



# MADDER LAKE: HISTORY, CHEMISTRY, AND PREPARATION

*The Making and Knowing Project*

*Last updated 2023-09-16 by*

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Much of this material was initially developed as part of public workshops at [Genspace Community Lab](#) (New York), made possible by the Public Outreach Grant, *Colorant Sustainability Workshops* (Naomi Rosenkranz and Sumeyye Yar), from Columbia University's [Center for Science and Society](#).

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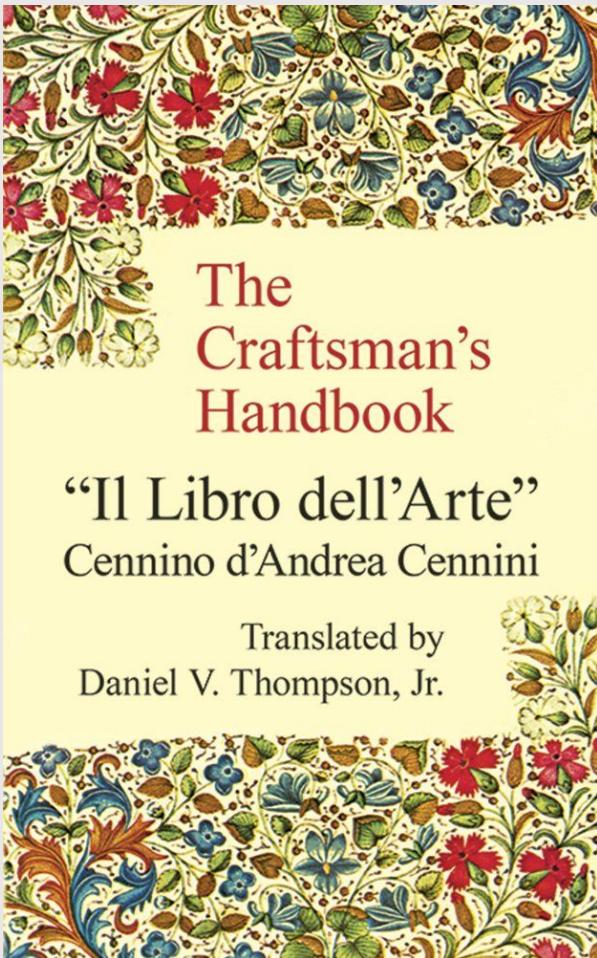


Jo Kirby, Maarten van Bommel and André Verhecken

# Main reference work

Jo Kirby, Maarten van Bommel, and Andre Verhecken  
*Natural Colorants for Dyeing and Lake Pigments:  
Practical Recipes and their Historical Sources*  
(Archetype, London, 2014).

# Primary sources

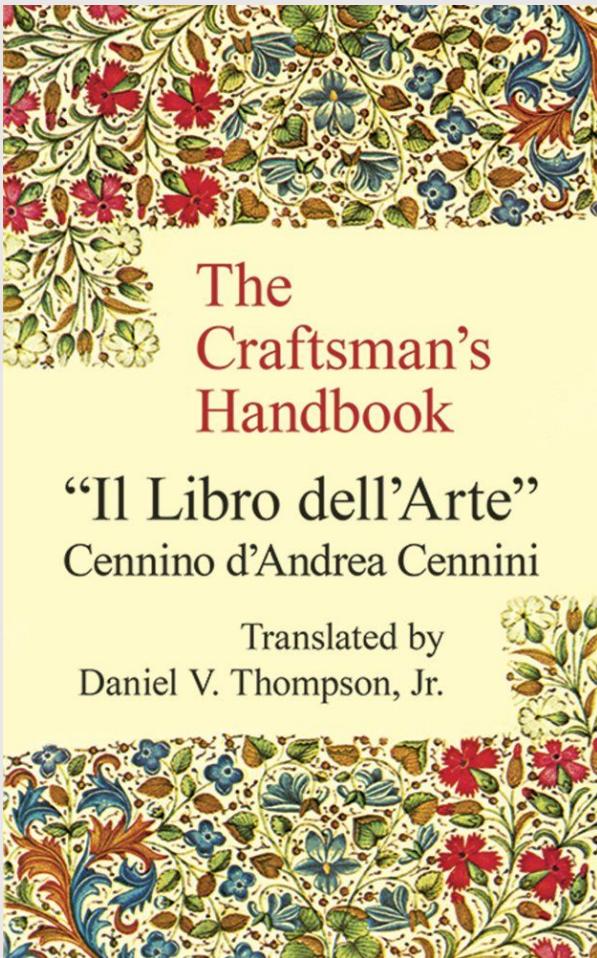


“Cennini”

end of the 14th century, Italian

Cennino Cennini, *The Craftsman's Handbook: "Il Libro Dell' Arte"* [End of 14th Century], ed. Daniel V. Thompson, 2nd Edition (New York: Dover Publications, 1954).

# Primary sources



## **Fundamental Provisions for Anyone Who Enters This Profession. Chapter III:**

You, therefore, who with lofty spirit are fired with this ambition, and are about to enter the profession, begin by decking yourself with this attire: Enthusiasm, Reverence, Obedience, and Constancy. And begin to submit yourself to the direction of a master for instruction as early as you can; and do not leave the master until you have to. (Cennini, 3)

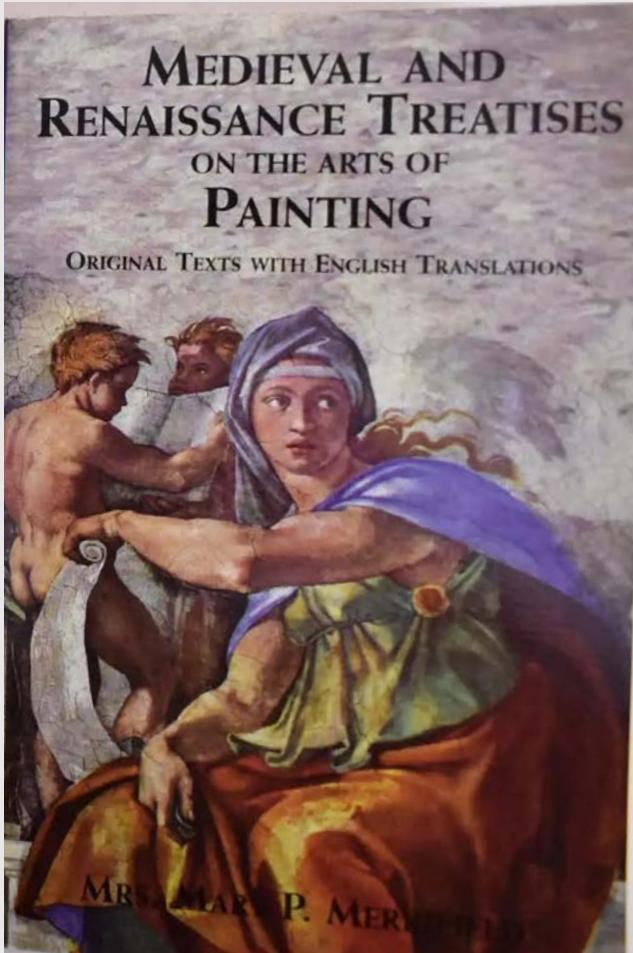
## **The Way to Paint a Drapery in Fresco. Chapter LXXI:**

...But you will learn far better by seeing it done than by reading ... (Cennini, 50)

## **How You Should Always Make a Practice of Working with Fine Gold and with Good Colors. Chapter LXXXVI:**

Most people make a practice of embellishing a wall with golden tin, because it is less costly. But I give you this urgent advice, to make an effort always to embellish with fine gold, and with good colors, especially in the figure of Our Lady. And if you wish to reply that a poor person cannot make the outlay, I answer that if you do your work well, and spend time on your jobs, and good colors, you will get a reputation that a wealthy person will come to compensate you for the poor one... And even if you were not adequately paid, God and Our Lady will reward you for it, body and soul. (Cennini, 60–61)

# Primary sources

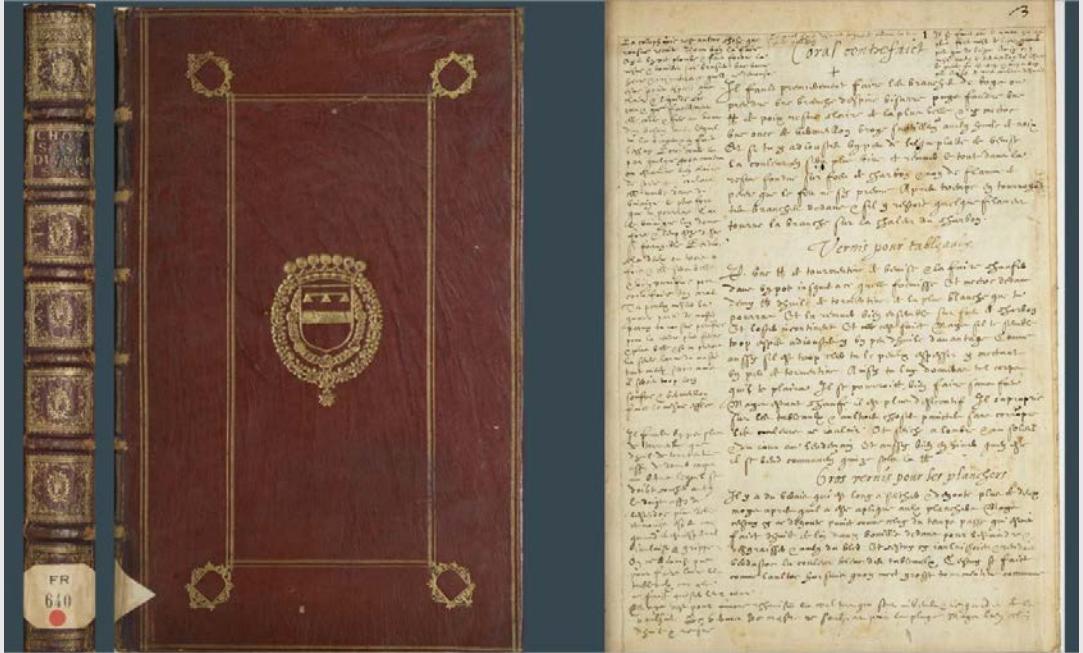


## "Merrifield"

with translated manuscripts from 13th – 17th centuries, including the “Marciana manuscript,” “Brussels manuscript,” and “Le Begue manuscript” (Italian, French, Latin)

Mary P. Merrifield, *Original treatises, dating from the XIIth to XVIIIth centuries on the arts of painting ... preceded by a general introduction, with translations, prefaces and notes*, 2 vols. (London: J. Murray, 1849).

# Primary sources



## “Ms. Fr. 640”

16th-century by anonymous  
“author-practitioner” (French)

Main object of study of the Making and Knowing Project.

*Secrets of Craft and Nature in Renaissance France. A Digital Critical Edition and English Translation of BnF Ms. Fr. 640*

edited by Making and Knowing Project, Pamela H. Smith, Naomi Rosenkranz, Tianna Helena Uchacz, Tillmann Taape, Clément Godbarge, Sophie Pitman, Jenny Boulbouillé, Joel Klein, Donna Bilak, Marc Smith, and Terry Catapano (New York: Making and Knowing Project, 2020),  
<https://edition640.makingandknowing.org/#/>.

# Definitions and background



# Pigment

- An insoluble, dry solid that is pulverized to a fine powder then mixed with a binder to form a paint, ink or crayon.
- See also [Introduction to paints and pigments 2021](#)



# Natural pigments

- Natural colorants are obtained from natural sources:
  - **Organic materials** (such as plants)
  - **Inorganic materials** (such as minerals)
- As most organic natural colorants are soluble, they cannot be mixed directly with a binding medium and therefore cannot be used as a pigment.
- **Lake pigments**: in general, pigments prepared from soluble natural colorants, formed by precipitating (or adsorbing) the dye onto a colorless or white, insoluble, relatively inert substrate.
- Thus, to understand **lake pigments**, we must discuss **organic dyes**.

# Dye definition and sources

A **DYE** is a compound that absorbs into and colors another material, and is generally a complex organic material.

Natural dyes have historically been extracted from:

- **PLANTS**

- Such as alkanet, annatto, archil, brazilwood, buckthorn berries, cudbear, cutch, fustic, madder, indigo, litmus, logwood, morinda, quercitron, safflower, saffron, sassafras, sumac, turmeric, turnsole, walnut, weld, and woad

- **INSECTS**

- Such as kermes, lac dye, cochineal

- **LICHENS (algae or fungi) and SHELLFISH**

- Such as archil (lichen) and Tyrian purple (extracted from mollusks)

Synthetic dyes were first derived in 1856 (from coal-tar extracts to create mauve)

## **DYESTUFFS**

The raw organic materials used to create a dye



# Natural colorants

While colors can be extracted from all plants and some animal products, not all of these colorants have **good dyeing (or coloring) properties**.

They are not **COLORFAST**



pomegranate



grass



Light fastness tests of textiles dyed with natural colorants. Small squares of each sample were exposed to light of varying intensities and for different durations. The squares exposed to the brightest light for the longest time have faded the most.

<http://www.conervationphysics.org/fading/fade.pdf>

# Color fastness

## FASTNESS

The resistance of color to fading.

A colorfast dye will maintain its color when exposed to light, steam, high temperatures, soap, salts, and other environmental conditions.

## LIGHT FASTNESS

How resistant a color is to fading when it is exposed to light, especially sunlight.

<http://cameo.mfa.org/wiki/Fastness>



# Classification of organic dyes

# Types of dyes (by chemical class)

## Indigoids



## Anthraquinones



## Flavonoids



## Carotenoids



## Neo-flavonoids/homoisoflavonoids

### Logwood



# Types of dyes (by process)

## DIRECT DYES

Colorant forms a direct bond to the textile fiber



Turmeric

## MORDANT DYES

Colorant needs to bind to a coordination metal as a bridge between the dye and textile fiber



Madder

## VAT DYES

A chemical reaction (reduction) in the dye vat is needed to bind the dye to the textile



Indigo

# Common red colorants in early modern Europe (1400-1700)



# Safflower or bastard saffron

Botanical name: *Carthamus tinctorius* L.

Chemical class: carthamin (C-glucosylquinochalcone)

Region: Mediterranean, spread to southern and central Europe

Dye type: Direct

Petals contain a water-soluble yellow dye that is discarded in the process of obtaining an alkali-soluble red. Textile is dyed by placing in red alkaline solution and adding an acid like lemon juice.



<http://collections.vam.ac.uk/item/O485844/fukusa-gift-cover-unknown/>

Japanese (ca. 1868-1912), silk

# Henna

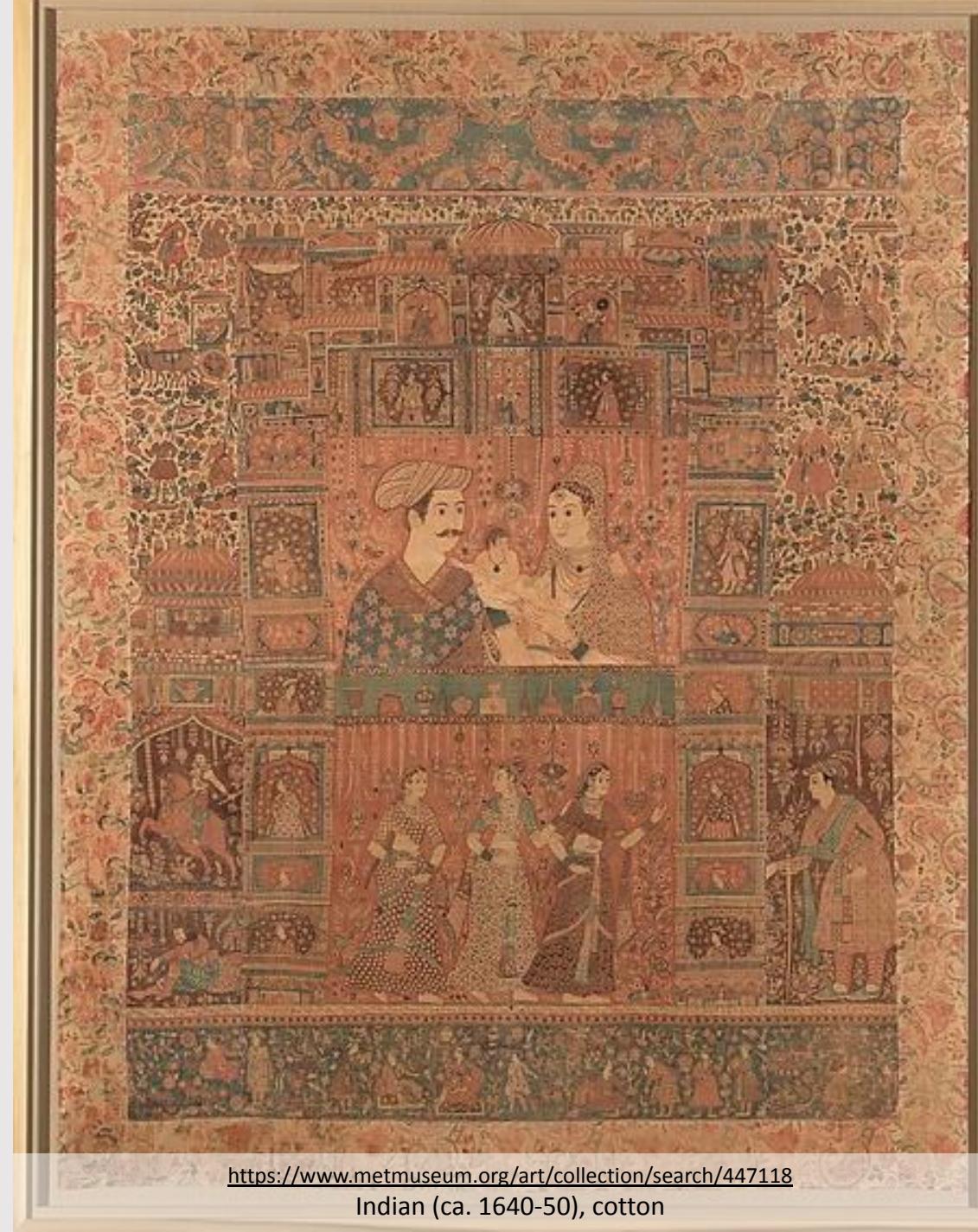
Botanical name: *Lawsonia inermis* L

Chemical class: lawsone or isojuglone (naphthoquinone)

Region: India, tropical and subtropical regions, spread to Mediterranean, Spain, and Sicily

Dye type: Direct or mordant dye.

