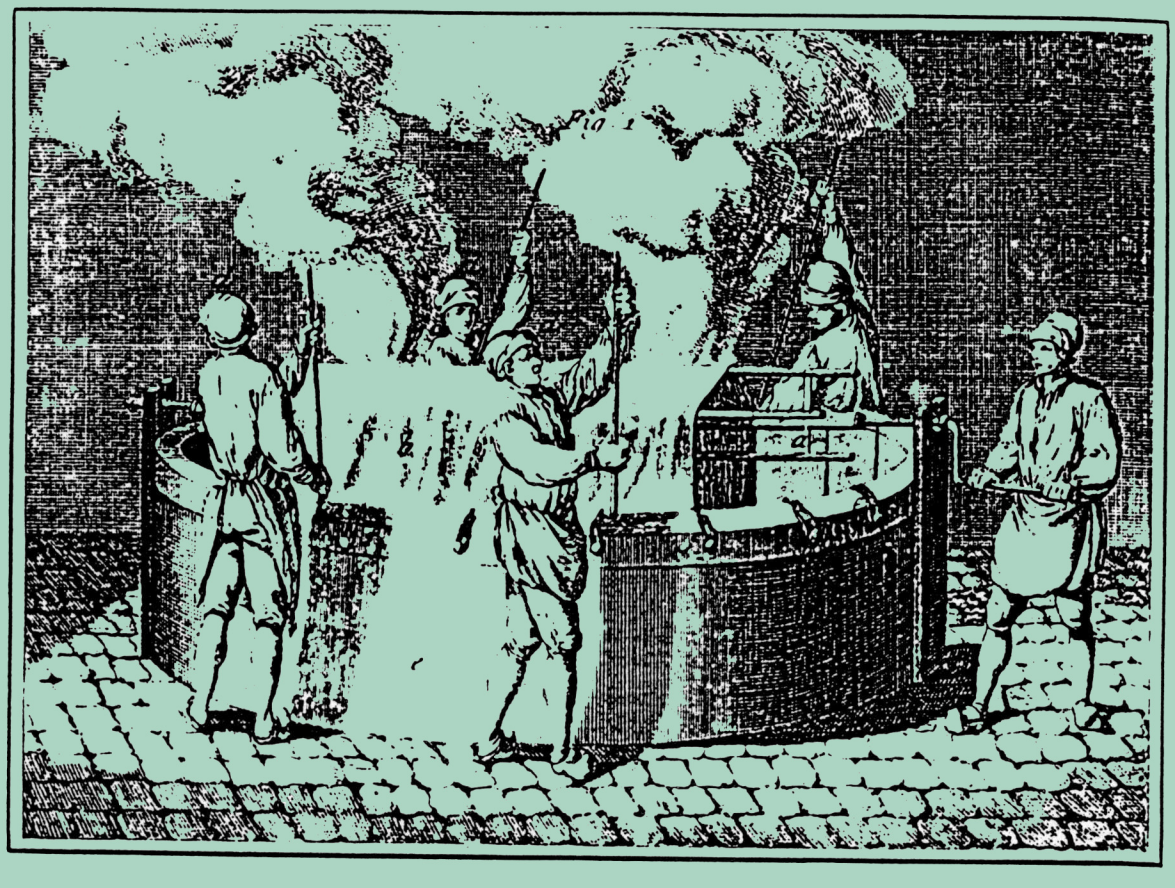
Practical hints on dyeing with natural dyes



Production of comparative dyeings for the identification of dyes on historic textile materials

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Practical hints on dyeing with natural dyes

(Production of comparative dyeings for the identification of dyes on historic textile materials)

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General

Wool was in the past the textile material most commonly used, and for this reason the following practical hints for the production of comparative dyeings refer mainly to wool dyeing.

For the production of dyeings that are intended for use as comparative materials for analytical purposes, small wool hanks weighing 5 grams, or as little as 2 grams, are adequate if only small amounts of natural dyes or dyer's plants are available.

When commercial hank wool is used for dyeing, a thorough wash prior to mordanting or dyeing is not necessary. A rinse in lukewarm water with an addition of a wool detergent is adequate to remove residues of spinning oils.

All dyeing recipes given in the following refer to the dyeing of 100 grams of hank wool.

Prior to dyeing or mordanting, the wool hanks are tied loosely with wool threads at two or more parts to prevent the individual yarns in the hank from becoming entangled during dyeing. The beginning and the end of the hank is tied into one of the tying threads.

When several hanks are to be dyed at the same time, a fairly long stable cord is drawn through all hanks, and the ends of the cord are then tied together. The hanks can then be moved in the dyebath, or lifted out in washing or rinsing, by gripping this loop. This cord can also be used for securing information regarding the dyeing. For instance, if wool is to be dyed with various mordants in the same dyebath, the hanks can be distinguished by one, two, or three knots tied in the cord, and a note is made in the record book to explain what these knots mean.

It is best to use soft water for dyeing. Only a few dyeing recipes prescribe the use of hard water, e.g. those for dyeing madder on iron mordant to obtain violet shades. In such cases, small amounts of powdered chalk are added to the dyebath.

For dyeing 100 grams of wool, the dyebath should contain at least 2.5 liters of water. In the dyer's language, this corresponds to a liquor ratio of 25:1. For mordanting wool, a liquor ratio of 20:1 to 22:1 is adequate.

The wool is always entered in the wet state into the mordanting or dyeing bath to ensure that the liquor is taken up evenly. Wool yarn should never be subjected to sudden changes in temperature. For this reason, the yarn is first placed in a dish with cold water, and warm water is then run slowly into the dish from the water pipe until the water has a temperature of about 40 °C. The yarn can then be entered into the dyebath at roughly the same temperature.

The dyebath must never be heated to a bubbling boil; the maximum temperature is 90 °C. Silk can only withstand dyeing temperatures up to 70 °C. In any case, the most suitable temperature indicated in the dyeing recipe should be observed.

Dyeing methods for natural dyes

(1) Direct dyeing (dyeing without mordant)

This method is suitable for natural dyes that go on to the wool fiber without a mordant, e.g. orseille, unripe, green walnut shells (C.I. Natural Brown 7), turmeric (C.I. Natural Yellow 3), saffron (C.I. Natural Yellow 6), and barberry (wood, bark and roots) (C.I. Natural Yellow 18).

Silk, cotton, and linen can be dyed direct with, for example, orlean (C.I. Natural Orange 4) and with carthamin, the red dye from the flowers of the safflower (Carthamus tinctorius L.) (C.I. Natural Red 26).

(2) Dyeing on mordant

This method is the one most commonly used for natural dyes, because these are mostly mordant dyes, which do not go on to unmordanted fibers.

The mordant most commonly used is alum (potassium aluminum sulfate), often together with cream of tartar (potassium hydrogen tartrate), which promotes even uptake of the dye and produces the desired bluish red in dyeing with madder and cochineal.

The premordanted, moist wool is then entered into the prepared dyebath, which is heated slowly to approx. 90 °C, and dyeing is carried out for at least one hour at this temperature.

(3) One-bath dyeing

In some cases, mordanting and dyeing of the wool can be carried out in one operation. In this case, the mordant is added to the dyebath, and the wool is then entered.

This one-bath method of dyeing is preferred mainly for the dyeing of cochineal (C.I. Natural Red 4) and lac dye (C.I. Natural Red 25) on tin mordant.

