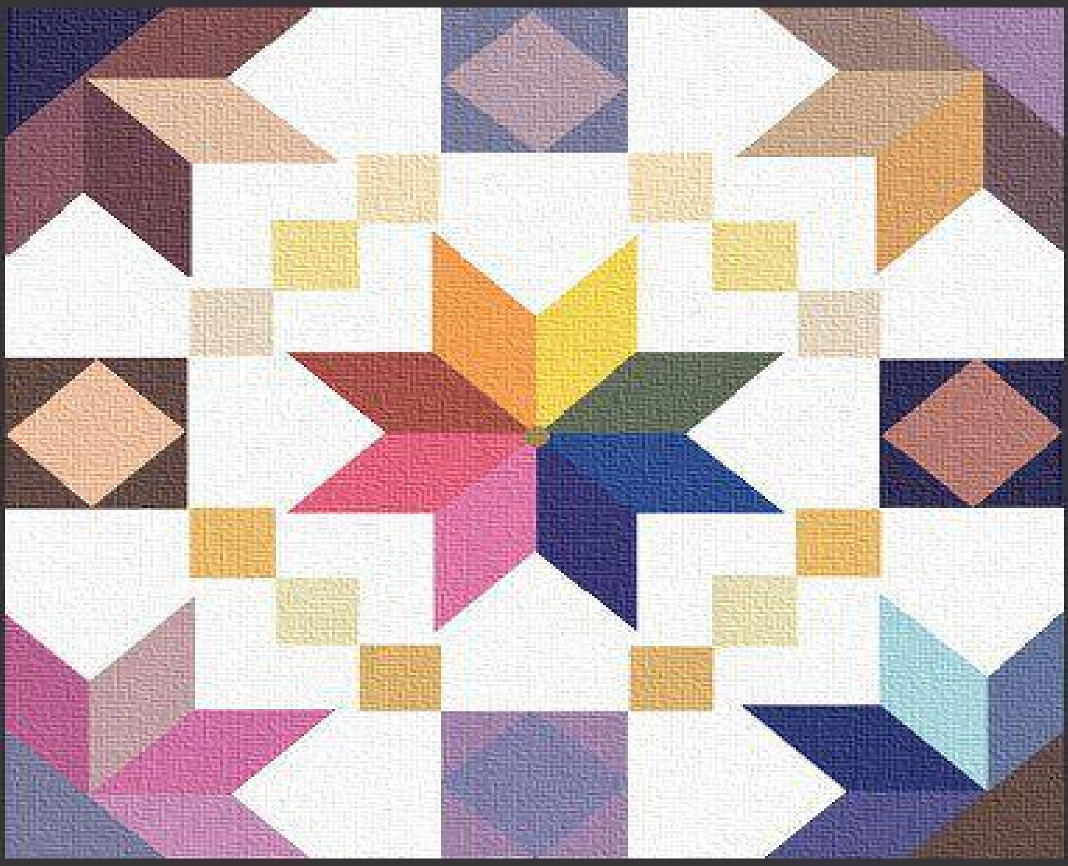
Medieval Dyes

by

Jodi Smith

illustrations by

C. Ellen Young



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INTRODUCTION

In this book, I explore the range of colors available to medieval European dyers. I have included dyes grown in Europe and the Near East, and some of the more popular dyes imported from the Far East and South America. I touch on some dyes for which I could not obtain samples.

No one medieval dyer would have had access to all these dyes at once. The availability and price of dyes varied with period and location.

Some medieval dyes are no longer readily available. In these cases, I have substituted dyes with chemically similar pigments. They are discussed under the individual dyes.

It is not possible to include all dyeplants or techniques ever used. Professional dyers used the brightest or the best quality dyes, which were limited in number. Nonprofessionals used whatever they could obtain. A great many plants give yellow dyes with alum, or various shades of browns. I concentrated on dyes that were important in the Middle Ages or which are readily available to modern dyers. Dyes may be combined, either in one pot or as several steps, to obtain still more colors, and naturally colored wools may be dyed.

Professional and Non-Professional Dyers

Dyeing was a specialized occupation, especially in urban areas. Quality, prices, business practices, and pollution were often strictly regulated, either by local government or by trade guilds. Luxury fibers, like silk, and expensive imported dyestuffs would be handled only by professional dyers. In isolated villages and rural estates there were always nonprofessional dyers working with local materials and homegrown wool. Even in rural areas, dyeing was something of a specialty because owning a second kettle one that was not already full of tonight's supper was a large investment. However, the "household advice" books popular in the late Middle Ages make it clear that ordinary housewives of this era often did some simple dyeing. I have included both commercial medieval dyes and some local peasant dyes. It is no surprise that the imported dyes give the most spectacular colors and justified the trouble and expense of transporting them long distances.

Historical Sources

In spite of the political and cultural upheavals, there is a surprising continuity in dye technology from ancient times into modern times. Although the popularity of certain dyestuffs shifted as supplies became scarce or were replaced by better, less expensive materials, there were very few dye methods that were "lost."

Most medieval dye books written before the 15th century were translations of books written by Arabs, or books written by and for the monasteries. Early medieval dyers seldom wrote down their recipes, partly because these were trade secrets that were too valuable to be entrusted to writing. From the 15th century onward, many more dye recipe books exist. The recipes we do have are not "exact" instructions and measurements; the dyer was expected to use his own judgement and experience.

Variations in Color

The colors obtained from natural dyes can vary. Some causes of variation are:

- species and variety of plant
- time of year and age of plant when gathered
- dried vs. fresh plants
- soil and climate where the plant grew
- type and processing of fiber (Two different wool yarns in the same dye pot may turn out different.)
- amount of dyestuff compared to fiber (Too much fiber for the amount of dye does not always give a simple pastel shade of the original dye.)
- mordanting done before, during or after the dyebath
- purity of the mordant
- metal of the pot
- water hardness
- other trace minerals in the water
- acidity or alkalinity of water (Many dye recipes add acid or alkali to the dye bath.)
- temperature of dye bath (boiling, simmering, or cold)

Different people see colors differently, so descriptions can vary from author to author.

All the existing medieval fabrics have faded, to some degree, from their original colors. Often, some dyes in a single piece have faded or discolored more than others, so the current colors do not depict the original colors.

FIBERS

"...the master of the house, . . . one that will weare no other shirts but of the flaxe that grows on his owne ground, and of his wives, daughters, or servants spinning; that has his stockings, hose and jerkin of the wooll of his owne sheepes backes; ... and yet this plain home-spunne fellow keepes and maintains thirty, forty, fifty servants, or perhaps more."

John Taylor, 1618,

describing Scottish nobility of his day (22).

"An excellent wife, who can find?

She looks for wool and flax,

And works with her hands in delight.

She stretches out her hands to the distaff,

And her hands grasp the spindle.

She makes linen garments and sells them,

And supplies belts to the merchants."

Bible, Proverbs 31:10

Wool

Wool was a common medieval fabric. Sometimes it was used in its natural colors (white, browns, gray and black), and at other times it was dyed. Wool was processed both by professional manufacturers and by housewives for use in their own households.

Sheep were domesticated in the Mediterranean region during the Stone Age and their wool (and hair) spun and woven. Woolen fabric has been found throughout Europe dating from at least 2000 B.C. White, natural colored, and dyed wool were all used since ancient times.

Other Animal Fibers

The hair and down of other animals, including camel, goat, and rabbit, were also spun and woven.

Many dyes used on wool were used on leather.

Silk

The earliest silk in Europe was imported from China. Some silk was imported to Persia from China as early as 600 - 400 b.c., and silk trickled into northern Europe about the same time. Large-scale silk trade from China to Persia — the Silk Road — began around 140 b.c. Major silk-weaving centers grew up in parts of the Near East in the 3rd or 4th century a.d., using silk fiber imported from China. Wild silkworms in India, Assyria, Persia, and the Mediterranean islands produced some silk.

Between the 5th and 7th centuries, the Near Eastern countries, including the Byzantine Empire, learned the secrets of raising their own silkworms. In the Late Middle Ages, important silk manufacturing centers were set up in Italy, Spain, and France.

Most silk was dyed, using the highest quality dyes available. The silk production centers tended to also become the centers of dye technology.

Strictly speaking, "raw silk" refers to silk before removing the gum (sericin) which the silkworm used to glue its cocoon together. The fashionable fabric currently known as "raw silk" is really made from silk noil, short ends of leftover silk fiber.

Cotton

"The upper part of Egypt lying in the direction of Arabia grows a bush that some people call cotton (gossypion) *but more often by a Greek word meaning wood* (xylon) *therefore the name* xylina *given to linens made from it. It is a small shrub and from it hangs a fruit resembling a bearded nut with an inner silky fiber from the down of which thread is spun. No kinds of thread are more brilliantly white or make smoother fabric than this. Garments made of* xylina *are very popular with the priests of Egypt."*

Pliny, Natural History, 1st century a.d. (39)

"These [Indian cotton] *cloths are chiefly valuable because of the "vivacity" (if I may so express it) and the lasting quality of the colors with which they are dyed, which, far from deteriorating when washed, only become more beautiful. It is this quality, which Europeans have not yet succeeded in imitating, that I now have learned how to obtain."*

Father Coeurdoux, 1742 (13)

Cotton was a luxury fabric in medieval Europe, and was primarily imported from India. Most of the imported cotton was already woven and dyed, printed, or painted, and was highly valued because of the brightness and colorfastness of the dyes. Cotton thread was also valued because it made the highest quality candlewicks.

Samples of cotton fabrics, some of them dyed, dating from 3000 b.c. have been found in what is now India and Pakistan. There is considerable uncertainly about the speed at which cotton cultivation spread westward from India during 300 b.c. - 800 a.d. Cotton cultivation was introduced into Egypt, Greece, and Roman Sudan sometime between the 4th century b.c.

and the 1st century a.d., but it did not attain major economic importance until after the Arab conquest.

A few pieces of cotton from the 4th century have been found in northern Europe. Cotton fabric from India was known in England as early as the 8th century.

In the 13th and 14th centuries, cotton-weaving centers were established in Italy. These centers had only a minor economic impact, because it was difficult for them to obtain a supply of cotton fiber, and because they produced a coarser quality fabric than the imported cotton fabric.

Linen

Linen, from the fiber of the flax plant, was a common fabric. Like wool, linen was often processed at home for household use.

Linen was occasionally dyed, but was normally used undyed. Even under the best conditions, linen does not take dye readily. European dyers (unlike their Indian counterparts) were not skilled in the proper mordanting of linen and other plant fibers. Woad blue, which does not require a mordant, was the most common medieval dye for linen.

Wild flax was used in Swiss Stone-Age settlements before 8000 b.c. It was cultivated in the Mediterranean region around 5000 b.c. Cultivated flax had established itself "everywhere" before the Roman period. In Egypt, linen was valued as "pure" fiber. The Greeks and Romans used linen, although it was more popular in the colonies than in the major cities. Early medieval European kings encouraged their subjects to grow and process flax.

In the Middle Ages, fabric was also commonly woven from nettles, hemp, mallow, and other "bast" (plant-stem) fibers. These fabrics were processed like to linen.

Today, fabric stores often gloss over the distinction between linen from the flax plant, and synthetic fibers or blends woven in a "linen-like" texture. Read the labels very carefully.

Dyeing Various Fibers

Wool and silk are made of protein. Cotton, linen, and other plant fibers are made of cellulose, so they require different handling and mordanting techniques, and absorb dyes differently from the protein fibers. Not all dyes work well on plant fibers; those containing tannin give the best results.

Synthetic fibers seldom take natural dyes well. Rayon, which contains cellulose, can be dyed like a plant fiber.

SAFETY

It is important to treat dyes and mordants with proper care. Even "natural" materials have their hazards. However, some authors view all dyes and mordants with panic, and needlessly complicate the safety issues. Liles has an excellent and level-headed discussion of safe handling and disposal of mordant and dye chemicals. I strongly recommend reading Liles pages 12-16 (30). See also, Appendix 1 (Chemicals Used in Dyeing).

In the briefest summary:

Use common sense.

Read the safety labels on all chemicals you use.

Don't use cooking pots or spoons for mordanting or dyeing, unless you are using a dye (like onion skins) which is safe to eat. Buy an old aluminum or stainless steel pot at a garage sale or thrift shop to use for dyeing.

Avoid breathing dusty powders, or fumes from boiling pots.

Use rubber gloves to protect your hands from harsh chemicals.

Don't eat, drink, or smoke while working with poisonous materials.

Keep all chemicals **away from children.**

Lye and Potassium hydroxide generate large amounts of heat when dissolving, or if the solution is mixed with an acid. They are also

deadly poisonous and cause severe caustic burns on skin.

Lime and Pearl Ash are strong caustics, and cause caustic burns.

Breathing large amounts of ammonia fumes is bad for the lungs

Oxalic acid and Copper Sulfate are extremely poisonous, and irritating to skin.

Iron sulfate is poisonous in large quantities.

Concentrated tannin is mildly poisonous and a skin irritant.

Washing soda is irritating to skin, especially in strong concentrations or with repeated exposure.

PREPARING THE FIBERS

Scouring

"Scouring" is cleaning the fiber before dyeing to remove any traces of grease, oil, or wax. All natural fibers, including commercially woven fabric (which may contain sizing or machine oils), benefit from scouring.

History

"Jesus took Peter and James and John with him and led them high up on a hillside. His whole appearance changed before their eyes, while his clothes became dazzling white, whiter than any earthly bleaching could make them."

<u>Bible</u>, *Mark 9:2-3*

Wool was cleaned with a combination of fat or oil and an alkali. Ammonia from stale urine, or lye from plant ashes was used as the alkali. Another alkali used for cleaning was soda ash (washing soda), the major component of the mineral natron, mined from salt lakes in Egypt.

The combination of fat or oil with ashes, soda, or ammonia produced a crude soap. However, not all cultures recognized "soap" as a distinct substance. The "soap" mentioned in the Bible (Jeremiah 2:22, Malachi 3:2) refers to "cleaning substances" in the most general sense.

The Romans learned soap-making from the inhabitants of Germany and Gaul, and spread the practice throughout their Empire. Small-scale soap-making continued in the Mediterranean region in the Middle Ages. Soap became popular in Europe in the 12th century, and major manufacturing centers were set up in Scandinavia, Spain, France, and Italy.

Various alkaline plants contain lathering and cleaning agents in their roots and leaves; these "soap-roots" were used to clean cloth.

Fuller's earth, a form of clay, was sometimes used to remove grease from wool.

After scouring, wool and silk were bleached in the fumes from burning sulfur.

Linen was scoured and bleached with a strong alkali — usually either lye or natron.

Scouring Recipes

Even if your fiber looks clean and white, try scouring it. You may be surprised how much gunk washes off "clean" fibers.

Cotton:

In a large pot, use a minimum of 2 quarts of water per ounce of cotton cloth (or minimum 1 quart per ounce of yarn). Add 1/2 teaspoon liquid detergent and 2 teaspoons washing soda per ounce of cotton. Add cotton. Simmer or boil for a minimum of 2 hours. Rinse well.

Linen:

In a large pot, use 1 quart of soft, room-temperature water per ounce of linen. Add 1/3 ounce (2 teaspoons) liquid detergent and 1/3 ounce of washing soda. Heat to simmering, and simmer 1 hour. Rinse well. Repeat the scouring operation.

Wool:

In a large pot, use 4 to 6 gallons of soft, room-temperature water per pound of wool. Add 1 to 2 Tablespoons of liquid detergent. Add the wool, and heat but do not boil. Turn the wool occasionally. Turn the wool in the same way that you fold a batter, by rolling the wool from top to bottom. Do not stir it. Boiling or strong stirring could cause felting. Soak for at least 2 hours, preferably overnight. Drain carefully, and rinse (without agitating) with water the same temperature as the final temperature of the wash solution. If the wool is very dirty or greasy, the entire process can be repeated.

Silk:

With silk, the scouring process is primarily the "degumming" process — removing the layer of sericin that glues the silkworm's cocoon together. Authors disagree whether commercially prepared silk needs scouring. I scour my silk just to be sure.

In a large pot, use 8 gallons of room-temperature water per pound of silk. Add 2 Tablespoons liquid detergent. Heat to simmering, and simmer until the silk does not feel slimy. (I simmer for 1 hour.) Cool partially, and rinse. Avoid sudden changes in temperature, as this could permanently set wrinkles into silk.

Mercerizing

Plant fibers take dye better if they are mercerized before dyeing. This means treating the fiber in a strong alkali bath. Mercerization makes the fibers stronger and shinier, and shrinks the fiber. Cotton bought as fabric is nearly always already mercerized; cotton yarn may or may not be.

Medieval weavers were not aware of the mercerizing process, but the strong alkalis they used in cleaning plant fibers probably had at least some of the same effect.

Bliss gives a recipe for mercerizing plant fibers. (3) (pp. 34-36) When mercerization is done at home, it comes after scouring and before mordanting.

Mordanting

"In Egypt they also colour cloth by an exceptionally remarkable kind of process. They first thoroughly rub white fabrics and then smear them not with colours but with chemicals that absorb colour. When this has been done, the fabrics show no sign of the treatment, but after being plunged into a cauldron of boiling dye they are drawn out a moment later dyed. And the remarkable thing is that although the cauldron contains only one colour, it produces a series of different colours on the fabric, the hue changing with the quality of the chemical employed, and it cannot afterwards be washed out."

Pliny the Elder, Natural History, 9:371, 1st century a.d (39)

"Let us now see how this red colour is prepared. Take bitter water, that is to say, the water of certain wells which have this taste.... Some people say bitter water is used to improve the colour of the red, but rather more commonly it is said that it is used to make it fast."

Father Coeurdoux, 1742 (13)

Principles of Mordanting

A dye that produces a bright, full color on fiber without needing any other chemicals is described as a "direct color" or "substantive dye". A dye that requires the assistance of another chemical to produce a full color is described as a "mordant color" or "adjective dye". A third category of dyes includes indigo, shellfish purple, and tannin-and-iron black, which form a coating on the fibers, but do not truly bond to the fibers.

A "mordant" is a chemical, usually a metal salt, that helps the dye attach securely to the fiber. A "color lake" is an insoluble colored compound, formed when a metal salt or oxide combines with a dye. A successful mordant needs to attach to the fiber, as well as to the dye.

Dyes give different shades of color, and different degrees of colorfastness, depending on which mordant is used. Some dyes require mordants on some fibers but not on others.

Other chemicals that assist in the dyeing process, such as cream of tartar or common salt, are not classified as mordants in the strict sense. Tannin is sometimes classified as a mordant (and sometimes used as a dye in its own right).

Mordants for cotton and linen are usually applied under alkaline conditions (such as washing soda), while mordants for wool and silk are usually applied under acidic conditions (such as cream of tartar). These conditions best allow the mordant to attach to the respective fibers. Tannin is often used along with mordants on cotton because the tannin attaches well to the plant fibers, and the mordant can then attach to the tannin.

Mordanting Before, During or After Dyeing

The original tests for this book were made by mordanting the fibers before dyeing ("premordanting"). This was convenient for the testing process. It allowed a number of fiber samples, each with a different mordant, to be dyed at once.

When dyeing larger lots of fiber using alum, the most common mordant, I usually premordant.

Sometimes dyers prefer to add the mordant directly to the dyebath ("one-pot dyeing".) This does save time, but it works only with some dyes. I have occasionally had the mordant and dye-stuff clump together and settle to the pot bottom, not sticking to the fiber at all.

Iron mordant is often applied after the dyebath ("postmordanting").

Since the first edition of this book, I have done more experimenting with postmordanting with copper and iron. Generally, postmordanted colors are a bit grayer than premordanted colors. However, postmordanting — either on unmordanted fiber or on fiber premordanted with alum — allows you to dye the fiber first, and then apply just enough copper or iron mordant to get the shade you want.

History

Ancient and medieval dyers most often mordanted before dyeing.

Alum and iron were used as mordants in India, Egypt, and Assyria from very early times. Alum is a mineral found in many parts of the world; there are many alum deposits in the Mediterranean region. As the following quote from Pliny shows, dyers were aware of various grades of alum, using the purer "light" alum for clear colors, and "dark" alum, containing iron salts, for dark colors.

The Romans used alum, iron, and probably copper as mordants.

Medieval dyers used alum, copper, and iron compounds as mordants. Common salt and cream of tartar were used as dye additives.

Modern chemistry began to develop in Europe in the 16th century, and a chemical manufacturing industry arose at the same time. In the 16th and 17th centuries, compounds of antimony, arsenic, mercury, and lead were used as mordants, in addition to the older mordants. Tin was first used as a mordant in the early 17th century.

Alum

"No less important are the uses of alum. This term refers to a salt exudation from the earth. There are several kinds. In Cyprus there occurs a white alum and a variety of a somewhat darker colour. Although the difference in colour is only marginal, the use to which each is put is very different: the white, liquid kind of alum is useful for dyeing woollens bright colours, whereas the black is best for dark or dull colours."

Pliny the Elder, Natural History, xxxv:183, 1st century a.d. (39)

In the Middle Ages, Italian merchants sold alum throughout Europe.

Some plants contain small amounts of aluminum compounds. By boiling these plants for several days, dyers can extract an alum mordant. Such plants include club mosses (*Lycopodium* species, *Huperzia selago*, and *Diphasiastrum alpinum*), which were used as mordants by the Vikings in Scandinavia and in Britain. Other alum-bearing plants are the lichen *Lecanora tartarea*, and the sweetleaf tree *Symplocos tinctoria*. Other so-called "alum root" plants (*Geranium maculatum, Heuchera americana*) which were used as mordants contain tannin, rather than alum.

Alum mordant gives bright colors, especially bright yellows and reds.

Copper

The Romans used copper lactate (copper metal dissolved in sour milk) as a green dye for wool, and bluestone (copper sulfate) as part of the leather dyeing process, so it is plausible that they also used copper as a mordant for wool. Medieval dyers used various copper compounds, including copper sulfate, as mordants. Historically, copper was one of the less important mordants.

Copper mordant gives more greenish or brownish colors than alum. Copper-mordanted colors are generally more lightfast than alum colors.

Iron

"Dyers tell merchants that vitriol (iron sulfate) *darkens cloth and produces a better result and does not harm the cloth. They do not tell the truth and use it to destroy cloth, using only a little woad and then covering it with vitriol later."*

L'arte della lana a Vicenza, 1550 (7)

The earliest iron mordant was probably iron-rich mud or water from iron-rich mineral springs. The Romans, and many later dyers, used ferrous acetate (scrap iron, or filings from grinding wheels, dissolved in vinegar) as an iron mordant. Vitriol (iron sulfate) was one of the dye supplies sold by medieval merchants.

Iron mordant is used for dark colors: "yellow" dyes generally give brown or olive green; "red" dyes generally give purple; tannin-rich dyes give black. Iron-mordanted colors are usually more lightfast than alum-mordanted colors.

Iron mordant is difficult to apply evenly. Often some patches of fabric will be mordanted more heavily than others. Iron mordant tends to cling to the mordanting pot, where it may contaminate later dye batches.

Iron is harsh to the fibers, and causes them to deteriorate more quickly. Use only as much iron as necessary — no more than the recipe calls for, and less (maybe half) for pale shades. A few authors are reluctant to use any iron mordant on wool or silk, for fear it will rot the fiber. Medieval dyers were aware of this problem.* However, medieval and modern commercial dyers did use iron mordants. After several hundred years, wool, silk, and cotton fibers dyed with iron mordants are often in worse condition than those dyed with other mordants.

Some dyers recommend mordanting with iron before using black dyes, and mordanting after dyeing for darkening colors.

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* It is not always clear, reading the various court cases and guild regulations, whether the real concern is that *any* iron damages the fiber, or that *excessive* iron damages the fiber, or that cheap dyes were fraudulently used to darken color, or that dyers of dark colors were infringing on the bright-color business.

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Tin

The Dutch physicist Cornelius van Drebbel is generally credited with discovering that tin creates a spectacular scarlet with cochineal. This discovery occurred in either 1607 or 1630. It is possible that a few people in the 16th century knew how to produce cochineal scarlet with tin, but there is no evidence that they used tin mordant on a commercial scale for cloth dyeing.

Tin was an expensive mordant, used more by the commercial dye works than by home dyers.

Tin mordant brightens colors. Modern commercial dyers seldom use tin mordant alone, because the colors are too garishly bright. More often, a small amount of tin is added, with another mordant.

Tannin

In India, tannin was used as a mordant on cotton cloth. Medieval European dyers were not skilled at mordanting cotton and linen fibers. They did use tannin as a yellow and black dye.

Tannin is found in a variety of plants, especially oak bark and galls, sumac, pomegranate rind, and myrobalan fruit in India.

Mordanting with Metal Pots and Pieces of Metal

"I say copper kettle, because it is most commonly used in all hot dyes, and all hot dyes may be coloured in the copper.... Block tin or brass, are better for red and yellow, than the copper; and iron the best for black or green; but this I leave to the discretion of those in practice."

