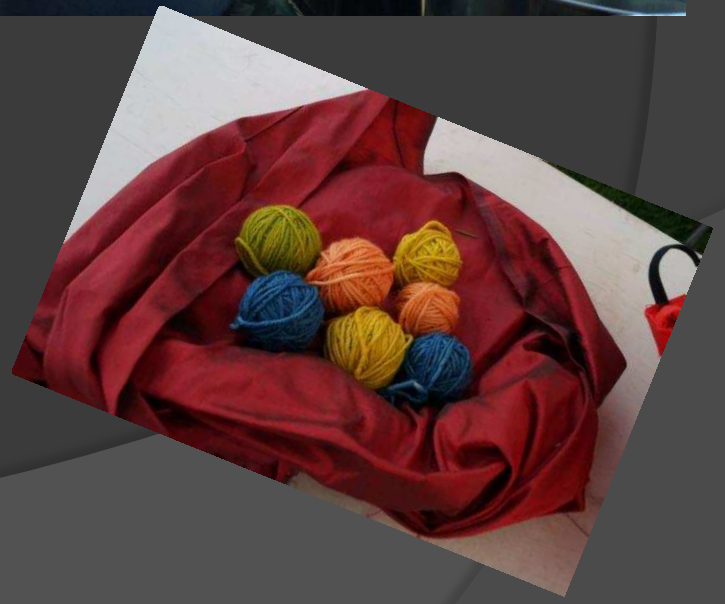
Woad

Modern Chemical Vat



- Substantive dye, no mordant needed
- More common on Norwegian & Danish finds
- Extant textiles show very dark blues as well as well as stripes and diamond outlines (in a twill)
- Has been used to create greens & purples by over-dyeing weld & madder

Woad Oxidizing



Woad Fermentation Vats

http://www.tubechop.com/watch/2374088

Isatis tinctoria	Woad	Indigotin	Blues, Greens	Seeds, Wool, Linen, Silk	Norway, Denmark, York, Sweden, Dublin

Weld

Weld

- Either dried or fresh weld is simmered in a pot for about 30 minutes.
- Dye “strikes” so the color won’t change with the amount of time in the pot.
- Adjective dye, mordant with alum
- Has been detected on more extant pieces in recent years (these aren’t on the table yet).
- Soda Ash will brighten the yellow.

Reseda luteola	Weld, Dyer’s Rocket	Luteolin	Yellows, Golds	Seeds, Silks	York, Sweden

Madder & Bedstraw

Madder & Bedstraw

- Madder can produce a huge range of colors depending on the pH, temperature and time it is soaked. We're in the middle of experimenting with the best way to get a true red.
- Madder works well as a sun tea, but can also be used in a hot dye-pot. The temp should be kept under 158°F if going for reds.
- There are two dye chemicals in madder. One produces yellow, one red.
- Adjective dyes, alum mordant
- Jenny Dean suggests using similar methods for Bedstraw.
- More common on Anglo-Scandinavian extant finds

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

Madder

Walnut

Walnut

- When using fresh walnuts, remove the hulls (wear gloves!), boil in water, strain to create dye-bath, and simmer fiber.
- Will stain everything!
- Substantive dye

Juglans regia	Walnut	Juglone, Tannin, Plumbagin	Browns, Tans	Wool, Plant Material	Norway, Denmark

Lichen

Lichen

- Ammonia Method (AM)- fermentation in 50/50 water/ammonia solution, shake daily to oxygenate. Takes several months.
- Boiling Water Method (BWM)- Lichens added to water & heated
- Substantive Dye
- More common on Hiberno-Norse extant finds