Leaves are used to obtain orange-red to brown colors.



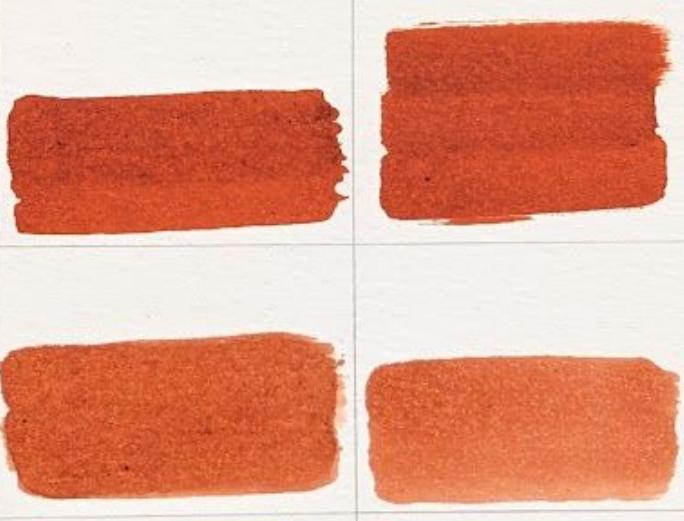
# Dragon's blood

Botanical name: *Dracaena draco* (and other related species)

Region: southeast Asia; initially from the island of Socotra before spreading to the New World.

The primary red coloring component is dracorubin.

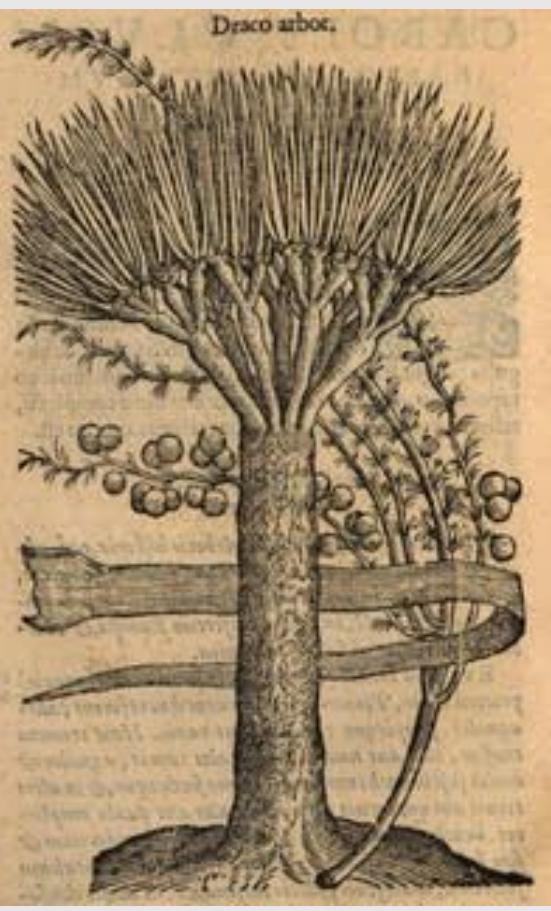
A transparent, red, resinous exudation from the fruit of several types of palms.



Portable Altar, ca. 1560–1580, likely the Netherlands. Wood, paint, and verre églomisé panels. red background of dragon's blood directly on glass. Permalink: <https://www.cmog.org/artwork/portable-altar>. © The Corning Museum of Glass.



Woodcut of *Dracaena Draco*, in Carolus Clusius, *Rariorum aliquot stirpium per Hispanias observatarum historia* (Antwerp: Christopher Plantin, 1576), 12. Bayerische Staatsbibliothek, Munich, Phyt. 98. [https://reader.digitale-sammlungen.de/de/fs1/object/display/bsb1111515\\_00014.html](https://reader.digitale-sammlungen.de/de/fs1/object/display/bsb1111515_00014.html).



# Dragon's blood



## ***On the Character of a Red Called Dragonsblood. Chapter XLIII:***

*A color known as dragonsblood is red. This color is used occasionally on parchment, for illuminating. But leave it alone, and do not have too much respect for it; for it is not of a constitution to do you much credit.*

Cennino Cennini, *The Craftsman's Handbook: "Il Libro Dell' Arte"* [End of 14th Century], ed. Daniel V. Thompson, 2nd Edition (New York: Dover Publications, 1954), 26.

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Cennino Cennini, *The Craftsman's Handbook: "Il Libro Dell' Arte"* [End of 14th Century], ed. Daniel V. Thompson, 2nd Edition (New York: Dover Publications, 1954).

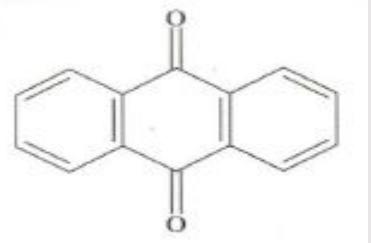
### ***Dragon's blood***

*It can be imitated with lake, which surpasses the dragon's blood in beauty if, tempered in oil, you glaze on gold or silver. Tempered in varnish, it dies.*

Folio 165r, in *Secrets of Craft and Nature in Renaissance France. A Digital Critical Edition and English Translation of BnF Ms. Fr. 640*, ed. Making and Knowing Project, et al. (New York: Making and Knowing Project, 2020), <https://edition640.makingandknowing.org/#/folios/165r/tl>.

# Lac

Species name: *Kerria lacca*, *Kerria chinensis*



Chemical class: laccaic acid and erythrilaccin among other similar constituents (anthraquinone)

Region: Southeast Asia. Spread to Mediterranean and then Europe.

Dye type: Mordant dye.

Scale insect parasitic on several tree species including bastard teak (*Butea monosperma* (Lam.)

Secretes a protective coating that encloses itself in a sticky brown mass similar to resin, known as sticklac. When purified, this is known as shellac which was less economically important than the dye unlike today.



[https://www.researchgate.net/figure/Some-lac-insects-known-from-the-New-World-a-Kerria-lacca-on-Albizia-sp-Peradeniya\\_fig1\\_51254451](https://www.researchgate.net/figure/Some-lac-insects-known-from-the-New-World-a-Kerria-lacca-on-Albizia-sp-Peradeniya_fig1_51254451)



Detail of Domenico Beccafumi, *The Story of Papirius* (NG 1430), probably 1540-50, oil on wood



<http://collections.vam.ac.uk/item/O61099/hanging-unknown/>  
Indian (ca. 1700), cotton and silk



15. Fragment of a caftan or robe with deer in a pearl roundel. Eastern Iran or Sogdiana, 8th–9th century. Compound twill weave silk (*samit*), the bright pink dyed with lac; 13 3/8 x 17 7/8 in. (34 x 44 cm). The Metropolitan Museum of Art, Purchase, Rogers Fund, by exchange, 2006 (2006.472)

# “Lake” etymology (Oxford English Dictionary)

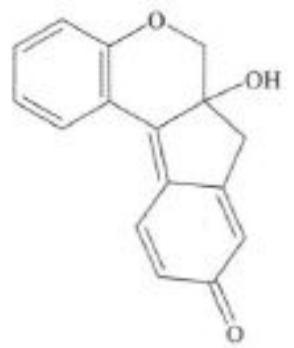
- The term derives from the Latin word *lacca*, used in the Middle Ages to denote both lake pigments and the Lac dye.
- **Origin:** Of multiple origins. Partly a borrowing from French. Partly a borrowing from Latin. **Etymons:** French *lac*, *laque*; Latin *lac*.
- **Etymology:** < (i) Anglo-Norman *lac*, *lak*, *lacca* and Middle French, French *laque*, †*lacque* natural lac (13th cent. in Old French as *lache*), coloured paint or varnish (mid 16th cent.), lacquerwork (1659 in the passage translated in quot. [1662 at sense 4](#)),
- and its etymon (ii) post-classical Latin *lac* (12th cent. in a British source), *lacca* (from 13th cent. in British and continental sources), both denoting natural lac

# Redwoods

Chemical class: Brazilin, colorless until oxidized by air becoming orange-red brazilein (homoisoflavanoid)

Dye type: Mordant dye.

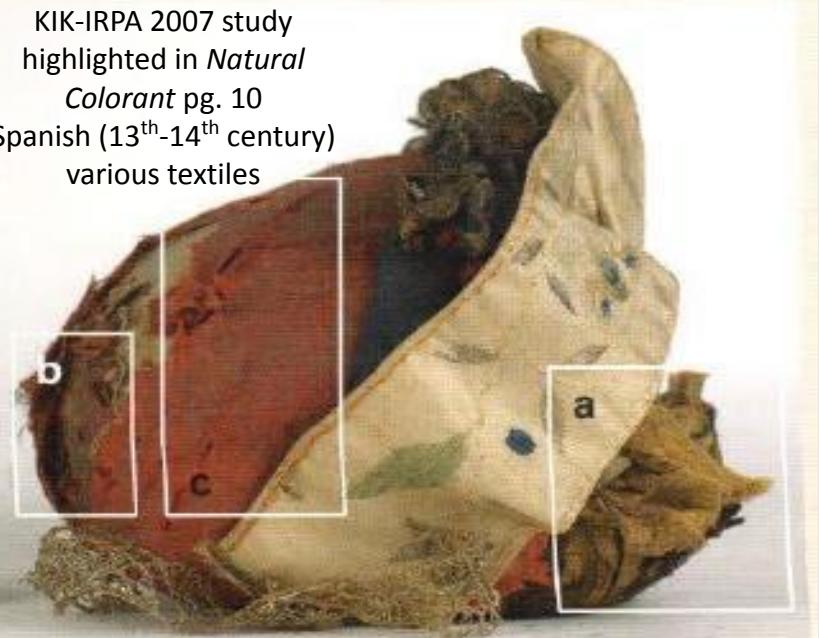
Extracted from orange-red wood, inner bark of trees, such as **sappanwood** (*Caesalpinia sappan* L.) - region: Central and southern India, Burma, Thailand, Indochina, southern China, Malaysia. Imported into Europe in early Middle Ages; **brazilwood** (*Caesalpinia brasiliensis*) and **pernambuco wood** (*Caesalpinia echinata Lamarck*) - region: Brazil and Caribbean Islands, then imported into Europe; **peachwood** (*Haematoxylum brasiletto* Karsten) - region: Central America, then imported into Europe.



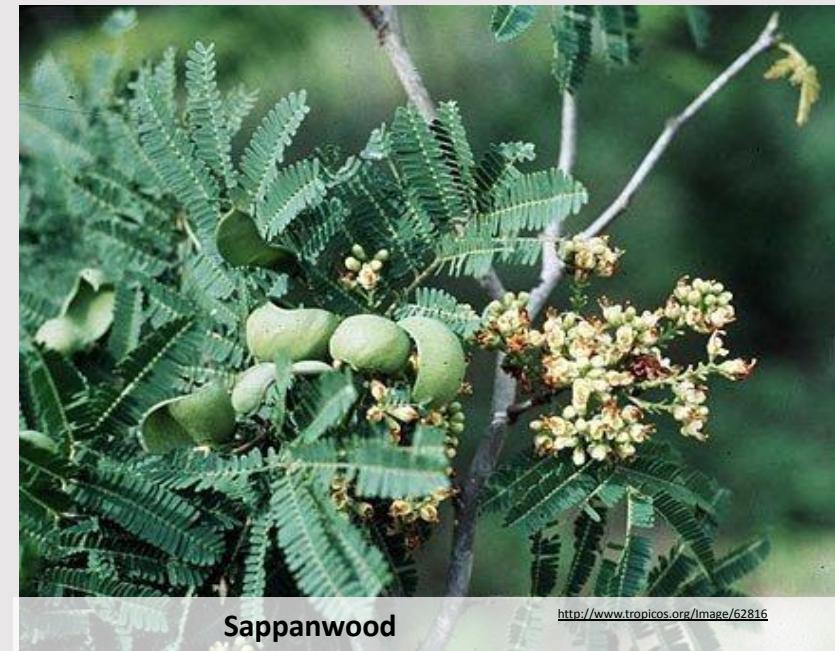
Brazilwood



KIK-IRPA 2007 study  
highlighted in *Natural Colorant* pg. 10  
Spanish (13<sup>th</sup>-14<sup>th</sup> century)  
various textiles



Brazilwood



Sappanwood

# Logwood

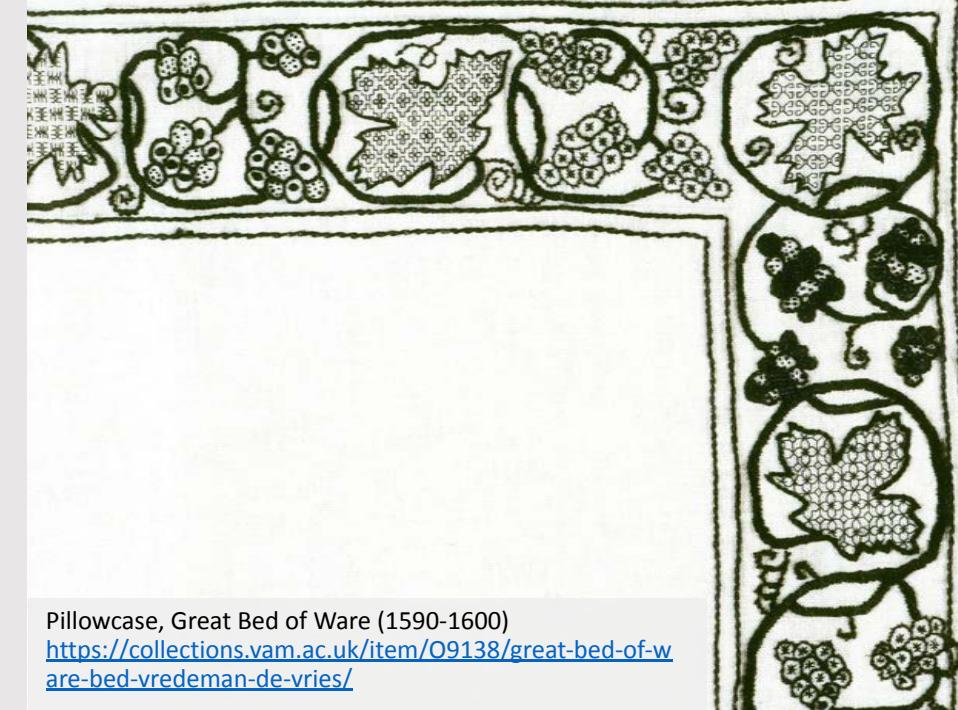
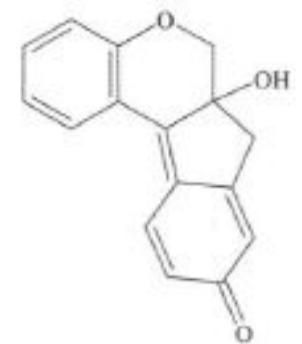
Botanical name: *Haematoxylon campechianum*

Chemical class: Hematoxylin (neo-flavonoid)

Region: Central America, Mexico, and the West Indies.

Dye type: Mordant dye.

Range of orange, red, brown, dark purple, and black dyes obtained from the heartwood of the tree. Also known as *Árbol de campeche*.



Pillowcase, Great Bed of Ware (1590-1600)  
<https://collections.vam.ac.uk/item/O9138/great-bed-of-were-bed-vredeman-de-vries/>



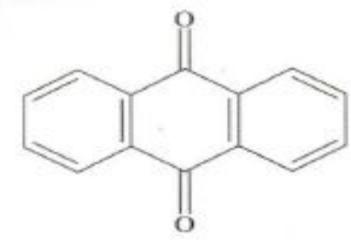
No mordant	Alum	Alum	No mordant
Logwood	Logwood	Logwood & potash	Logwood & potash



Logwood

# Kermes

Species name: *Kermes vermilio*



Chemical class: kermesic acid (anthraquinone)

Region: Limestone coastal regions around the Mediterranean in Spain, southern France, North Africa, and the eastern Mediterranean.

Dye type: Mordant dye.