The Dyer's Companion, 1815 (2)

"I must here take notice of the bad custom of letting sour liquors (acidic solutions) remain in copper-vessels, as I have seen in some eminent dye-houses; for this liquor being an acid, corrodes the copper, and if it remains long enough to take in a portion of this metal, it will cause a defect both in the dye and in the quality of the stuff (fabric): in the dye, because the dissolved copper gives a greenish cast; in the quality of the stuff, because the copper dissolved preys on all animal substances."

The Dyer's Companion, 1815 (2)

"It is impossible to obtain a pure scarlet [using cochineal] in a copper pan, and tin vessels must therefore be used. The colour obtained by dyeing in wooden vessels, ... is less handsome than that produced in tin vessels."

The Chemical Technology of Textile Fibers, 1920 (19)

Many references imply that dyeing in iron, copper, tin or aluminum pots (or adding a piece of appropriate metal to the dyebath) will supply enough metal to serve as a mordant.

Using the metal of the pot as the mordant may indeed have been a medieval practice (though certainly not the only medieval mordanting practice). Pots were made from iron, copper, and pewter, for those who could afford them.

The Experiment

To test this theory, I used weld, brazilwood, and logwood as test dyes because various mordants gave different shades with these dyes.

The dyebaths were prepared as is usual for each dye. The baths were deliberately made up rather weak, so that the colors would not become too dark to see the results easily.

- weld: dried leaves, equal to 3/16 the weight of fabric, plus a pinch of washing soda.
- brazilwood: sawdust, equal to 6/100 the weight of fabric.
- logwood: sawdust, equal to 6/100 the weight of fabric, which was still stronger than I wanted.

The dyestuffs were soaked in warm water for one hour before adding the fabric. The dyebaths were not strained (which was a mistake).

All the fabric samples were pre-mordanted with alum. Each dyebath was split into four parts and put into in plastic containers. Various pieces of metal were added to each container in the following manner.

- no additional metal (only the alum pre-mordant)
- tin block (equal to weight of fabric)
- copper pennies (equal to 6/10 the weight of fabric)
- rusty iron nails (equal to 1/4 the weight of fabric)

Half the fabric samples were removed after 8 1/2 hours. The rest stayed in the dyebaths for several days. The wool samples in brazilwood and logwood had shorter dye times because they were getting too dark.

weld:	wool: 7 days	linen: 7 days
brazilwood:	wool: 4 days	linen: 7 days
logwood:	wool: 1 1/2 days	linen: 7 days

I compared the fabric samples dyed this way to those dyed using the standard pre-mordant method.

weld	wool, short	wool, long	premordanted
alum	yellow	greenish-yellow	yellow
tin	pale yellow	yellowish-green	

copper	yellow	yellowish-green	brownish green
iron	olive green	dark olive green	dark greenish brown

weld	wool, short	wool, long	premordanted
alum	tan	tan	yellowish brown
tin	tan	tan	
copper	brown	brown	yellow
iron	brownish-gray	gray	brown

brazilwood	wool, short	wool, long	premordanted
alum	salmon	purplish-red	reddish salmon
tin	salmon	purple	
copper	salmon	dark red	grayish red
iron	gray-purple	gray	purple

brazilwood	wool, short	wool, long	premordanted
alum	pink	pink	grayish pink
tin	pink	gray-pink	
copper	pink	brown-pink	lavender
iron	lavender	gray-brown	lavender

logwood	wool, short	wool, long
alum	gray-purple	navy blue
tin	purple	dark purple
copper	gray-purple	dark gray-purple
iron	dark gray	blue black

logwood	wool, short	wool, long	premordanted
alum	grayish-pink	bluish-purple	purple
tin	grayish-pink	purple	
copper	grayish-pink	gray-purple	dark blue
iron	grayish-blue	grayish-blue	grayish blue

Results

In general, only iron had any effect in 8 1/2 hours. Copper and tin affected the colors after 4 to 7 days in the dyebath. The premordanted colors were almost always brighter and clearer.

The metals caused spots of uneven color wherever they touched the fabric.

I think this method of mordanting is overrated. It is not quick. It requires tending a heated pot for days, and the colors are not as pretty as those from premordanting. If you want to try mordanting this way, keep several points in mind:

These tests used a substantial amount of metal compared to the amount of fiber. One penny won't have much effect on a whole pot of dye. (However, the amount of iron exposed by dyeing in a chipped enamel pot will dull your colors.)

The fabric spent a long time in the dyebath. This means you need a very weak dyebath to prevent the colors from becoming too dark.

The dyebaths in this test were kept warm most of the time.

Mordant Recipes

All recipes are for 1 pound of material (fabric, yarn or loose wool). The recipes can be multiplied or divided to suit the amount of material you have.

Use the premordanted fiber wet for immediate dyeing, or dry the material if it is to be dyed later.

Alum (1) using potassium alum.

Potassium alum is slightly different from pickling alum (ammonium alum). Pickling alum will work in this recipe, but potassium alum gives brighter and more colorfast colors.

Cotton & Linen

"alum-tannin-alum" mordant

First bath: Dissolve 4 oz. (= 20 teaspoons) alum and 1 oz. (= 5 1/2 teaspoons) washing soda in 4 gallons of warm water. Add the material, and boil one hour. Allow the bath to cool several hours (overnight is better) with the material in it. Rinse.

Second bath: Dissolve 1 oz. tannin in 4 gallons warm water. Add the material, and boil one hour. Allow the bath to cool several hours (overnight is better) with the material in it. Rinse.

Third bath: Same as the first bath, using a fresh alum-and-soda solution.

Wool & Silk

The recipe I used for the samples for this book is: dissolve 3 oz. (= 5 Tablespoons) alum and 1 oz. (= 7 teaspoons) cream of tartar in 4 gallons warm water. Add the fiber and simmer the fiber one hour. Rinse.

My current (as of 2001) favorite recipe is: dissolve 1.6 oz. (= 8 teaspoons) alum and 0.8 oz. (= 5 1/2 teaspoons) cream of tartar in 4 gallons warm water. Add the fiber and simmer the fiber one hour. Rinse.

Alum (2) using aluminum sulfate

Aluminum sulfate will probably be less expensive than alum. Aluminum sulfate can be purchased at a garden store and may or may not contain some iron contamination. Pure aluminum sulfate is white; iron contamination is brownish. If the mordant is contaminated, the yellows and the reds will be dingy, but other colors should be fine.

I have used the alum sulfate recipes frequently, though not for any of the samples for this book.

Cotton & Linen

"alum-tannin-alum" mordant

First bath: Dissolve 3 oz. (= 5 Tablespoons) aluminum sulfate and 1 oz. (= 5 1/2 teaspoons) washing soda in 4 gallons of warm water. Process the same as in the recipe above ("alum-tannin-alum" with potassium alum).

Second bath: Same as second bath in the recipe above (1 oz. tannin in 4 gallons water).

Third bath: Same as the first bath, using a fresh alum-and-soda solution.

Wool & Silk

Dissolve 2 oz. (= 10 teaspoons) aluminum sulfate and 1 oz. (= 5 1/2 teaspoons) cream of tartar in 4 gallons warm water. Add the fiber and simmer one hour. Rinse.

Copper using copper sulfate

Remember that copper sulfate is poisonous.

Cotton & Linen

Dissolve 1 oz. (= 7 teaspoons) copper sulfate in 4 gallons warm water. Simmer material in this solution 1 hour. Squeeze out excess liquid. Rinse.

Wool & Silk

The recipe I used for the samples for this book is: dissolve 3/8 oz. (=2 1/2 teaspoons) cream of tartar in 4 gallons warm water. When it is dissolved, add 3/4 oz. (= 5 teaspoons) copper sulfate.

My current (as of 2001) favorite recipe is: dissolve 1/3 oz. (=2 1/3 teaspoons) copper sulfate in 4 gallons warm water.

In either case, simmer material in the solution 1 hour. Rinse well.

Alum & Copper

Sometimes a small amount of copper is combined with alum mordant in an effort to achieve alum-mordanted colors with copper-mordanted lightfastness.

For the "alum & copper" samples, I first mordanted with alum as usual, then simmered 5 minutes in the copper mordant.

You can get pleasant colors partway between the "alum" and "copper" colors by premordanting with alum, dyeing, and then using a short copper postmordant. Use the recipe for the copper mordant bath, but simmer the fiber for only about 5 minutes or until you like the color.

Iron using copperas garden fertilizer (30% iron sulfate)

Cotton & Linen

The recipe I used for the samples in this book is the same as the "Iron" dye. This recipe uses too much iron, and is unnecessarily complicated.

My current (as of 2001) recipe is: dissolve 1/2 oz. iron sulfate (= 1 1/2 oz. = 3 Tablespoons fertilizer) in 4 gallons warm water. Simmer material in the solution 30 minutes. Rinse very well.

Wool & Silk

The recipe I used for the samples for this book is: dissolve 1/2 oz. iron sulfate (= 1 1/2 oz. = 3 Tablespoons fertilizer) and 1 oz. (= 7 teaspoons) cream of tarter in 4 gallons of warm water.

My current (as of 2001) favorite recipe is: dissolve 1/3 oz. iron sulfate (= 1 oz. = 2 Tablespoons fertilizer) in 4 gallons warm water.

In either case, simmer material in the solution 30 minutes. Rinse very well.

Alum & Iron

You can get colors partway between the “alum” and “iron” colors by premordanting with alum, dyeing, and then using a short iron postmordant. Use the recipe for the iron mordant bath, but simmer the fiber for only about 30 seconds to 5 minutes or until the color is dark enough.

COLORFASTNESS

"The best of our modern synthetic dyes are superior in light- and washfastness to the natural dyes, with a few exceptions, but many items we purchase today are not dyed with the best modern dyes, and are not particularly fast, partly because certain hues and shades are not possible with the most durable dyes."

Jim Liles (30)

Lightfastness

Dyers are nearly always faced with a choice, in that the most attractive colors are often **not** the most lightfast. Historically, dyers (and their customers) have preferred the brighter colors, even when these were not the most fast.

Colorfastness depends both on the mordant used and on the dye technique. Repeated dippings in the mordant and dye baths give more fast results than a single dipping.

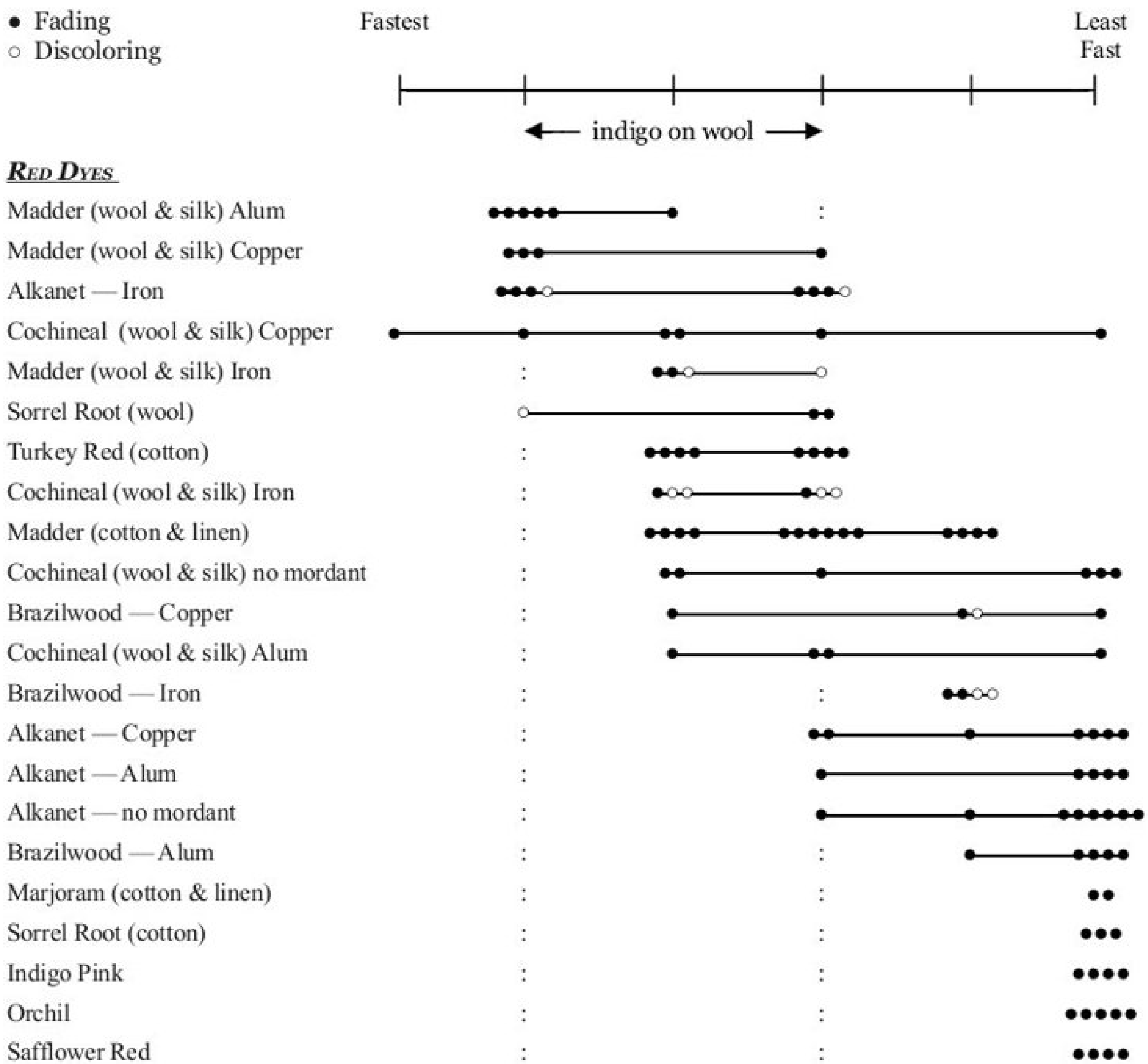
Lightfastness Testing

"As it is recognized that the prescribed method of boil-testing in Article XXVII of the Regulations ... is insufficient for exactly judging the good quality, or the poor quality of many colors, ... various experiments have been made on wool ... in order to determine the goodness of every color, as well as the boil test required for each.

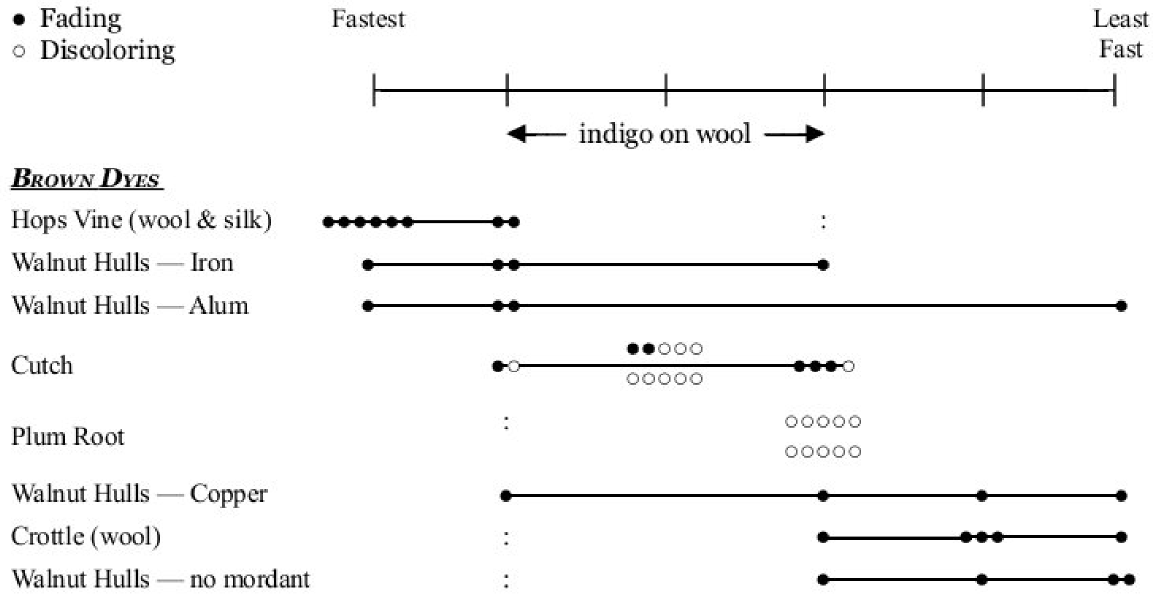
To accomplish this task, the fine wool was dyed ..., and this was exposed to air and sun for a moderate length of time. The satisfactory colors kept perfectly and the poor ones faded more or less in proportion to the degree of their poorness."

Charles Francois du Fay de Cisternay, Instructions, 1737 (7)

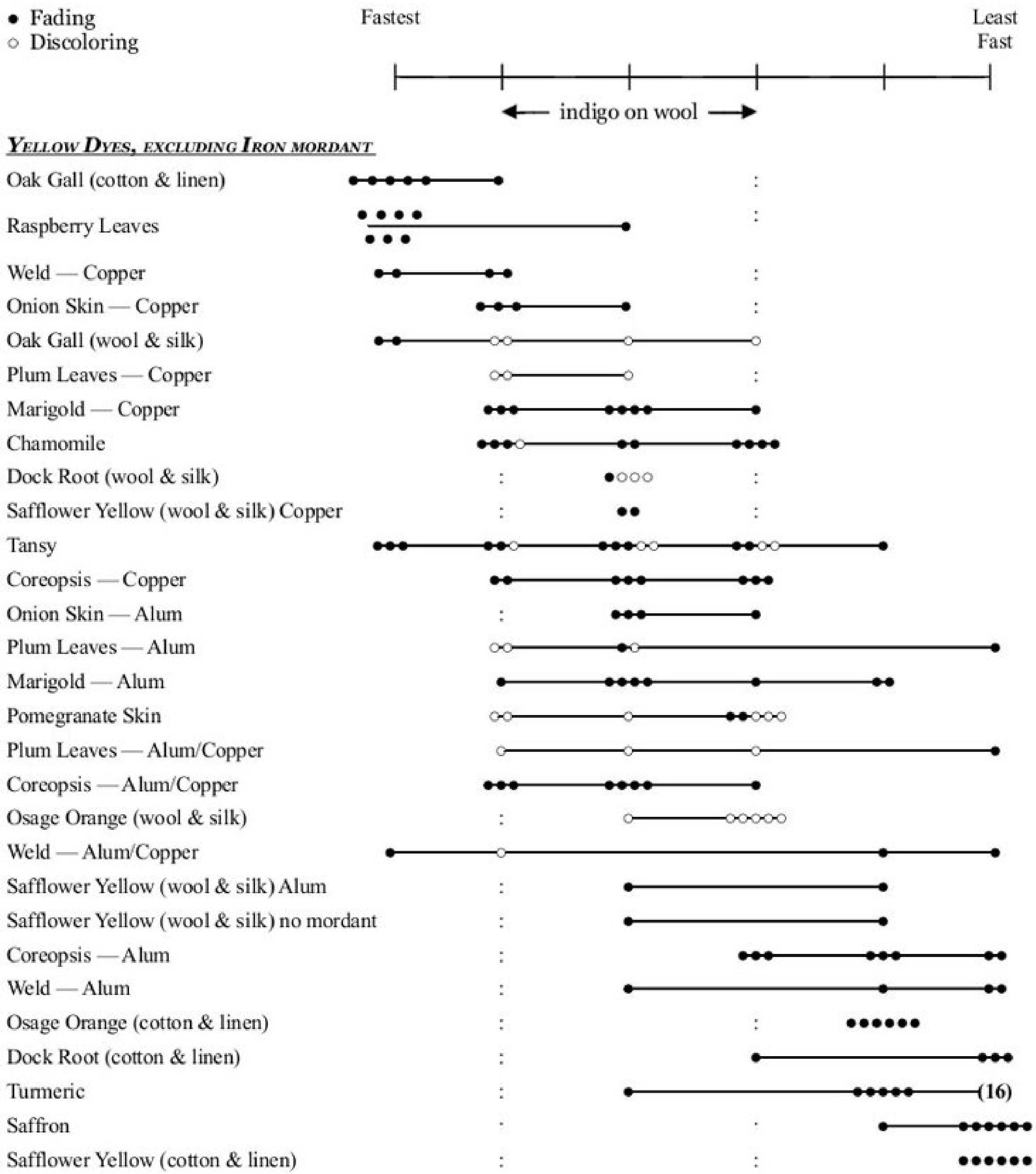
To evaluate lightfastness, I exposed approximately 1 inch of each sample in a brightly-lit south-facing window for 6 weeks (at 5000 feet elevation, and relatively clean air). The length of time was chosen arbitrarily. It now appears that this was a very severe test. Two weeks would have been long enough. I then sorted the samples according to how much fading, or other discoloring, occurred. For comparison, I have marked how much fading occurred on the indigo samples. Indigo is regarded as an excellent light-fast dye, especially on wool. I also exposed some commercially-dyed cotton and wool fabrics and yarns to the same test. The lightfastness testing was done at various times of year, so the samples tested in summer were exposed to more hours of sunlight than those tested in winter.