(4) Development dyeing

The wool dyed according to Process (1), (2), or (3) can be converted into color lakes by after-treatment with various metal salts, e.g. tin-II-chloride (0.5%), iron-II-sulfate (1%), copper sulfate (1%), or potassium dichromate, usually with a change in shade of the dyeing.

The aftertreatment of the previously dyed wool with the metal salt solutions indicated above is generally carried out for 15-30 minutes at simmering temperature.

(5) Vat dyeing

Natural indigo (C.I. Natural Blue 1) belongs to the few natural vat dyes. These are insoluble dyes that have to be reduced in an alkaline solution before they can be converted into a soluble form and applied to the fibrous material. For this reduction, or vatting, sodium dithionite is used as reducing agent. The dye solution obtained by reduction is known as the "vat". Indigo has a yellow vat, in which the wool is treated for 30 minutes at a temperature at aroung 55 °C. Subsequent reoxidation in the air causes the original blue indigo shade to return.

Special directions for mordanting wool

(1) Alum (potassium aluminum sulfate, $KAl(SO_4)_2 \cdot 12H_2O$)

Alum is the most important mordant for dyeing with natural dyes. Almost all natural mordant dyes can be applied on an alum mordant. Dyes belonging to the class of the hydroxyflavones form yellow to orange color lakes on the fiber, while those belonging to the class of the hydroxyanthraquinones form red color lakes.

Depending on the depth of shade to be dyed, 15 to 25 % of alum is used for mordanting, calculated on the dry wool that is to be dyed. The use of a larger amount of mordant does not increase the depth of shade; it merely makes the wool more ready to take up the dye. An excess or a deficiency of mordant makes the dyed shade duller. For pale shades about 15 % of alum is required, and for very dark shades about 25 %.

Dyeings on an alum mordant can be changed in shade by aftertreatment with metal salts according to the dyeing process (4) Development dyeing (page 4).

Mordanting recipe for 100 grams of commercial hank wool: In an approx. 5-liter, stainless steel (or enamelled) vessel, heat 3 liters of soft water to about 40 °C, and then add 15 or 25 grams of alum, dissolved in a small amount of hot water.
Enter the wool, which has previously been washed in lukewarm water with a wool detergent to remove spinning oils and then rinsed, into the mordant solution. Heat slowly to about 90 °C, turning the wool occasionally to ensure that it takes up the mordant evenly.

Leave the mordant solution for one hour at this temperature, and let the wool cool in this solution. Then take the wool out, press it or centrifuge, and let it dry spread out in the shade, unless it is to be dyed immediately.

(2) Alum and cream of tartar

For mordanting wool, this mixture is used in a ratio of roughly 4:1, e.g. 25 % of alum + 6 % of cream of tartar, or 15 % of alum + 4 % of cream of tartar.
The addition of cream of tartar to the alum mordant brightens the dyed shade, or it reduces the dulling effect of metal mordants. This mixed mordant is used mainly for dyeing reds with madder and galium roots.

In many cases, there is only a very slight difference in shade between a dyeing on an alum mordant and a dyeing on an alum-cream of tartar mordant. On the other hand, when the dyeing is aftertreated with metal salt (development dyeing (4), page 4), the influence on the dyed shade may differ widely.

(3) Chrome mordant (potassium bichromate, $K_2Cr_2O_7$) (5)*

Although potassium bichromate is an excellent mordant for wool, it is so sensitive to light that it may cause uneven dyeings. In order to prevent this, the wool is kept completely immersed in the mordant solution by a glass plate during the process of mordanting, and it is dyed immediately after mordanting.

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* Reference number

Mordanting directions for 100 grams of commercial hank wool: In a 5-liter stainless steel vessel, heat about 3.5 liters of soft water to approx. 40 °C, add a solution of 3.0 grams of potassium bichromate in 100 milliliters of hot water, and stir. Enter the thoroughly wetted wool into the mordant solution. Heat slowly within one hour to about 90 °C, and leave the mordant solution standing for one hour at this temperature. Turn the wool during this time only once or twice. Then let the bath cool down, and wash the wool thoroughly in water at a similar temperature; squeeze the wool carefully to remove the excess water,* and keep it in a closed vessel until the dyebath is ready.

(4) Iron mordant (iron-II-sulfate, $FeSO_4 \cdot 7H_2O$) (5)

The most common method is to dye the wool first at about 90 °C, then remove it from the dyebath, and add 3 grams of iron-II-sulfate and 6 grams of cream of tartar (for 100 grams of wool). Then return the wool to the dyebath, and maintain the bath for half an hour at 90 °C. In order to keep the wool soft and to obtain the correct shade with iron mordant, rinse thoroughly with water.

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* Use rubber gloves

(5) Tin mordant (tin-II-chloride, $SnCl_2 \cdot 2H_2O$) (7)

Mordanting directions for 100 grams of commercial hank wool: Heat 3.3 liters of soft water to about 40 °C, and stir in a solution of 3 grams of cream of tartar and 3 grams of oxalic acid in 100 milliliters of hot water. When this is thoroughly dissolved, stir in a solution of 3 grams of tin-II-chloride in 100 milliliters of hot water. Maintain the mordant solution at about 40 °C, and then enter the thoroughly wetted wool. Heat the bath slowly to 90 °C (within one hour), and keep it at this temperature for 60 to 90 minutes for coarse wool, or for 45 to 60 minutes for fine wool. Lift the wool out of the bath with a glass rod and hold it to drip over the bath. Wash the wool in warm soapy water and then rinse it in warm water.

(6) Copper mordant (copper sulfate, $CuSO_4 \cdot 5H_2O$)

Mordanting directions for 100 grams of commercial hank wool: Dissolve 6 grams of powdered copper sulfate crystals in a little boiling water. Add 3.3 liters of soft water, heat to about 40 °C, and enter the moistened wool. Now raise the temperature within one hour to 90 °C and maintain this temperature for 60 to 90 minutes (for coarse wool) or for 45 to 60 minutes (for fine wool). During this time, turn the wool occasionally. When the mordanting solution has cooled, remove the wool with a glass rod and hold it to drip over the bath. Gently squeeze out the excess water. Then either dye the wool immediately, or keep it damp in a cloth to be dyed the next day, or dry and store it for later.

Conversion tables

Many dyer's books issued in the U.S. or the U.K. still use historical units of weight and volume. Factors for converting these units into the metric system are given below.

Weight

1 Ounce (oz.)	= 28.35	grams
1 Pound (lb.)	= 453	grams
1 Grain (weight) (gr.wt.)	= 35.48	milligrams

Volume

1 Fluid ounce (fl.oz.)	= 30	milliliters
1 British gallon (gal./Brit.) (or Imperial gallon)	= 4.55	liters
1 Imperial quart (qt./Brit.)	= 1.14	liters
1 British cup (= 10 fluid ounces)	= 300	milliliters
1 European coffee spoon (tsp.) (= 1/6 fluid ounce)	= 5	milliliters
1 European soup spoon (tbsp.)	= 15	milliliters

Temperatures

Degrees Centigrade (°C) ⟷ Degrees Fahrenheit (°F)					
(°C) ⟷	(°F)	(°C) ⟷	(°F)	(°C) ⟷	(°F)
0	32	40	104	80	176
10	50	50	122	90	194
20	68	60	140	100	212
30	86	70	158		

DYEING RECIPES

Dyer's rocket

Dyer's rocket or weld (bot.: Reseda luteola L.) is one of the oldest textile dyes known to man. The ancient Romans used it on a large scale for dyeing. In the Middle Ages, it was planted and used in the whole of Central and Western Europe.