<http://www.projectnoah.org/spottings/255006061>

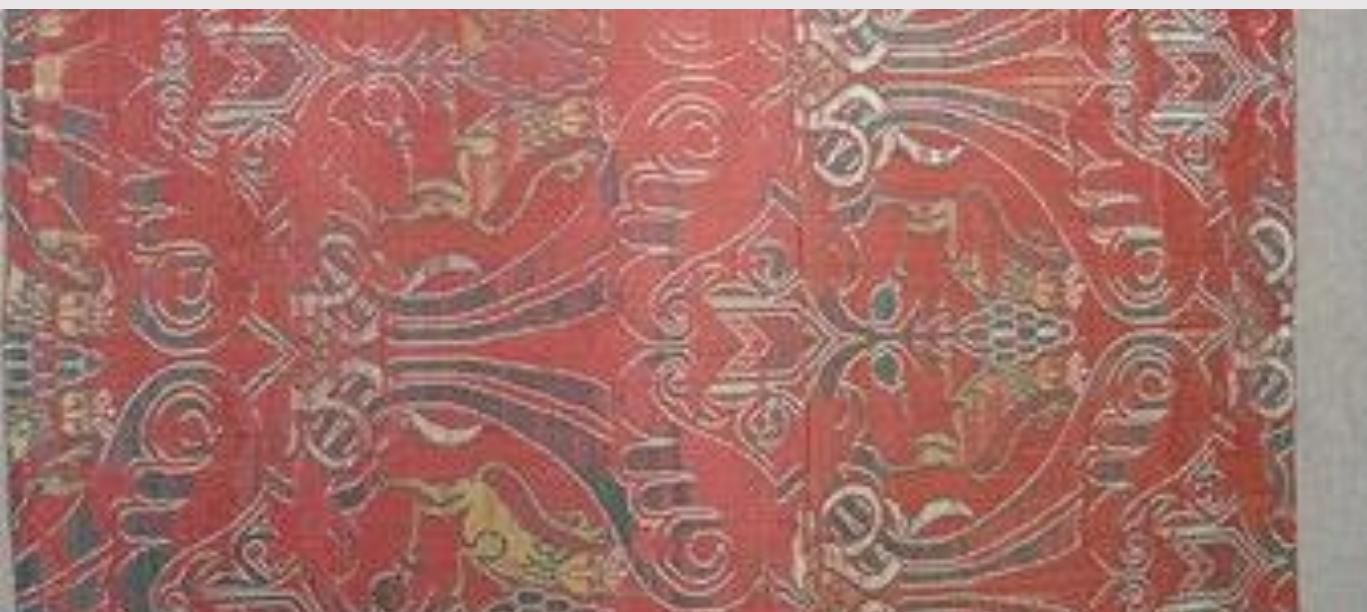
Scale insect parasitic to an evergreen oak (*Quercus coccifera* L.). Scarlet red color used to dye the highest quality fabrics. Used extensively throughout Europe until the arrival of cochineal from the New World in 16<sup>th</sup> century.

Dye is contained in the unhatched eggs of insect, and so can be extracted from females with unhatched eggs (more common) or from the eggs directly.

# Kermes



<http://collections.vam.ac.uk/item/O261109/woven-silk-unknown/>, Spanish (ca. 14<sup>th</sup> century), woven silk and satin



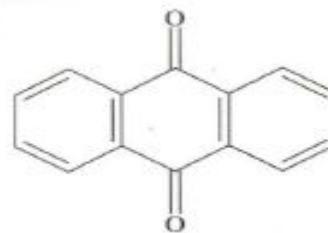
<http://collections.vam.ac.uk/item/O264602/woven-silk-unknown/>, Spanish (ca. 15<sup>th</sup> century), silk damask



The Virgin and Child with a Pomegranate, probably about 1480-1500, Workshop of Sandro Botticelli, <https://www.nationalgallery.org.uk/paintings/workshop-of-sandro-botticelli-the-virgin-and-child-with-a-pomegranate>

# Cochineal

Species name: *Dactylopius coccus*



Chemical class: carminic acid (anthraquinone)

Region: Cultivated in Mexico and Peruvian Andes, before Spain brought to Europe in 1523 where it spread rapidly.

Dye type: Mordant dye.



Scale insect found on prickly pear or Barbary fig cactus (*Opuntia ficusindica* (L.)).

Led to decline of use of kermes as it is almost **20% by weight more potent than kermes**. Dye is extracted from females with unhatched eggs.

# Cochineal



<https://www.metmuseum.org/art/collection/search/91678>

British (1750-75), silk and wool (uniform for redcoats)



<https://www.metmuseum.org/art/collection/search/307941>

Peruvian (15th-16th century), cotton & camelid hair



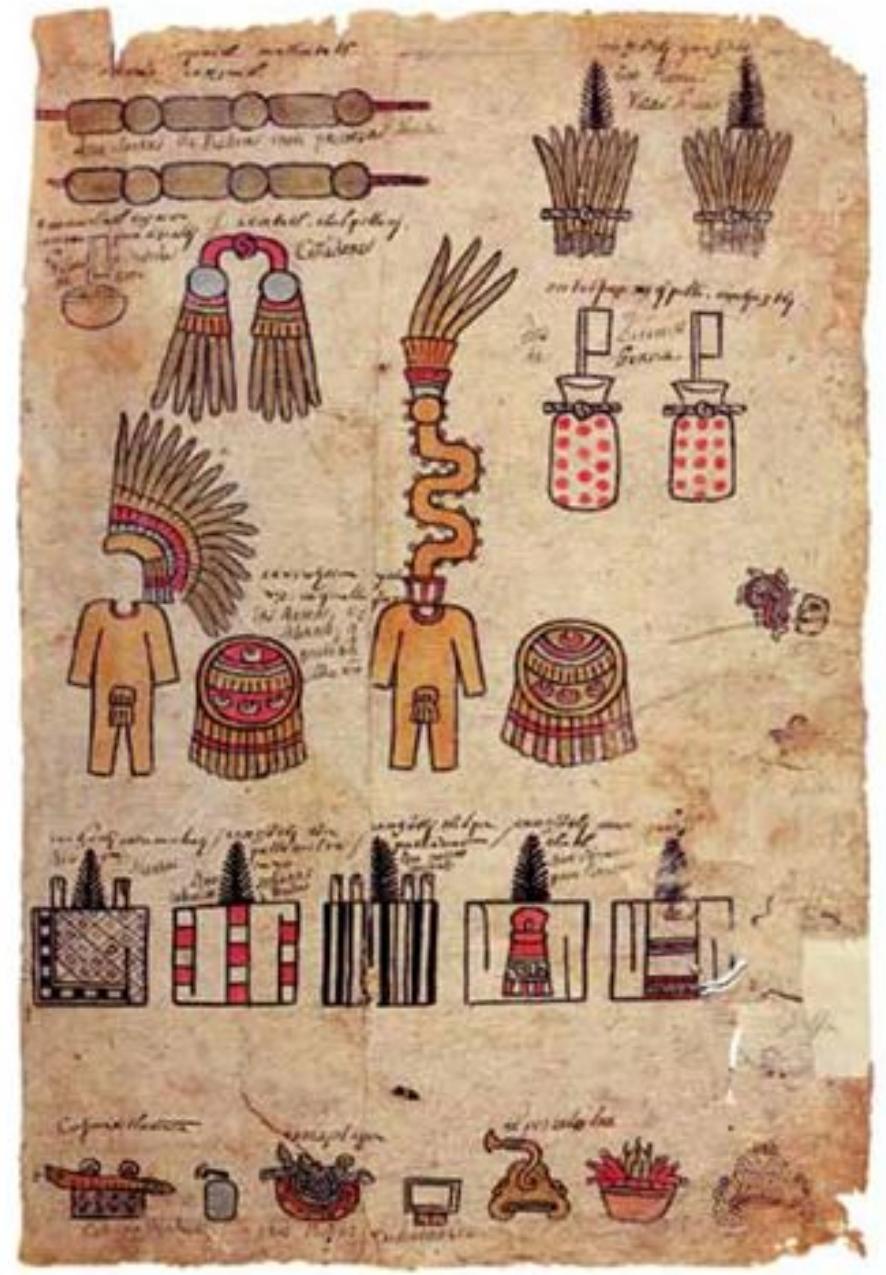
<https://www.metmuseum.org/art/collection/search/320804>

Peruvian (ca. 16<sup>th</sup>-17<sup>th</sup> century), camelid hair and cotton

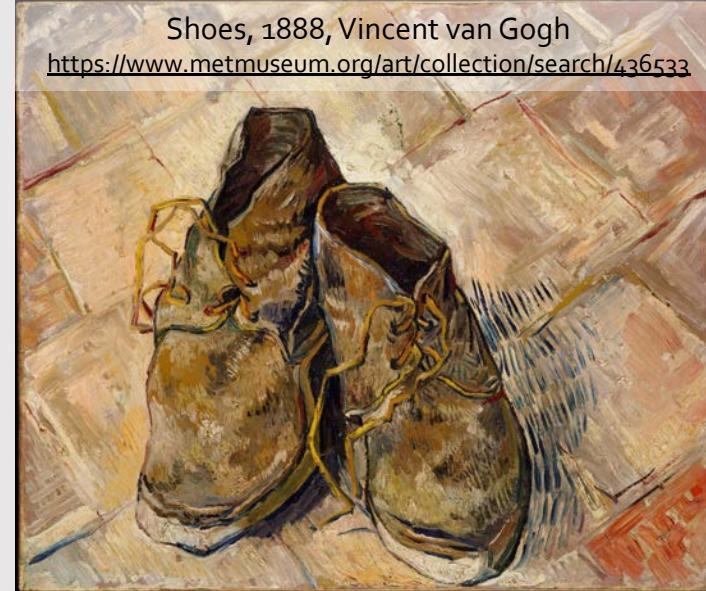
# Cochineal



The Virgin and Child with a Pomegranate, ~1480-1500  
<https://www.nationalgallery.org.uk/paintings/workshop-of-sandro-botticelli-the-virgin-and-child-with-a-pomegranate>



Matricula de tributos, early 16th-century, Mexico codex  
Biblioteca Nacional de Antropología y Historia (Codex 35-52)



Shoes, 1888, Vincent van Gogh  
<https://www.metmuseum.org/art/collection/search/436533>



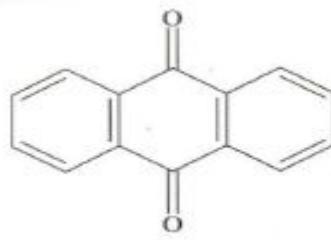
Two Tax-Gatherers, 1540s  
<https://www.nationalgallery.org.uk/paintings/workshop-of-marinus-van-reymerswale-two-tax-gatherers>



# Madder

# Madder

Botanical name: *Rubia tinctorum* L.



Chemical class: alizarin and purpurin (anthraquinones)

Region: Native to Middle East and east Mediterranean, then spread to Europe.

Dye type: Mordant dye.

Range of red-orange-brown dyes obtained from the roots of a bedstraw.



Dyer's Madder (1484)

Anonymous, *The Illustrated Bartsch. Vol. 90, German Book Illustration through 1500: Herbals through 1500*  
[https://library.artstor.org/#/asset/BARTSCH\\_4540006](https://library.artstor.org/#/asset/BARTSCH_4540006)



<http://spareatalent.blogspot.com/2020/11/roman-red-dying-leather-with-madder.html>



[http://thedomesticsoundscape.com/wordpress/?attachment\\_id=3451](http://thedomesticsoundscape.com/wordpress/?attachment_id=3451)



Madder plant  
Tropicos.org. Missouri Botanical Garden. <http://www.tropicos.org/Image/100119747>. Photographer: David Stang

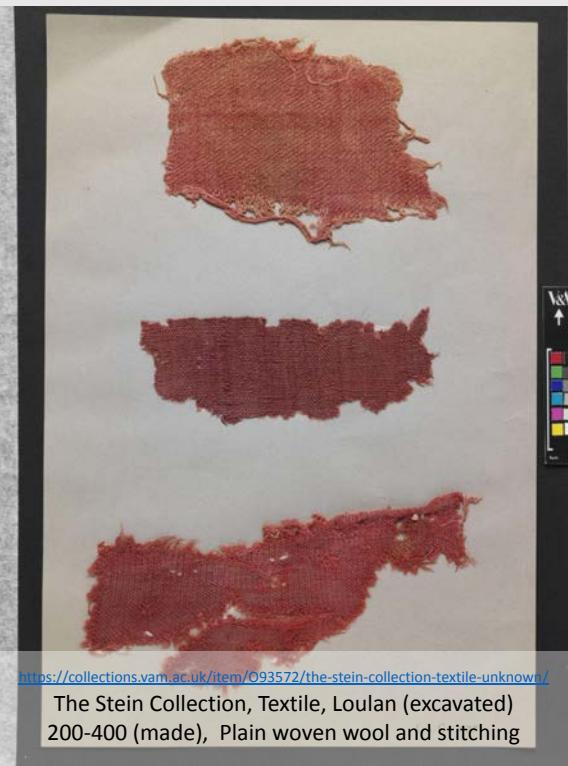
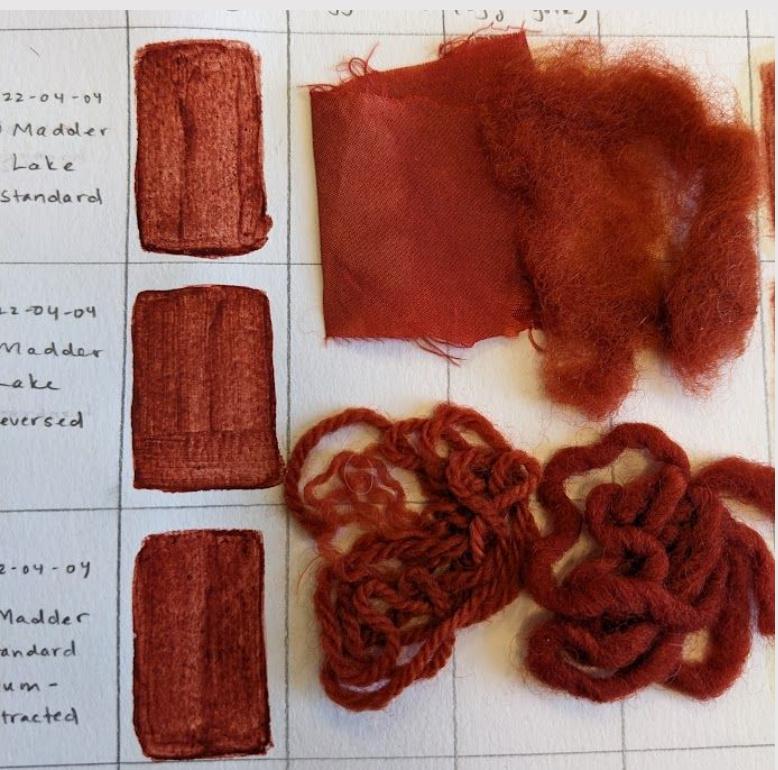


NB: report on dyes shows:  
red = lac, yellow = luteolin,  
green = luteolin and indigo,  
orange = madder.

<https://collections.vam.ac.uk/item/067199/carpet-fragment-unknown/>

Carpet Fragment, Iran (made), 1550-1600 (made)

Hand knotted woollen pile, on woollen warp and weft; asymmetrical knot, open to the left



<https://collections.vam.ac.uk/item/093572/the-stein-collection-textile-unknown/>  
The Stein Collection, Textile, Loulan (excavated)  
200-400 (made), Plain woven wool and stitching



<https://collections.vam.ac.uk/item/0119614/cap-unknown/>  
Cap, London (made), 1500-1550 (made), Wool; handknit, fulled

# Madder

- Madder has been used as a colorant for dyeing textiles since ancient times in India, Persia, and Egypt.
- Its cultivation and use then spread across the Mediterranean regions and into Europe: it was well known in Classical Greek and Roman times as both a dye and a pigment.
- Its use continued in Europe thereafter, notably for dyeing wool. From the 13th century it was cultivated in France, parts of Spain, northern Italy and notably the Netherlands (Zeeland) and was of great economic importance.



Sock for the left foot of a child (EA53913), 3rd-4th century (radiocarbon), Egyptian,  
Wool dyed with madder (red), woad (blue), and weld (yellow)  
© The Trustees of the British Museum,  
[https://www.britishmuseum.org/collection/object/Y\\_EA53913](https://www.britishmuseum.org/collection/object/Y_EA53913)

Smithsonian Magazine and Katherine J. Wu, "1,700-Year-Old Sock Spins Yarn About Ancient Egyptian Fashion," Smithsonian Magazine, accessed September 19, 2023, <https://www.smithsonianmag.com/smartnews-history-archaeology/1700-year-old-sock-spins-yarn-about-ancient-egyptian-fashion-180970501/>.

Joanne Dyer et al., "A Multispectral Imaging Approach Integrated into the Study of Late Antique Textiles from Egypt," *PLOS ONE* 13, no. 10 (October 4, 2018): e0204699, <https://doi.org/10.1371/journal.pone.0204699>.

"the tanner's", of a reddish colour, a cubit high, and of the thickness of a finger, the leaves of which when dried are used as is pomegranate rind in the tanning of leather. Physicians moreover use the leaves of rhus for bruises, likewise for coeliac trouble, sores in the seat and for what they call eating (phagedaenic) ulcers.

Pounded with honey and applied with vinegar . . .<sup>a</sup> a decoction of them is dropped into suppurating ears. A decoction of the branches makes a mouth-wash, which is used for the same purposes as that made from mulberries, but it is more efficacious when mixed with alum. This is also applied to dropsical swellings.

LV. What is called rhus erythros (red sumach) is the seed of this shrub. It has astringent and cooling properties. It is sprinkled on viands instead of salt when the bowels have been relaxed, and with silphium added makes all meat sweeter. With honey it cures running sores, roughness of the tongue, and livid or excoriated bruises; applied in the same way it very quickly causes wounds on the head to cicatrize.<sup>b</sup> Taken as food it checks excessive menstruation.

LVI. A different plant is erythrodanum, called by some ereuthodanum, and rubia by the Romans, which is used to dye wool and to tan leather. As a medicine it is diuretic, and taken in hydromel cures jaundice (lichen too if applied with vinegar), sciatica and paralysis if the patient bathes daily while taking the draught.<sup>c</sup> The root and the seed are emmenagogues, check diarrhoea and disperse gatherings. The

*Rhus erythros.*

*Erythrodanum.*

branches with the leaves are applied for snake-bites. The leaves also dye the hair. I find in some authorities that jaundice is cured if this shrub is merely looked at while worn as an amulet.