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

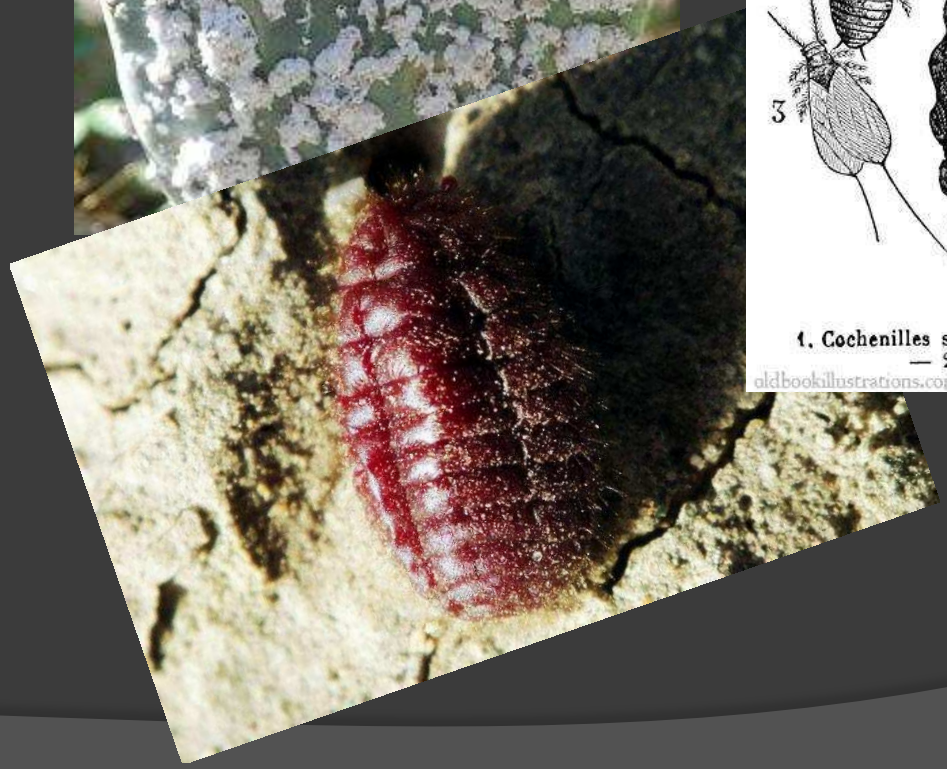
Heather & Broom

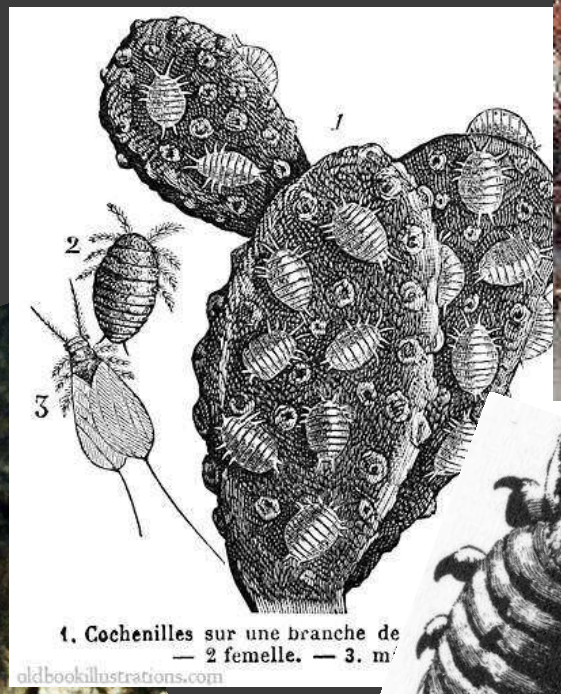
Heather & Broom

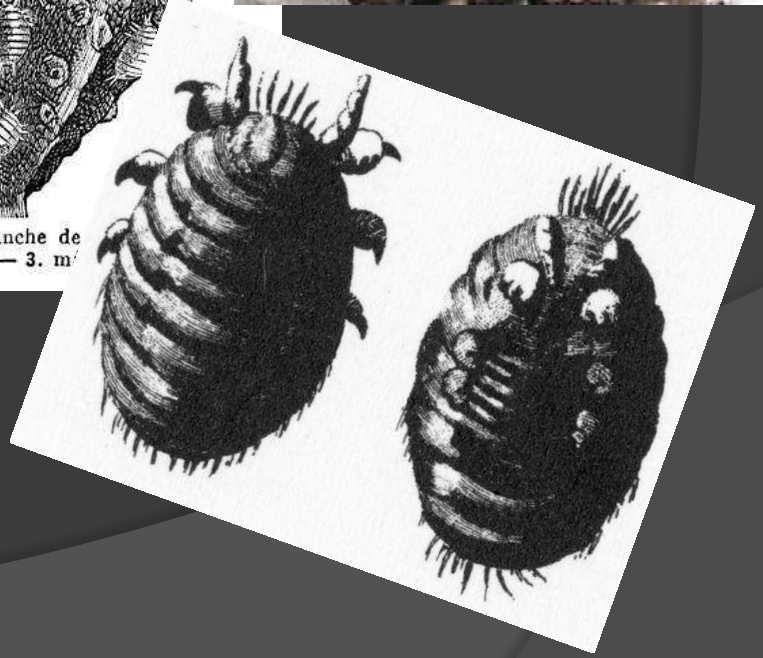
- Both produce yellow dyes, which are more difficult to detect.
- Flowers yield the dye. Simmer in water.
- Adjective dyes, alum mordant

Calluna vulgaris	Heather	Flavonols: Quercetin & Myricetin	Yellow	Plant Material	York
Genista tinctoria	Broom, Dyer's Greenwood, Woadwaxen	Genistein	Yellow	Plant Material	York

Polish Cochineal & Kermes







Polish Cochineal & Kermes

- Mostly found on imported silks
- Kermes & Polish Cochineal have slightly different chemical signatures
- Very sensitive to pH
- You can either crush the dried insects, or use them whole. Using them whole requires boiling several times to extract the dye.
- Adjective dye, requires a mordant

Kermes vermilio	Kermes	Kermesic Acid	Reds	Silks, Wool Tunic	Norway, York
Porphyrophora polonica	Polish Cochineal	Carminic Acid	Reds	Silks	Norway, Sweden

Dog Whelk

Nucella lapillus	Dog Whelk	Dibromoindigo	Tyrian Purple	Silks, Shells in Dye Workshop	Ireland

William Cole in 1685 described in some detail how to use *Nucella lapillus* (his drawing on the left) to obtain the purple dye.

"found this species on the shores of the Bristol Channel, which on cracking and picking off the shell, exhibited a white vein lying transversely in a little furrow or cleft next the head of the fish; which must be digged out with the stiff point of a horse hair pencil being made short and tapering; which must be so formed by reason of the viscous claminess of that white liquor in the vein so that by its stiffness it may drive in the matter into the fine linnen or white silk ..... if placed in the Sun will change into the following colours, i.e., if in the winter about noon, if in the summer an hour or two after sunrise and so much before setting (for in the heat of the day the colours will come on so fast, that the succession of each colour will scarce be distinguishable) next to the first light green will appear a deep green; and in a few minutes this will change into a dull sea green; after which, in a few minutes more, it will alter into a watchet blue; from that in a little time more it will be purplish red; after which, lying an hour or two (supposing the Sun still shining) it will be of a very deep purple red; beyond which the Sun can do no more."

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