Generic name in the Color Index*: C.I. Natural Yellow 2

Recipe 1

Preparing the dyeing liquor

Cut 300 grams of dried weld over a cotton cloth with scissors or shears into fine pieces, taking care not to lose the seeds, which contain a large amount of dye. Then wrap the whole loosely in the cloth and tie it with a cotton thread. Soak the bundle overnight in 3 liters of water. The next day, heat the infusion to the boil and let it draw for 45 minutes at about 80 °C. Then remove the bundle with the weld out of the dyeing liquor and make up with water to 3 liters.

Lemon yellow with weld on alum mordant

Bring the dyebath to 35-40 °C. Wet thoroughly under the water tap 100 grams of wool hanks (20 skeins of 5 grams each, previously tied with a cord, see page 2), which have been mordanted with 25 % of alum and 6 % of cream of tartar (see page 6) and then enter the material into the dyeing liquor. Heat the liquor to about 80 °C and leave it standing at this temperature for one hour. Let the wool cool in the dyeing liquor, rinse it thoroughly with water, and let it dry in the air.

Literature: 11, 18

* The "Color Index" (C.I.), a multi-volume English handbook (21), lists the names, commercial denominations, constitution and chemical properties of the dyes. Each dye has a "generic name" and if the constitution is known, a "constitution number".

Turmeric

Turmeric or yellow root (bot.: Curcuma longa L., rhizoma) is domiciled in India and China. It is used not only as a dye for wool and silk, but also as a spice for curry powder.

C.I. Natural Yellow 3

Recipe 2

Preparing the dyeing liquor

Wrap 45 grams of turmeric powder loosely in a cotton cloth, and soak overnight in 3 liters of water. The next day, bring the bath slowly to 90 °C, and let it draw for one hour at this temperature. Press the bundle containing the turmeric powder frequently with a spoon to help the dye to dissolve.
Then remove the bundle from the bath, and press as much dye as possible out of the bundle. Then make up the dyebath with water to 3 liters.

Yellow with turmeric on alum mordant

Wet thoroughly under the water tap 100 grams of wool hanks (20 skeins of 5 grams each, previously tied together with a cord (see page 2), which have been mordanted with 25 % of alum and 6 % of cream of tartar (see page 6), and then enter into the prepared dyeing liquor at 35-40 °C. Elevate the temperature to 80 °C, and leave standing for one hour.
When the dyeing liquor has cooled, remove the wool, rinse it thoroughly with water containing a little wool detergent, and let it dry in the air.

Literature: 18

Safflower yellow

The dried florets of dyer's thistle (safflower) (bot.: Carthamus tinctorius L.), which is domiciled in the whole area reaching from Central Asia to the Mediterranean region, were used in the past as dye for silk, cotton and wool. Safflower contains two dyes, viz. the safflower yellow which dissolves in cold water and dyes wool on an alum mordant to a golden yellow, and the red dye carthamin, which dyes silk, cotton and linen direct without a mordant.

C.I. Natural Yellow 5

Recipe 3

Preparing the dyeing liquor

Wrap 100 grams of safflower loosely in a cotton cloth, and soak for 3-4 hours in 3 liters of water. Then bring the bath to about 90 °C, and let it draw for 45 minutes at about 80 °C. Now remove the bundle and allow the bath to cool. The cotton cloth is then dyed in a red shade by the red direct dye carthamin.

Golden yellow with safflower yellow on alum mordant

Make up the dyeing liquor with water to 3 liters and bring it to 35-40 °C. Wet thoroughly under the water tap 100 grams of wool hanks (20 skeins of 5 grams each, previously tied together with a cord, see page 2), which have been mordanted with 25 % of alum and 6 % of cream of tartar (see page 6), and enter into the prepared dyeing liquor. Heat the liquor slowly to 90 °C, and let the wool draw for 45 minutes at 80 °C.
When the liquor has cooled, remove the wool, rinse it thoroughly with water, and let it dry in the air.

Literature: 18

Saffron

Saffron is the dye obtained from the dried stigmas of Crocus sativus L., which is domiciled in the Middle and Near East, and was later cultivated in Southern France, Austria, Spain, Switzerland, and North Africa. Saffron is one of the oldest dyes used by man, and it has been mentioned by Homer and Virgil. It is used not only for dyeing silk, but also for dyeing foods and as a spice.

C.I. Natural Yellow 6

Recipe 4

Preparing the dyeing liquor

Wrap 5 grams of saffron in a loosely woven cotton cloth, and soak the bundle overnight in 600 milliliters of water. The next day, bring the water to the boil and let the dyebath draw for 30 minutes at about 70 °C. Then remove the bundle from the bath, and make up if necessary with water to 600 milliliters.

Brilliant yellow with saffron on unmordanted wool

Wet thoroughly under the water tap at about 40 °C 20 grams of unmordanted wool hanks (10 skeins of 2 grams each, previously tied together with a cord, see page 2), and enter into the dyeing liquor. Heat the liquor to 80 °C and let it draw at this temperature for about 30 minutes.
When the bath has cooled, remove the wool, rinse it thoroughly with water, and let it dry in the air.

Literature: 18

Chinese yellow pods

These yellow pods from the Chinese pagoda-tree (bot.: Sophora japonica L.) were used in China in the past for dyeing silk on alum mordant for mandarins' robes. In Japan, this dye was used exclusively for dyeing imperial robes.

C.I. Natural Yellow 6

(The Color Index lists the Chinese yellow pods under the same generic name as saffron, although the two contain completely different natural dyes.)

Recipe 5

Preparing the dyeing liquor

Soak 200 grams of ground Chinese yellow pods overnight in 3 liters of water. The next day, let the infusion draw for 45 minutes at about 80 °C, and then filter through a cotton cloth. If necessary, make up the filtrate to 3 liters again.

Yellow with Chinese yellow pods on alum mordant

Bring the prepared dyeing liquor to about 40 °C. Enter 100 grams of wool hanks (20 skeins of 5 grams each, previously tied together with a cord, see page 2), which have been mordanted with 25 % of alum and 6 % of cream of tartar (see page 6), into the liquor and heat slowly to 80 °C. Let it draw for one hour at this temperature. Then allow the wool in the dyeing liquor to cool. Remove the wool, rinse it thoroughly with water, and let it dry in the air.

Literature: No literature (my own recipe)

Osage orange

Osage orange trees (bot.: Maclura pomifera) grow in Southwestern U.S. Extracts of the wood were used by the Red Indians in these regions in the 19th century for dyeing before the introduction of the synthetic dyes. The dyeing properties are similar to those of old fustic (bot.: Chlorophora tinctoria GAUD.). Osage orange wood was also marketed in the U.S. as an extract.

C.I. Natural Yellow 8

Recipe 6

Preparing the dyeing liquor

Soak 150 grams of ground osage orange wood overnight in 3 liters of water. The next day, heat for 45 minutes at about 80 °C, and filter the concoction through a cotton cloth. Make up the cold filtrate, if necessary, with water to 3 liters again.

Yellow with osage orange on alum mordant

Heat the dyeing liquor to about 40 °C. Enter 100 grams of wool hanks (20 skeins of 5 grams each, previously tied together with a cord, see page 2), which have been mordanted with 25 % of alum and 6 % of cream of tartar (see page 6), into the liquor and heat slowly to 80 °C. Let it draw at this temperature for one hour. Then let the wool in the liquor cool, remove it, and rinse it thoroughly with water. Finally, let the wool dry in the air.