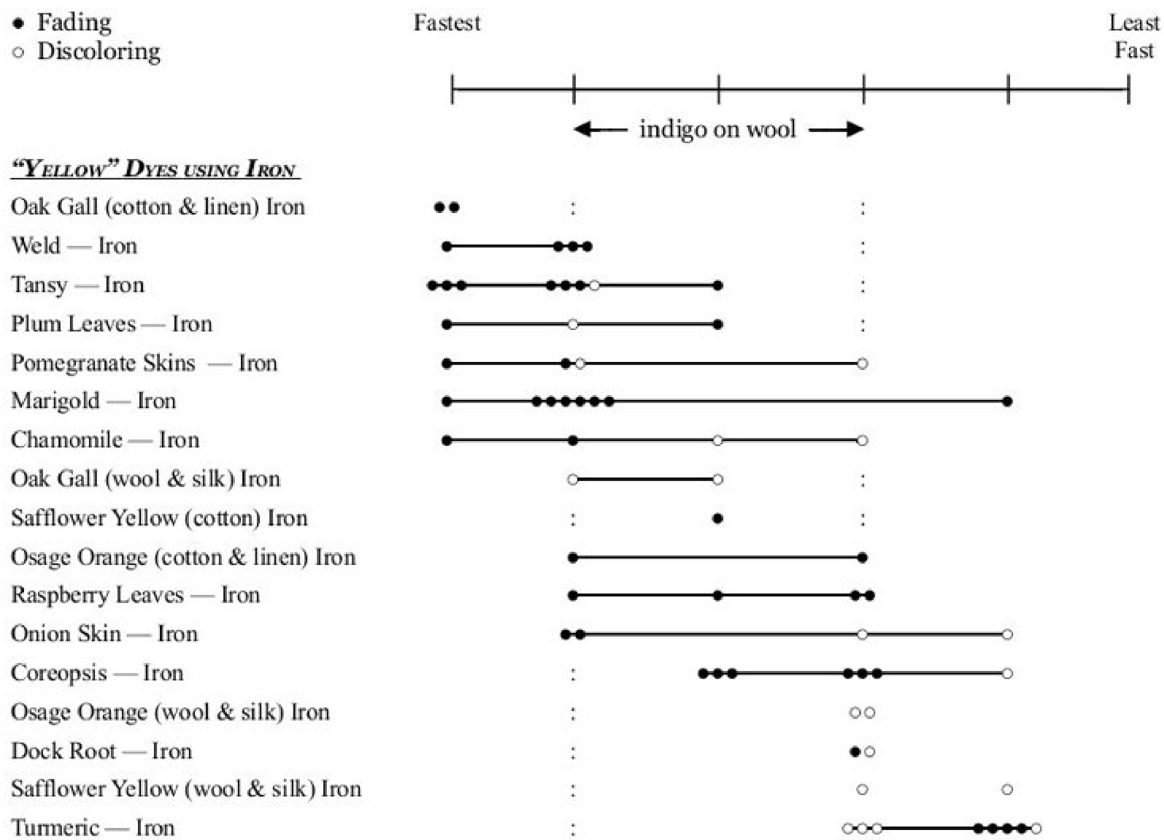
Lightfastness: Red Dyes



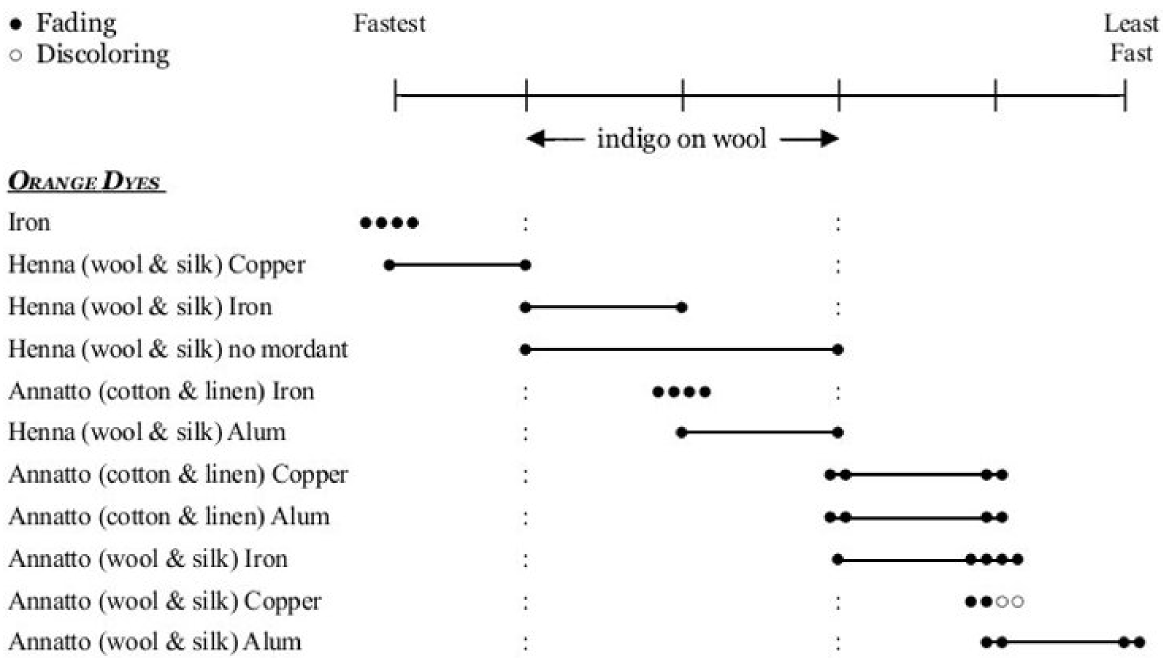
Lightfastness: Brown Dyes



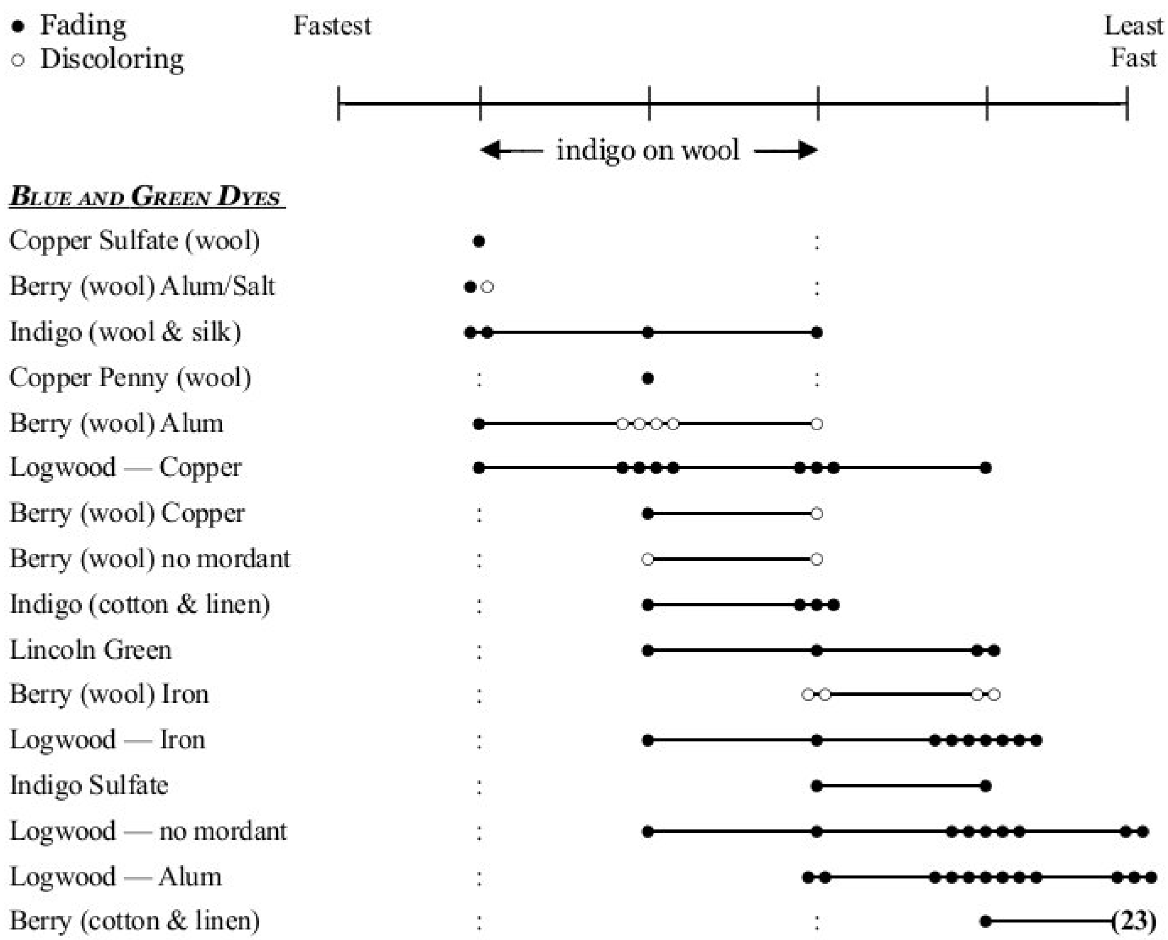
Lightfastness: Yellow Dyes



Lightfastness: "Yellow" Dyes Using Iron



Lightfastness: Orange Dyes



Lightfastness: Blue and Green Dyes

Washfastness

I made no attempt to evaluate the wash-fastness of these dyes. Medieval fabrics were generally washed less frequently than modern fabrics, but using harsher chemicals, such as lye, ammonia, washing soda, and burning sulfur.

Some dyes, like saffron and turmeric, achieved major commercial importance in the Middle Ages, even though, by modern standards, they are not extremely washfast.

Keep in mind that many modern fabrics fade in the wash. Most "bright" or "dark" colors bleed noticeably in the first few washings.

GENERAL COMMENTS ABOUT THE DYES

"Both quantities and times will vary according to the condition and age of the plant, to the nature and preparation of the fibre and to the mordants used. The skill of dyeing with native plants is largely that of making judgements. The dyer must watch what is happening in the dyebath and learn to make judgements and decisions accordingly. Whilst this is not the neat answer that many would like, giving set 'recipes' wrongly fosters the notion that making a dye from plants is like baking a cake, where following the instructions to the letter will give a guaranteed and consistent end product."

Su Grierson, The Colour Caldron (22)

General Procedure for Dyeing

Pre-mordant the fiber using the recipes in the previous sections.

Chop, grind, or crumble the dyestuff. Soak it in warm water to extract the dye. One hour of soaking may be enough for leaves and flowers; roots and barks should be soaked overnight.

It is best to strain the dyebath before adding the fiber. Add the fiber to the dyebath. In most cases, the dye will work faster if the dyebath is kept warm. Avoid boiling, which sometimes damages the colors, and felts wool. Stir often. (Turn wool gently to avoid felting). Leave the fiber in the dyebath as long as necessary to get the depth of color you want.

Rinse the fibers. In some cases, a final rinse in a vinegar solution, washing soda, or ammonia will change the color. Wash the fibers in mild detergent, and rinse again.

Acids and Alkalis

Acids (in moderation) are good for wool and silk, but harsh to plant fibers. Alkalis are good for plant fibers, but harsh to wool and silk. Some soaps and detergents are alkaline. Even if practical issues like these limit the choice of acid or alkaline conditions, the dyer should be aware of the effect of acids or alkalis on the final color.

Vinegar and oxalic acid are acids. Cream of tartar and tannin have mildly acidic effects on fibers.

Lye, potash, pearl ash, washing soda, lime and ammonia are alkalis. Baking soda and chalk have mildly alkaline effects.

Color Descriptions

The color descriptions are, of necessity, somewhat vague. Do not assume that all the samples described as, say, "reddish brown" are the same shade. Also remember that my idea of "reddish brown" may not be exactly the same as yours. There are systems to precisely describe colors, but these are only useful if you have a copy of the same color chart that I have. It is safe to assume that medieval dyers, like modern dyers, experienced some variations in their dyes, so it is unrealistic to say that there is one and only one "correct" shade for a given dye.

MADDER

Rubia tinctorum

Major Pigment: alizarin ("madder red")

Minor Pigments: purpurin ("madder purple"), rubiacin ("madder orange"), xanthine ("madder yellow")

Plant:

Madder is a perennial herb native to the Mediterranean, Middle East, and Asia Minor. The roots are used for dyeing. The pigment is in the red layer between the outer skin of the root and woody heart.

History:

Madder red dye was used in Egypt about 1500-1400 b.c. The Greek writers Herodotus (450 b.c.) and Dioscorides (1st century a.d.) both mention it as a dyeplant.

Jars of madder, presumably imported from the Mediterranean, were found among the weaving and dyeing implements buried with Queen Asa in Norway about 800 b.c.

Madder was the most important red dye for the Romans. It was grown in Italy as early as 50 a.d. Pliny claims that madder was grown in all the Roman provinces, and mentions that it was used for dyeing wool and hides.

The Persians fermented madder with whey to give rose-red.

After the collapse of the Roman Empire, the cultivation of madder in Europe seems to have dropped off sharply for several hundred years. Madder was imported to Europe from the East, primarily from Baghdad.

In the 8th century, Charlemagne encouraged madder cultivation within his empire, and madder became part of the officially accepted crop rotation schedule.

Madder was grown in Holland as early as the 10th century. In the Middle Ages, Holland was the major producer, exporting madder to the rest of Europe and Britain.

Textiles dyed with madder have been found in excavations of Saxon and Viking settlements in the British Isles dating from the 9th - 11th centuries . Some madder was grown in Britain during this time, but the demand exceeded local production, so madder was imported from the mainland.

The Moors introduced madder cultivation to Spain around 900 a.d. About the 12th century, madder cultivation was reintroduced in Italy and France.

The color red (primarily from madder) was second in popularity only to purple during Middle Ages.

Dye:

The Persians called the red dye from madder "*al lizari*", which gives us the name of the pigment "alizarin".

Madder is one of the most variable of the natural dyes.

In the Middle Ages, Arabic madder was regarded as higher quality than European madder. This was because Arabs harvested madder from older roots, which were thought to contain more pigment, and dried the roots in open air instead of in heated drying rooms.

Modern growers claim the best dye comes from "small bright and young roots that have no bark nor pith". They prefer to harvest in the fall, three years after setting out the roots. Slow drying of roots (and slow heating of the dyebath) allows an enzyme to release the coloring material. Rapid heating destroys this enzyme. Storing powdered root for several years also improves the color.

The color depends on the soil in which the madder was grown. Calcium-rich soil is especially good for madder to be used for dyeing fabric. Medieval Italian painters preferred madder grown in swamps near oak trees, because they thought the pigment from these plants was easier to purify for paint.

The quality of mordanting strongly affects the final color and colorfastness. Minerals in the local water also have a surprisingly strong influence. Most, but not all, dyers prefer to use hard water for madder dyeing, and some add a pinch of chalk if the local water is not hard enough.

Madder is colorfast, and dyes on all natural fibers.

Various authors report bright red and orange on wool and silk with alum mordant. Others describe the color as "often a rather dull terra cotta".

On cotton and linen, madder gives red and purplish red with alum, pink with copper, and purple and brown with iron.

If you dye a second batch of fiber with the left-over dyebath, the color of the second batch will be more orange than the first batch. This is because the red pigments in madder are used up faster than the orange pigments.

Do not boil the dyebath, as boiling turns the reds to brown.

Madder

Recipe:

Test #1

Use roots equal to 1/2 the weight of fabric. Soak roots in water overnight. Add fabric samples to dyebath.

For some samples, I rinsed the fabric in a solution containing washing soda

	silk	cotton & linen
alum:	brownish orange	grayish pink *(Other times I have gotten light red.)*
copper:	orangish brown	pink
iron:	grayish pink	grayish pink

The samples with washing soda were slightly brighter than the samples without.

The labels on the wool samples were lost. Wool gave reddish brown and grayish red. On other occasions, I have gotten bright red and bright orange-red on wool with alum.

Test #2

I dyed alum-mordanted samples of wool and cotton in the same madder dyebath used for Turkey red.

wool, alum: bright red

cotton, alum: pink

Additional Tests

Later tests with madder on wool revealed additional information.

Extracting the dye from the madder roots at a warm temperature (160-180°, no record of the soaking time) worked at least as well as soaking the roots in room-temperature water overnight. Adding a small amount of vinegar to the water during the soaking often improved the final color.

With no mordant, I got bright red; with alum premordant, orangey bright red; with iron sulfate premordant, purple; with iron sulfate postmordant, brownish purple.

Premordanting with a solution made by soaking rusty nails in the whey-like liquid that collects on top of plain yogurt gave purple. I have no idea how to calculate quantities for such a mordant solution.

A vinegar rinse after dyeing makes the colors more orange. A washing soda rinse makes the colors more purple.

Copper postmordant, followed by a washing soda rinse, gives a nice greyish purple.

Related Plants:

Other plants containing some of the same pigments as madder, and used similarly:

Cistus salvifolius, (berbesc), North Africa

Galium species, (bedstraws), Europe and North America

Hydrophylax maritima, Indonesia

Morinda species, (al, aich, surangi), Southeast Asia

Oldenlandia umbellata, (chay, chayaver), India and Ceylon

Relbunium species, Central and South America

Rhus oxycantha, (taunight), North Africa

Rubia cordifolia, (mungeet, manjit, munjista, majnistry), Southeast Asia

Rubia peregrina, (wild madder), Near East, Caucasus, Europe

I have obtained red dye from *Galium boreale* growing in the Rocky Mountains in north-eastern Colorado.

TURKEY RED

Adrianople (or Adrianopolis) Red, Smyrna Red

"Turkey red is the most complex of any dye known, ancient or modern, and its entire chemistry has never been totally confirmed."

Jim Liles, The Art and Craft of Natural Dyeing (30)

Pigment:

Turkey Red is a unique process for dyeing cotton with madder.

History:

The Turkey Red process was first developed in India. It originated with attempts to "animalize" cotton to treat it with animal products in hopes of making it take mordant the way wool and silk do.

In the 15th century, dyers in Venice were experimenting with a dye process that involved madder mixed with goat or cattle blood and mordanted with fats. Rosetti, writing in Italy, about 1548, includes a recipe for "fine scarlet" using cattle blood and madder. These early attempts did not duplicate the color of Turkey Red from India.

The secret of making Turkey Red reached Persia, Turkey, and Greece around 1600. European dyers did not succeed in stealing the recipe until the 18th century.

Dye:

The dyeing was always done in specialized dyehouses, under strict secrecy. The original process involved 13 to 20 steps and took 3 to 4 months to complete. Even the best dye houses often had batches fail. However, the high prices obtained for Turkey Red cotton made the long and uncertain process worthwhile.

The process requires a complex pre-mordanting, using fats or soap, lime or chalk, and alum. The cloth is dyed with madder and lime, and then steamed.

The result is a very bright and fast red. There is no comparable process for dyeing such bright madder reds on wool.

Many manufacturers, past and present, have attempted to pass off inferior red dyes as "Turkey Red". I do not know of any genuine Turkey Red being manufactured commercially now.

Recipe:

If you want to try dyeing Turkey Red, you will definitely want to read the complete recipe in Liles. *(30)* It gives options for many of the steps.

I prepared four variations of the "oil" mordant:

• Dissolve 1 oz. commercial glycerine soap in 1 quart water. Solution had a pH of about 9.

• Dissolve 1 oz. commercial Castile soap in 1 quart water. Solution had a pH of about 9.

• Dissolve 1 oz. homemade soap in 1 quart water. Solution had a pH of about 9.

• Dissolve 1/4 oz. washing soda in 1 quart water. Add 1/4 oz. rancid olive oil. Over the next few days, continue adding a concentrated solution of washing soda, trying to get a mixture that did not separate. It still separated.

Dip the fabric in the appropriate "oil" solution, and rub in the solution thoroughly. Squeeze out the liquid, and let the fabric sit damp overnight. Hang up in a sunny window for at least 4 days. Repeat this process for a total of 7 dips. The fabric feels heavily coated at this stage.

Soak the fabric in a solution of 1/4 teaspoon washing soda in 1 gallon water. Repeat this several times to remove any loose "oil".

Mordant for about 10 hours in a solution of 1 oz. tannin dissolved in 4 gallons of warm water. Dry overnight. The fabric is now pinkish-tan.

Prepare alum mordant, as follows (recipe for 1 pound of material):

Dissolve 1 pound of potassium alum in 2 quarts hot water. Allow to cool to room temperature. Dissolve 1 1/2 oz. washing soda in 1 pint of room temperature water. Add this slowly, stirring steadily, to the alum solution. It will bubble. Make a paste of water and 1/2 oz. chalk. Add this slowly, stirring steadily, to the alum solution. It will again bubble. When all the bubbling stops, add 12 oz. (= 1 1/2 cups) vinegar.

Soak fabric in this mordant solution 10 to 12 hours. Add water until the mordant covers the fabric. (Don't throw out the solution after the first soak.) Rinse the fabric, and dry for 2 days. Soak the fabric again for another 10-12 hours. The fabric is still pinkish-tan.

Prepare the madder dyebath, using powdered dried madder root equal to twice the weight of fabric. Add a small amount of powdered chalk, and some tannin. Let these ingredients soak in warm water 1 1/2 hours before dyeing.

Meanwhile, make a fixing solution by soaking 1/2 oz. fresh goat manure in 1 quart hot water. Soak and scrub the fabric in this for 1 hour. This step removes any unattached alum.

Strain the madder dyebath, and soak the fabric in the cold bath for 1/2 hour. Then slowly heat it to 160º (**no hotter**). Continue dyeing hot for 3 hours. Remove the fabric, cool, and rinse.

Steam the fabric in a pressure cooker for 2 hours at 15 pounds. Some samples were steamed in plain water, some in water with a pinch of washing soda and a bit of liquid detergent.

Wash well with soap, and rinse.

<u>Steamed in plain water</u>: brilliant dark red

<u>Steamed in washing soda</u>: brilliant dark purplish-red

All four "oil mordants" gave identical results.

For comparison, I dyed wool and cotton samples premordanted with ordinary alum mordant (see "Madder", Test 2).

SAFFLOWER (Red Dye)

Carthamus tinctorius (or *Carthamus tinctoria*)
false saffron, bastard saffronn American saffron, dyer's thistle

(The yellow dye from safflower is described later.)

Red Pigment: carthamine, carthamic acid

Safflower

Plant:

An annual thistle, native to central Asia and India. Red and yellow dyes can be extracted from the flower petals.

History:

Safflower has been cultivated for red and yellow dye in China, Japan, and India since very early times.

The ancient Egyptians, Greeks and Mesopotamians used safflower as a red dye on linen.

In the Middle Ages, safflower was cultivated in southern Europe. Safflower was used to dye the original cotton "red tape" for tying legal documents.

Dye:

The name safflower comes from its Arabic name *"usfur"*.

Safflower contains a red pigment and two less valuable yellow pigments.

The first yellow dye is extracted from the flower petals under acidic conditions.

The red dye is extracted from the petals under alkaline conditions. The second yellow comes out at the same time as the red dye. This yellow is not absorbed onto cotton. Thus cotton can be dyed red from this second extract. To dye silk red (rather than orange), the red dye is first absorbed onto cotton cloth, then removed from the cotton and used to dye the silk.

Safflower must be grown under very hot conditions to produce a good red dye.

The red dye is used on silk and plant fibers, not on wool. It is usually used without mordant. On plant fibers it gives rose and purplish-red. Safflower red is not colorfast.

Do not boil the dyebaths. The red dye extract must be used within a day, before it decomposes.

Recipe:

I used dried flower petals, equal to 1/3 the weight of fabric. (This was all the safflower I had. According to the literature, this amount would give pink; for deep reds, use equal weight of dried flower petals and fabric.)

Remove the yellow dye by repeatedly soaking and rinsing the petals in solutions of 1 Tablespoon vinegar in 1 quart water. This took about a day.

Squeeze out the petals and soak in a solution of 1 teaspoon washing soda and 1 quart water, for 8 hours. The solution is now golden yellow. Add vinegar (about 1 pint) until solution turns pinkish orange.

Add fabric, and soak in cold dyebath 2 1/2 hours. Then soak the fabric in a solution of equal parts vinegar and water to fix the color.

	wool & silk	cotton & linen
no mordant:	pink	rose pink
alum:	pink	grayish pink

Removing the second yellow dye, to dye silk:

Soak a large piece of cotton muslin, mordanted with alum, in the dyebath overnight, to absorb the red dye. In the morning, rinse the cotton in cold water. Soak in a solution of 1 teaspoon washing soda in 1 quart water for 15 minutes to extract the red dye.

Add vinegar to acidify the solution and soak the silk overnight in this dyebath.

This method appeared to work in principle, but the dyebath was too weak to get a strong color.

silk

no mordant:	brownish pink
alum:	brownish pink

The safflower-red dyebath is said to decompose if it sits around for more than a day, so it is important to use enough safflower to get a strong color promptly.

SHELLFISH PURPLE

"Tyrian purple", "true purple", "royal purple"

The term "twice-dyed red" sometimes refers to Tyrian purple, dyed with two different species of mollusk, and sometimes to the highest quality kermes scarlet.

Obtained from various mollusca (salt-water snails):

Murex species, especially *Murex brandaris:* Mediterranean

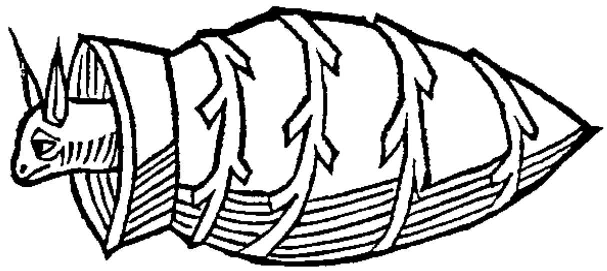
Purpura species: Mediterranean, Great Britain, and Central America and other mollusca

Major Pigment: 6,6-dibromoindigo

Minor Pigment: indigo

"It [purple] *distinguishes senators from knights, and is summoned to appease the gods. Purple makes all clothes bright and, in the case of triumphal robes, is mixed with gold. Therefore, the obsession with purple may be excused."*

Pliny the Elder, Natural History, ix:127, 1st century a.d. (39)



A "purple" shell from a wood engraving from "Hortus Sanitatis", Munich 1484 (7)

History:

This famous purple dye is generally attributed to the Phoenicians, but it is actually older. It was first manufactured on a small scale in Crete, about 1600 b.c. Purple dyeing became a major industry in Phoenicia by 1440 b.c. Phoenician merchants distributed it, making Tyre a prosperous trade center, and giving the name "Tyrian purple" to the dye.

The Phoenicians maintained dye factories all over the Mediterranean and the west coast of Africa. Archaeologists find large mounds of used mollusk shells at the sites of these factories.

The Phoenicians were experts at imitating purple color with less expensive dyes, and at stretching a weak bath of true purple with other dyes (especially orchil and kermes).

The technique of purple dyeing passed from the Phoenicians to the Greeks, to the Romans, and then to the Byzantines. Pliny the Elder, in the 1st century a.d., gives a detailed description of the dye process. In the 6th century, the Byzantine Emperor Theodosius established a purple dye-works at his imperial cloth works in Constantinople.

The Romans in Gaul manufactured purple from a species of mollusk on the Atlantic coast of Gaul. Dyeworks for purple, with mounds of crushed shells, have been found in Ireland dating from the 7th century.

The Jewish blue dye "*tekhelet*" seems to have been a variety of shellfish dye. The recipe for *tekhelet* blue was lost by 760 a.d.

The use of shellfish purple dye declined during the Middle Ages. Historians attribute this decline to the political instability in the Mediterranean, to the secret being lost after Constantinople was conquered in 1453, or to over-harvesting of the dye-producing mollusca. Kermes scarlet replaced purple in medieval use.

Although the official recipe was lost, peasants continued to use the raw mollusk juice as a dye, both in the Mediterranean and in Britain. The Pre-Columbian Central Americans made a similar red dye with local mollusks.

Dye:

The dye is extracted from a pale yellow fluid located in a small bladder under the mollusk's shell. This fluid turns purple or red when it is exposed to light and oxygen.

Large species of mollusca can be "milked" for a drop of fluid. For smaller species, the entire snail is crushed. Brunello states that it is impossible to dye purple directly, without complicated processing; however, several authors describe successfully applying fresh juice directly to fiber.

The ancient commercial process involved crushing, salting, and boiling the entire mollusk. The snails had to be harvested in fall and winter, and had to be used immediately. Around the 4th century a.d., a technique was developed for preserving the dead mollusks, so they could be stored up to six months for later use, and transported to more convenient processing locations.