LVII. The plant called alysson differs from the last only in having smaller leaves and branches. It has received its name because it prevents persons bitten by a dog from going mad if they take it in vinegar and wear it as an amulet. The authorities add the wonderful marvel that the mere sight of this shrub dries up sanies.<sup>a</sup>

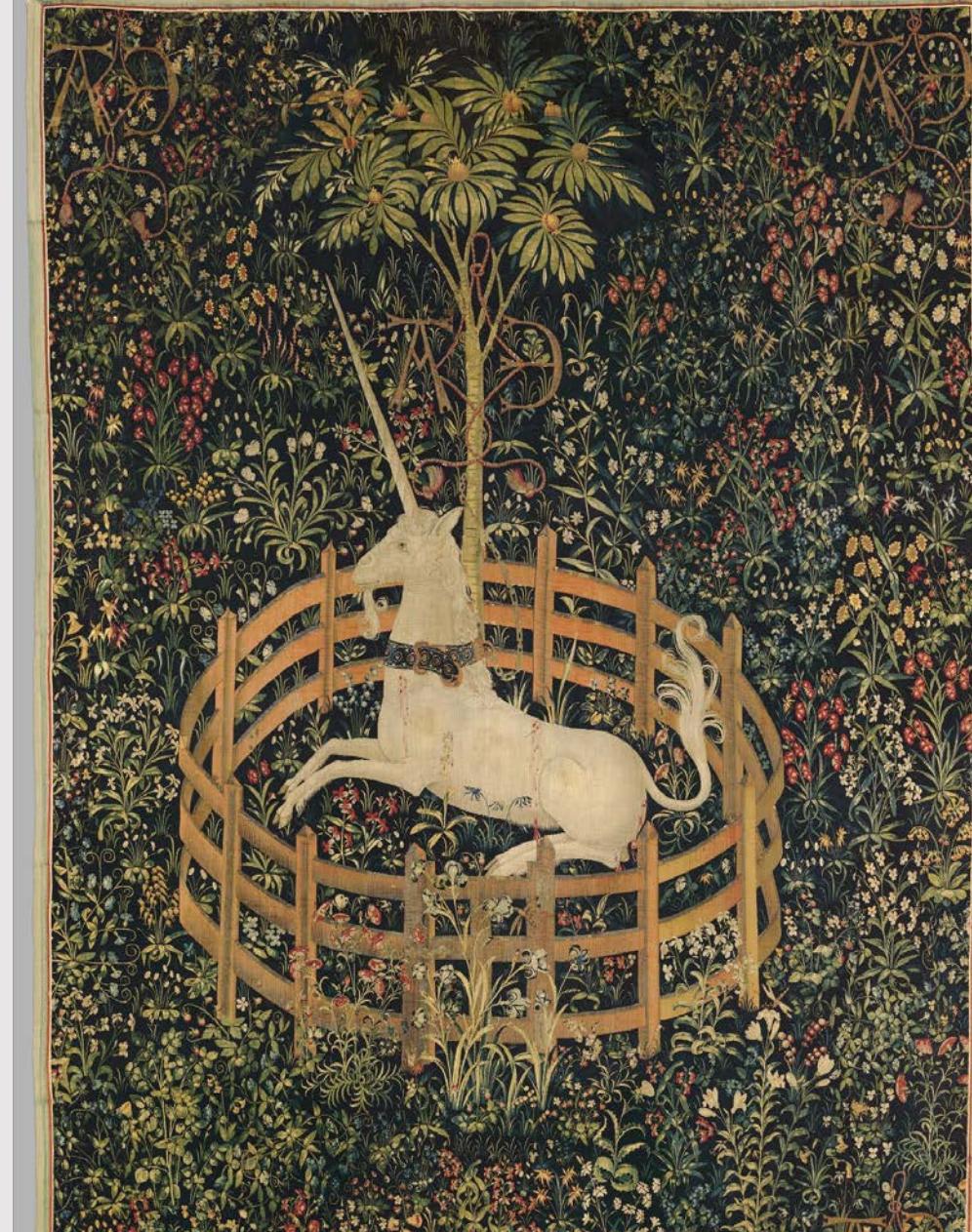
Alysson.

LVIII. Radicula too prepares wools for the dyers; I have said<sup>b</sup> that it is called struthion by the Greeks. It cures jaundice both when taken by itself in drink and in the form of a decoction, and likewise chest troubles; it promotes urine, loosens the bowels and purges the uterus, for which reason physicians call it "golden goblet".<sup>c</sup> With honey too it is a splendid remedy for a cough, and in doses of a spoonful for orthopnoea; but with pearl barley and vinegar it removes leprous sores. Again, with panaces<sup>d</sup> and caper root it breaks up and expels stone in the bladder, and a decoction with barley meal and wine disperses superficial abscesses. It is used as an ingredient of poultices, and of eye-salves to improve

Radicula.

# Madder

- Madder was the “common” red, less expensive than the two other major red dyes, kermes and cochineal.
- Most madder-dyed items tend to be made of wool, rather than silk.
- Some guild regulations prohibited the dyeing of expensive textiles with inexpensive dyes (and vice versa):
  - Silk is to be dyed with kermes or cochineal
  - Wool is to be dyed with madder
- Dye recipes and surviving objects support this, as do pigment recipes. Madder lake is often made from dyed wool shearings while cochineal or kermes is made from dyed silk fragments.
- The lengthy and complicated method of dyeing the vivid red colour on Cotton known as **Turkey red**, first seen in Europe on printed cottons imported from India in the 17th century, only became known in western Europe in the second half of the 18th century.



<https://www.metmuseum.org/art/collection/search/467642>

The Unicorn Rests in a Garden, French (cartoon)/South Netherlandish (woven), 1495–1505, Wool warp with wool, silk, silver, and gilt wefts

# Madder - Names, synonyms, and related terms

- madder (colorant) (preferred,C,U,LC,English-P,D,U,N)
- root madder (C,U,English,UF,U,N)
- madder lake (C,U,English,UF,U,N)
- meekraprood (C,U,Dutch-P,D,U,U)
- **laque de garance** (C,U,French-P,D,U,N)
- Krapplock (C,U,German-P,D,U,N)
- **lacca di robbia** (C,U,Italian-P,D,U,N)
- laca de rubia (C,U,Spanish-P,D,U,N)
- **rubia** (C,U,Spanish,AD,U,U)

- *Rubia tinctorum*;
- Pigment Red 83;
- CI 58000:1;
- Natural Red 9;
- CI Nos. 75330, 75420;
- alizarin (natural);
- purpurin (natural);
- xanthine (natural);
- Färberrote (Deut.);
- Krapplock (Deut.);
- Krapp (Deut.);
- **garance** (Fr.);
- **laca de rubia** (Esp.);
- **granza** (Esp.);
- **robbia** (It.);
- **garanza** (It.);
- **rizari** (Gr.);
- meekrap (Ned.);
- **garança** (Port.);
- rose madder;
- **Turkey red**;
- garancine;
- **dyer's root**;
- madder lake;
- **alizarin red**



<http://vocab.getty.edu/page/aat/300013062> madder (colorant)

Art and Architecture Thesaurus Online, <http://www.getty.edu/research/tools/vocabulary/aat/>,  
J. Paul Getty Trust, Los Angeles, 2000.

"Madder," The Conservation and Art Materials Encyclopedia Online (CAMEO),  
<https://cameo.mfa.org/wiki/Madder>.

# Madder production

- In about 1500, Reymerswale was reckoned to be, after Middelburg and Zierikzee, the third most important town in Zeeland. At that time salt-refining was an important industry in Zeeland, centred around Reymerswale, Zierikzee, Goes and other towns – the salt sack of Zeeland was to become the dominant measure, over that of Flanders – and seasalt was an important item of Reymerswale trade.
- Zeeland was most renowned for the cultivation of madder (three towns in this region (Reymerswale, Middelburg, and Zierikzee) were also important sites of salt-mining and refining). Madder, like salt, was among the goods regularly exported from the towns.
- Until the rise of the French madder industry during the second half of the eighteenth century, Zeeland was the principal madder-producing region for north-western Europe.
- Trade in madder was well established in the fourteenth century and references to its cultivation and processing in Zierikzee, Reymerswale and other parts of the region occur from quite early in the fifteenth century.
- That the Zeeland madder industry was highly developed and sophisticated by this time is demonstrated by the Reymerswale madder regulations of 1480. From these it is clear that, for example:
  - different grades of madder root were available;
  - the amount of earth that each grade was permitted to contain was defined;
  - and drying of the root in the *stoven* was permitted only between 15 August of one year and 1 May of the next.



Location of Zeeland province in the Netherlands  
TUBS, 4 March 2011,  
[https://commons.wikimedia.org/wiki/File:Zeeland\\_in\\_the\\_Netherlands.svg](https://commons.wikimedia.org/wiki/File:Zeeland_in_the_Netherlands.svg)



Ackroyd, P., Billinge, R., Campbell, L., Kirby, J. 'The "Two Tax-Gatherers" by Marinus van Reymerswale: Original and Replica'. *National Gallery Technical Bulletin* Vol 24, pp 50–63.  
[http://www.nationalgallery.org.uk/technical-bulletin/ackroyd\\_billinge\\_campbell\\_kirby2003](http://www.nationalgallery.org.uk/technical-bulletin/ackroyd_billinge_campbell_kirby2003).

Referencing: G.A. Fokker, 'De oudst bekende keur op het bereiden van en den handel in meekrap in Zeeland', *Archief: Vroegere en latere mededelingen voornamelijk in betrekking tot Zeeland*, II, vi, 1866–9, pp. 317–28; C. Wiskerke, 'De geschiedenis van het meekrapbedrijf in Nederland', *Economisch-Historisch Jaarboek*, XXV, 1952, pp. 1–144, esp. pp. 10–22; W.S. Unger and J.J. Westendorp Boerma, 'De steden van Zeeland, IV. De steden van de Bevelanden en van Tolen', *Archief: Vroegere en latere mededelingen voornamelijk in betrekking tot Zeeland uitgegeven door het Zeeuwsch Genootschap der Wetenschappen*, 1957, pp. 1–42, esp. pp. 1–5 and references; H. van der Wee, *The Growth of the Antwerp Market and the European Economy*, The Hague 1963, Vol. 1, pp. 96, 288–95. For examples of goods exported from Reymerswale to London see H.S. Cobb (ed.), *The Overseas Trade of London, Exchequer Customs Accounts 1480–1*, London 1990, pp. 22, 44, 58–9, 98, 136, 141. Apart from salt and madder, other items exported included teasles, bricks, paving tiles and hats.

# Uses of Madder

Pliny is one of the first to write that it is good for use as a dye. Dioscorides describes madder under the name Eruthrodanon and recounts that it **can be used not only for medicinal purposes, but also for the dye derived from its roots**. Madder was found on ancient Egyptian cloth fragments in an excavation of a shop in Pompeii and in pots of dye in the Egyptian pyramid Hawwarat Al Maqta.

Cloth dyed with madder was sold in the seventh century CE in St. Denis, not far from Paris, and Charlemagne even promoted the cultivation of madder in his kingdom in the eighth century.

Madder Root	Recipe 1 April No Soak	Recipe 1 August No Soak	Recipe 1 August Soak	Recipe 2 April No Soak	Recipe 2 August No Soak	Recipe 2 August Soak	Recipe 3 April No Soak	Recipe 3 August No Soak	Recipe 3 August Soak
Medium	Linseed oil								

Ms. Fr. 640's List of Entries lets you filter by "medicinal entries" <https://edition640.makingandknowing.org/#/entries>

# Madder as medicine

**Description.** GARDEN-MADDER shooteth forth many very long, weak, four-square, reddish, stalks, trailing on the ground a great way, very rough and hairy, and full of joints, at every one of which come forth divers long and somewhat narrow leaves, standing like a star about the stalks; rough also and hairy, toward the tops whereof come forth many small pale-yellow flowers; after which come small round heads, green at first, and reddish afterwards, but black when they are ripe, wherein is contained the seed. **The root is not very great, though about a yard long, spreading divers ways, and is of a clear red colour while it is fresh.**

**Place.** It is cultivated in gardens or large fields on account of the profits.

**Time.** It flowereth toward the end of summer, and the seed is ripe quickly after.

**Government and Virtues.** It is an herb of Mars; hath an opening quality, but afterwards binds and strengthens; is an assured remedy for the yellow jaundice by opening the obstructions of the liver and gall, and cleansing those parts; it openeth also the obstructions of the spleen, and diminisheth the melancholic humour. It is available for the palsy and sciatica; is effectual for inward and outward bruises, and is therefore much used in vulnerary drinks. **The root, for all those aforesaid purposes, is to be boiled in wine or water, as the cafe requireth, and fome honey or sugar put thereunto afterwards. The feed hereof, taken with vinegar and honey, helpeth the swelling and hardness of the spleen.** The decoction of the leaves and branches is a good somentation for women to sit over that have not their courses. The leaves and roots, beaten and applied to any part that is discoloured with freckles, morphew, white scurf, or any fuch deformity of the skin, cleanfeth and thoroughly taketh them away.

**The root of this madder, holden in the hand, while fresh, will, when a person makes water, change it to the colour of blood.** (p 236)

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- For expediting childbirth : birthwort, mercury, adder, ditany, dittander, pepperwort, holm-oak, and its chermes. (p 15)

# Madder Lake Recipes

- Antiquity – 14th century
  - Recipes for madder lake extract the colorant from the **roots** directly
- Late 14th century – 17th century
  - Recipes for madder lake extract the colorant from **wool dyed** with madder
- 18th century onwards
  - Recipes for madder lake extract the colorant from the **roots** directly



Ly commence le viv. suix  
des proprietez des choses Ou  
quel est trauctie des coules  
des odeurs et des saueurs  
**E**t premierement  
Sensicut le prologue avec  
l'intention de l'auteur.

*De proprietatibus rerum (Livre des proprietez des choses)*  
Bartholomaeus Anglicus, translated by Jean Corbechon  
Bruges (1482)

Royal 15 E III f. 269 "Dyers"

<https://www.bl.uk/catalogues/illuminatedmanuscripts/ILLUMIN.ASP?Size=mid&IILID=54981>

Detail of a miniature of dyers at work, at the beginning of book 19 (Attribution: Master of Edward IV)

# Lake pigments





KREMER PIGMENTS 37199 (PIECES)



KREMER PIGMENTS 37201 (GROUND)



KREMER PIGMENTS 37202



RECIPE M-I



37202

MADDER LAKE  
Rubia tinctorium  
Rose madder  
Garancine  
Dyer's root

M-I



KREMER PIGMENTS 36150 (PIECES)



CLOTHLET RECIPE B-I



B-1

BRAZILWOOD  
Bresilwood  
Bresill  
Pernambucco wood  
Verzino



RECIPE B-2



RECIPE B-3



B-2

BRAZILWOOD  
LAKE

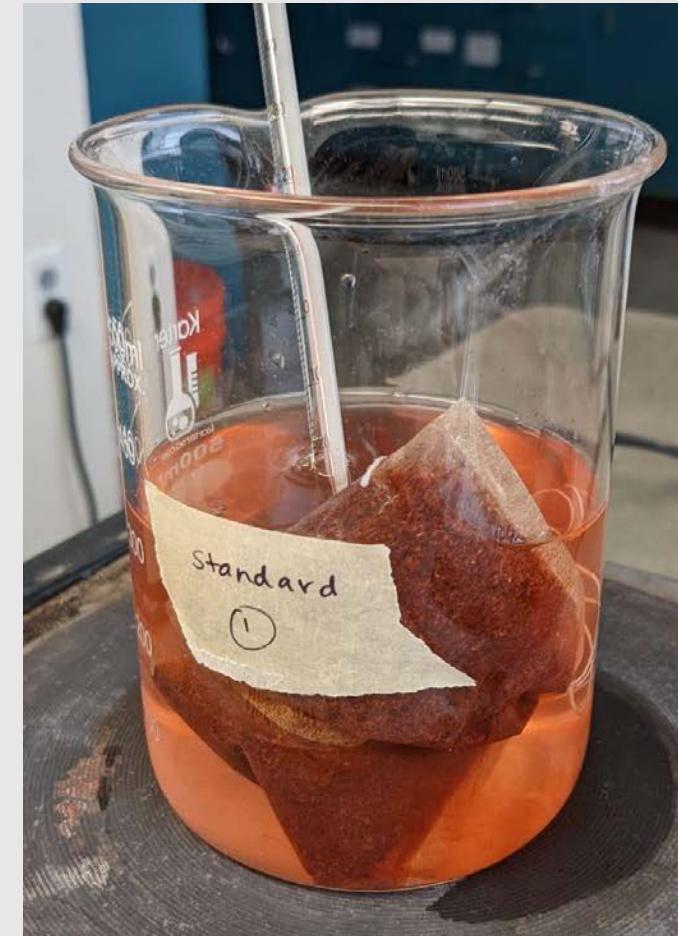
B-3

# Natural colorants - Lakes

- **Lake pigments:** in general, pigments prepared from soluble natural colorants, formed by precipitating (or adsorbing) the dye onto a colorless or white, insoluble, relatively inert substrate.
- This is traditionally a form of amorphous hydrated alumina, which can bind the colorant through complexation with aluminum, a process analogous to mordant dyeing of textiles.
- As most natural colorants are soluble, they cannot be mixed directly with a binding medium and therefore cannot be used as a pigment.
- The red colorants most commonly used for lake pigments are the plant dyes madder, brazilwood and sappan wood, and the insect dyes lac, kermes, and cochineal.
- However, the final color, and the composition of the substrate, can vary depending on the recipe, which will also influence the physical characteristics of the pigment such as transparency or working properties.