Literature: 1

Quercitron bark

Quercitron is obtained from the inner bark of the black oak (bot.: Quercus velutina LAM.), which is indigenous in Pennsylvania, Georgia, and Carolina. 'Flavin yellowish', a dye that was of great commercial importance before the advent of the synthetic dyes, was obtained from this bark by extraction with steam.

C.I. Natural Yellow 10

Recipe 7

Preparing the dyeing liquor

Boil 400 grams of quercitron bark (cut into small pieces) in 3 liters of water for 60-90 minutes. Then filter through a cotton cloth and allow it to cool.

Yellow with quercitron and alum mordant

Enter 100 grams of moistened wool (20 skeins of 5 grams each, previously tied together with a cord, see page 2), which has been mordanted with 25 % of alum and 6 % of cream of tartar (see page 6), into the dyeing liquor at about 40 °C, and dye for one hour at about 90 °C. After cooling, take the wool out of the bath, rinse it with water and let it dry in the air.

Literature: 7

Old fustic

This dye is obtained from the wood of the fustic tree (Chlorophora tinctoria GAUD.), a tree of the mulberry family that grows in the tropical forests of America and East India. In the past, the best quality came from Cuba and was known as 'Cuba Old Fustic'.

C.I. Natural Yellow 11

Recipe 8

Preparing the dyeing liquor

Wrap 100 grams of old fustic chips in a cotton cloth and soak in 3 liters of water for 24 hours. Then bring to the simmer and let it draw for 45 minutes at about 80 °C. Remove the old fustic bundle from the liquor, and make up with water to 3 liters.

Golden yellow with old fustic on alum mordant

Enter 100 grams of moistened wool hanks (20 skeins of 5 grams each, previously tied together with a cord, see page 2), which have been mordanted with 25 % of alum and 6 % of cream of tartar (see page 6), into the dyebath at about 40 °C and dye for 30 minutes at about 90 °C. After cooling, remove the wool from the liquor, rinse it until the rinse water runs off clear, and dry it in the air.

Literature: 18

Dyer's buckthorn

Unripe, dried berries of various rhamnus species

Rhamnus cathartica L.	(German berries)
Rhamnus oleoides L.	(Persian berries)
Rhamnus saxatilis L.	(Hungarian berries)
Rhamnus infectoria L.	(French berries)
Rhamnus alaternus L.	(Turkish berries)
Rhamnus graecus L., Rhamnus amygdalinus L.	(Greek berries)
Rhamnus caroliniana L.	(American berries)

C.I. Natural Yellow 13

Recipe 9

Preparing the dyeing liquor

Grind 200 grams of dyer's buckthorn (Rhamnus cathartica L., fructi immaturi siccati) in a cross-beater mill, or pulverize it in a mortar, and soak for 3 hours covered with water. Then make up with water to 3 liters, boil for 45 minutes and filter through a cotton cloth.

Golden yellow with dyer's buckthorn on alum

If necessary, make up the filtrate with water to 3 liters, and bring to 40 °C. Enter 100 grams of moistened wool hanks (20 skeins of 5 grams each, previously tied together with a cord, see page 2), which have been mordanted with 25 % of alum and 6 % of cream of tartar (see page 6). Dye for one hour at 70-80 °C, and then heat the dyeing liquor just once to the boil, because otherwise the liquor will not become clear. After cooling, remove the wool from the liquor, rinse it thoroughly with water and dry it in the air.

Literature: 19

Barberry

The yellow dye barberry, the only basic natural dye, is obtained mainly from the bark and roots of various barberry shrubs, e.g. Berberis vulgaris L. It was used in the past on a limited scale for dyeing silk and leather.

C.I. Natural Yellow 18

Recipe 10

Preparing the dyeing liquor

Wrap 300 grams of disintegrated barberry bark (Berberis vulgaris L., cortex, concisus) loosely in a cotton cloth, and soak in 3 liters of water for at least 3 days to soften the wood. Then bring the water with the barberry to the simmer, and let it draw for 2 hours at 90 °C. Put a lid on the vessel to prevent excessive evaporation of water. Then take the bundle with the barberry out of the liquor, add 100 milliliters of acetic acid conc. and 100 grams of sodium sulfate, and make up with water to 3 liters.

Brilliant yellow with barberry on unmordanted wool

Enter 100 grams of wool hanks (20 skeins of 5 grams each, previously tied together with a cord, see page 2), moistened with water, into the dyeing liquor at 40 °C and dye for 40 minutes at 80-90 °C. Then let the wool cool in the dyeing liquor, rinse it thoroughly with water and dry it in the air.

Literature: 7, 18

Kamala

Orange-red powder found on capsules on the lower side of the leaves of Mallotus philippinensis MUELL.AEG., a shrub that is indigenous in India, Burmah and Ceylon.

C.I. Natural Orange 2

Recipe 11

Phadke (17) informs us that the East Indians used kamala to dye silk in the district of Thana, north of Bombay, in the following manner:

Preparing the dyeing liquor

Dissolve 30 grams of kamala and 120 grams of soda in 2500 milliliters of water at 90 °C.

Golden yellow with kamala on alum-mordanted silk

Enter 100 grams of bleached silk, which has previously been wetted thoroughly with water, into the hot solution. Maintain the temperature at 90 °C, and after 15 minutes add 30 grams of pulverized alum to the liquor. After another 15 minutes at constant temperature, cool the bath, wash the silk thoroughly with water and dry it in the air.

Literature: 17

Orlean

Orlean is contained in the red, fleshy skin of the seed of the rukus shrub, Bixa orellana L., which is cultivated in Central and South America and on the Antilles. It was used in the past for dyeing wool, cotton and silk, and is still used today as a food dye for coloring butter, margarine and cheese.

C.I. Natural Orange 4

Recipe 12

Preparing the dyeing liquor

Wrap 100 grams of orlean seeds in a cotton cloth and beat the bundle with a hammer to disintegrate the seeds. Then soak the bundle overnight in 3 liters of water containing 45 grams of soda. The next day, boil for one hour, remove the bundle with the orlean seeds from the liquor, and make up with water to 3 liters again.

Orange with orlean on alum mordant

Enter 100 grams of wool (20 skeins of 5 grams each, previously tied together with a cord, see page 2), which has been mordanted with 25 % of alum and 6 % of cream of tartar (see page 6), after moistening with water, into the dyeing liquor at about 40 °C. Heat slowly to 90 °C, and dye for 45 minutes at this temperature. After cooling, remove the wool from the dyebath, rinse it thoroughly and let it dry in the air.

Literature: 18

Henna

Dried and pulverized leaves of the henna shrub, Lawsonia inermis, L., which is indigenous in Africa, Asia, and North Australia. It was used in Ancient Egypt for dyeing hair and finger-nails.

C.I. Natural Orange 6

Recipe 13

Preparing the dyeing liquor

Soak 250 grams of henna powder, wrapped in a cotton cloth, overnight in 3 liters of water. The next day, bring the water to the boil, and let it draw for one hour at about 80 °C. Remove the bundle from the bath, and make up again with water to 3 liters.

Orange-brown with henna on unmordanted wool

Enter 100 grams of wool hanks (20 skeins of 5 grams each, previously tied together with a cord, see page 2), thoroughly wetted with water, into the dyeing liquor at about 40 °C. Heat slowly to 90 °C, and let it draw at this temperature for 45 minutes. After cooling, remove the wool from the bath, rinse it thoroughly with water and let it dry in the air.