The term "purple" formerly included shades we would now call red or blue. Plain mollusk juice always gives red or violet colors. The ancient dyers obtained deep red, blue, violet, black, and green, by using various species and different processes, and mordants and other additives.

Shellfish purple was always a rare, costly, and sought-after dye. Sometimes royal edict restricted its use to royal and religious uses; sometimes it was limited only by the prohibitive cost.

Buyers always worried about counterfeit purple dyes. Greek writings from the 3rd century have recipes for imitating true purple. Byzantine and Hebrew authorities describe tests to distinguish cloth dyed with true purple from that dyed with indigo; these tests don't really work because the pigments are chemically very similar.

Purple is very fast on wool, silk, and plant fibers.

Grierson, who actually tested this dye by crushing whelks from the coast of Scotland, described it as "an unpleasant and stinking process", but she did get a successful "amethyst" color.

ORCHIL

archil, orseille, argol, cudbear, litmus, lacmus, cork

(Not to be confused with deposits of cream of tartar on wine casks, which are also called “argol”.)

Pigments: orchil acids

The most famous orchil-producing lichens are:

Ochrolechia tartarea (also known as *Lecanora tartarea*)

Roccella tinctoria

History:

The ancient Greeks and Phoenicians used orchil to imitate and to dilute shellfish purple. Cloth dyed with orchil was available in the far ends of the Roman empire.

Early in the 14th century, a Florentine spice merchant traveling in the Levant learned the technique of making orchil, and re-introduced it to Italy. The Italian cities of Florence, Genoa, and Venice had a monopoly on orchil paste for nearly 400 years, until the early 18th century. Orchil was used as a commercial dye in Europe until the early 20th century.

As articles of commerce, "orchil", "litmus", and "cudbear" referred to specific preparations, marketed in specific forms — paste, blocks, and powder, respectively.

Recent archeological evidence shows purple dyes from local lichens were used in northern Europe as early as the 1st century, and continued into the "Dark Ages." The evidence for later medieval use is sketchy and contradictory. Perhaps, as more colorfast purple dyes became available, commercial dyers lost interest in lichens, or at least local lichens. As late as the 18th century in Scotland, the rural people dyed with local lichens, but commercial dyers imported orchil.

Dye:

Soaking the lichen plants in ammonia converts various colorless acids into red and purple pigments. There are at least a dozen of these "orchil acids", and many orchil lichens contain more than one. This ammonia soaking is often called "fermentation", even though that is not strictly correct. The traditional source of ammonia was stale urine.

The "litmus" used in chemical laboratories is a form of orchil.

Orchil does not need a mordant, but using a mordant or a vinegar afterbath will affect the shade. It is not lightfast

General Technique:

Moisten the lichens with a little water, and crumble or chop finely. Make a mixture of one part clear household ammonia to two parts water. Place the lichens in a jar with a tight-fitting lid, and pour in enough of the ammonia mixture to make a stirrable mass. If the lichens absorb liquid, add more ammonia mixture. Stir the mass several times a day, replacing the lid tightly. Most authors claim that you want to get a lot of oxygen into the "fermenting" dyebath; Grierson claims that the old traditional recipes avoided mixing in air, and that both methods work. Some types of lichen need sunlight to ferment properly; some don't care. Keep the mixture at room temperature.

At first the liquid will be brown, but after several weeks, it will be red or purple from the extracted dye pigment. This red liquid is used as the dye. Some types of lichen will be ready in a few weeks, but some take several months. Soak the wool in the dyebath several days. For some types of lichen, the dye is ruined by boiling.

The following species of lichen are known to yield orchil dye. There are probably more.

Cetraria delisei

Cladonia impexa

Dactylina arcticum

Diploschistes species

Evernia vulpina

Evernia prunastr Do not boil. The dye turns brown if steeped more than 3 weeks.

Haematomma lapponicum

Haematomma ventosum Requires 4 months of steeping for dye to turn purple.

Lecanora species

Ochrolechia species

Parmelia fulginosa

Parmelia laeteivirens (Parmelia saxatilis and *Parmelia omphalodes* do not produce orchil.)

Roccella species

Umbilicaria species

Usnea hirta

NOTE: If you should decide to harvest some lichen for dyeing, please remember to be very careful in harvesting, as many of these plants take decades to grow. Careful "crop management" will allow years of harvesting. Also, be sure to check with the proper authorities before harvesting on public lands.

Recipe:

Using a gray-black rock lichen, an *Umbilicaria* of some sort, possibly *Umbilicaria hyperborea*.

Test #1

I used dried lichen equal to the weight of fabric. Crumble lichen. Soak in a solution of 50% clear household ammonia and 50% water in a closed jar for two weeks. Shake the solution often to mix in air. Soak the fabric in this solution for 2 days. The sample appeared tan in the solution, but turned pink when removed.

<u>wool, no mordant</u>:   bright fuchsia pink

Test #2

I used the same dye solution, which by now has been soaking 4 months.

wool, no mordant:	pink
wool, alum	pink
wool, copper	grayish-pink

Digression:

Species of *Xanthoria* lichens have an interesting photochemical reaction. Extract the pink dye, using the same process described for orchil. Soak the wool in the dyebath until it is dyed pink. Then place the wool in direct sunlight while it is still wet; the light will turn the dye permanently blue. Soak the blue wool in a salt solution to make the color more fast.

This is a very recent technique, not medieval at all. The oldest reference to this technique seems to be Bolton's book, originally published in 1960.

The roots of garden rhubarb contain a pigment closely related to the *Xanthoria* pigment, and produce the same pink-to-blue color change. I have tried this one. It works best if the wool is kept damp while being exposed to the sun. The wool must be directly in the sun, not inside a glass jar or plastic bag. I placed the wool on a plate, to which I could add a little water.

ALKANET

dyer's bugloss

Anchusa tinctoria or *Alkanna tinctoria*

It is not clear, in comparing the various references, whether "*Anchusa tinctoria*" and "*Alkanna tinctoria* " refer to two different plants or whether they are alternate names for the same plant.

Pigment: alkannin, similar to the pigment in henna.

Plant:

A perennial herb with a thick root, from the Borage family. It is native to Southern Europe, and was later grown throughout Southern and Central Europe. The root bark contains the dye.

Alkanet

History:

The Babylonians used alkanet as a red dye, around 600 b.c. It was used in ancient Greece as a hair bleach and to dye wool yellow and red.

Dye:

The name comes from the Spanish name "*alcanna*", from the Arabic "*al hinna*" or "*al henna*", meaning henna.

The pigment must be extracted from the root bark with an alkali, traditionally urine or lye. Do not boil the dyebath.

Various authors report red, purple, and brown colors with alum mordant and an acid dyebath, purples with alum and an alkaline dyebath, gray-blue with no mordant, and violet with iron. Alkanet is not fast to light or washing.

Recipe:

Alkanet root can be obtained from dye suppliers. Use the papery root bark, not the woody parts of the roots.

Use root bark equal to 1/2 the weight of fabric. Soak bark about 4 hours in a solution of 1/4 tsp. washing soda in 1 quart water. Add fabric and soak 3 hours.

I tried no mordant, alum, copper, and iron, with alkaline dyebath and with vinegar rinse, on wool, silk, cotton, and linen. All the samples were dingy grayish-pinks, dingy grayish-lavenders, and dingy grays.

MARJORAM

Origanum vulgare

Plant: a perennial herb native to Europe

Dye:

Marjoram flower heads dye purple with alum mordant. A "traditional" northern European crimson (purplish-red) dye is made by fermenting marjoram flowers and apple leaves.

Marjoram

Recipe:

If you have a marjoram plant, save the flowers as they bloom during the summer.

I soaked dried marjoram flowers, equal to 1/10 the weight of fabric, and fresh apple bark, equal to 1/5 the weight of the fabric, in warm water. (This was all the flowers I had, but it made a very weak dyebath. It would be better to use more flowers, if possible.) I added a pinch of sugar and a pinch of baking yeast, and let the mixture sit for a week to ferment. After 4 days my batch became moldy.

After fermenting one week, I simmered mixture 6 hours (still with the flowers and bark in the solution). I added the fabric and simmered 3 days.

	wool & silk	cotton & linen
no mordant:	pale tan	no color
alum:	pale tan	pale brownish pink

DANDELION

Taraxacum officinale

"It is difficult to ascertain when the first reports appeared crediting the dandelion plant with the ability to give a dye called 'Magenta', but they do not feature in any of the 18th century works."

Su Grierson (22)

Plant:

This common plant is native to Europe and Asia. The dandelion is a highly variable plant, with over 100 sub-species.

Dye:

Many books report that dandelion roots produce "magenta" dye on wool with alum mordant. Other books accept dandelion root as a traditional "magenta" dye, but could not duplicate the color first hand.

Davenport reports that she once saw this color: "One specimen gathered recently by a student of Goldsmith's College, London, from the Dundoon area, undoubtedly produced a purplish red with alum." (17)

Grierson suggests that the reports of dandelion "magenta" are all naively copied from an inaccurate original source; possibly dandelion root was once used by rural dyers as an acidic additive with purple lichen dyes or with the synthetic dye "Magenta S".

There is no evidence that North American dandelion roots ever produce red or purple dyes. It seems highly unlikely that dandelions were "traditionally" used as dyeplants in Europe or Britain.

SORREL

Rumex acetosa and *Rumex acetosella* (Other *Rumex* species are discussed under Dock.)

Plant:

An herbaceous perennial, native to Europe. The leaves contain oxalic acid, and are used as an additive with other dyes. The roots contain up to 25 % tannin.

The roots produce pink, red, or brick red dye on wool with alum. Some authors prefer *Rumex acetosa* roots; others prefer *Rumex acetosella*.

Recipe:

Use fresh roots, equal to 2/3 the weight of fabric.

Chop the roots, and simmer in warm water 3 hours. Add the "plain" fabric samples to the dyebath, and simmer overnight.

I added some ammonia to the dyebath, and added the "ammonia" and "vinegar" fabric samples. Simmer 13 hours. I rinsed the "vinegar" samples in a vinegar solution after dyeing.

	wool, alum	cotton, alum
plain:	orangish brown	pale pink
ammonia:	reddish brown	brownish pink
vinegar:	pale orangish brown	pale pink

BRAZILWOOD

Caesalpinia sappan ("sappan"): India and Southeast Asia

Caesalpinia echinata, Caesalpinia brasiliensis, and other species ("pernambuco", "fernambouc", "verzino"): Brazil

Pigment: brasilin (brezilin)

Plant:

Various species of *Caesalpinia*, which are tropical trees of the legume family. The wood is used for the dye.

Haematoxylin brasiletto is a Central American tree containing the same pigment as brazilwood "Redwood" refers to any tree used for red dyes; brazilwood is one of the redwoods.

History:

Sappan was used as a red dye in ancient India and China.

Records from Venice in 1194 show indigo and brazilwood imported from India. Dyers throughout Europe were using brazilwood at as early as the mid-13th-century.

In the late 15th century, the new Portuguese ocean route to India made it possible to ship brazilwood, and other Eastern commodities, to Portugal much less expensively. About the same time, Portuguese explorers in the "New World" discovered trees growing that were similar to sappan, and began exported these back to Portugal.

The country of Brazil was named after the wood, "Terra de Brazil" ("Brazilwood Land").

Rosetti, writing in Italy, about in 1548, mentions brazilwood dye. Late-medieval German home recipe books describe a blue dye with brazilwood and copper acetate.

Dye:

The name "brazilwood" comes from the Portuguese "*braza*" and Arabic "*braza*" or "*bresil*", all meaning fiery red.

Brazilwood can be used on all natural fibers. It dyes red. The color is more orangeish in an acid dyebath, and more red in an alkaline dyebath. Brazilwood has moderate to poor lightfastness.

Recipe:

Use sawdust, from dye suppliers, equal to 1/5 the weight of fabric. Soak sawdust in boiling water 1 hour.

Add fabric. I removed the wool after 1/2 hour; and soaked the cotton, linen, and silk overnight.

I did not test the effects of acid or alkaline rinses, but this would be worth trying.

	wool & silk	cotton & linen
alum:	reddish salmon	grayish pink
copper:	grayish red	lavender
iron:	purple	lavender

DYE INSECTS

The insect dyes — kermes, cochineal, lac, St. John's blood, and related insects — all contain closely related pigments and give extremely similar colors. Any apparent color differences between the insects can be explained by different dye methods and mordants. Medieval dyers seem to have generally used whichever insect was currently most economical, unless a tradition-oriented guild insisted on a specific dye.

The words for cochineal and kermes were often used interchangeably, which leads to confusing translations; possibly these same words sometimes referred to St. John's blood.

The insect dyes give purplish reds ("crimson") on wool and silk with no mordant, with alum, and with alum and ammonia; bright reds ("scarlet") with alum and various acids; and black or purple with iron.

Sometimes a small amount of yellow dye is added to produce less-purple reds.

The insect dyes have good lightfastness, especially with alum mordant; the tin mordant sometimes used with cochineal is not as lightfast.

Insect dyes were historically used on wool, silk, and leather, rather than plant fibers. I saw a comment about "carmine cochineal", which is said to dye cotton well, but I have not found a recipe.

KERMES

"And you shall make a screen for the doorway of the tent of blue and purple and scarlet material and fine twisted linen, the work of a weaver."

Bible, Exodus 26:36

grain, scarlet, vermilion, crimson

The term "twice-dyed red" sometimes refers to the highest quality kermes scarlet, and sometimes to a type of Tyrian purple.

Kermococcus vermilis (Kermococcus vermilius), also called *Kermes vermilio*

possibly *Kermes ilicis (Kermes illicus),* also called *Coccus ilicic (Coccus illicus, Coccus ilicis)*

Coccus arborum and other closely related species

There is an amazing disagreement among authors on how to spell the Latin species names of these insects.

Pigment:

Kermesic acid, which is very closely related to the pigment in cochineal and the other scale insects.

Insect:

Kermes is extracted from the bodies and eggs of female shield louse insects which live on various species of shrub oak, especially *Quercus coccifera* and *Quercus ilix*. These insects are native to the Mediterranean region.

The oak of the "true" kermes (*Kermococcus vermilius*) was introduced into Assyria from Persia about 1100 b.c. Before that time, other related insects native to Assyria (such as *Kermococcus greeni, K. nahalchi, and K. roboris*) were used to produce similar red dyes. These insect species, including the so-called "Persian cochineal", remained in local use in the Middle East. In Armenia, the insect *Porphirophora hamelii* was used.

There is current disagreement whether the species *Kermes illicus* really yields dye.

History:

There is some evidence that the Phoenicians were the first to dye with kermes. Kermes was widely used in the Near East by the second millennium b.c. Red fabrics dyed with kermes were imported to Greece from Persia and India around 500 b.c.

The Romans valued kermes red nearly as highly as shellfish purple. The cloth was imported to Rome already dyed. Only the later Roman dyers learned how to use kermes.

Kermes "scarlet" is frequently mentioned by Arab and Hebrew writers.

In the early Middle Ages, Venice was the principle center for dyeing scarlet cloth, for export throughout Europe. "Venetian scarlet" used kermes with a then-secret process of mordanting with alum and cream of tartar. When Pope Paul II ordered red robes for his Cardinals in 1464, they were dyed with kermes scarlet.

By at least the 14th century, kermes as a dyestuff was exported to England. Kermes was grown in France and Spain, as well as Italy.

In the early 16th century, cochineal from the Spanish colonies in Mexico began to replace kermes in Europe. In Italy, regulations still required dyers to use the traditional kermes for dyeing "Venetian scarlet".

Dye:

The name "kermes" is Armenian, meaning little worm, or insect. The Sanskrit form is "*krmi*", and the Arabic form "*qirmiz*", which gives us the English "crimson". In the Middle Ages, the "little worm" was called in Latin "*vermilium*", which is the origin of the English "vermilion".

In Persian, "*sakirlat*" meant "red clothing". The Latin "*scarlatum*", from which we get "scarlet", referred to a high quality wool broadcloth, which was not always red. (Compare the English word "denim", which refers to the cotton fabric. Not all denim is blue, but people know exactly what "denim blue" means.)

Kermes red was bright enough and colorfast enough to compete in value with shellfish purple. It was sometimes used as an imitation or an underdye for shellfish purple.

The ancient people knew kermes was an animal. Dried kermes insects looked like little seeds, and were thus called "grain" (Italian "*grana*"). The Greeks, Romans, and Europeans until the 17th century, often considered kermes to be the acorn or berry of the scrub oak.

COCHINEAL

The name of the insect is variously reported as *Dactylopius coccus, Dactylopius coccus cacti, Coccus cacti*.

Other *Dactylopius* species are also used.

Pigment: Carminic acid, which is very closely related to the pigment in kermes and the other scale insects.

Insect:

Cochineal is extracted from the bodies of female shield louse, or scale, insects which feed on prickly pear cactus (*Opuntia* species, "nopal"). Cochineal is native to Central America and southern North America. I have seen species of wild cochineal in northern Colorado and central Nebraska.

South American native collecting cochineal insects from a nopal. (XVII century engraving, by R. Blanchard) (7)

History:

Cochineal has been used as a red dye in Mexico, Central and South America since about 1500 b.c. The Aztecs called it "*nochezli*".

The Spanish explorers in Mexico soon recognized the similarity between cochineal and kermes. Shortly after the Spanish conquest of Mexico, cultivated cochineal was a regular part of the colonial shipments back to Spain.

Cochineal soon replaced kermes for most uses as a red dye in Europe. In France, cochineal was used for the famous "Gobelin scarlet".

Tin chloride mordant was discovered early in the 17th century. It was used in commercial processes to dye a spectacular (but not lightfast) scarlet with cochineal. "Bow scarlet" was dyed with cochineal, probably using tin mordant.

Many Europeans, even into the 17th and 18th centuries, considered cochineal a vegetable product. The Spanish encouraged false reports about origin of cochineal, to help protect their monopoly. For example, cochineal was often said to be the dried sap extruded from the nopal cactus.

Cochineal continued in use as a commercial dye and a red food coloring into the early 20th century.

Dye:

The name "cochineal" comes from the Spanish "*grana cochinilla*". Some authors derive this name from the Latin "*coccinus*", meaning scarlet in color; others say "*cochinilla*" means small female hog, referring to the appearance of the shield louse insect.

The Spanish called the larger cultivated cochineal insects "*grana fina*" (fine grain), and smaller wild ones with white hairy covering "*grana silvestra*" (wild grain).

Cochineal is more prolific and more concentrated than kermes, making it a more economical dyestuff.

Before the Europeans introduced the practice of mordanting with alum, the natives of South America used lemon juice (citric acid) or the juice of unripe fruits to fix cochineal dye. Oxalic acid is commonly used as an additive for dyeing cochineal.

Recipe:

Using wild cochineal bugs collected near Ft. Collins, Colorado. (Commercial cochineal, grown in Central America, is also available from dye suppliers.)

Wild cochineal is difficult to weigh accurately because any stray twigs and rocks weigh more than the cochineal. Cochineal varies considerably in concentration, but it is always a very concentrated dyestuff.

Use dried wild cochineal equal to 1/15 weight of fabric. Grind up cochineal bugs, and soak them in warm water 1 1/2 hours.

Meanwhile, soak a pot full of sorrel leaves (a source of oxalic acid) in hot water.

Simmer wool and silk 1 1/2 hours in cochineal dyebath; simmer cotton and linen 4 hours.

Some samples were rinsed in a solution of washing soda; some samples were simmered 5 minutes in the sorrel-leaf solution.

wool & silk	"plain"	sorrel	washing soda
no mordant	pink	orangish pink	lavender pink
alum	purplish pink	reddish pink	purplish pink

copper	purplish pink	grayish pink	purplish pink
iron	purplish pink	grayish pink	grayish lavender

<u>cotton & linen</u>

no mordant	no color
alum	pink
copper	very faint pink
iron	pale gray

Alum was the only mordant that gave worthwhile colors on cotton and linen.

LAC

Lakshadia chinensis

Lakshadia communis

Laccifer lacca, also called *Laccifer indiana*, *Coccus lacca, Tachardia lacca, Kerria lacca*

Pigment:

laccaic acid, which is very closely related to the pigment in kermes and the other scale insects

Insect:

Lac is extracted from the resinous wax secreted by female scale insects. These insects infest a variety of trees, especially fig trees. They are native to southern Asia and China. The insects are closely related to kermes and cochineal.

History:

Lac was used in Asia as a red dye since ancient times.

Rosetti, writing in Italy, probably in 1548, includes a recipe for dyeing silk red with lac.

Lac became more popular in Europe in the late 18th and 19th centuries as an inexpensive substitute for cochineal.

Dye:

The name lac comes from the Sanskrit "*laksha*" and Hindu "*lakh*", meaning one hundred thousand, referring to the masses of insects infesting the trees. The words "lacquer" and "shellac" also come from the same root, and were originally made from the same insect resin.

ST. JOHN'S BLOOD

Polish cochineal

The name of the insect is variously reported as *Margarodes polonicus, Coccus polonicus, Coccus margarodes, Porphyrophora polonica*

Pigment: carminic and kermesic acids

Insect:

St. John's blood was extracted from the bodies of scale insects which feed on the roots of German knot grass, *Sclerantus perennis*. During the Middle Ages, this insect was plentiful throughout northern and eastern Europe.

History:

St. John's blood was collected as a dyestuff in Germany and Poland as early as the 12th century. It was widely used in eastern Europe, especially in the monasteries. It was used commercially in Poland as late as the 18th century.

It was eventually replaced by kermes and cochineal.

Dye:

The name "St. John's blood" refers to the fact that the harvest season traditionally began, with great ceremony, on St. John's Day (midsummer).

St. John's blood contains the same pigments as kermes and cochineal, and is used the same. It is less concentrated than either kermes or cochineal.

Since the insects live on the roots of plants, harvesting the dye is extremely tedious, and damages the host plants.

St. John's blood is now very seldom available commercially.

IRON

ochre

History:

Iron oxides have been used as a coloring material since the time of the Cro-Magnon and Neanderthal races. Samples of Egyptian linen dyed yellow with iron have been found dating from 1900 b.c.

Historical sources of iron were scrap iron soaked in vinegar (ferrous acetate), water from iron-rich mineral springs, or soaking the fibers in iron-rich mud (ochre).

Peasants early in the 20th century still dyed linen by soaking it in colored clay. I have seen contemporary souvenir T-shirts dyed with local clays, usually iron-based reds and oranges.

Dye:

Iron produces shades of yellow and orange. It is extremely fast to light and washing. Pale colors are less damaging to the fiber than full colors.

Recipe: Using copperas garden fertilizer (30% iron sulphate)

Dissolve copperas in warm water at the rate of 6 Tablespoons copperas (= 18 Tablespoons = 1 1/8 cup fertilizer) per pound of fiber. Soak the material in this solution 30 minutes. Squeeze out.

Dissolve 1 Tablespoon washing soda in 1 gallon warm water, and soak the material in this for 15 minutes. Squeeze out the fabric, and spread it out. The air causes the iron to oxidize to a rust-orange.

wool, silk, cotton, & linen: rust orange

HENNA

Lawsonia species, especially *Lawsonia inermis* , Egyptian privet

Pigment: lawsone (henno-tannic acid, or oxynaphthochinon)

Henna

Plant:

Henna is a shrub native to the Near and Middle East. The dye is extracted from the leaves.

History:

Henna was, and is, an important cosmetic and hair color in India and the Middle East. Egyptian mummies from around 3000 b.c. show a mixture of henna and indigo used as black hair dye.

In North Africa and Arabia, henna has long been used as a fabric dye. Egyptian linen has been found from around 800 b.c. dyed red, orange, and brown with henna.

Dye:

The name comes from the Arabic, "*al kenna*" or "*alhenna*".

Untreated henna leaves give a brown color. The dried leaves are treated with lime to produce an orange-red dye.

Henna dyes well on skin, hair, and animal fibers. Without mordant, it produced yellows and oranges on wool and silk. Traditional dyers used a variety of additives to change the color.

Recipe:

Using "red henna" powder sold at health food stores for hair color. (Other forms of henna would give slightly different shades of color.) Use an amount equal to weight of fabric. Soak the powder in boiling water 1 hour. Add fabric.

	wool & silk	cotton & linen
no mordant:	reddish brown	no color

(On other occasions, I have obtained bright brownish-orange on wool.)

alum:	reddish brown	pale yellow
copper:	brown	pale yellow
iron:	brown	pale gray

Henna did not dye at all well on cotton and linen.

ANNATTO

anatto, arnatto, attalo, roucou, urucu, uruco, oriana, nonnogo, achiote
Bixa orellana

Pigment: Bixin

Plant:

The annatto plant is native to Central and South America. The dye is found in the pulp of the seeds.

History:

The Aztecs used annatto, which they called "*achiotl*", to produce reds and yellows. The Spanish colonists were aware of this Aztec dye, but it did not become commercially popular in Europe until the 18th and 19th centuries.