# Lake – a few other helpful definitions

- An organic pigment prepared by precipitation of a dye on a powdered, inorganic substrate. Because of its transparency, alumina trihydrate, is the most commonly used substrate or carrier. Baryte (barium sulfate), produces an opaque lake pigment. Other compounds used as carriers are: chalk, clay, gypsum, zinc oxide, white earth, and green earth. Often a mordant, such as tannic acid, lactic acid, or sodium phosphate, is used to fix the dye to the substrate. Many natural dyes were made into lake pigments, such as cochineal, kermes, madder, and lac for use in oil painting. Some modern synthetic dyes, such as aniline dyes, are also prepared in this manner for use as paint pigments. Lake pigments are used in painting, printing inks, plastic colorants, and coated fabrics. – <http://cameo.mfa.org/wiki/Lake>
- General term for numerous oil-soluble organic pigments that are prepared by the precipitation of a dye on an absorptive powdered, inorganic substrate; alumina trihydrate is most often used as the substrate because of its transparency. All pigments invented in relatively early periods and made in this way are still called "lakes." – [http://www.getty.edu/vow/AATFullDisplay?find=lake&logic=AND&note=&english=N&prev\\_page=1&subjectid=300014015](http://www.getty.edu/vow/AATFullDisplay?find=lake&logic=AND&note=&english=N&prev_page=1&subjectid=300014015)



# Preparing and Using Organic Pigments



Crush dyestuffs



Extract



Precipitate



Filter and wash



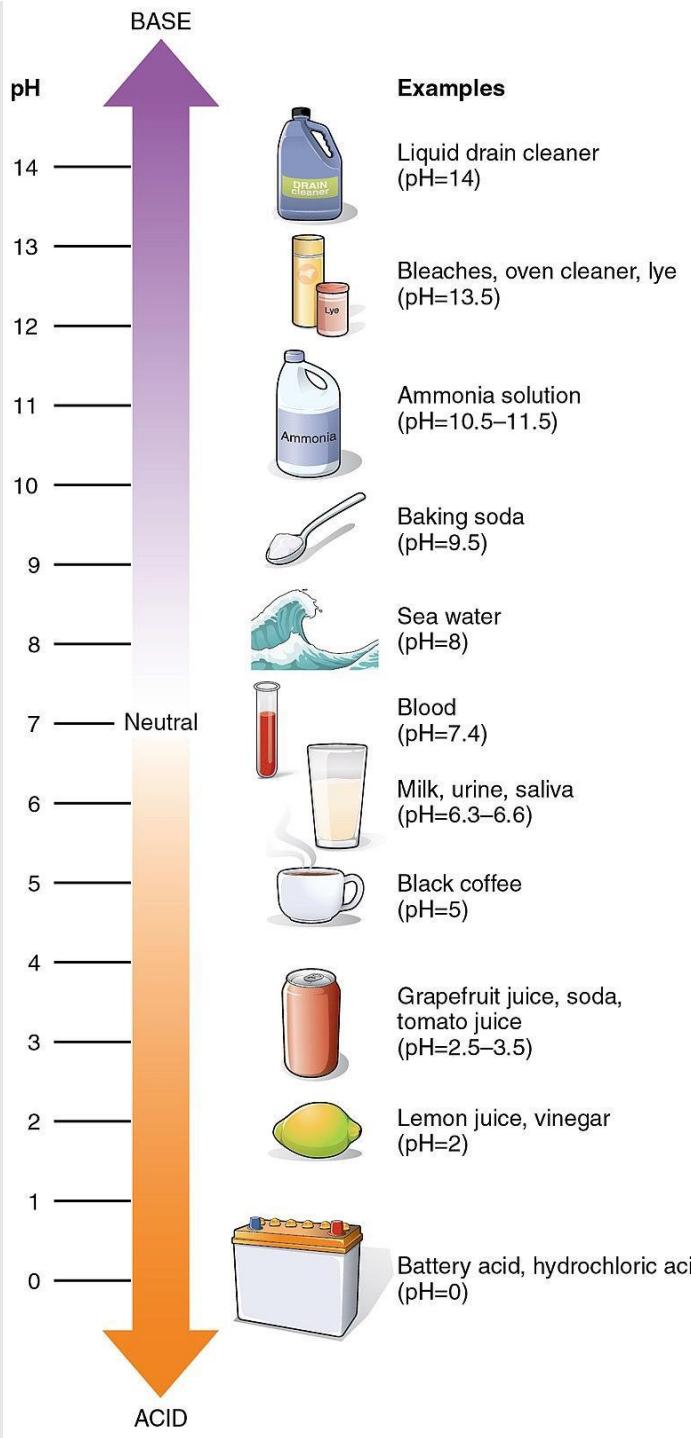
Pigment



Paint



Chemistry



# Overview of pH

**pH** is a numerical scale from 0 to 14 that describes the relative acidity or alkalinity of a solution

## ACID

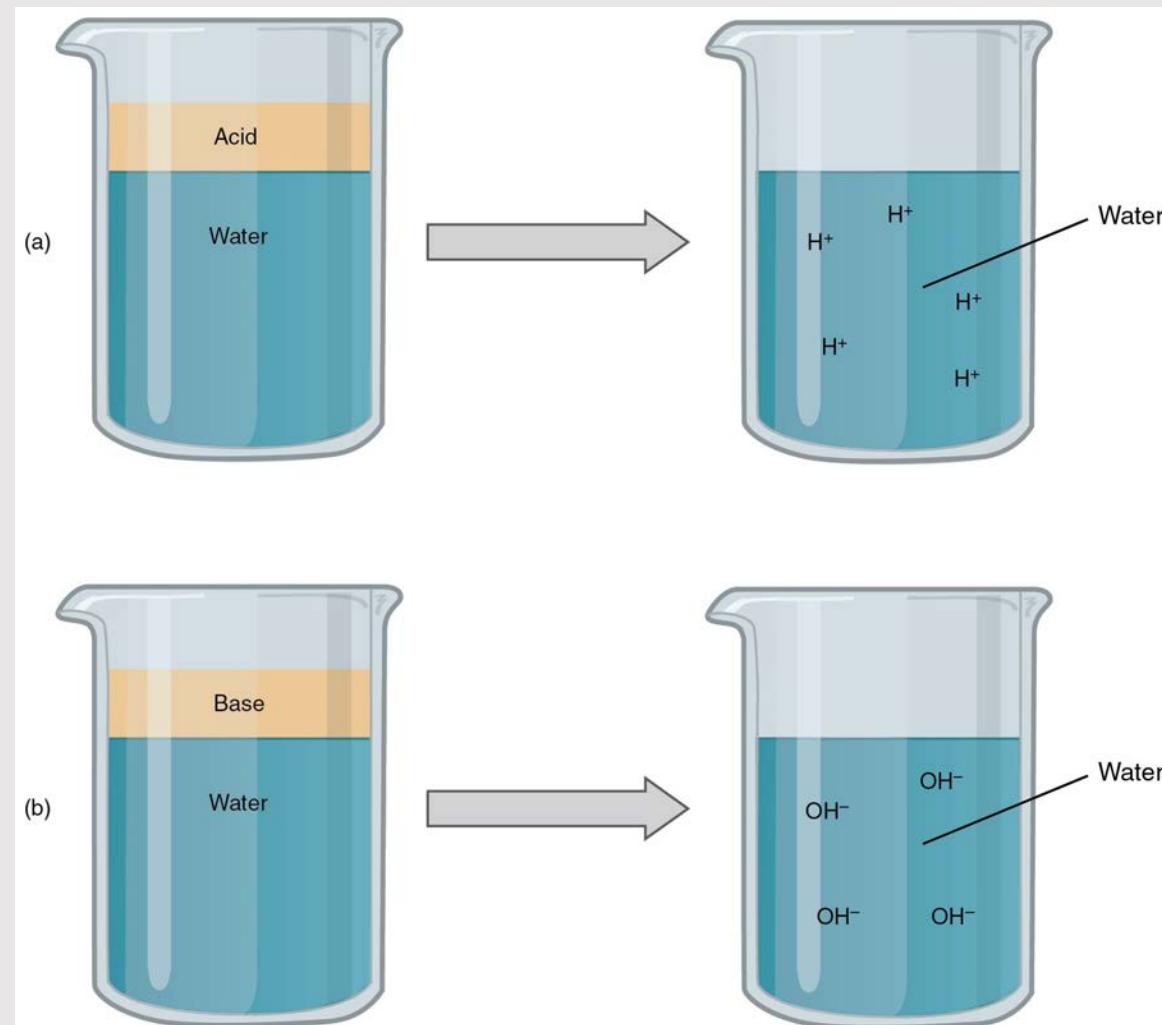
Donates a hydron (proton or hydrogen ion  $H^+$ )

## BASE/ALKALI

Releases hydroxide ( $OH^-$ ) ions.

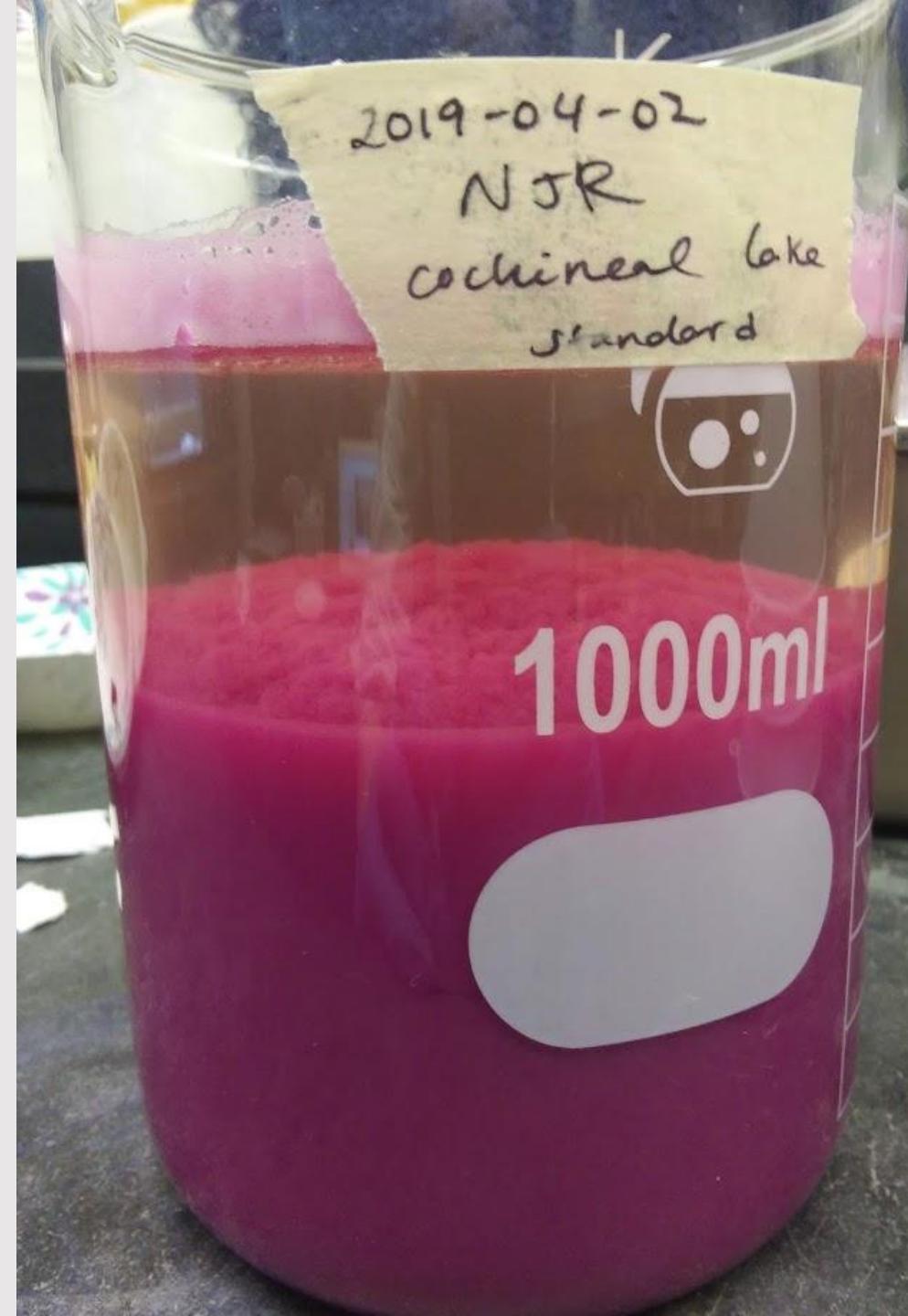
Many times the terms “base” and “alkali” (or basic and alkaline) are used interchangeably.

More precisely, an alkali is a base that can be dissolved in water.



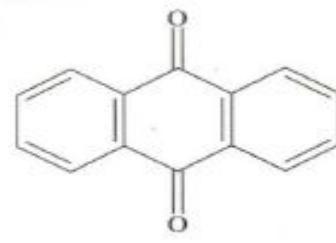
# Lake – Process 1

- Earlier recipes, used for most lakes at least until the beginning of the eighteenth century.
- **The dye is extracted into an alkaline solution, usually potash** (while heating).
- The dye solution is then filtered to remove any remnants of the dyestuff source. **Alum is added to the dyestuff solution.**
- It reacts with the alkali to **produce an amorphous hydrated alumina substrate** which precipitates together with the dyestuff, forming the pigment.
- The sulphate remains in solution as the potassium salt, and the pigment is retrieved by filtering.



# Madder

Botanical name: *Rubia tinctorum* L.



**Chemical class: alizarin and purpurin (anthraquinones)**

Region: Native to Middle East and east Mediterranean, then spread to Europe.

Dye type: Mordant dye.

Range of red-orange-brown dyes obtained from the roots of a bedstraw.



[http://thedomesticsoundscape.com.wordpress/?attachment\\_id=3451](http://thedomesticsoundscape.com.wordpress/?attachment_id=3451)



<https://www.metmuseum.org/art/collection/search/445750>  
Egyptian (5<sup>th</sup>-8<sup>th</sup> century), linen and wool



<http://collections.vam.ac.uk/item/O146101/jacket-unknown/>  
Iranian (ca. 1800-1870), cotton and silk

# Anthraquinones - coordination with aluminum ions

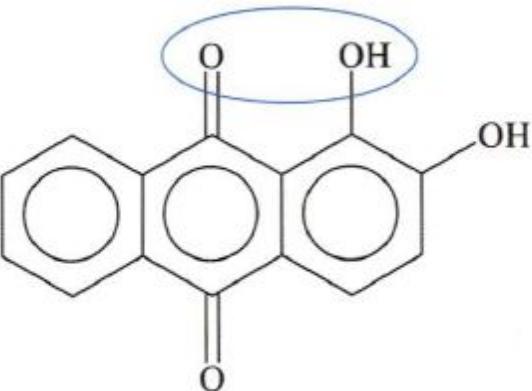
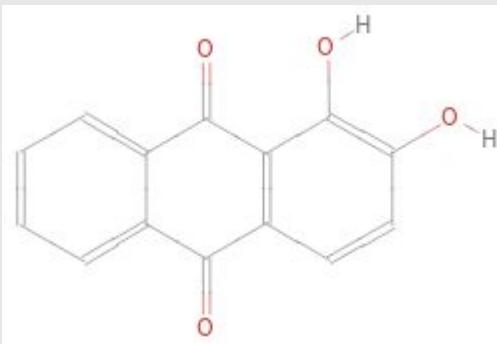


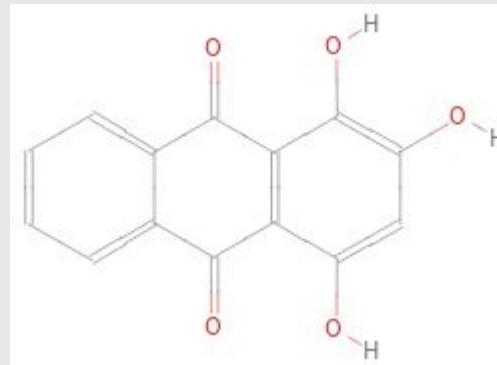
Figure 2 Probable position for coordination with aluminium ions taking alizarin as an example (Sanyova 2000/1: 66–78).

Alizarin  $C_{14}H_8O_4$



<https://www.wolframalpha.com/input?i=alizarin>

Purpurin  $C_{14}H_8O_5$



<https://www.wolframalpha.com/input?i=purpurin>

BASE  
pH = 12

# Potash = Potassium carbonate $K_2CO_3$

White deliquescent powder. **Potassium carbonate is used in the manufacture of glass, ceramics, smalt, and soap. It is also used in printing inks, process engraving, and lithography and in tanning and finishing leather.** In a closed environment, a saturated solution of potassium carbonate will form an equilibrium at a relative humidity of about 44% (20C).

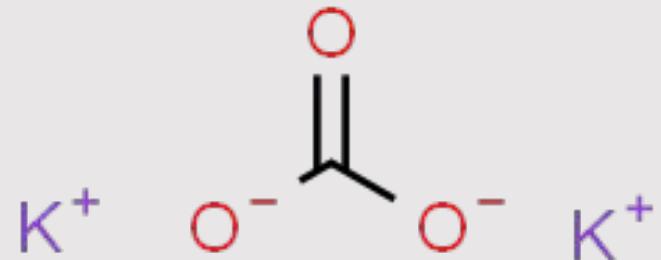
Addition of potash to dye baths is based on historical examples.