Literature: 18

Cochineal

Cochineal is a red dye obtained from the cochineal insect Dactylopius coccus COSTA, which was originally found on cactus plants in Central and South America. The dye was known to the Aztecs, and it was used in Mexico long before the Spaniards conquered the country in the 16th century. Around 1525, the Spaniards brought cochineal to Europe, where it gradually replaced the weaker dye kermes, the red dye made from the dried bodies of the females of the scale insect that feeds on oak trees 'Kermes vermilio (PLANCH.) TARG.', which had been used since antiquity to dye reds.

C.I. Natural Red 4

Recipe 14

Preparing the dyeing liquor

Wrap 30 grams of cochineal loosely in a cotton cloth, and soak the bundle overnight in 3 liters of water. The next day, heat the infusion and let it simmer for 15 minutes. Then take the cotton cloth with the cochineal out of the bath and let it cool. Make up the dyeing liquor with water to 3 liters.

Crimson red with cochineal on alum-mordanted wool

Enter 100 grams of wool (20 skeins of 5 grams each, previously tied together with a cord, see page 2), which has been mordanted with 25 % of alum and 6 % of cream of tartar (see page 6), thoroughly wetted with water, into the dyebath at about 40 °C. Heat slowly to about 90 °C and leave standing for one hour at this temperature. After cooling the dyeing liquor, remove the wool, rinse it and let it dry in the air.

Literature: 18

Recipe 15

Scarlet red with cochineal, tin salt, and cream of tartar

Prepare the dyeing liquor as for Recipe 14. Enter 100 grams of unmordanted wool (20 skeins of 5 grams each, previously tied together with a cord, see page 2), thoroughly wetted with water, into the dyeing liquor at about 40 °C. Heat slowly to 90 °C, and let the wool draw for 45 minutes at this temperature. Remove the wool from the dyeing liquor and place it at one side. Dissolve 3 grams of tin-II-chloride and 5 grams of cream of tartar in 100 milliliters of water, and add the solution to the dyebath, with stirring. Enter the wool into the bath again, and let it draw for 30 minutes at 80 °C. When the dyebath has cooled, rinse the wool first with a little wool detergent or soap, and then with plain water.

Literature: 18

Notes on Recipes 14 and 15

After dyeing, the cochineal dyebaths still contain adequate dye for a second or even a third dyeing. The depth of shade, however, decreases steadily. We could call this the second or third exhaust dyeing.

Madder

Madder (or more correctly, madder root) (bot.: Rubia tinctorum L., radix) is one of the oldest known dyes. The ancient Egyptians used it for dyeing textiles. Pliny the Elder informs us that madder was cultivated in the neighbourhood of Rome in the 1st century A.D. In the Middle Ages, madder was cultivated on a large scale in France and Holland.

The dye is found beneath the outer skin of the root of the madder plant. It takes about three years for the madder plant to collect sufficient dye in its roots to be suitable for dyeing.

Madder roots are available commercially in small pieces and in the powder form. Before use, these pieces should be disintegrated with a cross-beater mill (or a coffee mill).

In dyeing with madder, the temperature must not be too high or the dyeing time must not be too long, because this would impair the brilliance of the red, and the result would be brown-red or even brown dyeings. It is always advisable to soak the madder overnight in water before use.

C.I. Natural Red 8

Recipe 16

Preparing the dyeing liquor

Wrap 100 grams of disintegrated or pulverized madder root loosely in a cotton cloth, and soak the bundle for 12 hours in 6 liters of water. Bring the water very slowly (within one hour) to the simmer; let it simmer for 10 minutes, and then remove the vessel from the heating plate. Take out the bundle with the madder, and make up the dyebath with water to 6 liters.

Red with madder on alum mordant

Wet thoroughly with water from the water tap 100 grams of wool (20 skeins of 5 grams each, previously tied together with a cord, see page 2), mordanted with 25 % of alum and 6 % of cream of tartar (see page 6), and then squeeze the water out. Enter the wool into the prepared dyeing liquor at 40 °C, and dye for 30 minutes at 70-80 °C. Remove the wool from the dyebath after cooling, rinse it thoroughly and let it dry in the air. A more brilliant dyeing is obtained when the same amount of wheat bran as of madder is added to the dyeing liquor.

Literature: 18, 19

Recipe 17

Orange-red with madder on alum and tin mordant

Aftertreat 100 grams of the red madder dyeing obtained with Recipe 16 on an alum and cream of tartar mordant with a solution of 5 grams of tin-II-chloride in 3 liters of water for 15 minutes at 90 °C. The result is an orange-red madder dyeing on alum and tin mordant.

Literature: 18

How to dye violet shades with madder on an iron mordant

In Oriental carpets of the last century dyed in violet shades, we can usually identify almost exclusively alizarin and only a very little purpurin (the second most important dye obtained from madder), and iron and calcium as mordants. We must, therefore, also produce madder dyeings of this type as reference material.

When we dye madder on wool that has been mordanted with iron salts, we obtain brown shades. According to Rosenstiehl (12, 13), the addition of carefully metered amounts of calcium acetate causes mainly formation of the alizarin lakes on the fiber in dyeing with madder, and the iron-calcium lake is in this case violet. A copy of the literature reference 13 is presented on the following two pages.

(Dingler's polytechnisches Journal 221, 167-69

Ueber die Correctur des Wassers für das Färben mit den Krappfarbstoffen; von J. Rosenstiehl. (1875)

(1) Es ist unter den Fachleuten eine bekannte Thatsache, daß die wirkliche Ausgiebigkeit eines Farbstoffes immer größer ist, als die im Kleinen angestellten Färbeversuche angeben. Bei letztern arbeitet man nur mit 1l, beim Färben im Großen mit 600 bis 800l Wasser; die kleinere Menge Wasser gibt ihren natürlichen Kohlensäuregehalt beim Erwärmen in unverhältnißmäßig kurzer Zeit ab, die größere Menge Wasser dagegen hält einen Theil ihres Kohlensäuregehaltes während der ganzen Dauer der Färbung zurück. Die frühern Untersuchungen Rosenstiehl's (1874 214 485. 1875 216 447) haben festgestellt, daß Alizarin, wenn es die Beizen vollständig sättigen soll, einen bestimmten Kalkgehalt des Färbebades voraussetzt, daß Purpurin einen solchen Kalkgehalt erträgt, aber nicht absolut verlangt, daß mit Pseudopurpurin nur in reinem destillirtem Wasser und auch dann nur unsolide, wenig haltbare Nüancen gefärbt werden können. Aus denselben Versuchen geht ferner hervor, daß der Kalklack des Alizarins durch freie Kohlensäure leicht, der des Purpurins schwierig und der des Pseudopurpurins fast gar nicht zerlegt wird; aber die Bildung der beiden letztern Kalklacke wird durch die Anwesenheit der Kohlensäure wesentlich verzögert. In diesen Verhältnissen ist nach der neuesten Arbeit Rosenstiehl's (Bulletin de Mulhouse, 1876 S. 112) der Grund für die Differenz zwischen der Färberei im Kleinen und der im Großen — und zusammenhängend damit auch die Erklärung für die weitere, ebenso bekannte, bis jetzt ebenso wenig enträthselte Thatsache zu suchen, daß es nicht möglich ist, in einem und demselben Bad zwei auf einander folgende Färbungen vorzunehmen, auch nicht wenn man gleichzeitig mit dem Farbstoff das zutreffende Quantum Kreide zusetzt. Die in der Flotte zurück gebliebene Menge Kohlensäure reicht nicht mehr aus, um den zugefügten kohlensauren Kalk für die active Theilnahme an der Färbung in Lösung überzuführen; sie reicht auch nicht aus, um die für das Färberesultat ungünstigen Kalklacke zu zersetzen, beziehungsweise deren Bildung zu verhindern. Es ist erinnerlich, daß Verfasser, von diesen Ideen geleitet, längere Zeit für seine Laboratoriumsversuche sich einer Lösung von doppeltkohlensaurem Natron mit Vortheil bedient hat, um das Wasser seiner Farbflotten im Kleinen zu corrigiren. Die Unbeständigkeit dieser Verbindung hat ihn jedoch später veranlaßt, die Kohlensäure in Form eines Kohlensäurestromes in das Farbbad einzuführen. Von nun an waren seine Versuche im Kleinen vollkommen in Uebereinstimmung mit den Färbungen im Großen, das Bad erhielt sich auffallend klar, und es resultirte eine Ersparniß an Farbmaterial bis zu 20 Proc.!