Annatto is still used as a food color for cheese and butter. It is now grown is southern Asia as well as Central America.

Dye:

Annatto dyes plant and animal fibers orange. An acidic dyebath gives a redder orange. Various authors give conflicting reports of its colorfastness.

Recipe:

I used annatto seed obtained from dye suppliers. Annatto is also sold as the Mexican spice "*achiote*".

I used weight of whole seeds equal to 1/5 weight of fabric. (This produced a fairly strong dyebath. For cotton, linen, and silk, you could probably use less.)

Grind up the seeds in a coffee mill; they are too tough to grind by hand. (Annatto is used as a food color, so it is not at all dangerous. To clean it out of the coffee mill afterwards, grind a bit of rice in the mill.)

Soak ground seeds in hot water 1 hour. Add washing soda to the dyebath, in equal weight to the seeds.

Add fabric. Removed cotton, linen, and silk after 1/2 hour. Soaked wool overnight.

For some samples, I rinsed in a solution containing vinegar, which had very little effect.

	wool & silk	cotton & linen
alum:	orange	brownish red
copper:	brown	salmon
iron:	dark orange	dark orange

COSMOS

Cosmos sulphureus

COREOPSIS

Coreopsis tinctoria (also called *Calliopsis tinctoria*) dyer's coreopsis

Coreopsis

Major Pigment: chalcones

Plant:

These two closely related plants are now widely grown as garden flowers. Cosmos is native to Central America; coreopsis is native to North America near the Gulf of Mexico. The yellow and orange flower petals are used for dye.

History:

The Aztecs used cosmos flowers to produce red and yellow dyes. The Spanish colonists were aware of this Aztec dye, but it never became a significant commercial dye in Europe.

Dye:

The pigments in cosmos and coreopsis are yellow in acid conditions and red in alkaline.

Cosmos and coreopsis gives yellow and orange on wool with alum mordant, and brown and olive with copper or iron. The colors are fast.

Buchanan feels this dye is "disappointing" on plant fibers, but I liked the colors I got.

Recipe:

I used dried flower petals, equal to 1/3 the weight of fabric. This made a very strong dyebath. You could use 1/10 the weight of fabric.

Soak petals in warm water 1 1/2 hour. Add fabric samples to dyebath.

For some samples, I rinsed in a solution containing washing soda.

	wool & silk	cotton & linen
alum:	orangish yellow	orange
washing soda	bright orange	brick red
alum & copper:	orangish yellow	brownish orange
washing soda	reddish orange	brick red
copper:	brown	brown
washing soda	reddish brown	reddish brown
iron:	olive green	yellowish brown

washing soda	greenish black	light brown

SAFFRON

Crocus sativus

Pigment: crocin

"I see certain women dye their hair blonde by using saffron. They are ashamed of their own nation that they are not by birth Germans or Gauls. ... Shall a Christian woman pour saffron on her head as upon an altar?"

Quintus Septimius Florens Tertullian,

From the Appearance of Women, ii,6, early 3rd century (5).

Saffron Crocus

Plant:

The dye comes from the yellow stalks (stigma) in the center of the flowers of the fall-flowering crocus.

History:

Saffron has always been valued as a spice and medicine, as well as a dye.

Saffron was used in ancient Egypt since about 2000 b.c. It was mentioned as a yellow dye in the Papyrus Ebers, an Egyptian medical writing from around 1400 b.c.

Saffron was the most popular yellow dye for the Greeks and Romans. The Romans used saffron as a hair color. The Persians used saffron dye in ancient and medieval times, and exported saffron to the Orient.

Saffron was an important trade commodity in medieval Europe. Saffron was grown in Spain in the 9th century. The returning Crusaders are generally credited with introducing it to northern Europe. In the 12th to 14th centuries, the cultivation of saffron spread throughout Europe.

Rosetti, writing in Italy, probably in 1548, includes a recipe for dyeing yellow with saffron.

In the late Middle Ages, saffron lost popularity to other, less expensive, yellow dyes.

The famous "saffron" shirts of the early Irish and Scots refers to the color, not necessarily the dyestuff. The shirts were probably dyed with a local yellow dye, such as bog myrtle or poplar bark.

Dye:

The name saffron comes from the Arabic "*za-faran*", meaning yellow.

Saffron does not require any mordant. It gives an orangish yellow on all natural fibers. It is not colorfast.

One herbalism book baldly asserts that saffron "cannot be used to dye fabrics as it is readily water soluble." (42) This is obviously an exaggeration, as elsewhere in the book there is an illustration showing saffron-dyed fabric.

The names "bastard saffron" and "American saffron" refer to Safflower (Red Dye, Yellow Dye).

Recipe:

Use dried flower centers, sold as a spice. (In 1992, I paid $1.39 for 0.2 grams)

I used saffron equal to 1/50 the weight of fabric (that is, at the rate of 0.6 grams saffron per ounce of fabric). This made a very strong dyebath; I would recommend using less saffron.

Soak the saffron threads in warm water 2 1/2 hour. Soak the fabric samples in the dyebath 1/2 hour.

	wool & silk	cotton & linen
no mordant:	orangish yellow	orange
alum:	bright yellow orange	brownish orange

TURMERIC

Curcuma longa
Indian saffron
Pigment: Curcumin

Turmeric

Plant:

A perennial herb with a large rootlike rhizome, native to south and east Asia. The rhizome "root" is used both for the dye and for the spice.

History:

Turmeric was used as a dye from the earliest times in India and China It was exported from Asia to ancient Mesopotamia, Egypt, Greece, and Rome. The Mesopotamians used sodium carbonate (washing soda) with their turmeric dye.

Turmeric was still used in Europe as a dye in the 15th century.

Dye:

The Romans named turmeric "*terra merita*", "meritorious earth".

Turmeric does not require a mordant to dye animal fibers. Some authors say that to dye plant fibers, it needs either a mordant or an acidic dyebath, but I did not find this to be true.

Turmeric gives yellow or gold with no mordant or with alum. Alkali turns the color red-brown.

Turmeric has been a popular dye because of the bright yellows it produces, even though these colors are not very fast. Rinsing the dyed fabric in salt sea water is said to improve the fastness.

Recipe:

Use powdered turmeric root, sold as a spice, equal to 1/10 the weight of the fabric. Soak the powder 5 hours in warm water.

Soak the fabric in the dyebath for 24 hours.

For some samples, I rinsed in a solution containing washing soda.

	wool & silk	cotton & linen
no mordant:	greenish yellow	bright yellow
washing soda	brownish yellow	bright yellow
alum:	bright yellow	grayish yellow
washing soda	grayish yellow	yellowish gray
copper:	yellow-green	yellow
washing soda	yellowish gray	yellow

iron:	greenish yellow	yellowish brown
washing soda	yellowish gray	yellowish brown

WELD

Reseda luteola
dyer's mignonette

Pigment: luteolin

Plant:

An annual or biennial plant, native to Britain, Europe, and the Mediterranean. The dye is produced in the leaves. Wild mignonette, *Reseda lutea*, gives similar but weaker colors.

History:

The Greek writer Dioscorides, in the 1st century a.d., lists weld as a dyeplant. The Romans used weld to dye wedding garments and the robes of the Vestal Virgins. The Persians used weld dye.

In the Middle Ages, weld was grown as a dyeplant throughout Europe and Britain. Rosetti, writing in Italy, probably in 1548, includes recipes for yellow dye, and for a green dye on linen using weld and verdigris.

Weld continued in use until the 19th century when "old" fustic and quercitron became more economical yellow dyes.

Dye:

Weld has the reputation of not being a very concentrated dye (compared to fustic or quercitron), but it is more concentrated than many dye flowers.

Weld works best with a slightly alkaline dyebath.

Keep the bath well stirred because the pigment tends to settle to bottom of pot.

Do not boil the dyebath, as boiling may make the yellows turn brownish.

Weld gives lemon yellow on wool and silk with alum mordant, greenish-yellow with copper, and olive with iron. The colors are lightfast. There are mixed reports on how successfully weld dyes cotton.

Recipe:

Use dried leaves, equal to 1/2 the weight of fabric.

Crumble the leaves and soak in warm water 6 hours.

Add a pinch of washing soda and the fibers. Simmer fibers 1 hour.

	wool & silk	cotton & linen
alum:	yellow	yellowish brown
alum & copper:	yellow	yellowish brown
copper:	brownish green	yellow
iron:	dark greenish brown	brown

DYER'S BROOM

dyer's greenwood, dyer's greenweed, woadwaxen, woodwaxen
Genista tinctoria (or *Genista tinctorum*)

Medieval Italian references to the yellow dye "*erba giulietta*" could refer either to *Serratula tinctoria* or *Genista tinctorum*.

Scotch broom, *Cytisus scoparius*, also called *Sarothamnus scoparius*, can be used for a similar yellow dye; in the Middle Ages, Scotch broom and dyer's broom were both called "*genista*".

Pigment: luteolin

Dyer's Broom

Scotch Broom

Plant:

A perennial shrub native to Europe and western Asia. The flowers and leaves are used for the dye.

History:

The Greek naturalist Dioscorides, writing in the 1st century a.d., lists dyer’s broom as a dyeplant.

In the Middle Ages, broom was a common dyeplant in Europe and Britain. Rosetti, writing in Italy, probably in 1548, includes recipes for dyeing yellow with broom and juniper. Regulations of the 13th century dyers' guild in Venice explicitly forbade dyeing yellow with *Genista tinctoria*, and required the use of weld instead.

Dye:

The pigment in dyer's broom is the same as that in weld.

Broom produces clear, fast yellows on plant and animal fibers.

The common names refer to the practice of overdyeing broom with woad to produce green.

ONION

"Onions do not grow wild."

Pliny the Elder, Natural History, xx:39, 1st century a.d. (39)

Allium cepa

Pigment: possibly quercitin

Onion

Plant:

Onions have been grown by humans for so long that it is impossible to tell where the plant originated. They are well documented in the early Mediterranean and Near Eastern civilizations.

History:

Onions were used as dye, as well as food, in Northern Europe and Arabia.

As late as the 19th century, onions were used as a commercial yellow dye.

Dye:

The papery outer skins are used as the dye.

With alum, onion skins produce yellow to burnt orange; with iron green or brown.

Recipe:

Test #1

Use papery outer skins of a yellow onion, equal to the weight of fabric. Soak skins in simmering water 1 hour.

Simmer fabric samples in dyebath 1 hour.

	wool & silk	cotton & linen
alum:	orangish brown	yellowish brown
	(At other times, I have obtained golden yellow on wool.)	
copper:	greenish orangish brown	yellowish brown
	(On other occasions, I have obtained dark gold on wool.)	
iron:	dark greenish brown	brown

Test #2

Use papery outer skins of several different onions, equal to the weight of fabric. Soak skins in warm water 4 hours.

Soak wool samples in warm dyebath 1 hour.

I rinsed some of the samples in a washing soda solution after dyeing.

wool	yellow onion	red onion #1	red onion #2
no mordant	pale orange	pale tan	pale pink
washing soda	light orange	pale greenish yellow	pale greenish yellow
alum premordant	light orange	pale greyish green	pale pink
washing soda	orange	spring green	green
copper postmordant (5 minutes)	light golden yellow	yellow green	yellow green
washing soda	golden yellow	yellow green	yellow green
copper postmordant (30 minutes)	goldish green	spring green	green
washing soda	goldish green	spring green	green

iron postmordant (30 seconds)	green	dark green	olive green
washing soda	green	dark green	olive green
iron postmordant (30 minutes)	dark green	dark olive green	dark olive green
washing soda	dark green	dark olive green	dark olive green

Clearly there is more difference among onions than simply “yellow” and “red” onions.

The 30 minute iron postmordant was more than enough time.

FUSTIC

fustet

The name "fustic" derives from the Arabic "*fustug*" or "*fustung*", meaning bush.

There are two distinct kinds of fustic, “old” and “young”. There is no reasonable explanation as to why the Europeans named these "old" and "young". "Young" fustic has been used in Europe much longer than the "old".

"Young Fustic"

Cotinus coggygria, also called *Rhus Cotinus*: European smoke tree, Venetian sumac

Cotinus obovatus: American smoke tree

The smoke trees are related to sumac and cashew trees.

The European smoke tree has been used as a yellow dye since the Middle Ages. Both the leaves and the wood were used. The regulations of the 13th century dyers' guild in Venice prohibited fustic because it was considered an inferior dye.

The American smoke tree is native to the southern United States.

"Young fustic" is seldom used as a dye any more because it is not lightfast.

"Old Fustic"

Morus tinctoria
Chlorophora tinctoria: yellow wood

The "old fustic" trees are native to Central and South America, and the West Indies. They are related to mulberries. The bark and wood is used for dye.

The Spanish introduced "old" fustic to Europe around 1510. It was still used commercially as a bright yellow dye in the early 20th century.

"Old" fustic is chemically similar to Osage Orange, and the two dyes can be used interchangeably.

OSAGE ORANGE

Maclura pomifera and *Maclura aurantiaca*
hedge apple, horse apple, *bois d'arc*, bow wood

Osage orange is a tree of the mulberry family, native to Oklahoma, Texas and Arkansas.

It is chemically similar to "old" fustic, and the two dyes can be used interchangeably.

Osage Orange

Osage orange and "old" fustic can be used on wool, silk or plant fibers. They give bright yellow to yellowish tan with alum mordant; green, brown, or olive with copper; and olive with iron.

They have moderate lightfastness, and may either fade or darken with light.

Do not boil the dyebath, as boiling may make the yellows turn brownish.

Recipe:

If you live outside the region where Osage orange grows, wood chips are available from dye suppliers, or sometimes from woodworkers, or from archers who make their own bows.

I used wood chips, equal to 2/3 the weight of fabric.

Soak wood chips overnight. Add fabric samples to dyebath. I let them simmer 10 hours.

	wool & silk	cotton & linen
alum:	greenish yellow	yellowish tan
alum & copper:	greenish yellow	yellowish tan
copper:	yellow-green	brownish yellow
iron:	olive green	yellowish brown

PERSIAN BERRIES

Rhamnus species

Rhamnus alternus and *Rhamnus infectoria*: "French" berries, "Avignon" berries

These are grown in southern France and Spain. They have 2 seeds.

Rhamnus amagdalinus, Rhamnus oleoides, Rhamnus saxatalis: "Turkey" berries

These are grown in Persia and the Orient. They have 4 seeds.

Rhamnus catharticus: buckthorn

These are mentioned in various medieval dye recipes for professional dyers and for home use.

The unripe berries of the various *Rhamnus* have been used since early times in Europe as a yellow dye on wool.

There are various opinions about the colorfastness of this dye.

SAFFLOWER (Yellow Dye)

The safflower plant and its history are described under red dyes.

Dye:

Safflower petals contain a red pigment and two yellow pigments. The yellow dye is extracted from the flower petals under acidic conditions.

The yellow dye may be used on wool, silk, or plant fibers, with no mordant, or with alum.

Do not boil the dyebath.

Recipe:

Use dried safflower petals, equal to 1/4 the weight of fabric. Soak the petals in a solution of 1 Tablespoon vinegar in 1 quart water overnight.

Simmer fabric samples in dyebath 6 hours.

	wool & silk	cotton & linen
no mordant:	grayish yellow	pale yellowish tan
alum:	grayish yellow	tan
copper:	greenish yellow	pale brownish yellow
iron:	dark grayish yellow	pale tan

Safflower yellow did not dye well on cotton and linen.

MARIGOLD

There are several types of marigold which all give yellow dyes from flower petals:

Tagetes species: garden marigolds

Calendula species: pot marigolds. Native to the Mediterranean region.

Chrysanthemum segetum: corn marigold. A weed in Scotland, which went by the medieval name *"gool"*. It gives a greenish-yellow color with alum.

Caltha palustris: marsh marigold. A European wild-flower. It gives a yellow or greenish-yellow with alum.

Bidens tripartita: bur marigold. A European flower, which gives orange-yellow with alum.

Garden Marigold, *Tagete*

Dye:

Marigold flowers are a popular "traditional" home dye.

Marigolds dye better on wool than on plant fibers. They give yellows with alum mordant; and olive brown with copper or iron. Ammonia turns the colors more brown. There are various opinions about the lightfastness of marigold dyes.

Recipe:

I used *Tagetes* flower petals, from our garden, approximately equal to 1/2 the weight of fabric; some were dried flowers and some were fresh. This was rather a weak bath.

I soaked flowers in boiling water 1 hour; I would have gotten a brighter yellow if the water was simmering rather than boiling.

I soaked wool samples in dyebath 1/2 hour; soaked the other fabrics overnight.

Some samples were rinsed in a solution containing washing soda.

	wool & silk	cotton & linen
alum:	greenish yellow	pale yellow brown

(At other times, I have obtained bright yellow or golden yellow on wool and bright yellow on cotton.)

	wool & silk	cotton & linen
washing soda	golden brown	pale yellow brown
copper:	dark yellow green	olive brown
washing soda	greenish brown	olive brown
iron:	olive green	olive green
washing soda	darker olive green	olive green

Some marigold plants seem to give more greenish yellows and some more brownish yellows. I do not yet know what causes this difference.

CHAMOMILE

"camomile"

There are several types of chamomile, all of which give similar dyes:

Anthemis tinctoria: dyer's chamomile, golden marguerite

A perennial plant with yellow flowers.

Chamaemelum nobile: Roman chamomile

An aromatic perennial herb native to southern Europe. It has been in continuous use since the time of the Egyptians. The Romans used it to lighten blond hair.

Matricaria recutita: German chamomile

An aromatic annual herb native to Europe and northern Asia.

Dye:

The flowers are used as the dye. These same flowers are sold as chamomile tea.

Chamomile gives yellow on wool with alum, yellow with copper, and olive with iron. Ammonia makes the colors more gray. The colors are fast.

Buchanan claims chamomile does not dye well on plant fibers, but I did not have any problems.

Recipe:

Use dried flower heads, from garden plants or from the health food store, equal to 1/2 weight of fabric. (Some recipes call for 1 quart of flowers for 1 ounce of wool.)

Soak flowers in boiling water 1 hour. (The color would have been better if the dyebath were simmered rather than boiled.)

Add fabric.

	wool	silk	cotton & linen
alum:	greenish yellow	greenish yellow	grayish yellow
copper:	yellowish green	greenish yellow	yellow
iron:	olive green	olive green	brownish yellow

TANSY

Tanacetum vulgare, formerly known as *Chrysanthemum vulgare*

Plant:

An aromatic perennial plant, native to Europe and Asia. It has now became a common weed in North America. Tansy is one of the plants used as an herbal insect repellent. The leaves and flowers are used for dye.

Dye:

Tansy produces yellow or greenish yellow on wool with alum mordant, grayish yellow with copper, and olive with iron. Ammonia causes the colors to turn more brown. The colors are lightfast, but turn somewhat browner with light.

Buchanan claims tansy does not dye well on plant fibers.

Recipe:

I used fresh leaves before flowering, equal to the weight of fabric.

Soak the leaves in simmering water 1 hour.

Simmer wool and silk samples in dyebath 1 1/2 hours; simmer cotton and linen samples 4 hours.

I soaked some samples for 5 minutes in a solution of washing soda.

	wool & silk	cotton & linen
alum:	greenish yellow	yellow brown
washing soda	brownish greenish yellow	yellow brown
copper:	brownish green	yellow
washing soda	olive green	yellow
iron:	greenish black	brown
washing soda	dark brown	brown

CUTCH

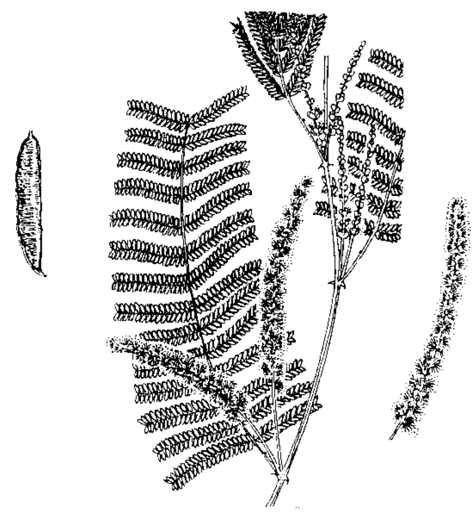
catechu

Acacia catechu and *Areca catechu* (betel nut tree)

Major Pigments: catechu-tannic acid and catechin

Minor Pigments: quercetin, catechu red, catechol

Plant: The wood of several south Asian trees.



Catechu - Black Cutch

History:

Cutch was exported from India to China, Arabia, and Persia in the 16th century. It was introduced to Europe, via Japan, in the 17th century.

Cutch was still used as a commercial dye in the early 20th century.

Dye:

Cutch is available as wood chips, or a solid extract made from the wood chips.

It can be used on all natural fibers. Cutch dyes well on cotton because of its high tannin content.

Used with copper mordant, it produces the original "khaki" dye. It can be used with other mordants, or no mordant, to produce various browns. The colors are very fast.

Recipe:

Use cutch extract equal to 1/4 the weight of fabric. Soak the solid extract in boiling water until dissolved, about 1 hour.

Simmer fabric samples in dyebath 1/2 hour.

	wool & silk	cotton & linen
no mordant:	brown	reddish brown
alum:	brown	reddish brown
copper:	dark brown	brown
iron:	black	dark brown

CROTTLE

"Tree-moss grows in Gaul as I have indicated."

Pliny the Elder, Natural History, xxiv:27, 1st century a.d. (39)

The name "crottle" in a strict sense refers to dye extracted from lichens by boiling water. It is sometimes used more loosely for any lichen dye, including orchil.

Pigments: There are at least nine different dye-acids found in boiling-water lichens.

History:

Crottle was used primarily in Scandinavia, northern Europe, and Scotland.

Crottle dyes have been recorded in Scotland since the 16th century. As with many "traditional" peasant dyes, there are not many early written records.

General Technique:

Crumble, shred or bruise the lichens. Soak the lichens in water with a little bit of vinegar for several days. Then simmer several hours until all the color is extracted. Strain the lichens out of the dyebath. Simmer the wool until it reaches the desired shade, which may take several days. Generally, use equal weights of dried lichens and wool.

Some people prefer to simmer the lichens and the wool together. This gives brighter colors, but gets bits of lichen stuck in the wool.

Many lichens will dye on unmordanted wool. Some give different colors with various mordants.

Various lichens give shades of red, orange, yellow, or brown.

Samples:

I used samples of five lichens, found in the eastern foothills of the Rocky Mountains in Colorado and Wyoming.

A: A greenish rock lichen with brown underside; a *Parmelia* species, possibly *Parmelia conspersa*

B: A lichen growing in moss; a *Peltigera* species, possibly *Peltigera canina*

C: A pale green lichen resembling lettuce leaves, growing on the ground or in moss on the ground; possibly *Platysma glaucum*

D: A gray-green species of *Usnea*

E: A bright yellow-green species of *Usnea*

Soak lichens in warm water with a little bit of vinegar overnight. Soak wool in dyebath several days.

wool, no mordant

A: brownish orange

B: tan

C: pale tan

D: orange

E: bright yellow

The following lichens give shades of red, orange, yellow, or brown in boiling water. There are probably many more that give similar colors.

Alectoria sarmentosa

Asahinea chrysantha

Bryopogon jubatum

Bryoria fuscescens, also known as *Alectoria fuscescens*

Cetraria species

Cladonia species

Cornicularia divergens

Dactylina arctica

Evernia prunastri

Evernia vulpina

Hypogymnia physodes, also known as *Parmelia physodes*

Hypogymnia tubulosa

Letharia vulpina

Lobaria pulmonaria, also known as *Sticta pulmonaria*

Lobaria scrobiculata

Parmelia species

Peltigera apthosa

Peltigera canina

Platysma glaucum, also known as *Cetraria glauca*

Pseudevernia furfuracea

Ramalina scopulorum

Stereocaulon species

Thamnolia subuliformis

Thamnolia vermicularis

Usnea species

Xanthoria parietina, also known as *Parmelia parientina*

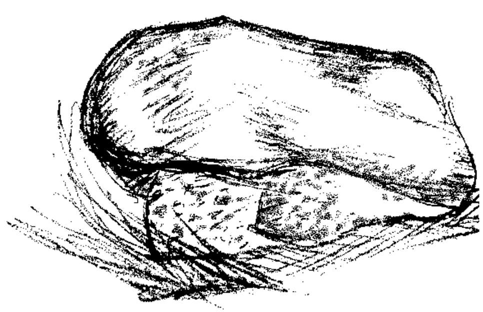
This list demonstrates that a wide variety of lichens give dyes. If you live in the same part of the world as these lichens, and if you have a good lichen identification book, you can try to find these. (Biologists are constantly renaming lichens at a dizzying rate.) Better yet, experiment with whatever lichens are plentiful where you live.

Be careful about over-collecting lichens. Remember that many lichens grow very slowly. Practice good crop management.