**It can result in:**

- Greater solubility of the dyestuff
- A different hue due to a reversible pH change of the dye
- Perhaps a conversion of the dye glycosides (sugars) to the corresponding free dye molecule
- Perhaps conserve the glycosides in the dyestuffs (seen in weld which becomes brighter)

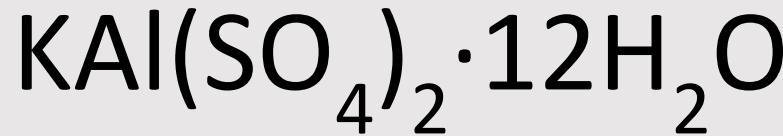
**Effect on dye color:**

- Anthraquinone dyes, particularly kermes and cochineal become much paler while madder becomes dull or pale
- In historical recipes, it is much more common to find preparation of these dyes in “sour water” aka acidic conditions



ACID  
pH = 3

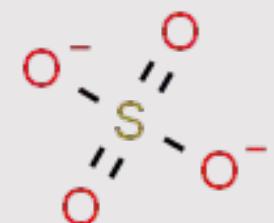
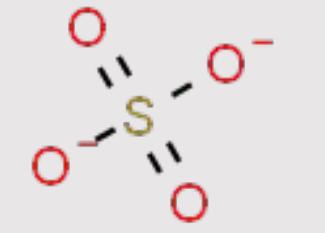
# Alum = Aluminum potassium sulfate



Also often called “potash alum”  
(NOT to be confused with “potash”)

A white odorless powder with transparent crystals. Aluminum potassium sulfate occurs naturally in the minerals alunite and leucite. **It has been used since ancient times as a mordant in dyeing textiles and for tawing skins.** Aluminum potassium sulfate, or potash alum, is also used as a filler in paper, cement, and paints. It is used to harden gelatin, plaster, and cement.

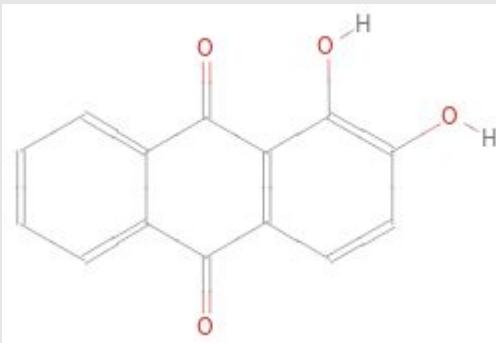
**Potash alum has also been used as a substrate in the preparation of lake pigments.**



# Madder lake



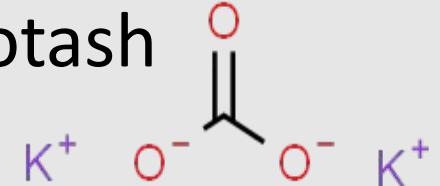
Alizarin  $C_{14}H_8O_4$



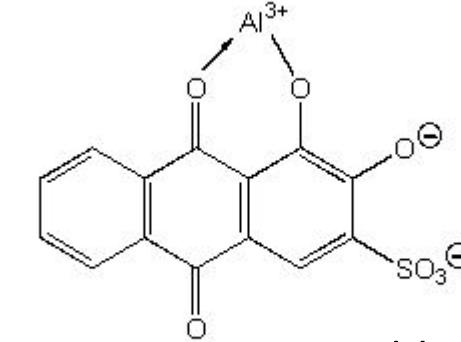
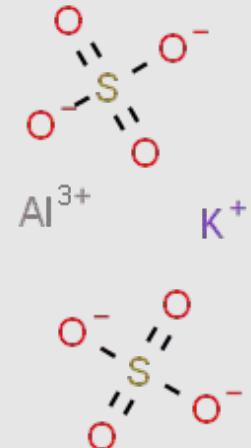
<https://www.wolframalpha.com/input/?i=alizarin>

Madder forms a bright red color when precipitated on an amorphous hydrated alumina substrate, such as Alumina trihydrate.

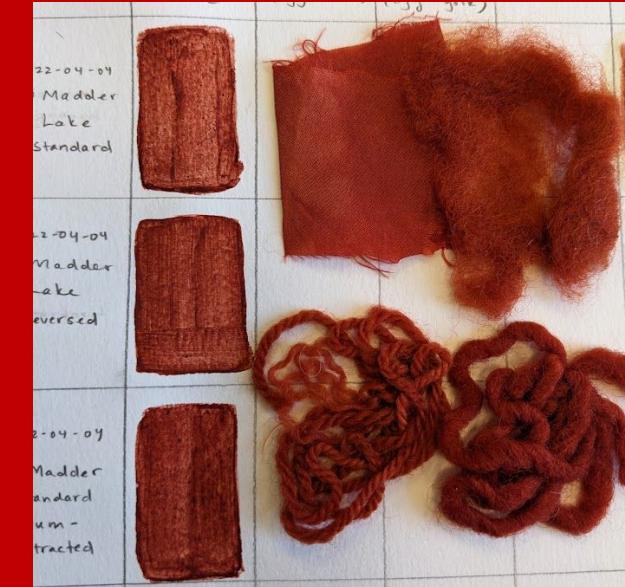
Potash



Alum



Madder lake

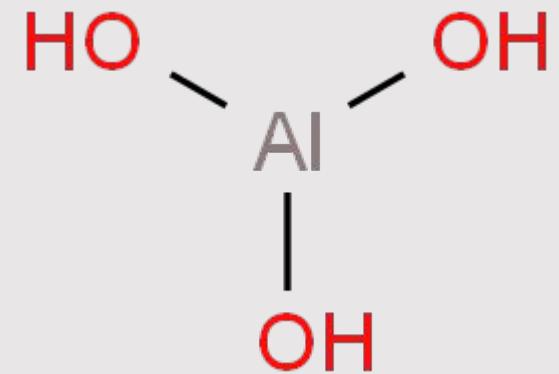


# Aluminum hydroxide (or alumina trihydrate) $\text{Al(OH)}_3$

A white, translucent powder that is also called aluminum hydroxide. Alumina trihydrate is obtained from bauxite. When it is strongly heated, alumina trihydrate will convert to aluminum oxide with the release of water.

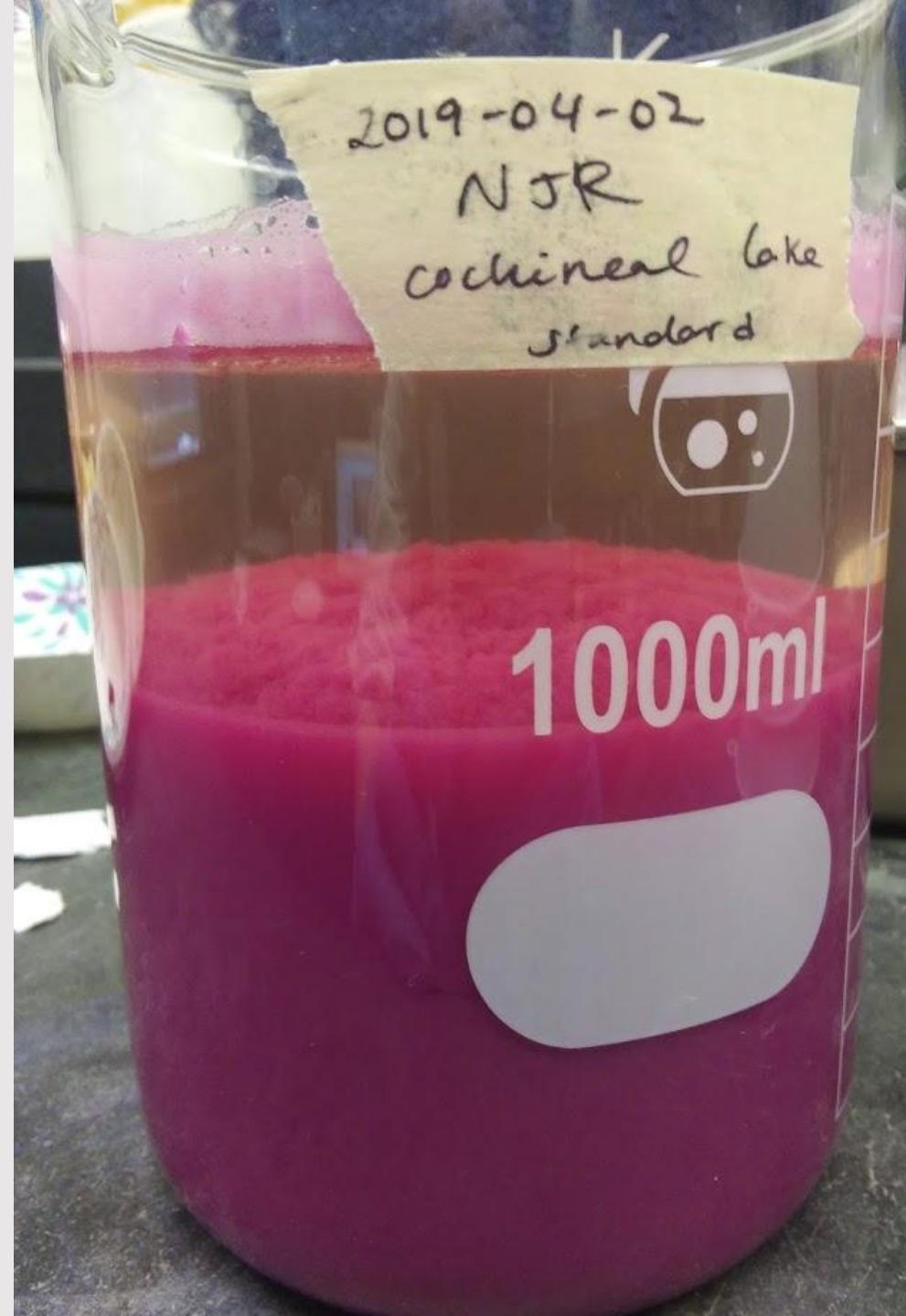
**Alumina trihydrate is used as a base in the preparation of transparent lake pigments. It is also used as an inert filler in paints and tends to increase the transparency of colors when dispersed in oils.**

Alumina trihydrate is used commercially as a paper coating, flame retardant, water repellent, and as a filler in glass, ceramics, inks, detergents, cosmetics, and plastics.



# Lake – Process 1

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# Recipe Example: Making Pigment from Madder

*If you want to make a good lake, which is a colour for painters, make the colour as follows:* Take beech or oak wood ash and add as much lime and make a cold solution [of lye] as strong as you can. Take then shearings of scarlet, place them in the lye and leave them there for three or four days and nights. Then take them and put them in a glazed pot, put it on a glowing fire and allow it to heat well until you can no longer put your hand in due to the heat. And press it through a cloth into a clean bowl and allow it to become cold. And take crushed alum and mix it with water and sprinkle a little over the coloured water, then the colour will fall to the bottom. Then pour the liquid above off, take the colour and dry it in the shade.

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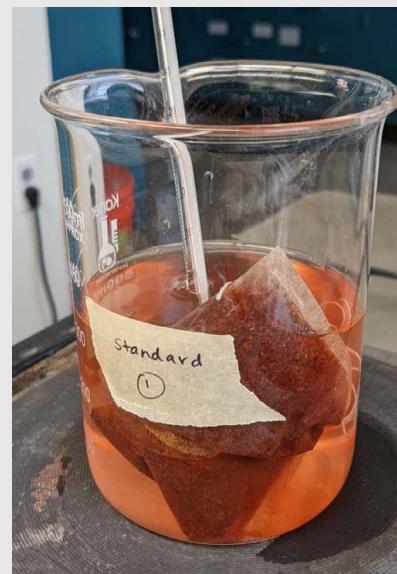


Heidelberg, Universitätsbibliothek MS cod. pal. germ. 620, ff. 73-74, Chapter 43 (15th century)

As translated by Jo Kirby et al, *Natural Colorants for Dyeing and Lake Pigments: Practical Recipes and their Historical Sources* (Archetype, London: 2014), 82.

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# Recipe Example: Making Pigment from Madder

*If you want to make a good lake, which is a colour for painters, make the colour as follows:* Take beech or oak wood ash and add as much lime and make a cold solution [of lye] as strong as you can. Take then shearings of scarlet, place them in the lye and leave them there for three or four days and nights. Then take them and put them in a glazed pot, put it on a glowing fire and allow it to heat well until you can no longer put your hand in due to the heat. And press it through a cloth into a clean bowl and allow it to become cold. And take crushed alum and mix it with water and sprinkle a little over the coloured water, **then the colour will fall to the bottom.** Then pour the liquid above off, take the colour and dry it in the shade.



Heidelberg, Universitätsbibliothek MS cod. pal. germ. 620, ff. 73-74, Chapter 43 (15th century)

As translated by Jo Kirby et al, *Natural Colorants for Dyeing and Lake Pigments: Practical Recipes and their Historical Sources* (Archetype, London: 2014), 82.

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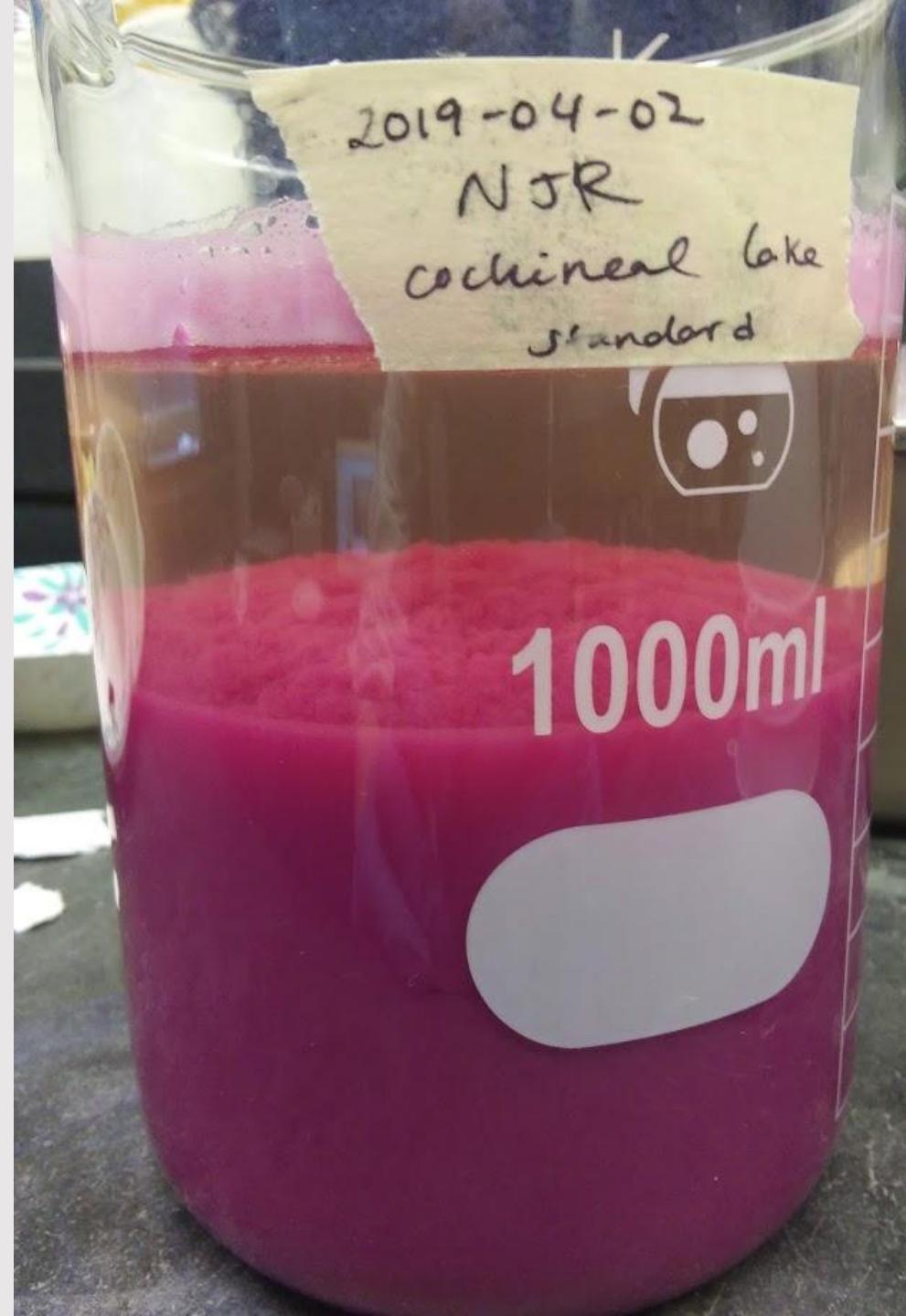


Heidelberg, Universitätsbibliothek MS cod. pal. germ. 620, ff. 73-74, Chapter 43 (15th

As translated by Jo Kirby et al, *Natural Colorants for Dyeing and Lake Pigments: Practica and their Historical Sources* (Archetype, London: 2014), 82.

# Lake – Process 1

- Earlier recipes, used for most lakes at least until the beginning of the eighteenth century.
- **The dye is extracted into an alkaline solution, usually potash** (while heating).
- The dye solution is then filtered to remove any remnants of the dyestuff source. **Alum is added to the dyestuff solution.**
- It reacts with the alkali to **produce an amorphous hydrated alumina substrate** which precipitates together with the dyestuff, forming the pigment.
- The sulphate remains in solution as the potassium salt, and the pigment is retrieved by filtering.