(2) Rosenstiehl hat auch diese Methode wieder verlassen, weil deren Ausführung im Großen nicht so leicht sich bewerkstelligen läßt. Er verwendet jetzt zu seinen Versuchen eine Lösung von essigsaurem Kalk. Vermöge ihrer sauren Natur sind die Krappfarbstoffe, die natürlichen sowohl als die künstlichen, im Stande, lösliche Kalksalze, wie essigsauren, salzsauren, salpetersauren Kalk, in der Siedhitze zu zerlegen, so daß in der ursprünglich neutralen Flüssigkeit die freien Säuren sich nachweisen lassen. Das Auftreten freier Salzsäure oder Salpetersäure in einer Farbflotte ist immerhin gefährlich; freie Essigsäure schadet in keiner Weise, weshalb die Anwendung des essigsauren Salzes allein für die Praxis zu berücksichtigen ist. Die Wirkung desselben ist bei Anwesenheit eines mordancirten Stoffes, also unter den Verhältnissen, wie sie gerade die Färberei mit sich bringt, eine noch viel durchschlagendere, sofern der Kalk sogleich Gelegenheit findet, mit dem Farbstoff und der Basis des Mordant einen jener für die Färberei mit den Krappfarbstoffen so

[illegible] (vgl. 1875 216 447) wird genau

ständiger wird das Bad ausgezogen bei Anwendung von 2, weniger vollständig bei Anwendung von 3 Aeq. Kalksalz. Auch das Purpurin färbt die Mordants leicht bei Gegenwart von essigsaurem Kalk; zwei Aequivalente des letztern auf 1 Aeq. Purpurin liefern sehr gute Färberesultate. Sogar das Pseudopurpurin verträgt einen Zusatz dieses Salzes, wenn auch im Ueberschuß zugefügt; während des Färbens geht es theilweise in Purpurin über. Schließlich folgt hieraus und ist durch die Versuche bestätigt, daß auch die Krapperträcte und die künstlichen Alizarine für Roth und für Violett bei Gegenwart von 2 Aeq. essigsaurem Kalk leicht die Mordants sättigen; das Farbbad wird vollkommen ausgezogen und ist zuletzt viel klarer, als wenn man mit Kohlensäure operirt.

[1] Es ist zu bemerken, daß Verfasser für seine Laboratoriumsversuche sich einer eigenen Miniaturfärbstande bediente, um den Verhältnissen der Fabrikation im Großen möglichst nahe zu kommen, namentlich in Ansehung der nöthigen Wassermenge. Dieselbe wurde ferner nicht, wie sonst üblich, mit frei ausströmendem Dampf, sondern mit geschlossenen Dampfröhren erwärmt. Es soll damit bezweckt werden (und diese Anordnung ist sicherlich die richtige), daß die Wirkung der Flotte, wenn sie auf den Höhepunkt ihrer Temperatur angekommen ist, nachdem sie schon einen großen Theil des Farbstoffes an die bedruckten Stoffe abgetreten hat, nicht eine weitere Abschwächung durch fortgesetzte Vermehrung des Condensationswassers erfahre — gerade in der Zeit, in welcher die möglichst vollständige Erschöpfung des Bades vor sich gehen soll. Die Versuche wurden mit 2m langen Abschnitten, unter Anwendung von 1½ bis 2l Wasser pro Meter, ausgeführt.

(3) Rosenstiehl verwendet nun den essigsauren Kalk bei seinen Färbeversuchen in folgender Weise. Das Wasser, welches ihm zu Gebote steht, ist das der Doller.* Dasselbe enthält 50mg (1 Milligrammäquivalent) kohlensauren Kalk in 1l; diesen führt er zunächst in essigsauren Kalk über durch Hinzufügen von 10cc einer Zehntelnormaleisigsäure (im Liter 6g $HC_2H_3O_2$, oder 15cc,3 Essigsäure von 1,045 spec. Gew.). Der Gehalt von 1l Flußwasser an essigsaurem Kalk ist jetzt äquivalent mit 0g,240 Alizarin oder mit 0g,256 Purpurin. Um in dem Färbebad das günstigere Verhältniß von 2 Aeq. Kalksalz auf 1 Aeq. Alizarin oder Purpurin herzustellen, werden noch weitere 10cc einer Zehntellösung von essigsaurem Kalk zugegeben. Diese Zehntellösung wird erhalten durch Vermischen von 41g,5 einer Lösung von essigsaurem Kalk, deren spec. Gew. 1,115 ist, mit 6g,1 Essigsäure vom spec. Gew. 1,045 und Auffüllen des Ganzen mit Wasser bis zu 1l. Die Flüssigkeit enthält somit einen Ueberschuß an Essigsäure, welcher beim Färben nicht schadet, sich vielmehr bei einer Reihe von Versuchen als vortheilhaft erwiesen hat.

* A river at Muhlhouse (Alsace)

Mit dieser Correctur des Wassers erhielt Rosenstiehl beim Färben im Kleinen Resultate, welche mit den beim Färben im Großen erhaltenen in möglichster Uebereinstimmung waren. Das Verfahren bietet aber außerdem den großen Vortheil, daß man ohne allen Anstand mehrere Färbungen hinter einander in demselben Bad, ohne zu leeren, ausführen kann, indem man nur für jede neue Färbung das entsprechende Farbmaterial und je auf 1 Aeq. des letzteren 1 Aeq. essigsauren Kalk hinzuzufügen hat, d. h. es bietet den großen Vortheil, daß es erlaubt, mit einem Ueberschuß von Farbmaterial bei niedrigerer Temperatur und in kürzerer Zeit zu färben, weil man eben nicht mehr genöthigt ist, die Flotte bei jedem Färberposten gänzlich zu erschöpfen. Gleichzeitig erhält das in manchen Fabriken schon längere Zeit übliche Verfahren, das Wasser der Farbflotten mit Essigsäure zu corrigiren, durch Rosenstiehl's Studien eine nachträgliche Bestätigung und theoretische Beleuchtung. Dasselbe erweist sich hiernach als ganz rationell und allgemein durchführbar, auch für Wasser, welches außer kohlensaurem Kalk noch Schwefelsäure- oder Salzsäureverbindungen enthält. In diesem Fall wird Zusatz von essigsaurem Kalk oder auch von essigsaurem Natron das bisherige Verfahren ergänzen. Doch ist letzteres Salz mit großer Vorsicht zu verwenden; denn sobald es in größerer Menge zugefügt wird, als die Umsetzung jener Schwefelsäure und Salzsäureverbindungen erfordert,

Alkanet

The genuine alkanet is obtained from the roots of the alkanna plant (bot.: Alkanna tinctoria TAUSCH.) that grows in North Africa, East India, and the Oriental countries. Alkanet has been used since antiquity as a wool dye. As Greek and Egyptian women painted their cheeks with alkanet-fat preparations, alkanet was also known as a root for make-ups.