MUSHROOMS

Many mushrooms produce useful dyes, in a wide range of colors. A complete discussion of mushroom dyes would take up another entire book. (For example, Rice's *Mushrooms for Color* (41).)

Mushrooms were probably used for dyes in the Middle Ages; the evidence is mostly circumstantial. Several mushrooms (*Boletus igniarius*, producing black dye, and *Boletus hirsutus*, producing yellow dye) are regarded as "traditional" dyestuffs.



Mushroom

HOPS

Humulus species

Pigment: Tannin

Hops

Plant:

A vine native to Europe and Asia. The fresh leaves and stems are used for the dye. Some sources say that October is the best time to harvest the vine for dyeing.

History:

The hops vine was known to the Romans, but it was not widely cultivated in Europe until the 9th and 10th centuries, when it began to be popular as a flavoring for beer.

Hops is mentioned as a dye plant, for yellow, at least as early as 1796.

Dye:

Hops is used to dye wool and silk. It is reported to give pink with no mordant, either yellow or brownish-red with alum, yellow-brown with copper, and greenish-gray with iron.

Recipe:

Using leaves and stems, gathered in the fall from our garden, equal to 3 times the weight of fabric. Soak leaves and stems 1 hour in boiling water.

Soak fabric in dyebath overnight.

	wool & silk	cotton & linen
no mordant:	olive green	no color
alum:	olive green	brown
copper:	olive green	no color
iron:	dark olive green	pale brown

Hops vine did not dye well on cotton and linen. It didn't give very interesting colors on wool and silk.

PLUM BARK and LEAVES

Prunus species, which also include Cherry, Chokecherry, Peach, Apricot, and Almond

Pigments: roots and bark contain tannin and other pigments

History:

The Persians made a yellow dye from some part of the plum tree.

The rind of the plum fruit was used as a yellow dye in *Liber Magistri Petri de Sancto Audemaro de coloribus faciendis* (The Book of Master Peter of St. Omer on Making Colors) in northern France, at the end of the 13th century.

Medieval German books on home dyeing recommended plum roots for red dye and apple bark for yellow dye. Alder bark was a common black dye.

Dye Bark:

The root bark of plum and chokecherry dyes wool purplish-brown with no mordant, purple or pink with alum, reddish-brown with copper, and reddish-gray with iron. The colors are fairly lightfast.

The bark of many trees gives yellow, brown, or "rosy tan" dyes. Some of these dyes are colorfast.

Recipe:

Using fresh plum root bark, equal to twice the weight of fabric. Chop root bark and soak in warm water 1 hour.

Simmer wool and silk samples 6 hours; leave cotton and linen samples in the dyebath overnight.

	wool	silk	cotton & linen
alum:	reddish brown	reddish brown	reddish brown
copper:	reddish brown	reddish brown	reddish brown
iron:	black	reddish brown	reddish brown

Dye Leaves:

Commercial dyers in the early 19th century used "leaves of the almond, peach and pear-trees". These leaves can be used to dye all natural fibers. They are reported to give clear yellow or golden brown with alum mordant, and greenish-yellow with copper. The colors are moderately lightfast with alum, and fast with copper. Do not boil the dyebath, as boiling may make the yellows turn brownish.

Recipe:

Test #1

Using fresh plum leaves, gathered in fall, equal to 1 1/2 times the weight of fabric. Chop leaves and soak in warm water 1 hour. Strain out the leaves.

Soak wool in dyebath 5 hours; leave cotton, linen, and silk in overnight.

	wool	silk	cotton & linen
alum:	olive green	tan	pale tan

alum & copper:	olive green	tan	pale tan
copper:	olive green	tan	no color
iron:	olive green	tan	pale tan

Test #2 "Fermented"

Soak fresh plum leaves, gathered in fall, in water for two weeks, in a glass jar in the sun. Soak fabric samples in room-temperature dyebath for several days.

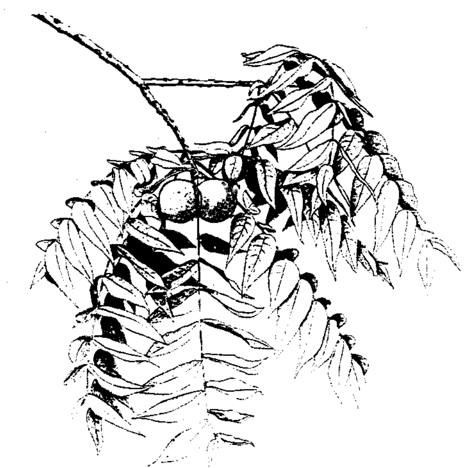
	wool	silk
alum:	grayish green	tan
copper:	brownish green	tan

Plum leaves did not dye well on cotton and linen. The colors were not very interesting on wool or silk.

WALNUT

Juglans species

Major Pigment: juglone
Minor Pigment: tannin



Black Walnut

Plant:

The Persian walnut (*Juglans regia*) is native to Asia Minor. The black walnut (*Juglans nigra*) and butternut (*Juglans cinerea*) are native to North America.

Most parts of the walnut tree (except the nutmeat) contain brown dye. The most concentrated dye is in the husks   the squishy outer coverings of the nut that make a terrible mess on your lawn and driveway and stain your hands when you pick them up.

History:

The Greeks and Romans used walnut husks as a black dye and hair color. The Romans brought walnut trees to Europe and Britain.

Dye:

Walnut husks can be used on all natural fibers. They produce colorfast browns and black. Mordants are not necessary, but they do affect the colors.

Recipe:

Use dried husks equal to the weight of fabric. Chop husks and soak overnight. Strain out husks. Add fabric to dyebath.

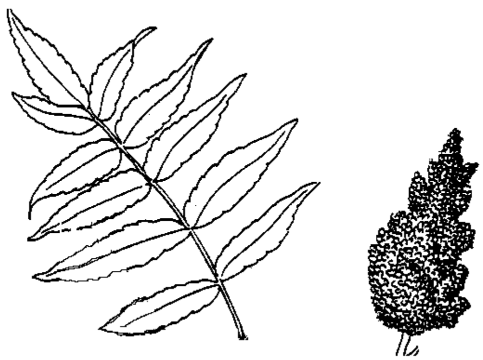
	wool & silk	cotton & linen
no mordant:	brown	brown
alum:	brown	brown
copper:	brown	brown
iron:	black	grayish brown

TANNIN DYES

Many plants containing tannin are used as dyes. These all produce a colorfast black with iron mordant. Most of these plants produce yellow with alum mordant; sometimes other dyes present in the plant produce browns with alum. Tannin dyes can be used on plant and animal fibers and on leather.

SUMAC

Rhus species
Pigment: tannin



Sumac

Plant:

Shrubs and trees native to Africa, Eurasia, and North America. The leaves, twigs, berries, bark and roots have all been used for dyeing.

"Young fustic" (smoke tree or Venetian sumac) is related to sumac.

History:

The ancient Egyptians used sumac for tanning and dyeing leather. The ancient Greeks and Assyrians used it as a yellow-brown dye on wool, and as a mordant.

Many medieval dyebooks give recipes for yellow and black dyes using sumac.

Dye:

With no mordant, sumac gives an orange or brown dye, and with alum, tan.

MYROBALAN

Terminalia species, especially *Terminalia chebula* and *Terminalia bellirica*

Pigment: tannin

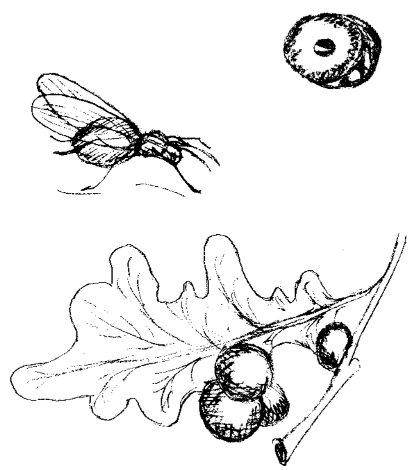
The fruit of a tree grown in the foothills of the Himalayas. This appears to be the same fruit referred to as "Cadou".

In India, myrobalan is used both as dye and a source of tannin to mordant cotton.

OAK GALLS

Quercus species

Pigment: tannin



Oak Galls

Plant:

Galls are woody swellings on oak leaves and twigs, caused by insect larvae. Oak galls contain 30-70 % tannin, making them one of the most concentrated tannin sources available.

History:

The ancient Greeks and Romans used oak galls as black dye and tannin mordant.

Rosetti, writing in Italy, probably in 1548, includes a recipe for dyeing black with oak galls and iron.

Recipe:

Using dried galls, equal to the weight of fabric. Crush galls, and soak in water overnight. Strain dyebath.

The wool and silk samples simmered in the dyebath 1 1/4 hours. The cotton and linen samples simmered 8 1/2 hours.

	wool & silk	cotton & linen
no mordant:	brownish yellow	tan
alum:	brownish yellow	tan
copper:	brownish green	greenish tan
iron:	black	dark charcoal gray

The oak galls in this test were collected in Southern California. I have also collected smaller oak galls in Colorado and New Mexico.

There is another oak dye, which was not used in medieval Europe:

BLACK OAK, *Quercus velutina*, also known as *Quercus tinctoria*, yellow-bark oak

pigment: quercitin

This oak tree is native to eastern United States. Its inner bark (known as quercitron) produces a concentrated, colorfast yellow dye which was commercially important in the late 18th to early 20th centuries.

POMEGRANATE RIND

Punica granatum

Pigment: tannin

Plant:

The pomegranate tree was originally native to Asia. It has been widely grown in the Mediterranean region. The outer rind of the fruit is used for dye.

History:

Pomegranate rinds were used for yellow dye in ancient Mesopotamia, Assyria, Egypt, and Persia since 2000 - 1500 b.c.

The Moors used pomegranate rind for tanning leather, and introduced this practice to Spain.

Recipe:

Using the rind of grocery store pomegranate, after eating the fruit. Used dried rind equal to weight of fabric. Grind up the dried rind in the blender.

Soak the ground rind 1 hour in boiling water. Add fabric.

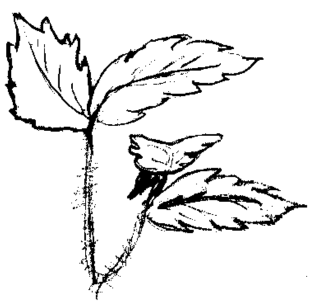
	wool & silk	cotton & linen
alum:	brownish yellow	pale brown

copper:	yellowish brown	pale brown
iron:	black	dark brown

RASPBERRY and BLACKBERRY LEAVES

bramble

Rubus species



Blackberry Leaves

Pigment: tannin

These berry vines are native to Europe. The leaves and stems are used for dye. Some authors recommend collecting the leaves and stalks in spring; some prefer harvesting in late summer.

Rosetti, writing in Italy, probably in 1548, includes a recipe for dyeing black with bramble leaves and iron.

Raspberry stems and leaves reportedly give reddish browns or orange with alum.

Recipe:

Use fresh leaves, gathered in fall, equal to the weight of fabric. Soak leaves in boiling water 3 hours.

I simmered the iron-mordanted wool and silk samples 1 3/4 hours, and the remaining samples 8 hours.

	wool & silk	cotton & linen
alum:	yellowish brown	yellowish brown
copper:	brown	brown
iron:	bluish black	bluish black

DOCK

Rumex species, especially:
Rumex crispus, yellow dock, curly dock
Rumex obtusifolius, broad leafed dock
(*Rumex acetosa* and *Rumex acetosella* are discussed under Sorrel.)

Pigment: tannin

Plant:

Dock is a perennial plant with a heavy taproot. It is native to Europe and Asia, and has been introduced in other parts of the world. The roots produce the dye.

Dye:

Dock root was a commercial dye in the early 19th century.

With no mordant, it is said to produce medium brown, with alum yellow orange, with copper olive brown, and with iron dark brown. The colors are fast, but they turn reddish brown in light. Boiling the dyebath causes the yellows to become brown.

Recipe:

Test #1

Using fresh root bark, from dock weeds in our yard, equal to weight of fabric.

Chop the root bark, and soak in warm water 1 hour.

Soak fabric in dyebath overnight.

	wool	cotton
no mordant:	greenish brown	pale gray
alum:	greenish brown	pale reddish gray
copper:	greenish brown	pale gray
iron:	dark olive green	pale gray

Dock root did not dye at all well on cotton.

Test #2

Using dried whole root, equal to the weight of fabric.

Chop root, and soak overnight in warm water.

Soak fabric in warm, not boiling, dyebath 24 hours.

For "washing soda" sample, I added a pinch of washing soda, and simmered an additional hour.

	wool
alum:	yellow
washing soda:	brown

LINCOLN GREEN

Kendal green, Saxon green, verdures

"To Dye Silk in Green Color: First one must alumate as one does for black and for grain. Then take two pounds of weld ... for each pound of silk. Make it boil one hour and a half, and when it has boiled, you take that liquor in a tub and you take your silk out of the aluming and squeeze it by hand, strongly. Then treat it in said water until it takes the color to your liking. When you have given the yellow, treat the silk in the cauldron and take it out and know ye that silk is more yellow or light green. When it is needy, treat the said silk in the cauldron with flower of indigo. When it is strongly yellow, the color becomes darker green. When it lacks yellow, the color becomes more open and less loaded. Take it out and spread it in the sun."

Plictho of Gioanventura Rosetti, 16th century (7)

The only way to get truly bright, colorfast greens is to use a combination of yellow and indigo-type blue dyes. This is called "overdyeing" because one color is dyed over another.

History:

The ancient Egyptians and Romans produced green by overdyeing woad and a yellow dye such as weld.

In the Middle Ages, overdyed greens were very common. Various names were applied to different combinations of woad or indigo with weld, dyer's broom, or other yellow dyes.

The dark blue-greens seen on old tapestries were originally bright green dyed by this method; the yellow dye has faded more than the blue.

Dye:

In theory, it does not matter whether the yellow or the blue is dyed first. However, it is usually safer to first apply the color that is hardest to dye a deep color. For most modern dyers, this means dyeing the yellow first.

Recipe:

First I dyed the fabric samples with weld.

I then dyed with indigo, using the same vat as for the indigo samples.

All the fabric samples (wool, silk, cotton, linen) turned out some shade of green. The wool was by far the brightest.

It is easy to get too much blue compared to the amount of yellow.

COPPER

History:

The ancient Egyptians used copper salts to dye green.

A green dye from Roman-era Britain may have been produced by copper lactate (sour milk soaked in a copper pot).

The "Innsbruck manuscript", a collection of German dye recipes from around 1330, tells how to produce green from copper acetate and other copper salts.

Remember that these copper compounds are poisonous.

Copper Penny & Ammonia Recipe:

Test #1:

Soak 50 pennies in 1/3 cup clear household ammonia and 1 gallon of water, in a closed jar, for 2 weeks. (This does not damage the pennies at all.) Add fabric to dyebath and soak another week. Use no heat at any time.

<u>wool, no mordant:</u> bluish gray

Test #2:

Ellen Young soaked copper pipe in industrial-strength (30%) ammonia. She soaked wool roving in this solution. After dyeing, she soaked the wool in vinegar and allowed in to air in direct sunlight.

wool, no mordant: bright green and blue-green

Casselman reports that this recipe sometimes gives "soft blue", but nearly everyone else gets only grayish slate blues, or gray-greens. The exact proportions of water, ammonia, and copper in the bath seems to have a strong influence on the color. A vinegar afterbath neutralizes the ammonia, and turns the color more green. There are reports of people using an ammonia afterbath to produce purples, but O'Connor could not duplicate these colors.

Some authors recommend using only "true copper" pennies, minted before 1981. Pieces of scrap copper also work.

Casselman also said that this dyebath will dye cotton, which did not work for me.

Remember that alkalis (including ammonia) are harsh to protein fibers like wool.

Copper Sulfate Recipe:

This is the same as the copper mordant.

wool: pale blue-green

INDIGO

Indigofera species, especially *Indigofera tinctoria* and *Indigofera suffruticosa* (formerly *Indigofera anil*)

Major Pigment: indigotin

Minor Pigment: indirubin, a red-purple isomer of indigotin

"Indigo also, of excellent quality and in large quantities, is made here. They procure it from an herbaceous plant, which is taken up by the roots and put into tubs of water, where it is suffered to remain till it rots; when they press out the juice. This, upon being exposed to the sun, and evaporated, leaves a kind of paste, which is cut into small pieces of the form in which we see it brought to us."

The Travels of Marco Polo, book iii, chapter xxv,

"Of the Kingdom of Koulam"

end of the 13th century (40)

"...that the recently invented, harmful and corrosive dye, which is named the Devil's dye [indigo]*, causes much injury to all persons, vitriol and other corrosive and cheap substances being used for such dye in place of woad; although the cloth so dyed is equally good in appearance as cloth dyed with woad, and can be sold more cheaply, such dyed cloth will be fretted and consumed in a matter of a few years even when it is not being worn and is laid away in chests and stores. For which reason we wish to prohibit entirely such harmful cloth dye."*

decree in Frankfurt on the Main, Germany, 1577

Plant:

The *Indigofera* are legume bushes. *Indigofera tinctoria* is native to India and Southeast Asia, and *Indigofera suffruticosa* to Central and South America.

History:

Indigo has been used in Asia as a dye and cosmetic for over 4000 years. It is unclear when and how much indigo was imported to the Mediterranean in ancient times. The early writers did not distinguish between woad and indigo.

The Greeks and Romans imported indigo, as well as using local woad. They were confused about the origins of this foreign substance. Pliny and Dioscorides describe two kinds of indigo, one a product of the sea, and the second a by-product of shellfish purple dyeing. This imported indigo was used as a paint, a cosmetic, and a medicine; it was too expensive to use as a textile dye.

Indigo was originally imported to Europe by the caravan routes. It is seldom mentioned in Europe before the 12th century. At that time, there are references to imported indigo used as a paint. About the same time, in Venice, indigo imported from India began to replace woad imported from northern Europe as a blue dye for fabric.

Marco Polo, writing at the end of the 13th century, refers to indigo and brazilwood as dyes familiar in Europe. He accurately describes how indigo is extracted and processed.

In Italy and England, where there was no powerful woad industry, indigo was quickly accepted as a better blue dye.

In the late 15th century, the price of imported indigo in Europe dropped significantly. The new Portuguese ocean route to India made trade with the East much easier, and the Spanish began importing indigo from their newly-conquered South American and Central American colonies. Dyers in northern and western Europe began to use inexpensive indigo, instead of and in combination with woad.

In the parts of northern and western Europe where woad growers were well organized, they fiercely opposed the use of indigo, and often succeeded in having the new dye outlawed. Many people believed that indigo damaged fibers, (probably due to poor dyeing technique). Indigo eventually, by the 17th century, became a popular dye because it was less expensive, more concentrated, and higher quality than woad.

Even as late as the 18th century there was confusion in Europe about the origins of indigo; some people regarded it as a mineral.

Names:

Indigo was known in medieval Europe as "*indicum*", a general Latin term for imports from India.

The medieval Persians, Indians, and Arabians called indigo dye "*nil*". The Portuguese adapted this name, as "*anil*". From this we get the term "aniline", for synthetic indigo.

Dye Chemistry:

In the indigo plant, the pigment is combined with glucose sugar to form a colorless, water-soluble compound "indican" ($C_{14}H_{17}NO_6 \cdot H_2O$). When the leaves are crushed and placed in water, plant enzymes and bacterial action separate the glucose from the compound "indoxyl" ($C_{16}H_{12}N_2O_2$), also known as "indigo white". Indigo white is insoluble in water, but soluble in alkali, forming a pale yellow solution.

If the indigo white is allowed to react with oxygen from the air, it will oxidize to "indigotin" ($C_{16}H_{10}N_2O_2$), known as "indigo blue". Indigo blue is insoluble, and can be stored as a dry powder or solid block.

The indigo blue can be returned to indigo white by chemical reduction (removing the oxygen). Fibers are then dyed by dipping them in the alkaline solution of dissolved indigo white. When the fibers are removed from the solution, the indigo reacts with oxygen in the air and turns blue. Dipping several times produces darker blues.

Dye Technique   Historical

The most ancient technique uses stale urine; the fermenting urine reduces indigo to indigo white, and the resulting ammonia provides the alkali. Sometimes fruit juices were fermented with yeast to reduce the indigo, and sometimes lime water or wood ash lye was used for the alkali. Some recipes included madder, which helped the fermentation and served as an additional dye to darken the color.

I have tried an indigo vat using fermented urine, with good success. The vat ferments much slower than using a chemical vat, especially in cool weather. Keep the vat outdoors because it is smelly.

It is possible, though not certain, that the chemical method of using lime and iron sulfate to reduce the indigo vat was invented in ancient India. This method was re-invented in the 18th century. The lime/iron sulfate vat only works for cotton and linen; it cannot be used for wool because the iron reacts with the wool.

Dye Technique   Modern

"Dyeing well with indigo is not the impossible bogeyman often depicted. However, it does require proper instruction, experience, commitment, and

comprehension of what is going on in the dye vat."

Jim Liles (30)

Indigo is usually used without mordant, on any natural fiber. It produces blue.

The most common modern method for operating a small indigo vat uses sodium hydrosulfite (a major ingredient in "Rit Color Remover" and similar products) or thiourea dioxide (sold as "Spectralite") to reduce the indigo, and lye as the alkali.

Thiourea dioxide has a longer shelf life than sodium hydrosulfite (which only keeps for about a year). One Tablespoon of thiourea dioxide will replace about 3 Tablespoons of sodium hydrosulfite (and remember that color remover is not 100 % sodium hydrosulfite).

Both "natural" and "synthetic" indigo are available commercially. "Natural" indigo is extracted from the indigo plant. Commercial natural indigo contains between 20% and 70% pure pigment. "Synthetic" indigo is the same pigment, relatively pure, manufactured chemically.

Synthetic indigo is used for blue denim. It is extremely lightfast and washfast. Denim "fades" in well-worn areas because indigo coats only the outside of the fibers. Poorly dyed indigo rubs off more readily than properly dyed indigo.

Some dyers use additional treatments after the indigo bath to improve the colorfastness. These treatments include steaming, aftermordanting with alum or copper sulfate, or soaking in a weak acid (vinegar, tartaric acid, or sorrel leaves). These treatments can produce slightly greener or purpler shades. However, well-dyed indigo does not need any additional treatment. The most important factor for colorfastness is that the indigo adheres well to the fiber in the dyebath; this means that the bath be alkaline enough, well reduced, and not too strong.

Tannin is sometimes added to vats used for cotton, to produce a deeper color.

Some dyers using natural indigo and various other additives (such as banana, molasses, or shredded chickens) obtained shades from greenish-blues to purplish-blues.

Recipe - to dye medium blue on one pound cotton, linen, or silk, or two pounds of wool:

Use appropriate respect when handling lye, thiourea dioxide, and sodium hydrosulfite.

First make up a concentrated solution: Fill a one-quart wide mouth canning jar with hot tap water. Dissolve 1 1/2 teaspoons of lye in the water. (The dissolving lye will further heat the water.) Add 2 teaspoons of finely powdered indigo, and stir for several minutes. Add 1 teaspoon thiourea dioxide ("Spectralite"), and stir gently, without stirring in extra air. In a minute or two, the surface should begin to look iridescent. Put the lid on the jar, and set it into a pot of hot tap water to keep it warm. When the solution has changed from blue to yellow, it is ready to use. This usually occurs within an hour, but sometimes takes overnight, especially if the indigo is coarsely powdered. Do not heat the solution above 140^{o} when it is in the yellow form.

The concentrated solution can be stored for a long time, with the lid tightly closed. Eventually the solution will turn blue again. If this happens, put it back into a pot of hot tap water, and add more Spectralite.

Second, prepare the dye vat: Fill a 5 gallon plastic bucket nearly full with hot tap water. Dissolve 1/8 teaspoon lye in the bucket. Add 1/2 teaspoon liquid detergent. Add 1 teaspoon Spectralite, and stir very gently. Put the lid on the bucket, or float a piece of plastic wrap on the surface. Allow at least 15 minutes for the Spectralite to remove the dissolved air from the dye vat. Very gently add the concentrated indigo solution; if you are only planning to dye a small amount, you can add half the concentrate, and save the rest for later. Let the vat sit covered for about an hour, until it turns yellow or yellowish green.

Some people prefer to dissolve the indigo directly into the dye vat. This appears simpler, on paper. But it doesn't really save much time because the indigo dissolves more readily in the concentrated solution.

The fibers should be thoroughly clean and wet before dyeing. Lower the material into the vat slowly, to avoid introducing air bubbles. Remove the material, using rubber gloves or a wooden stick. Squeeze the excess dye solution out of the fibers, back into the vat, trying to splash as little air as possible into the vat. Spread out the material, and watch it turn from yellow to blue before your eyes! You can keep putting the material back in the vat to produce darker blues. Allow 15 minutes to an hour between dips, to be sure all the indigo has turned blue. You can soak the material in the vat for longer times (up to about half an hour), to produce darker colors. But several shorter dips usually give more even and more colorfast colors, and make it easier to stop when you have the shade you want. When you have the final color, allow the fibers to air for at least an hour, and then rinse thoroughly. For wool and silk, add a little vinegar to the rinse water to neutralize any remaining lye.