# Lake – Process 2

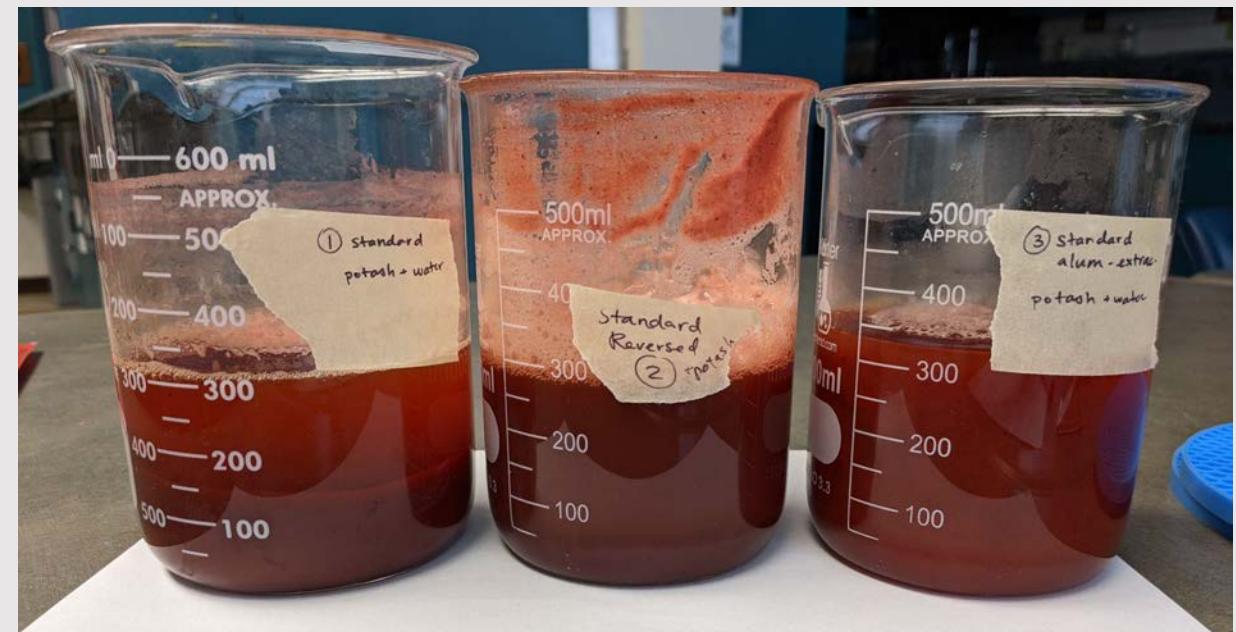
- Recipes more typical of the nineteenth century and onwards.
- **The substrate is made by the reverse sequence, adding alkali to an alum solution that contains the dyestuff.**
- The dyestuff is first extracted with water, the solution is filtered and then alum is added.
- This **forms a complex with the colorant via the neighbouring hydroxyl groups** present on the organic colorant. It is still soluble; **precipitation occurs when the acidic solution is neutralized by means of the slow addition of an alkali or base**, which again might be potassium carbonate solution.
- The composition of this pigment is slightly different to the first type. It is similar to **the 'light alumina hydrate'** described in modern paint technology literature, with the most evident difference being that sulphate anions become incorporated into the substrate as it precipitates



# Madder - 3 recipes



Madder Root	Recipe 1 April No Soak	Recipe 1 August No Soak	Recipe 1 August Soak	Recipe 2 April No Soak	Recipe 2 August No Soak	Recipe 2 August Soak	Recipe 3 April No Soak	Recipe 3 August No Soak	Recipe 3 August Soak
Medium									
Linen Oil									



# Lake – Extracting from dyed textiles



Dye silk or wool



Cut textile into  
small pieces



Extract from  
textile



Filter to  
remove textile



Precipitate



Filter and wash



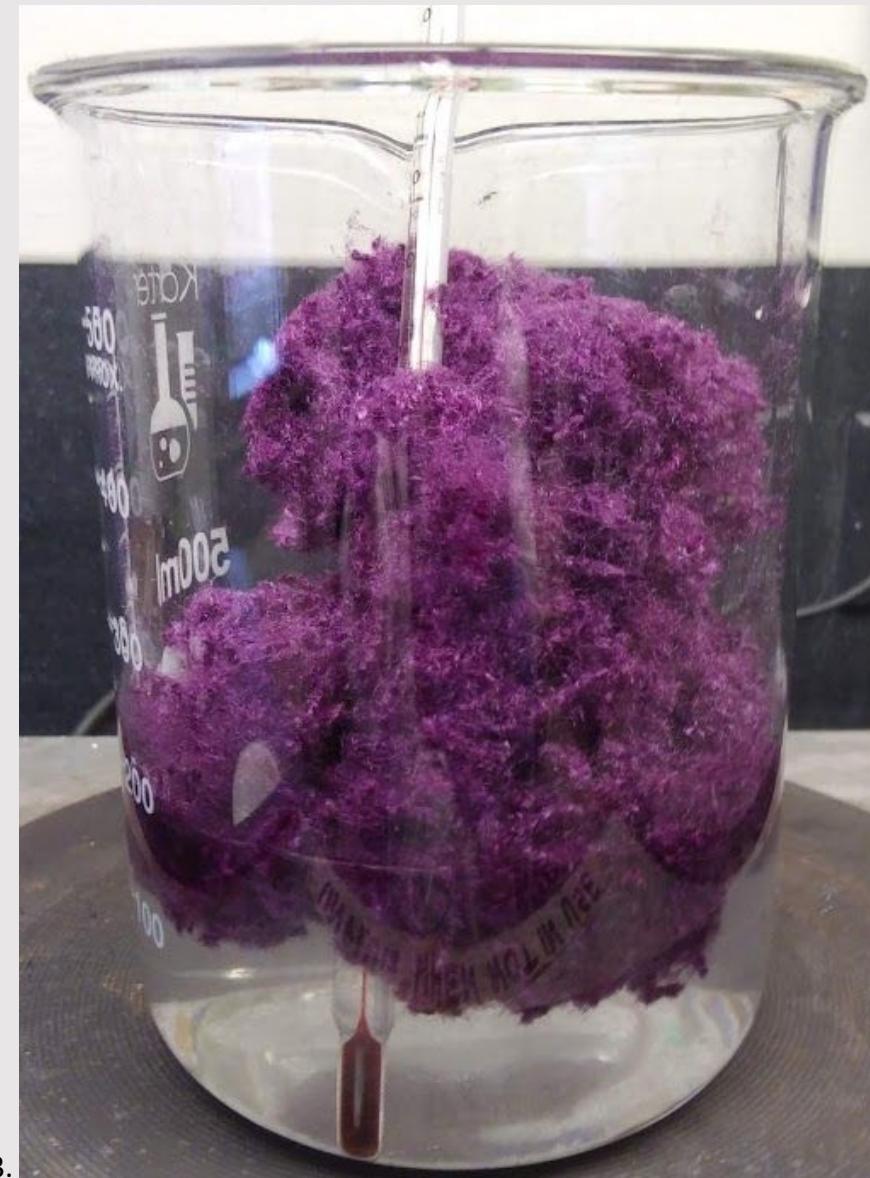
Pigment



Paint

# Lake from raw material vs. dyed cloth - Thoughts about why?

- For kermes, cochineal and madder lakes, the recipes and analyses of pigments in paintings suggest that **from the fourteenth to the seventeenth century**, at least in Europe, **the dyestuff source was usually shearings of dyed textile**. Kermes or cochineal shearings were generally silk, from which the dye was easily extracted into solution.
- **For madder, the fibre was commonly wool** so a stronger lye solution was needed, which usually dissolved the proteinaceous fibre at the same time, at least to some extent. In some recipes, this implies an adapted sequence of steps, since they instruct that all the fibres should be dissolved, giving a red 'jelly' that would remain in the sieve or cloth when the solution was filtered. **The 'jelly' was then ground with alum on a slab, forming the pigment**, still containing the dissolved fibre but together with the alumina substrate and often residual unreacted alum. This was then boiled in water and finally washed several times at the final stage.



# Recipe examples



# Notes by the author-practitioner of Ms. Fr. 640 (late 16th c.)

## Folio 66r, "Glazing"

*One commonly glazes with colors that do not have body, such as lake & verdigris.*

*However, to use other colors, one mixes in a quantity of calcined & ground cristallin, which also has no body & ~~makes~~ lightens the density of the others.*



The Virgin and Child with a Pomegranate, ~1480-1500,  
Workshop of Sandro Botticelli

# Notes by the author-practitioner of Ms. Fr. 640 (late 16th c.)

## Folio 58r, "Painter"

...Continued

One needs to make at least three layers of flesh color to accomplish faces in oil. And at the beginning, one puts the black and umber where it is appropriate. Next, the [e] heightening with lead white must not be put on the black. Flesh colors, and [gap] where the ceruse enters will yellow in five or six months, but lead white does not change.

Florence **lake** is better than that from Flanders for in Florence the best dyes are made. To make a beautiful flesh color, the reddest & liveliest **lake** is the best, for the kind that contains purple & violet, by admixture of too much alum, makes flesh color like that of one who is very cold. That is why ladies, wanting to color their cheeks, grind Florence **lake** very finely, then fill a little cotton with it, which they next wrap in a little fabric of Cambray which is clear. And thus they pounce the **lake** on their cheeks & then, with another clean cotton, they soften it.

...Continues

58

56

Il faut faire pour le peintre trois couches de carnation pour une face —  
Les drayages ayelle et au commencement du peintre le noir est dans ou il —  
Commence apres le regalissage de blanc de plomb ~~ou~~ de doblement autre —  
Sur la noire l'or carnation est —  
Sur cette la ceruse est en cinq ou —  
Sur meye jaunesseuse pluie de blanc de plomb que se change point.

La lagune & florante apres malles que celle de flandres  
Car & florante & four est meilleur tonichanture. Pour faire  
Sole carnation la lagune la plus rouge & plus bon que la malles  
Car celle qui tient du purpury & bleuet par la mixture de trop  
& alun fait la carnation de day qui est grand foy. Ce  
pourquoi celle d'ameule & soulance volont le soleil bruyer  
La lagune & florante est plus belle. D'ou il emploie  
Le plus & estoit l'oyat apres celle d'ameule pour la carnation  
& soleil & cambray qui est clair. On misse celle pour la  
La lagune sur la soie & pinceau amy sur autre. Volley ne  
elle abouillonne.

Il est de Flandres le noir est pour meye corps  
Majeur & gris il n'y a pas point de brys amy la lagune  
Cambray l'apaisant qui est preferable & force long temps pour  
ela.

Il faut d'apres il met communement amy le blanc & plomb dey  
par tout pour meye corps amy. En plus il aultre chose d'autre.  
Il adoit que l'apais ne fust pas bon. amy la lagune &  
soulance qui n'est pas de corps. Majeur amy le brys qui est  
pour autre & grappe celle qu'il est propre.

Le gris de gris & corps amy & doiblant premeillant brys amy. Si on  
plus que le doiblant a gris. Qu'il est plus blanc. C'est autre  
point.

# Notes by Cennini (end of 14th c.)

## On the Character of a Red Called Lac (Lake).

### Chapter XLIIII:

*A color known as lac is red, and it is an artificial color. And I have various receipts for it; but I advise you, for the sake of your works, to get the color ready-made for your money. But take care to recognize the good kind, because there are several types of it. Some lake is made from the shearings of cloth, and it is very attractive to the eye. Beware of this type, for it always retains some fatness in it, because of the alum, and does not last at all, either with temperas or without temperas, and quickly loses its color. Take good care to avoid this; but get the lac which is made from gum; and it is dry, lean, granular, and looks almost black, and contains a sanguine color. This cannot be other than good and perfect. Take this, and work it up on your slab; grind it with clear water. And it is good on panel; and it is also used on the wall with a tempora; but the air is its undoing. There are those who grind it with urine; but it becomes unpleasant, for it promptly goes bad.*

Cennino Cennini, *The Craftsman's Handbook: "Il Libro Dell' Arte,"* ed. Daniel V. Thompson, 2nd Edition (New York: Dover Publications, 1954), 26–27.



The Virgin and Child ('The Madonna with the Iris') (NG5592)

1471 - 1528, Workshop of Albrecht Dürer, Oil on lime

<https://www.nationalgallery.org.uk/paintings/workshop-of-albrecht-durer-the-virgin-and-child-the-madonna-with-the-iris>

# Le Begue Manuscript (pg. 50)

*Original Treatises, Dating from the XIIth to XVIIIth Centuries, on the Arts of Painting in Oil, Miniature, Mosaic, and on Glass of Gilding, Dyeing, and the Preparation of Colours and Artificial Gems* by Mary P. Merrifield (1804)

## MADDER

11. To make fine lake. —Take the ashes of oak, and make **a ley**, and boil in it **clippings of fine scarlet of rubea de grana** until the colour is extracted from the clippings, and then strain the ley with the colour through a linen cloth. Afterwards take some more ley, similar to what you first took, and heat it, and put into it some **finely powdered roche alum**, and let it stand until the alum is dissolved. Then strain it through the strainer with the other liquor or ley in which the clippings were put, and immediately the ley will be coagulated, and make a lump or mass, which you must stir well. Remove it afterwards from the vase, and lay it on a new hollow brick, which will absorb the ley, and the lake will be left dry. You must afterwards take it off the brick and keep it for use.

# Le Begue Manuscript (pg. 90)

*Original Treatises, Dating from the XIIth to XVIIIth Centuries, on the Arts of Painting in Oil, Miniature, Mosaic, and on Glass of Gilding, Dyeing, and the Preparation of Colours and Artificial Gems* by Mary P. Merrifield (1804)

## MADDER

100. To make lake. —Take ashes of oak, and boil them in a boiler full of water, namely, in one containing 6 small cups of water, and one parasis, i. e. a large [saucer or] basin full of the ashes, and boil it until it is reduced to three cups. Then let it settle, and when it is clear, pour it into a glazed earthen basin; then take a woollen cloth, and strain the said water, and when it is strained it will be a ley. Put into **the said ley** a sufficient quantity of the clippings, that is, **cuttings of scarlet cloth of rubeum de grana**, to be perfectly covered by the ley. Then put it into a glazed earthen jar, and let it rest for twelve hours. Next take that ley, together with the clippings, and put it into a glazed earthen pipkin, and set it by the fire, and let it simmer gently for an hour. After that try it, by putting it on your nail, and if it stands up well on your nail, it is done; then remove it from the fire and strain it through a thick woollen cloth. You must then have a new glazed earthen pot, and pour into it what was strained through the said cloth; add to it vi oz. of **roche alum**, and stir it together until it is dissolved. Then take a spoon and skim off all the froth that forms over the top of it, and throw away this scum, for it is not good. But the other part is good, and should be put into a glazed earthen vase, and suffered to stand until it has become somewhat dry, when it must be formed into small grains, and be put in the sun.

# Bolognese Manuscript (pg. 554) – Dye recipe

*Original Treatises, Dating from the XIIth to XVIIIth Centuries, on the Arts of Painting in Oil, Miniature, Mosaic, and on Glass of Gilding, Dyeing, and the Preparation of Colours and Artificial Gems* by Mary P. Merrifield (1804)

## MADDER

328. To dye scarlet. —Take £ 1lb- of sandal wood and J lb. of madder, boil them together with plain water until reduced to one -half, and then add half a fogliecto<sup>1</sup> of ley for its maestra to make the colour deeper, and a piece of quicklime, and boil it until reduced to one-third; then prepare the skins for dyeing as in the other recipes.

# Bolognese Manuscript (pg. 588) – Dye recipe

*Original Treatises, Dating from the XIIth to XVIIIth Centuries, on the Arts of Painting in Oil, Miniature, Mosaic, and on Glass of Gilding, Dyeing, and the Preparation of Colours and Artificial Gems* by Mary P. Merrifield (1804)

## MADDER

367. To dye thread red. —Take some madder well pounded, and put it into a little ley made from vine ashes, and let it boil, and put the thread to boil in the ley for some time; then remove it from the fire, and let it dry; when it is dry alum it, and then boil it in a little verzino well boiled with water and ley mixed together; then dry it in the wind without sun, and it will be fine.

# The Plictho (pg. 109-110) – Dye recipe

*The Plictho: instructions in the art of the dyers which teaches the dyeing of woolen cloths, linens, cottons, and silk by the great art as well as by the common* by Giovanventura Rosetti (active 1530-1548)

## MADDER

### To dye wool or cloths in red.

48. For each pound of wool take 4 ounces of roche alum and make it boil one\*hour and a half. Wash it very well in clear water. Then after it is well washed, take for each pound of wool 4 ounces of madder and make it boil in clear water. Throw in the madder when it is about to boil, then the wool, and let it boil for half an hour, stirring constantly. On washing it becomes well dyed, that is, red.

Plictho 48: To dye wool or cloths in red.

For each pound of wool take 4 ounces of roche alum and make it boil one hour and a half. Wash it very well in clear water. Then after it is well washed, take for each pound of wool 4 ounces of madder and make it boil in clear water. Throw in the madder when it is about to boil, then the wool, and let it boil for half an hour, stirring constantly. On washing it becomes well dyed, that is, red.

# The Plictho (pg. 127) – Dye recipe

*The Plictho: instructions in the art of the dyers which teaches the dyeing of woolen cloths, linens, cottons, and silk by the great art as well as by the common* by Giovanventura Rosetti (active 1530-1548)

## MADDER

To make a fine wool with madder follow this manner.

101. When you are about to mordant you take 6 pounds of alum for each dozen pounds of wool by weight, and one pound of grain and mordant according to the usage. When you are ready to madder, you will take twelve pounds of madder for each dozen pounds as above I said, and three pails of strong water. Put your wool into the cauldron when it is good and hot, and have it well raked. When it is about to boil poke it well under the water and go two shots. Then take it out and drain it in the basket and wash well. Give it then a new bath while it is good and hot and then take it out. If you wish you can have it washed and you will have good color and pretty wool.