C.I. Natural Red 20

Recipe 18

Preparing the dyeing liquor

Chop 100 grams of alkanet roots into small pieces, and pour 300 milliliters of isopropanol and 1 milliliter of a dishwasher preparation over it. Leave the whole lying for 3 hours (or overnight); then filter through a cotton cloth and wash with about 100 milliliters of isopropanol. Pour the filtrate into 2500 milliliters of condensed water at about 50 °C containing 3 milliliters of a dishwasher preparation.

Violet with alkanna on wool mordanted with alum and cream of tartar

Enter 100 grams of wool (20 skeins of 5 grams each, previously tied together with a cord, see page 2), mordanted with 25 % of alum and 6 % of cream of tartar (see page 6), and thoroughly wet it with water containing an addition of a dishwasher preparation, into the prepared dyeing liquor. Dye for 45 minutes at about 80 °C; let the dyeing liquor cool, remove the wool and rinse it thoroughly with warm water with addition of a dishwasher preparation. Then dry the wool in the air.

Literature: My own, unpublished method

Red sanderswood

Red sanderswood is obtained from the wood of the Pterocarpus santalinus L. and P. indicus L., which grow in East India, Ceylon, Timor, and on the Coromandel coast.

C.I. Natural Red 22

Recipe 19

Preparing the dyeing liquor

Pour 300 milliliters of methanol containing 2 milliliters of a dishwasher preparation over 200 grams of coarsely ground red sanderswood, and leave standing for at least 3 hours. Then filter through a cotton cloth and wash with 100 milliliters of methanol. Pour the filtrate into 2500 milliliters of water at 50 °C containing 2 milliliters of a dishwasher preparation.

Red-orange with sanderswood on wool mordanted with alum and cream of tartar

Enter 100 grams of wool (20 skeins of 5 grams each, previously tied together with a cord, see page 2), which has been mordanted with 25 % of alum and 6 % of cream of tartar (see page 6), and thoroughly wetted with water containing a little dishwasher preparation, into the prepared dyeing liquor. Then adjust the pH of the dyeing liquor to 3-4 by adding 25 milliliters of 30% acetic acid, and dye for one hour at 90 °C. After this, allow the dyeing liquor to cool, remove the wool from the bath and rinse it thoroughly with warm water with addition of a little dishwasher preparation. Finally, dry the wool in the air.

Literature: My own, unpublished method

Brazil wood

Brazil wood or redwood is the wood from the trunk of various Caesalpinia species. The Pernambuk wood of Caesalpinia crista from Jamaica and Brazil is the species with the highest content of dye.

C.I. Natural Red 24

Recipe 20

Preparing the dyeing liquor

Soak 100 grams of Brazil wood chips overnight in 5 liters of soft water (condensed water) and then boil for one hour. Replace the water lost by evaporation. Filter the concoction through a cotton cloth and let the filtrate ferment for one week in a cool room.

Crimson red with Brazil wood on wool mordanted with alum and cream of tartar

Place 100 grams of wool (20 skeins of 5 grams each, previously tied together with a cord, see page 2), mordanted with 25 % of alum and 6 % of cream of tartar (see page 6), in water at about 50 °C for a few minutes. Then place the prewarmed wool in the dyeing liquor at 85 °C, and dye for 45 minutes at 80 °C. Let the wool cool in the liquor; then take it out and rinse it carefully. Finally, let it dry in the air.

Literature: 7, 18

Lac dye

The raw material for shellac is stick-lac, which is formed by the cochineal insect Coccus laccae. This insect form a mixture of red, water-soluble mordant dyes (laccaic acid A, B, C, D, and E), which are removed by extraction with soda solution when stick-lac is processed to shellac. The laccaic acids are precipitated from this extract in the form of Ca and Al lakes and filtered off. The dried filter residues are known as lac dye.

C.I. Natural Red 25

Recipe 21

Preparing the dyeing liquor

Grind 50 grams of lac dye in the cross-beater mill (coffee mill) and then rub down in a mortar together with 50 grams of cream of tartar and 100 milliliters of hydrochloric tin-II-chloride solution*. Then pour the whole together with abundant water into the dyeing vessel. Make up with water to 3 liters, and heat to 40 °C, with stirring.

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*Dissolve 100 grams of tin-II-chloride in 100 milliliters of hydrochloric acid conc. and then dilute with 100 milliliters of water.

Scarlet red with lac dye and tin salt, dyed on unmordanted wool

Wet 100 grams of unmordanted wool (20 skeins of wool of 5 grams each, previously tied together with a cord, see page 2) in lukewarm water containing a little dishwasher preparation, and enter it into the prepared dyeing liquor at 40 °C. Elevate the temperature slowly to 90 °C, and dye for 75 minutes at this temperature. Let the wool cool in the dyebath, and then rinse it with water and a little dishwasher preparation. Let the wool dry in the air. Remove any residues of insoluble components of the lac dye by shaking the wool skeins.

Recipe 22

Crimson red with lac dye on wool mordanted with alum and cream of tartar

When 100 grams of the scarlet-red dyeing produced with Recipe 21 is treated in 3 liters of water containing 25 grams of alum and 6 grams of cream of tartar for 60 minutes at 90 °C, a crimson-red dyeing is obtained, similar in shade to a corresponding dyeing produced with cochineal. When alum without any addition of cream of tartar is used for the aftertreatment, a more bluish red is obtained.

Literature (for Recipes 21, 22): 8 (with my own variations)

Safflower carmine

The dried florets of the safflower (bot.: Carthamus tinctorius L.) have already been mentioned in connection with the dyeing of wool with safflower yellow (Recipe 3 on page 8).
On cotton and silk in an alkaline bath, gradually acidified with citric acid, safflower produces a fine red or pink, with however only poor lightfastness. Before dyeing, however, it is necessary to wash out as completely as possible the safflower yellow, which is readily soluble in cold water.

C.I. Natural Red 26

Recipe 23

Preparing the dyeing liquor

Fill 200 grams of safflower (ripe, dried florets) loosely in a large bag of cotton cloth; tie the bag and hang overnight in a plastic bucket filled with water. The next day, press out the water as completely as possible by tying a second knot in the cord used to tie the bag, inserting a broomstick in the loop between the two knots, and pressing the bag out by twisting the bag while holding the broomstick still. The yellow, aqueous solutions of safflower yellow can be thrown away. Soaking and wringing the bag must be repeated several times, in order to remove most of the safflower yellow. Wringing can now be carried out shortly after soaking. The last time this is done, the water is squeezed out of the bag as completely as possible. The 'washed safflower' remaining in the bag is taken out and entered into a solution of 50 grams of soda in 3 liters of water, and the whole is stirred thoroughly with a

glass rod. After about one hour, the paste is poured through a large household sieve, and the residue on the sieve is pressed out. The filtrate is the dyeing liquor. It is made up with water to 3 liters.