In general, if the vat remains green or blue instead of yellow, add more Spectralite. If yellow or white powder ("indigo white") settles to the bottom of the vat, add more lye. Use only as much lye as you need; too much lye damages the fibers, especially wool. If the vat become too weak, add more concentrated indigo. In theory, there is no need to ever throw out an indigo vat; save it for next time, and add whatever ingredients it is low on.

One ounce of indigo is approximately 3 Tablespoons.

Test 1 commercial indigo

Using synthetic indigo, with a lye and hydrosulfate vat. The vat was rather weak.

Each dip was approximately 10 minutes, with 30 minutes airing between dips.

	wool & silk	cotton & linen
no mordant:	greenish blue	denim blue

On other occasions, I have obtained denim blue on wool.

My daughter had cotton diapers that I dyed with indigo. These were washed twice a week for two years, and showed only moderate fading.

Test 2 fresh indigo leaves ("Indigo Pink")

I covered fresh leaves of *Baptisia* (Mayo indigo), and *Polygonium* (Japanese indigo) with warm water and soaked them, warm, for a day or two to extract indigo white. I soaked unmordanted wool in this solution for an hour. When the wool was removed from the dyebath and exposed to air, indigo blue formed; most of this indigo blue washed off immediately, leaving pink.

The liquid was later shaken vigorously to oxidize the indigo white to indigo blue. The indigo blue settled to the bottom of the jar, and was strained off and dried as indigo powder.

In other occasions, I added washing soda to the liquid extracted from the leaves. This had no effect on the results.

Test 3 - fresh indigo leaves (More "Indigo Pink")

I covered fresh leaves of *Polygonium* (Japanese indigo) with warm water and soaked them, warm, for two days to extract indigo white. I poured off this liquid and shook it vigorously to mix in lots of air. The liquid turned blue, and the indigo blue settled to the bottom of the jar. I separated the liquid and the blue sludge by carefully pouring off the liquid. I used this indigo blue powder in a small lye and hydrosulfate vat, where it behaved exactly like commercial indigo powder.

	wool
no mordant	greyish blue

I dyed wool with the liquid left after separating out the indigo blue. I tested several dyebath temperatures. For some batches I used the liquid as it was (rather alkaline, pH 9), and for some I added vinegar (to pH 6, slightly acidic). I rinsed some samples with a washing soda solution after dyeing. The washing soda had no effect.

wool	160°F	180°F	200°F
acidic dyebath			
no mordant	brownish pink	brownish pink	pale pink
alum premordant	brownish pink		pale pink
copper postmordant	gray	gray	pale greenish gray

iron postmordant	brown	brown	pale brown

wool	160°F	180°F	200°F
alkaline dyebath			
no mordant	very pale tan	very pale tan	pale pink
alum premordant	very pale tan	very pale tan	pale pink
copper postmordant	blue green	blue green	greenish gray
iron postmordant	yellow brown	greyish yellow brown	greyish yellow brown

Test 4 - Fresh indigo leaves, Flower heads

I covered fresh leaves of *Polygonium* (Japanese indigo), four times the weight of fiber, with warm water and soaked them, warm, for two days. I likewise soaked *Polygonium* flower heads, three times the weight of fiber. I used each of these as an ordinary dye bath, at 160° - 185° F. I rinsed some samples with a washing soda solution after dyeing.

Leaves

wool	as dyed	washing soda rinse
no mordant	pinkish grey	pinkish grey
alum premordant	greying pink	dingy pink
copper postmordant	dingy green	dingy green

iron postmordant	greyish brown	greyish brown

Flower Heads

wool	as dyed	washing soda rinse
no mordant	pale tan	pale yellow
alum premordant	pale yellow	yellow
copper postmordant	pale yellow green	spring green
iron postmordant	dark green	dark green

Conclusions

Indigo blue is present in *Baptisia* (Mayo indigo), and *Polygonium* (Japanese indigo). The most practical way to use it is to soak the leaves in warm water to extract the indigo, convert it to indigo blue, and use the indigo blue in your favorite conventional indigo vat.

Baptisia and *Polygonium* leaves also contain a pink pigment, which remains in the liquid left after extracting the indigo blue. This pink dyes best in a slightly acidic dyebath, at temperatures of 180°F or lower, with alum mordant.

Polygonium flower heads contain a yellow pigment which works with alum, copper, and iron mordant, and is brightened by an alkaline rinse.

INDIGO SULFATE

Indigo extract, chemic, Saxon Blue

This is a chemical (acid) dye, not a natural dye. I have included it in this book because some modern dyers use it as a substitute for fermented indigo.

On wool and silk it produces a greenish blue with no mordant or with alum. It is less lightfast than fermented indigo.

The term "Saxon blue" is also used in a completely different sense to refer to a natural indigo vat process, using unscoured fleece.

Recipe:

Use commercial "indigo extract" solution equal to 1/100 the weight of fabric. Mix into enough water to cover fabric. Add the fabric and soak until color is dark enough.

wool & silk, no mordant: turquoise blue

WOAD

pastel (However, the term "pastel" is occasionally used for dyes other than woad.)

Isatis species, especially *Isatis tinctoria*

Pigment: indigotin

"All the Britanni spot themselves with woad that produces a blue color and with which they assume a horrible aspect in battle."

Julius Caesar, Commentaries on the Gallic Wars, book v (7)

Plant:

The woad plant was originally native to Southern Europe or the Near East. It was widely grown and used in Britain, Europe, Asia, North Africa, and now North and South America.

History:

The very earliest history of woad in the Mediterranean is confused because the early writers used the same term for woad and indigo, and it is impossible for archeologists to determine from dyed cloth which plant was used.

Egyptian linen fabrics from 2400 b.c. have woven stripes of indigotin blue. Around 300 b.c., the Greeks and Egyptians began large-scale cultivation of an indigotin-bearing plant, presumably woad. Woad was a common dye in Rome, and throughout the Roman Empire.

Meanwhile, woad was in common use in Northern Europe. Textiles dyed with woad have been found from Bronze-Age settlements in Austria. Jars of woad and madder were found among the weaving and dyeing implements buried with Queen Asa, about 800 b.c., in Norway.

Woad was consistently the most popular dye throughout medieval Northern Europe. The Saxon settlers in Britain were fond of woad as a cloth dye, and imported additional woad from Germany. Woad stems have been excavated from the Viking settlement at York. Some woad was grown throughout Northern Europe and Britain for local use, but the demand exceeded the supply. The woad-growing regions of Saxony and Thuringia exported woad to the cloth-producing centers of Europe.

Business records indicate that the woad growers and merchants were well organized. Pressure from the woad growers kept indigo from replacing woad in northern Europe until about the 17th century.

Dye:

Woad was used to dye blue and black (really a very, very dark navy blue), and combined with weld for "Lincoln green", or with madder for inexpensive purple. Woad blue was one of the very few dyes that worked well on linen.

In the traditional harvesting technique, woad leaves were crushed, rolled into balls, and dried for several weeks. When the entire crop had been harvested, the balls were ground into powder and sprinkled with water. A long and tricky process composted this paste down to about 1/9 the original weight, getting rid of the useless plant matter and leaving the pigment.

The name "woad" is Saxon, from the Germanic "*weedt*" or "*weeda*". This may well be the source of our English word "weed".

The names "woad" (the blue dye) and "weld" (the yellow dye) are often confused. Equally bad, the Italian for weld is "*erba guada*" and the French "*guade*", while the Italian for woad is "*guado*" and the French is "*gouade*". Authors and translators sometimes get these mixed up.

In Colorado, woad is now classified as a "noxious weed", and growing woad is illegal. Check with your county weed control agent. If woad is a local weed, you may be able to find wild woad to harvest, and you don't need to grow your own.

Related Plants:

There are more than 50 plants which are known to contain the pigment indigotin. Many widely separated cultures all around the world seem to have independently discovered, at very early dates, how to use the various local indigo-bearing plants. Some of the other common plants are:

Baptisia tinctoria (formerly *Sophora tinctoria*): North America

Lonchocarpus cyanescens: Africa

Marsdenia tinctoria, a milkweed: Southeast Asia

Polygonum tinctorium, "dyer's knotweed", "Japanese indigo": Southeast Asia, China

Strobilanthes flaccidifolus: Southeast Asia

Wrightia tinctoria (formerly *Nerium tinctorium)*, "dye oleander": India

LOGWOOD

campeachy wood
Haemotoxylum campechianum

Pigment: haematein

Plant: The wood of a legume tree, native to Central America

History:

The Spanish began importing logwood from their Central American colonies in the early 16th century. From Spain, logwood spread to other European countries.

The name "logwood" came from the practice of selling the trees as whole logs, rather than wood chips, to prove that they had not been adulterated. The second name, "campeachy wood", refers to the port of San Francisco de Campeche, in Yucatan, Mexico, from which it was shipped.

Logwood was not used in England until reign of Elizabeth I. In 1580 and 1581, it was prohibited by Act of Parliament, as an inferior, non-colorfast dye.

However, logwood continued to be popular because it was cheap and produced pretty colors. It was still used commercially in the early 20th century.

Dye:

Some recipes call for "fermenting" (that is, oxidizing) the wood chips by sprinkling them with water and allowing them to sit for several days or several weeks. The wood is fermented enough when it is dark red-brown color, with a patches of "a greenish incrustation of haematein crystals, with metallic luster". Too much fermenting will ruin the color. Some mordants, such as iron and copper, are oxidizing, and are best used with unfermented logwood.

Logwood can be used on all natural fibers. It produces blues and browns with no mordant; purples and blues with alum; blues, grays, and purples with copper; and black, gray, or dark blue with iron. Logwood colors are strongly affected by acid or alkaline conditions.

The colorfastness depends on the mordant. Copper gives the most colorfast colors, and alum and no mordant the least colorfast.

Recipe:

Using logwood sawdust, from dye suppliers, equal to 1/4 the weight of fabric. I did not oxidize the logwood before using it. Soak sawdust in warm water overnight.

I simmered the fabric samples in dyebath 7 hours, which was too long, especially for the wool. The dyepot was not large enough, and the fabric samples too cramped, which caused the dye to be uneven.

I rinsed some samples in a solution of vinegar, and some in a solution of washing soda.

	as dyed	vinegar rinse	washing soda rinse
no mordant			
cotton & linen	denim blue	grayish blue	denim blue

silk	purplish blue	grayish purple	brown
alum			
cotton & linen	purple	purple	purplish blue
silk	purple	purple	brown
copper			
cotton & linen	dark blue	dark blue	dark blue
silk	purplish blue	grayish blue	grayish blue
iron			
cotton & linen	grayish blue	gray	grayish brown
silk	purple	purple	gray

The wool samples dyed so dark it is no longer possible to read their labels. They are black, dark blue, dark brown, and purple.

On other occasions, I have obtained brown on wool with no mordant, gray with no mordant and washing soda, purple with alum, dark blue or blue-gray with copper, and dark blue with iron.

BERRIES

"Many blue skinned fruits of this kind, that are known to give blue dyes, will only do so in Scotland in exceptionally sunny years."

Su Grierson (22)

Morus species: mulberry

Opuntia species: prickly pear cactus

Prunus species: plum and cherry

Punica granatum: pomegranate

Ribes species: currants

Rubus species: blackberry and raspberry

Sambucus species: elderberry

Vaccinium species whortleberry (also known as huckleberry), blueberry, cranberry

Vitis species: grape

Pigments: mostly anthocyanins

History:

The pre-Roman Gauls used elderberry *(Sambucus nigra)*, myrtle *(Vaccinium myrtillus)* and other berries as violet dyes, and juniper *(Juniperus communis)* and blackcurrant *(Ribes nigrum)* as green dyes. The Roman invaders continued to use these local dyes.

Medieval German books for non-professional dyers contain recipes using elderberry and myrtle: grayish-blue with no mordant, violet-blue with copper sulphate, and red with vinegar. These same books also describe using viola *(Viola odorosa)* and cornflower *(Centaurea cyanus)* flowers for dyeing violet, buckthorn berries *(Rhamnus catharticus*) for yellow, and privet berries *(Ligustrum vulgare*) for green.

Dye:

Berries do not produce very good dyes. They are probably mentioned so often because there are so few good blue dyes.

All the berry dyes oxidize, especially in sunlight, and turn drab with washing.

In general, use twice as much fruit as fiber, by weight. Soak the fruit 12-48 hours in soft water with a little vinegar, then simmer one hour, and strain. Do not boil the dyebath. Adding vinegar or oxalic acid will make the color more pink; adding ammonia or washing soda after the dyeing will make the color more blue, green, or gray.

Some fruits only dye on plant fibers, others only on wool. Some work better when the dyebath is not heated at all.

Most fruits will dye without mordant. Using mordants or salt changes the color and improves the fastness. The colors are usually described as "soft murky blues and lavenders".

Recipe:

Using frozen grape juice and red raspberry juice, each diluted to 1/4 normal strength with water. Use enough of this solution to cover the fabric.

I soaked the grape samples 12 hours, without heat. All fabric samples were bright purples in the dyebath.

I soaked the raspberry samples 7 1/2 hours, without heat. All the fabric samples were bright pinks in the dyebath.

For the "washing soda" samples, I rinsed in a solution containing washing soda; for the "vinegar" samples, I rinsed in a solution containing vinegar. For the "salt" samples, I soaked overnight in a cold solution of salt water.

raspberry	wool	cotton & linen
no mordant	grayish pink	pink
alum	grayish pink	pink
vinegar	grayish pink	pink
washing soda	blueish gray	grayish lavender
salt	gray	pink
copper	grayish pink	pink
iron	pinkish gray	gray

grape	wool	cotton & linen
no mordant	grayish lavender	lavender
alum	grayish lavender	lavender
vinegar	grayish lavender	lavender
washing soda	gray	brownish gray
salt	gray	pink
copper	grayish lavender	lavender
iron	grayish lavender	lavender

These are all rather dull colors.

APPENDIX 1 – CHEMICALS USED IN DYEING

"Take the brazil wood ... and dissolve in lye or in the urine of a drunken man who has drunk strong wine."

Alcherius, De coloribus diversis modis tractatur, 1398 (7)

Alum – $Kal(SO_4)_2$ *

potassium alum, aluminum potassium sulfate

Used as a mordant to produce bright colors. Too much alum makes wool sticky.

Alum occurs naturally as a mineral.

Alum - $AlNH_4(SO_4)_2$ *

ammonium alum, aluminum ammonium sulfate, pickling alum

This is the familiar grocery-store alum. As a mordant, it gives a more yellow color than potassium alum, and is not as colorfast.

Aluminum Sulfate – $Al_2(SO_4)_3$ *

This is another naturally occurring "alum" mineral. It is sold in garden stores as a soil additive.

Aluminum sulfate purchased at a garden store may or may not contain some iron contamination. Pure aluminum sulfate is white; iron contamination is brownish. If it is contaminated, yellows and sometimes reds will be dingy, but other colors should be fine.

<u>Copper Sulfate</u> – $CuSO_4$ *

cupric sulfate, blue vitriol, Roman vitriol, blue copperas, blue stone

Used as a mordant to produce greens and browns. It occurs naturally as the mineral "chalcanthite".

It is used to kill algae and pond scum, and by plumbers to kill tree roots in sewer systems. It is usually found in the plumbing department of hardware stores.

Copper sulfate is very poisonous, and a strong skin irritant.

<u>Iron Sulfate</u> – **$FeSO_4$ ***

ferrous sulfate, copperas, green copperas, green vitriol

Used as a mordant for dark colors. It occurs naturally in several minerals. Too much iron hardens wool and causes fibers to deteriorate more rapidly.

Iron sulfate is sold as a garden fertilizer ("copperas"). You don't need pure copperas, because iron mordant is only used for dark colors, which will hide any contamination. If the fertilizer is not 100% copperas, adjust the amount of iron the dye calls for.

Iron sulfate is poisonous in large quantities.

<u>Iron Acetate</u>

ferric acetate

An iron mordant traditionally made by soaking iron filings in vinegar.

Tannin, Tannic Acid

Used as a mordant, a dye and to make the dyebath more acidic.

It is found in a variety of plants, especially oak bark and galls, sumac, and myrobalan fruit.

"Tannin" and "tannic acid" are the same. The tannins are a family of chemical compounds, not a single chemical.

Powdered tannin is sold in winemaking stores as a wine additive.

Concentrated tannin is mildly poisonous and a skin irritant.

Cream of Tartar - $KHC_4H_4O_6$

potassium bitartrate, potassium acid tartrate, argol

Cream of tartar is used to make the dyebath more acidic. It brightens some colors, but using too much can dull the colors. It softens wool.

Cream of tartar was first known as "argol", and was collected from deposits formed on wine casks.

Tartaric Acid

Tartaric acid can be used in place of cream of tartar in dyeing, but the amounts needed will not necessarily be the same.

Tartaric acid is a natural fruit acid; cream of tartar is the potassium salt.

<u>Vinegar</u> - CH_3COOH

acetic acid

Used to make the dyebath more acid.

Vinegar is traditionally made from sour wine. Grocery store white vinegar is usually 4 to 6 percent acetic acid.

<u>Oxalic Acid</u> - $(COOH)_2$

Used to acidify the dyebath, and to brighten some colors, especially cochineal red.

It is found in sorrel and rhubarb leaves. You can boil some rhubarb or sorrel leaves in water, and use the liquid as a source of oxalic acid, especially if you don't need to know the exact concentration.

Oxalic acid is extremely poisonous, and irritating to skin.

<u>Ammonia</u> - NH_4OH

ammonium hydroxide, chamber lye, sig

Ammonia is used to make the dyebath more alkaline, and also to release dye from orchil lichens and some other dyes.

The traditional source of ammonia was stale urine ("chamber lye", "sig"). The 19th century efforts at producing cudbear, a lichen dye, indicate that the quality of the urine really does have some influence.

Ammonia is sold as a household cleaner. Use the "clear" (non-sudsy) type.

Breathing large amounts of ammonia fumes is bad for the lungs, not to mention very unpleasant.

<u>Washing Soda</u> – Na_2CO_3 *

sodium carbonate, soda ash, sal soda

Used for scouring fibers before dyeing, and to make the dyebath more alkaline.

It occurs naturally as "natron" and other minerals. "Soda ash" is the anhydrous form (with all moisture baked out), so the amounts of soda ash and washing soda needed may be different.

Washing soda is irritating to skin, especially in strong concentrations or with repeated exposure.

<u>Baking Soda</u> - $NaHCO_3$

sodium bicarbonate

Used to make the dyebath more alkaline.

<u>Lye</u> – NaOH

sodium hydroxide, caustic soda

Lye is used in cleaning and mercerizing plant fibers, as an alkali in the indigo vat, and as an ingredient in soap.

Lye was traditionally extracted from wood ashes.

Lye generates large amounts of heat when dissolving, or if the solution is mixed with an acid. It is also deadly poisonous and causes severe caustic burns on skin. Keep it in a tightly closed container to prevent it from absorbing moisture from the air.

Potash

"Potash" originally referred to vegetable ashes, which contained a mixture of sodium hydroxide and potassium hydroxide. "Barilla" was the name of a specific type of plant ash.

Some books now use "potash" to refer to potassium hydroxide, KOH; some use it to refer to potassium carbonate (pearl ash), K_2CO_3.

Potassium hydroxide, KOH, is used for the same purposes as lye, sodium hydroxide.

Potassium hydroxide generates large amounts of heat when dissolving, or if the solution is mixed with an acid. It is also deadly poisonous and causes severe caustic burns on skin. Keep it in a tightly closed container to prevent it from absorbing moisture from the air.

Pearl Ash – K_2CO_3

potassium carbonate

Used to make the dyebath more alkaline.

Pearl ash was traditionally extracted from ashes of wood and plants.

It is caustic and irritating to skin. Keep it in a tightly closed container to prevent it from absorbing moisture from the air.

Sodium Hydrosulfite – $Na_2S_2O_4$

A major ingredient in "Rit Color Remover", "Tintex Color Remover", and similar products. It is used as a reducing agent in modern indigo recipes.

Sodium hydrosulfite will last longer if kept in a tightly closed container; even so, it has a shelf life of about a year.

Thiourea Dioxide

"Spectralite"

Sold by dye suppliers, under several brand names. It is used as a reducing agent in modern indigo recipes. One Tablespoon of thiourea dioxide will replace about 3 Tablespoons of sodium hydrosulfite in dye recipes (and remember color remover is not 100% sodium hydrosulfite).

Keep it dry. It has a shelf life of several years.

All three of these closely-related chemicals below are used to make the dyebath more alkaline. They make the water harder.

Lime - **CaO**

calcium oxide, burnt lime, quicklime

Lime dissolves in water, ***generating a large amount of heat.***

It absorbs moisture and carbon dioxide from the air and converts to slaked lime and chalk, so keep it tightly closed and dry.

Lime is a strong caustic, and causes caustic burns.

<u>Slaked Lime</u> - $Ca(OH)_2$

calcium hydroxide

Slaked lime is slightly soluble in plain water; it dissolves in acidic solutions, ***generating a large amount of heat.***

It absorbs carbon dioxide from the air and converts to chalk; keep tightly closed.

<u>Chalk</u> - $CaCO_3$

calcium carbonate

Chalk does not dissolve in water, but it does dissolve in acidic solutions.

It occurs naturally as the mineral calcite and other minerals.

<u>Table Salt</u> - NaCl

sodium chloride

Salt helps dyes bond to the fiber, and helps to "exhaust" the dyebath (use up all the color). It occurs naturally as sea salt and rock salt.

<u>Glauber's Salt</u> - $NaSO_4$**

sodium sulfate

Glauber's salt helps dyes to bond more evenly, and helps to "exhaust" the dyebath (use up all the color). Some dyers believe it gives brighter colors and better fastness.

It occurs naturally in the minerals "mirabilite" and "thenardite".

Keep in a tightly closed container to prevent moisture absorption from the air.

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* The common crystals of these chemicals also contain water molecules. These crystals are known as "hydrates". Some books include the water molecules when writing the chemical formula; for example, copper sulfate $CuSO_4$ could be written pentahydrate of copper sulfate, $CuSO_4 \cdot 5H_2O$.

APPENDIX 2 – WEIGHTS AND VOLUMES

Weights and Volumes of Some Useful Chemicals

Potassium Alum	1 tsp.= 2/10 oz. = 5.6 g	1 oz. = 5 tsp.
Aluminum sulfate	1 tsp. = 2/10 oz. = 5 g	1 oz. = 5 tsp.
Copper Sulfate	1 tsp. = 1/7 oz. = 4 g	1 oz. = 7 tsp.
Iron Sulfate	1 tsp. = 3/20 oz. = 5 g	1 oz. = 6 tsp.
Cream of Tartar	1 tsp. = 1/7 oz. = 4 g	1 oz. = 7 tsp.
Tannic Acid	1 tsp. = 1/10 oz. = 3 g	1 oz. = 9 tsp.
Fluffy Tannin	1 tsp. = 1/14 oz. = 2 g	1 oz. = 14 tsp.
Washing Soda	1 tsp. = 3/20 oz. = 5 g	1 oz. = 5 1/2 tsp.
Baking Soda	1 tsp. = 1/7 oz. = 4 g	1 oz. = 7 tsp.
Lye	1 tsp. = 2/10 oz. = 5.5 g	1 oz. = 5 tsp.
Chalk	1 tsp. = 1/14 oz. = 2 g	1 oz. = 14 tsp.
Table Salt	1 tsp. = 2/10 oz. = 6 g	1 oz. = 4 1/2 tsp.
Glauber's Salt	1 tsp. = 1/4 oz. = 7 g	1 oz. = 4 tsp.

Traditional "English" Measurements

1 Tablespoon (Tbsp.)	= 3 teaspoons (tsp.)
1/4 cup	= 4 Tablespoons
1 pint	= 2 cups
1 quart	= 2 pints
1 quart	= 4 cups
1 gallon	= 4 quarts
1 pound (lb.)	= 16 ounces (oz.)

Metric Measurements

1 kilogram (kg)	= 1000 grams (g)
l liter (l)	= 1000 milliliters (ml)

Approximate Metric and English Conversions

1 ounce	= 28 grams
1 pound	= 450 grams
1 kilogram	= 2 1/4 pounds
1 teaspoon	= 5 ml

1 Tablespoon	= 15 ml
1 cup	= 250 ml
1 quart	= 1 liter
1 gallon	= 4 liters

APPENDIX 3 – FAVORITE DYESTUFFS

These are some of my personal favorites – dyes which are medieval, still available, and give pretty colors. You will develop your own list of personal favorites. But this list may be helpful for people interested in trying natural dyes, with no idea of where to start.