# The Plictho (pg. 151) – Dye recipe

*The Plictho: instructions in the art of the dyers which teaches the dyeing of woolen cloths, linens, cottons, and silk by the great art as well as by the common* by Giovanventura Rosetti (active 1530-1548)

## MADDER

### To dye silk in madder.

132. First one must alumate silk and for each pound of silk take four ounces of madder that is madder of Flanders,<sup>60</sup> and if it were madder of another sort take of it two pounds for each pound of silk.<sup>146</sup> When you want to dye put the madder into the cauldron with the water and let the madder be well pestled. Then make fire until the water gets hot and scalding to the hand. See that you have your silk in loops and go handling the silk in the water above said. Then take it out and wring the silk by hand. Then return it to the cauldron, that is, into the liquor. When you get the color to your liking, take it out, and when it is cold wring it by hand. Then wring it on the hook and then set it to dry in the sun.

plictho notes pg 191

The use of a solution of bran helped cleanse the goods of its impurities and made it more amenable to the absorption of the alum and subsequently the dyestuff.

plictho 192

The use of a small amount of tartar along with the alum is characteristic of many of the dyeing recipes; the use of tartar was noted in preceding formulas and will also be found in subsequent ones. It was probably an empirical thing which may or may not have been important. It is conceivable that the tartar would tend to regulate the pH and hence the rate of exhaustion of the alum. Also, since the alums normally used were impure in many ways, the tartar could have a certain amount of sequestering effect on some inorganic impurities.

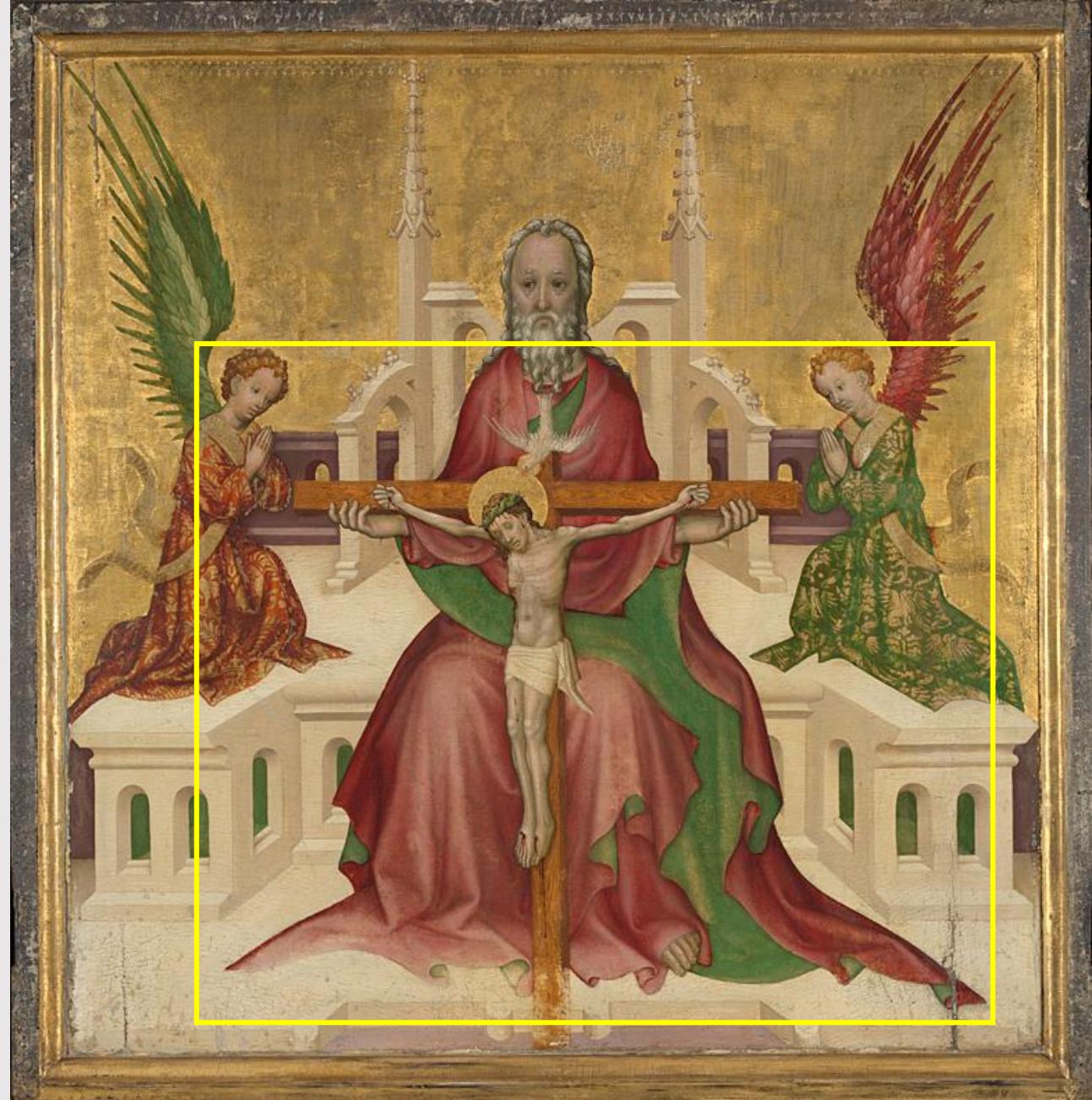
# Examples of madder lakes in art



The thick red paint used for the drapery of the central figure of God the Father and in several other areas has a distinctive lumpy texture, and is poorly covering, due to the use of a transparent madder lake pigment of large particle.

Kirby, J., Spring, M., Higgitt, C. 'The Technology of Red Lake Pigment Manufacture: Study of the Dyestuff Substrate'. *National Gallery Technical Bulletin* Vol 26, pp 71–87.  
[http://www.nationalgallery.org.uk/technical-bulletin/kirby\\_spring\\_higgitt2005](http://www.nationalgallery.org.uk/technical-bulletin/kirby_spring_higgitt2005).

The Trinity with Christ Crucified (NG3662)  
about 1410, Austrian, Egg on silver fir  
<https://www.nationalgallery.org.uk/paintings/austrian-the-trinity-with-christ-crucified>

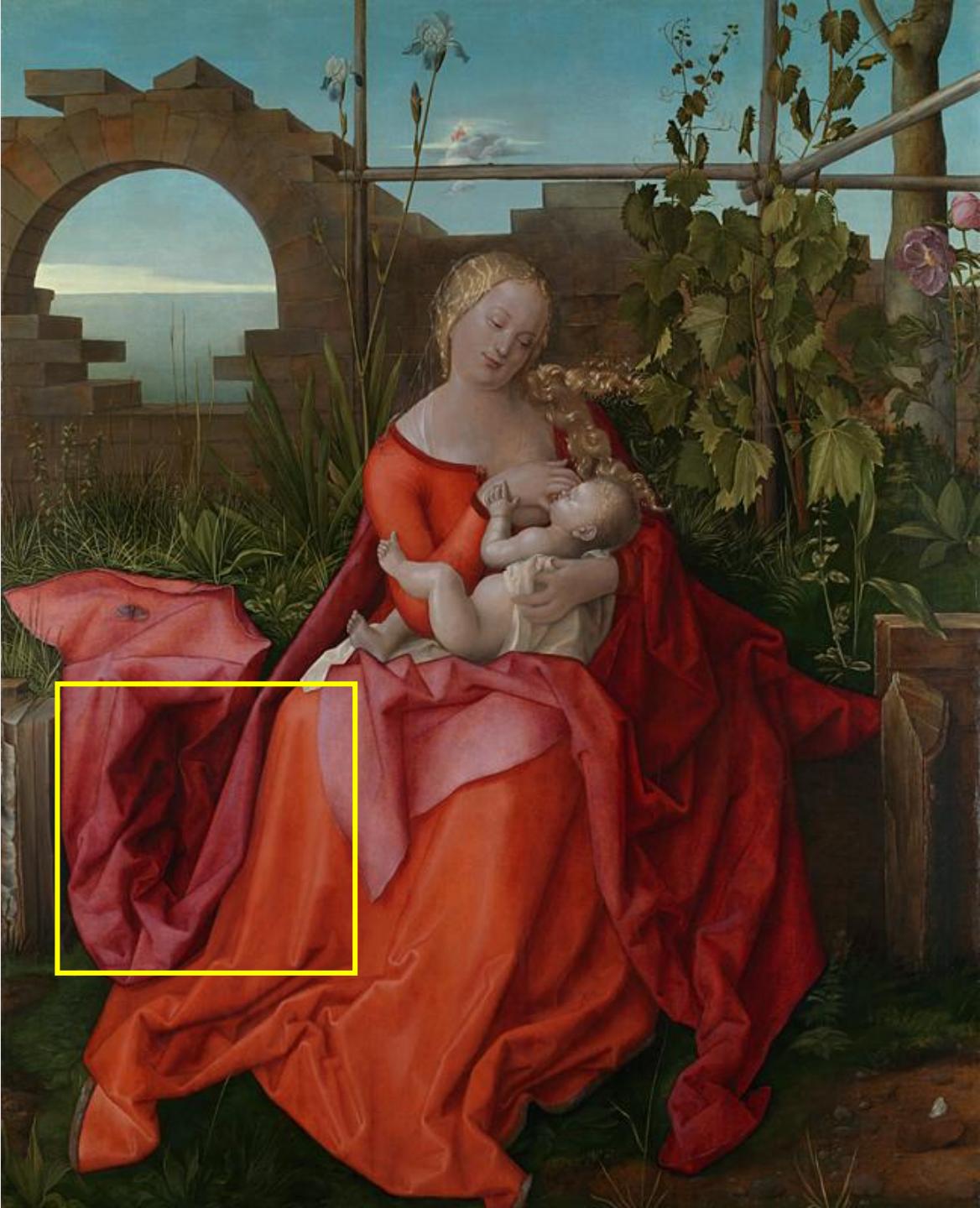


Red of Virgin's robe: two layers, lower layer mainly madder, upper layer mainly kermes.

Kirby, J., Spring, M., Higgitt, C. 'The Technology of Red Lake Pigment Manufacture: Study of the Dyestuff Substrate'. *National Gallery Technical Bulletin* Vol 26, pp 71–87.

[http://www.nationalgallery.org.uk/technical-bulletin/kirby\\_spring\\_higgitt2005](http://www.nationalgallery.org.uk/technical-bulletin/kirby_spring_higgitt2005)

The Virgin and Child ('The Madonna with the Iris') (NG5592)  
1471 - 1528, Workshop of Albrecht Dürer, Oil on lime  
<https://www.nationalgallery.org.uk/paintings/workshop-of-albrecht-durer-the-virgin-and-child-the-madonna-with-the-iris>



Red brocade of Saint Catherine's dress:  
kermes and madder. Madder probably  
extracted from wool.

Kirby, J., Spring, M., Higgitt, C. 'The Technology of Red Lake Pigment Manufacture: Study of the Dyestuff Substrate'. *National Gallery Technical Bulletin* Vol 26, pp 71–87.  
[http://www.nationalgallery.org.uk/technical-bulletin/kirby\\_spring\\_higgitt2005](http://www.nationalgallery.org.uk/technical-bulletin/kirby_spring_higgitt2005)



The Virgin and Child with Saints and Donor (NG1432)  
probably 1510, Gerard David, Oil on oak  
<https://www.nationalgallery.org.uk/paintings/gerard-david-the-virgin-and-child-with-saints-and-donor>

Red of cloth on altar frontal: kermes and madder in separate layers.  
Madder lake in lower later, probably extracted from wool.

Kirby, J., Spring, M., Higgitt, C. 'The Technology of Red Lake Pigment Manufacture: Study of the Dyestuff Substrate'. National Gallery Technical Bulletin Vol 26, pp 71–87.

[http://www.nationalgallery.org.uk/technical-bulletin/kirby\\_spring\\_higgitt2005](http://www.nationalgallery.org.uk/technical-bulletin/kirby_spring_higgitt2005)

The Mass of Saint Giles (NG4681)  
about 1500, Master of Saint Giles, Oil on oak  
<https://www.nationalgallery.org.uk/paintings/master-of-saint-giles-the-mass-of-saint-giles>



Red of curtain in background: madder and kermes in separate red lake pigments. Madder lake likely extracted from wool, and unreacted potash alum is present.

Kirby, J., Spring, M., Higgitt, C. 'The Technology of Red Lake Pigment Manufacture: Study of the Dyestuff Substrate'. National Gallery Technical Bulletin Vol 26, pp 71–87.

[http://www.nationalgallery.org.uk/technical-bulletin/kirby\\_spring\\_higgitt2005](http://www.nationalgallery.org.uk/technical-bulletin/kirby_spring_higgitt2005)

The Virgin and Child enthroned with Saint Dominic and Saint Catherine of Siena ('Madonna della Scimmia') (NG3102)  
about 1499 - 1502, Garofalo, Oil on wood  
<https://www.nationalgallery.org.uk/paintings/garofalo-the-virgin-and-child-enthroned-with-saints-1>



Red of sleeve of left figure: underpaint contains madder lake (HPLC), upper layer contains kermes lake. Madder lake; Al, large S (slightly smaller than Al). FTIR microscopy: the red lake particles contain protein suggesting that the dyestuff has been extracted from wool. Also amorphous hydrated alumina, some calcium carbonate and calcium sulphate.



## Two Tax-Gatherers

probably 1540s, Workshop of Marinus van Reymerswale

<https://www.nationalgallery.org.uk/paintings/workshop-of-marinus-van-reymerswale-two-tax-gatherers>



# Resources and References

# Sources of historical evidence

- Analysis of existing objects, such as surviving textiles and paintings in museum collections
  - However, it must be kept in mind that these represent only a small part of history. They are items that have been selectively collected by museums or upper class. Many were made for or bought by the elite, were luxury or just generally expensive items
- Recipe books and collections, instruction manuals
- Work orders, inventories, accounts, orders for materials, import records, and guild regulations

# References and Links

- Jo Kirby et al, *Natural Colorants for Dyeing and Lake Pigments: Practical Recipes and their Historical Sources* (Archetype Publications, London, 2014)
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[https://www.metmuseum.org/art/metpublications/cochineal\\_red\\_the\\_art\\_history\\_of\\_a\\_color](https://www.metmuseum.org/art/metpublications/cochineal_red_the_art_history_of_a_color)
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- CAMEO: Conservation & Art Materials Encyclopedia Online: [http://cameo.mfa.org/wiki/Main\\_Page](http://cameo.mfa.org/wiki/Main_Page)
  - CAMEO is a searchable information resource developed by the Museum of Fine Arts, Boston. The MATERIALS database contains chemical, physical, visual, and analytical information on historic and contemporary materials used in the production and conservation of artistic, architectural, archaeological, and anthropological materials.
- <http://shop.kremerpigments.com/en/>
- <https://maiwa.com/pages/natural-dyes>
- Greenfield, Amy Butler. *A Perfect Red Empire, Espionage, and the Quest for the Color of Desire*. Harper Perennial, 2006.
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- Beatriz Fonseca et al., "Seeing Red: Towards an Improved Protocol for the Identification of Madder- and Cochineal-Based Pigments by Fiber Optics Reflectance Spectroscopy (FORS)," *Heritage Science* 7, no. 1 (November 8, 2019): 92, <https://doi.org/10.1186/s40494-019-0335-1>.
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- Jo Kirby et al, *The Technology of Red Lake Pigment Manufacture: Study of the Dyestuff Substrate* (National Gallery Technical Bulletin, Vol. 26 (2005), pp. 71-87)
- Jo Kirby et al, *The Technology of Eighteenth and Nineteenth Century Red Lake Pigments* (National Gallery Technical Bulletin, Vol. 28 (2007), pp. 69-95)
- <https://www.naturalpigments.com/>
  - And their very helpful blog postings: <https://www.naturalpigments.com/artist-materials/>
  - Ancient Pigments and their Identification in Works of Art \_\_\_\_\_
  - Traditional Oil Painting: The Revival of Historical Artists' Materials \_\_\_\_\_
- <https://travelingscriptorium.library.yale.edu/>
  - See blog posts as well as resources on inks and pigments: <https://travelingscriptorium.library.yale.edu/inks-and-pigments/>
  - [https://travelingscriptorium.files.wordpress.com/2012/03/scopa-pigment-swatches\\_web.pdf](https://travelingscriptorium.files.wordpress.com/2012/03/scopa-pigment-swatches_web.pdf)

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## *Madder dye identification is used to prove this object was a forgery*

The Privilegium maius is one of the most famous and spectacular forgeries in medieval Europe. It is a set of charters made in the 14th century upon commitment by Duke Rudolf IV, a member of the Habsburg family, to elevate the rank and the prestige of his family. These five charters, now kept at the Österreichisches Staatsarchiv in Vienna, have been subjected to a thorough interdisciplinary study in order to shed light on its controversial story. The charters are composed of pergameneaceous documents bound to wax seals with coloured textile threads. The present contribution concerns the characterisation of the inks used for writing and of the dyes used to colour to the threads: Are they compatible with the presumed age of the charters? Though showing only a part of the whole story of the charters, dyes analysis could contribute in assessing their complex history from manufacturing to nowadays. The dyes were characterised with non-invasive in situ measurements by means of fibre optic (FORS) and with micro-invasive measurements by means of Surface Enhanced Raman Spectroscopy (SERS) and High-Performance Liquid Chromatography with Mass Spectrometry (HPLC-MS) analysis. The results showed that the threads of four of the charters (three dyed with madder, one with orchil) were apparently coloured at different dyeing stages, then re-dyed in the 19–20th century.

The Privilegium maius is one of the most famous and most spectacular forgeries in medieval Europe. It is a set of five pergameneaceous charters dating to the 14th century AD with a highly controversial story. In 1156, the Emperor of the Holy Roman Empire Frederick I called Barbarossa issued the Privilegium minus, a charter with a decree that elevated Austria to the rank of Duchy ruled by the Babenberg family.

As to the dyes, it was found that the purple threads were most probably dyed at different stages. The threads of three charters, i.e., AUR 187, AUR 520 and AUR 708 were dyed with natural madder obtained from *Rubia tinctorum*, but the threads of the charter AUR 1845 were apparently dyed with orchil, a lichen dye; in addition, HPLC-MS analysis revealed that the distributions of anthraquinones in the threads of AUR 187, AUR 520 and AUR 708 were significantly different, as if they were dyed with madder but in different dyeing baths or at different times.