<u>complexity</u>:

easy almost impossible to do wrong

moderate requires paying some attention (includes all dyes that should not be boiled)

hard complex process

<u>availability</u>:

C buy commercially

H commonly found at home

P grow from plants

W collect in the wild

for WOOL

dye	mordant	color	light fastness	complexity	availability
RED:					
madder	alum	orangish red	excellent	moderate	C, P
cochineal	alum	red, bright pink	moderate	easy	C, W
brazilwood	alum	reddish salmon	poor	easy	C
ORANGE:					
iron		orange	excellent	moderate	H
henna	none	orangish brown	excellent	easy	C (hair color)
coreopsis	copper	brick	excellent	moderate	P
coreopsis	alum	yellow, bright orange	moderate	moderate	P
annatto	alum	orange	poor	easy	C
YELLOW:					
onion	alum	gold	excellent	moderate	H
marigold, tansy, chamomile	alum	greenish-yellow	excellent	moderate	P
weld	alum	yellow	moderate	moderate	C, P
saffron	none	golden yellow	poor	easy	C (spice)
turmeric	none	yellow	poor	easy	C (spice)
GREEN:					
onion	copper	"green"	excellent	moderate	H
marigold, tansy, chamomile	copper	"green"	excellent	moderate	P
onion	iron	olive	excellent	easy	H
marigold, tansy, chamomile	iron	olive	excellent	easy	P

(The best greens are produced with indigo blue and a yellow dye, especially weld or marigold.)

for WOOL (continued)

dye	mordant	color	light fastness	complexity	availability
BLUE:					
copper sulfate	--	blue-green	excellent	easy	C
copper & ammonia	--	blue-gray	excellent	moderate	H
indigo	none	blue	excellent	hard	C, P
logwood	copper	navy blue	excellent	easy	C
PURPLE:					
logwood	alum	purple	moderate	easy	C
logwood	iron	dark purple	moderate	easy	C
(Purple can be produced with indigo blue and cochineal.)					
BROWN:					
cutch	none	brown	excellent	easy	C
plum roots	alum	brown	excellent	moderate	P, W
walnut	alum	brown	excellent	easy	P, W
BLACK:					
plum roots	iron	black	excellent	moderate	P,W
walnut	iron	black, dark brown	excellent	easy	P, W
pomegranate	iron	black	excellent	easy	H
raspberry leaf	iron	black	excellent	easy	P
oak galls	iron	black	excellent	easy	W

for COTTON

dye	mordant	color	light fastness	complexity	availability
RED:					
madder	alum	red	excellent	moderate	C, P
Turkey red		bright red	excellent	hard	C, P
brazilwood	alum	pink	poor	moderate	C
ORANGE:					
iron	rust	orange	excellent	moderate	H
annatto	iron	orange	excellent	easy	C
coreopsis	copper	brick	excellent	moderate	P
coreopsis	alum	orange	moderate	moderate	P
annatto	alum	reddish brown	moderate	moderate	C
YELLOW:					
onion	alum	yellow-brown	excellent	moderate	H
marigold, tansy, chamomile	alum	brownish yellow	excellent	moderate	P
weld	alum	brownish yellow	moderate	moderate	C, P
saffron	none	yellowish orange	poor	easy	C (spice)
turmeric	none	yellow	poor	easy	C (spice)

GREEN:

(Greens are produced with indigo blue and a yellow dye, especially weld or marigold.)

for COTTON (continued)

dye	mordant	color	light fastness	complexity	availability
BLUE:					
indigo	none	denim blue	excellent	hard	C, P
logwood	copper	navy blue	excellent	easy	C
logwood	none	blue	moderate	easy	C
PURPLE:					
logwood	alum	purple	moderate	moderate	C
BROWN:					
cutch	none	brown	excellent	easy	C
plum roots	alum	pinkish brown	excellent	moderate	P, W
BLACK:					
oak galls	iron	black	excellent	easy	W
pomegranate	iron	gray	excellent	easy	H
raspberry leaf	iron	gray	excellent	easy	P, W
walnut	iron	gray	excellent	easy	P, W

REFERENCES

1 Baines, Patricia, Linen, *Hand Spinning and Weaving*, B.T. Batsford Ltd., London, 1989

2 Bemiss, Elijah, *The Dyer's Companion*, originally published by Evert Duyckinck, New York, second edition 1815; reprinted by Dover Publications, New York, 1973

Early 19th century American manual for the commercial dyer.

3 Bliss, Anne, *A Handbook of Dyes from Natural Materials*, Charles Scribner's Sons, New York, 1981

A collection of recipes using natural dyes, from various dyers, mostly in North America. Also covers scouring, mercerizing, and mordanting.

4 Bliss, Anne, "Lightfastness", Handwoven, vol. ix, no. 2, March/April 1988, pp. 28-29

5 Blamires, Alcuin, editor, *Woman Defamed and Woman Defended, an Anthology of Medieval Texts*, Clarendon Press, Oxford, 1992

Source for some of the historical quotes.

6 Bolton, Eileen M., *Lichens for Vegetable Dyeing*, originally published by Studio Books, Longacre Press Ltd, 1960; published in United States by Robin & Russ, Handweavers, McMinnville, Oregon, 1972; reprinted by Robin & Russ, Handweavers, 1991

7 Brunello, Franco, *The Art of Dyeing in the History of Mankind*, originally published by Neri Pozza Editore, Vicenza, Italy, 1968, translated by Bernard Hickery and reprinted by Phoenix Dye Works, Cleveland, Ohio, 1973

Discusses the history and use of a large number of dyes. Includes quotes and illustrations from primary sources.

8 Bryan, Nonabah G. and Stella Young, *Navajo Native Dyes, Their Preparation and Use*, originally published U.S. Bureau of Indian Affairs, 1940; reprinted Filter Press, Palmer Lake, Colorado, 1978

Recipes for natural dyes used by the Navajo people.

9 Buchanan, Rita, guest editor, *Dyes from Nature*, Plants & Gardens, Brooklyn Botanic Garden Record, Vol. 46, No. 2, Summer 1990

A collection of articles discussing the current and historical uses of various natural dyes. Very few recipes.

9a Chambers, Wendy, "Arctic Lichen Dyes"

9b Grierson, Su, "Lady's Bedstraw, A Scottish Dyeplant for Wool"

9c Hirota, Seiko, "Traditional Plant Dyes in Japan"

9d Lintaulut, M. Joan, "Kalamkari, Dye Painted Fabrics of Sri Kalahasti"

9e Myers, Diana K., "Dyeing in the Himalayas"

9f Ross, Gary N., "Cochineal, The Bug in the Rug"

9g Skirvin, Susan, "Mayo Indigo"

9h Stralen, Trudy van, "Using Cochineal and Indigo in Dye Combinations"

9i Upton, June, "Blue Dyes from Xanthoria Lichens"

9j Wickens, Hetty, "Weld"

10 Buchanan, Rita, "Shades of Green", Handwoven, vol. xiii, no. 1, January/February 1992, pp. 44-46

Recipe for producing green by overdyeing Osage-orange yellow with indigo blue.

11 Buchanan, Rita, *A Weaver's Garden*, Interweave Press, Loveland, Colorado, 1987

How to grow and use plants for dyes, fibers, soaps, and other fabric-related uses. Also discusses some imported plant dyes.

12 Casselman, Karen Leigh, *Craft of the Dyer: Colour from Plants and Lichens of the Northwest*, University of Toronto Press, Toronto, 1980

Discussion, and some interesting recipes, for a large number of natural dyes.

13 Coeurdoux, *Lettres Edifiantes*, letter of 18 January, 1742, translated and reprinted by Maciver Percival, *The Chintz Book*, William Heinemann Ltd., London, 1923

Although he was writing after the "medieval" era, the process he describes for dyeing Indian cotton is undoubtedly the very old traditional process.

14 Cohen, Amnon, *Economic Life in Ottoman Jerusalem*, Cambridge University Press, Cambridge, England, 1989

Detailed descriptions of important commercial products, including soap, in early 1500's.

15 Crews, Patricia Cox, "The Influence of Mordant on the Lighfastness of Yellow Natural Dyes", Journal of the American Institute for Conservation, vol. 21, no. 2, spring 1982, pp. 43-58

16 Crowfoot, Elisabeth, Frances Pritchard, and Kay Staniland, *Textiles and Clothing, c. 1150 - 1450, Medieval Finds from Excavations in London*, Museum of London, Her Majesty's Stationery Office, London, 1992

Thorough and easy-to-read analysis of archeological textile finds from medieval London. Includes results of chemical analysis to determine which dyes were used on colored fabrics.

17 Davenport, Elsie G., *Your Yarn Dyeing*, Select Books, Tarzana, California, 1953

Recipes for some natural (and synthetic) dyes, with instructions for scouring and mordanting various fibers.

18 Geijer, Agnes, *A History of Textile Art*, Sotheby Parke Bernet Publications, Totowa, New Jersey, 1979

19 Georgievics, Georg von, *The Chemical Technology of Textile Fibers*, translated from the German by Charles Salter; Scott, Greenwood & Son, publisher, London, 1920

A description of "modern" dye techniques and recipes in the early 20th century. Includes instructions and chemistry of Turkey Red.

20 Gervers, Veronica, editor, *Studies in Textile History*, Royal Ontario Museum, Toronto, Canada, 1977

An assortment of articles on various aspects of historical textiles.

20a Lemberg, Mechthild, "The Problem of Brown Wool in Mediaeval Tapestries"

20b Needler, Winifred, "Three Pieces of Unpatterned Linen from Ancient Egypt in the Royal Ontario Museum"

20c Watson, Andrew, "The Rise and Spread of Old World Cotton"

21 Goodwin, Jill, *A Dyer's Manual*, Pelham Books, London, 1982

An advocate of experimentation, very encouraging for beginning dyers. Weak on chemistry and history.

22 Grierson, Su, *The Colour Caldron, the History and Use of Natural Dyes in Scotland*, Mill Books, Perth, Scotland, 1986

An uncommonly well-researched book, containing both historical uses of dyes, and instructions, tested by the author, for modern dyers.

23 Hoffmann, Roald, "Blue as the Sea", *American Scientist*, vol. 78, July-August 1990, pp.308-309

Shellfish purple dye and the Hebrew color *tekhelet*.

24 Indictor, N., R.J. Koestler, and R. Sheryll, "The Detection of Metallic Mordants by Energy Dispersive X-Ray Spectrometry", Journal of the American Institute for Conservation, vol. 24, no. 2, Spring 1985, pp. 104-115

A modern scientific technique for chemical analysis, for use on museum samples of textiles. Describes tests on modern wool samples with known mordants, and 9th - 10th century Persian silks.

25 Irwin, John, and Margaret Hall, *Indian Painted and Printed Fabrics*, Historic Textiles of India at the Calico Museum, vol. 1, Calico Museum, 1971

26 Keene, Derek, and Alexander Rumble, *Survey of Medieval Winchester*, Part 1, Winchester Studies 2, Claredon Press, Oxford, 1985

A detailed examination of the social and economic conditions in one city, based largely on 14th and 15th century records.

27 Kolander, Cheryl, *A Silk Worker's Notebook*, Interweave Press, 1979

Instructions for processing silk, from raising silkworms to finished fabrics. Chapters on history of silk, and on varieties of silkworms.

28 Leggett, William F., *Ancient and Medieval Dyes*, Chemical Publishing Co., Brooklyn, New York, 1944

Interesting history of many medieval dyes.

29 Lesch, Alma, *Vegetable Dyeing*, Watson-Guptill Publications, New York

Modern recipes using plant dyes.

30 Liles, J.N., *The Art and Craft of Natural Dyeing*, Traditional Recipes for Modern Use, University of Tennessee Press, Knoxville, 1990

An excellent how-to reference. Includes many recipes tested by the author for nearly all the major historical dyes, as well as scouring, mordanting, and safety. The emphasis is on cotton, but linen, wool, and silk are also covered. If you only get one book, get this one.

31 McGrath, Judy Waldner, *Dyes from Lichens & Plants*, Van Nostrand Reinhold Ltd, Toronto, 1977

Detailed instructions on dyeing with lichens. The emphasis is on arctic lichens, but the techniques apply to any lichen.

32 Megan ni Laine de Bell Rive, "In Search of Lost Pigments, The Quest for the Pink", *Tournaments Illuminated*, no. 87, summer 1988, pp. 8-9, 13

Following the instructions in a 15th century Italian manuscript to recreate pink paint from madder.

33 Miller, Dorothy, "Dyeing with Indigo", *Handwoven*, vol. xiii, no. 5, November/December 1992, pp. 30-31, 66

A simple recipe using easy-to-obtain ingredients.

34 Mitchell, R.W., "A Monograph Covering the Origin, History and Significance of theTerm CASTILE SOAP, Together with a Discussion of the Properties, Uses, Reputation, Adulteration, and Imitation of the Product; Based upon over 900 Extracts from the Literature of 400 Years", Lockwood Brackett Co., Boston, 1927

This article defines "Castile" soap for truth-in-advertising purposes. It includes many historical references.

35 Nha-Jandria, Gwennis (Lady Gwynydd ni Gelligaer), *Dyestuffs*, Compleat Anachronist

#44, Society for Creative Anachronism, 1989

A brief listing of a large number of dyes available in medieval Europe.

36 O'Connor, Marina, "Experiments in Copper Penny Dyeing", Handwoven, vol. xiii, no. 4, September/October 1992, pp. 68-69

Describes the author's experience with this dye technique, but not the actual recipe .

37 Olney, Loius A., *Textile Chemistry and Dyeing*, American School of Correspondence, Chicago, 1909

A description of "modern" dye techniques at the turn of the century, written by the Head of the Department of Textile Chemistry and Dyeing, Lowell Textile School, Lowell, Mass. Detailed explanations of dye chemistry.

38 Petzel, Florence Eloise, *Textiles of Ancient Mesopotamia*, Persia, and Egypt, Cascade Printing Company, Corvallis, Oregon, 1987

39 Pliny the Elder, *Natural History, A Selection*, translated by John F. Healy, Penguin Books, London, 1991

Excerpts from the famous 1st-century Roman encyclopedia. In the interest of space, only parts of the original 37 books are included; some passages about dyeplants and dye practices are included, and some left out.

40 Polo, Marco, *The Travels of Marco Polo*, translator not listed, J.M. Dent & Sons Ltd, publishers, first printing 1908, current re-printing 1983

The famous account by a late-13th century European traveller in Asia.

41 Rice, Miriam, *Mushrooms for Color*, Mad River Press, Eureka, California, 1980

Contains a detailed chapter on dye chemistry.

42 Schetky, EthelJane McD., guest editor, *Dye Plants & Dyeing*, Plants & Gardens,

Brooklyn Botanic Garden Record, Vol. 20, No. 3, 1964, A collection of articles, covering history and recipes for various natural dyes.

42a "Basic Steps in Mordanting and Dyeing"

42b "Dyes of Ancient Usage"

42c Emmart, Emily W., "Notes on Aztec Dye Plants"

42d Johansson, Lisa, "Recipes from Lappland"

42e Parrott, Allen M., "In the United States"

42f Robertson, William, "Dye Plants in a Scottish Garden"

42g Schetky, EthelJane McD., "The Ageless Art of Dyeing"

42h Shand, Winifred A., "Dyeing Wool in the Outer Hebrides"

42i Sverdrup, Sophie, "Using Plants for Dyes in Norway"

42j "35 Recipes for the Home Dyer"

43 Storey, Joyce, *The Thames and Hudson Manual of Dyes and Fabrics*, Thames and Hudson, London, 1978

Modern commercial methods for textile dyeing and printing. Contains a chapter on historical natural dyes.

44 Stuart, Malcolm, editor, *The Encyclopedia of Herbs and Herbalism*, Crescent Books, New York, 1979

Not totally accurate, but a useful reference for active chemicals and scientific names of many plants.

45 Sunset ("by the editors of Sunset Books and Sunset Magazine") *New Western Garden Book*, Lane Publishing Co., Menlo Park, California, 1979

A standard reference for deciphering the scientific names of commonly available dye plants.

46 Wild, John Peter, "Some Early Silk Finds in Northwest Europe", *Textile Museum Journal*, volume 23, 1984, pp. 17-23

47 Wild, J.P., *Textile Manufacture in the Northern Roman Provinces*, Cambridge at the University Press, 1970

48 Wilson, Kax, *A History of Textiles*, Westview Press, Boulder, Colorado, 1979

49 Windholz, Martha, editor, *The Merck Index*, published by Merck & Co., Rahway, New Jersey, 9th edition, 1976

A standard chemical reference manual.

50 Wipplinger, Michele, "Cotton Colors ... the Natural Way", *Handwoven*, vol. xiv, no. 1, January/February 1993, pp. 74-77

Overview of use of natural dyes on cotton throughout the world.

51 Irwin, Bobbie, “An Ode to Woad”, *Spin-Off*, Summer 1997, Interweave Press, Loveland, Colorado

52 Skirvin, Susan, “Dyeing Yarn with Homegrown Indigo”, *The Seedhead News*, no. 14, Summer 1986, Native Seeds/SEARCH, Tucson, Arizona

53 Van Stralen, Trudy, *Indigo, Madder & Marigold, a portfolio of colors from natural dyes,* Interweave Press, 1993

Good dye and mordant recipes, with a discussion of mordant safety and disposal.

"I have been dyeing with plants for over half a century and realize how little I know .... My bookshelves are lined with a great variety of tomes, all reflecting the experiences and conclusions of their authors. All are different; not one contains every dye plant or every shade or process of dyeing. On reading them it is manifest that the only certain thing about the use of natural dyes is the extreme uncertainty of the results."

Jill Goodwin (21)

Index of Dye Common Names

pastel Woad

peach see Plum bark and leaves

pernambuco Brazilwood

Persian Berries

Persian cochineal Kermes

plum Berries

plum bark and leaves

Polish cochineal St. John's Blood

pomegranate Berries

pomegranate rind

pot marigold Marigold

prickly pear cactus Berries

prickly pear cactus see Cochineal

privet berries see Berries

privet, Egyptian Henna

purple, true or royal Shellfish Purple

quercitron see Oak Galls

raspberry Berries

raspberry leaves

redwood see Brazilwood

Index of Scientific Names

Murex species Shellfish Purple

Nerium tinctorium see Woad

Ochrolechia species Orchil

Oldenlandia umbellata see Madder

Opuntia species Berries

Opuntia species see Cochineal

Origanum vulgare Marjoram

Parmelia fulginosa and *laeteivirens* Orchil

Parmelia species Crottle

Peltigera apthosa and *canina* Crottle

Platysma glaucum Crottle

Polygonium tinctorium see Indigo

Polygonum tinctorium see Woad

Porphirophora hamelii see Kermes

Porphyrophora polonica St. John's Blood

Prunus species Plum bark and leaves

Prunus species Berries

Pseudevernia furfuracea Crottle

Punica granatum Pomegranate Rind

Punica granatum Berries

Xanthoria parietina Crottle

Xanthoria species see Orchil

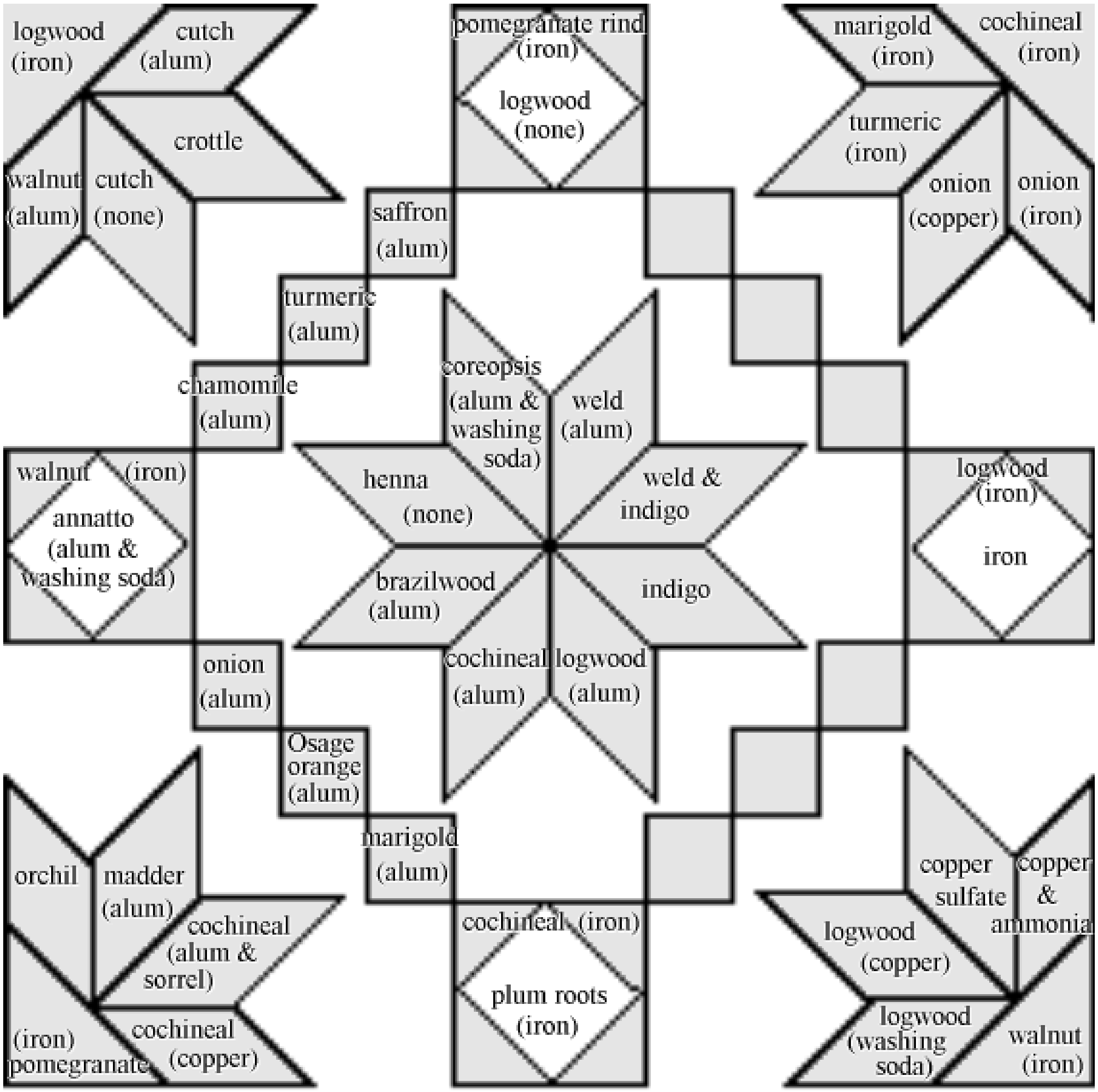
"*Doubtless God showed men how to dye wool with the juice of herbs and the slime of shells? It had escaped Him, when He commanded all things to be created, to specify purple and scarlet sheep!"*

Quintus Septimus Florence Tertullian,

From the Appearance of Women, ii, 10, early 3rd century (5).

Sampler

Sampler woven by Jodi Smith, from wool samples from the research for this book. Tapestry weave.


logwood (iron)
cutch (alum)
crottle
walnut (alum)
cutch (none)
pomegranate rind (iron)
logwood (none)
marigold (iron)
cochineal (iron)
turmeric (iron)
onion (copper)
onion (iron)
saffron (alum)
turmeric (alum)
chamomile (alum)
coreopsis (alum & washing soda)
weld (alum)
henna (none)
weld & indigo
brazilwood (alum)
indigo
cochineal (alum)
logwood (alum)
walnut (iron)
annatto (alum & washing soda)
logwood (iron)
iron
onion (alum)
Osage orange (alum)
marigold (alum)
orchil
madder (alum)
cochineal (alum & sorrel)
(iron) pomegranate
cochineal (copper)
cochineal (iron)
plum roots (iron)
copper sulfate
copper & ammonia
logwood (copper)
logwood (washing soda)
walnut (iron)

Author

Jodi Smith raises goats on a small farm in western Maine, near the White Mountains. Jodi spins, weaves, dyes, knits, and makes goat cheese for her family. She is member of the Down Home Spinners, and a former officer of the Northern Colorado Weavers' Guild. She is a member of the Society for Creative Anachronism, a medieval living-history group. Besides the goats, she has 3 Churro sheep, chickens, heirloom turkeys, and 3 cats on the farm.

Jodi graduated from the California Institute of Technology in 1976, with a degree in Chemical Engineering. Jodi's background in chemical engineering, and her interests in fiber and in medieval life all lead to her work with natural dyes. *Medieval Dyes*, based on her own experimental research, is her first book

Jodi's husband has a job with a real paycheck, but he still finds time to help fix the pasture fences. Their 15-year-old daughter loves playing with the goats, and hates homework and cleaning her room.

Within the Society for Creative Anachronism, Jodi is known as Mistress Drahomira Jaroslavna. She is a member of the Order of the Laurel, and resides in the Province of Malagentia, in the East Kingdom.