Red with safflower on cotton, and pink-red on silk

Add a 10% solution of citric acid in water in increments to the dyeing liquor, until the latter no longer foams on addition of citric acid and has a pH value of 4 to 5 (measured with pH paper). Then divide the liquor into two equal portions, and add 50 grams of cotton hanks (10 skeins of 5 grams each) to the one portion, and 50 grams of silk hanks (10 skeins of 5 grams each) to the other. Leave the hanks overnight in the liquor at room temperature, moving them frequently in the bath during the first hour with a glass rod.
The next day, rinse the hanks with cold water, finally with addition of a little acetic acid and cream of tartar, and dry them in the air in a shadowy place.

Literature: 4

Indigo

Indigo is one of the oldest dyes ever used by man for dyeing, although it has to be applied by a very complicated process. Indigo is found in various dye plants in the form of indoxyl glucoside, an intermediate for the blue indigo dye. Indigo is obtained from indoxyl glucoside by fermenting the leaves of the indigo plant, thus producing a greenish yellow liquid, which can be used for dyeing after addition of stale urine as alkali donor. This was also the method used in antiquity and in the Middle Ages in the Old World for dyeing with

woad (Isatis tinctoria L.), the occidental indigo plant. Indigo is formed by oxidation. Later, starting from the 16th century, the indigo produced from the tropical indigo plant Indigofera tinctoria L. came to Europe from India and other southeast Asian countries to compete successfully with the woad indigo previously used.

In India, the yellow soluble form of indigo was produced in large production sites from leaves of the indigo plant not only by the fermentation vat method. From this form, the blue insoluble indigo dye was obtained by oxidation with atmospheric oxygen, and this dye was offered as a commercial product throughout the world in the form of 5-cm cubes. This almost immediately killed the cultivation of woad in Europe in the 18th century.

C.I. Natural Blue 1

Recipe 24

Preparing the dyeing liquor

Stir 15 grams of indigo powder with 75 milliliters of warm water in a beaker glass until it forms a paste. In a second vessel, dissolve 30 grams of soda in 120 milliliters of warm water. Pour 60-70 milliliters of this solution over the indigo paste and stir vigorously. Then add 30 grams of sodium dithionite and stir again. Add one litre of warm water and stir carefully until the whole is thoroughly mixed. Heat this mixture to 55 °C (never higher than 60 °C). The liquid should now have a yellowish colour. When it is left standing for 20 minutes, the colour should have turned yellow-green. Strew 30 grams of sodium dithionite over the solution (vat).

Blue with indigo on wool

Heat the one-liter dyebath to 55 °C. Immerse 30 grams of wool hanks (6 skeins of 5 grams each) in warm water until the material is thoroughly wet, and then enter it into the dyeing liquor. Let the dyebath stand still, so that no oxygen can enter into the vat. Keep the wool in the vat for some minutes, and then take it out of the vat and squeeze the liquor out thoroughly (with rubber gloves). When the wool hanks come out of the vat, they have a green-yellow colour, which turns blue when the material is exposed to the air. After 15-20 minutes, the hanks are completely blue. Rinse them thoroughly with water, but only after the material has dried completely. In order to obtain a deeper shade, dip the hanks into the liquor again and take them out after 15-20 minutes. Repeated dipping and airing makes the dyed shade deeper and deeper.
Further wool hanks can be dyed in this manner in various depths of shade.
The dyebath is adequate for dyeing many wool hanks.

Literature: 5, 18

Indigo carmine

Indigo disulfonic acid, a water-soluble dye with which wool can be dyed by a very simple method, has been produced from plant indigo and sulfuric acid since 1740. Barth from Großenhain in Saxony first produced this dye in 1740 and called it 'Saxon blue'.

C.I. Natural Blue 2

Recipe 25

Producing the dyeing liquor

Dissolve 2 grams of indigo disulfonic acid in 3 liters of water and add 100 milliliters of glacial acetic acid.

Turquoise blue with indigo carmine on wool (with alum mordant)

Wet thoroughly with water 100 grams of wool (20 skeins of 5 grams each, previously tied together with a cord, see page 2.), mordanted with 25 % of alum and 6 % of cream of tartar (see page 6), and enter it into the dyebath at 40 °C. Elevate the temperature slowly to 90 °C, and dye for 30 minutes at this temperature. The dyeing liquor is then (almost) colorless, because the dye has gone almost completely on to the wool. Let the wool cool in the liquor; then take it out, rinse it with water and let it dry in the air.

Literature: 21

Young fustic

Young fustic is the dye obtained from the wood of the tanner's sumac (bot.: Cotinus coggygria SCOP.), which grows in southern Europe, Spain, Turkey, Hungary, and Dalmatia. When dyed on an alum mordant, it produces orange shades. It is also known as Hungarian yellow-wood.

C.I. Natural Brown 1

Recipe 26

Preparing the dyeing liquor

Dissolve 20 grams of young fustic in 3 liters of water and warm to 40 °C.

Intensive orange with young fustic on wool (mordanted with alum)

Wet thoroughly with water 100 grams of wool (20 skeins of 5 grams each, previously tied together with a cord, see page 2), mordanted with 25 % of alum and 6 % of cream of tartar, and enter it into the prepared dyebath at 40 °C. Elevate the temperature slowly to 90 °C, and dye for one hour at this temperature. Then let the wool cool in the liquor; remove it, wash it thoroughly with water, and let it dry in the air.

Literature: 9 and several unpublished tests

Catechu

Catechu or cutch, which is obtained from the heartwood of acacia (bot.: Acacia catechu WILLD.), was known in India as a dye over 2000 years ago. It is obtained from acacia trees that have been cut down just when they contain the most sap. The aqueous extract from this heartwood is concentrated by boiling down until the viscous sap remaining hardens on cooling. This concentrate is cut into pieces and sold as cutch or catechu.

C.I. Natural Brown 3

Recipe 27

Preparing the dyeing liquor

Boil 50 grams of cutch and 5 grams of copper sulfate in 750 milliliters of water, with stirring, until the whole has dissolved. Replace the evaporated water.

Brown with cutch and copper sulfate

Place 100 grams of thoroughly wetted, unmordanted wool (20 skeins of 5 grams each, previously tied together with a cord, see page 2) in 3 liters of water and heat to 90 °C. Then remove the wool from the bath and place it at one side. Now pour the hot water into the prepared dyeing liquor in an adequately dimensioned dyeing vessel, with stirring. Enter the wet wool hanks into the bath again and leave them lying there overnight. The next day, rinse the wool thoroughly with water and dry it in the air.

Literature: 18

Walnut shells

Walnut shells (bot.: Juglans regia L.) have been used since antiquity to dye brown shades with good lightfastness on unmordanted wool.
The best dyeings are obtained when the nuts have been collected in the fresh and green state. Green shells should be soaked in water for at least 24 hours before extracting the dye by boiling with water. The green shells can also be dried in the air and used later for dyeing.

Recipe 28

Preparing the liquor from dried walnut shells

Grind coarsely 300 grams of dried walnut shells in the cross-beater mill (or coffee mill) and then soak in 3 liters of water for 24 hours. Keep the vessel closed with a lid. Then boil for 2 hours in the closed vessel, make up again to 3 liters with water, and filter through a cotton cloth.

Brown with walnut shells on unmordanted wool

Place 100 grams of unmordanted wool (20 skeins of 5 grams each, previously tied together with a cord, see page 2) into the prepared dyeing liquor and heat slowly to 45 °C. Without applying any more heat, leave the wool for some hours or overnight in the liquor.
Then heat the dyeing liquor rapidly to 90 °C, and let the wool draw for 20-30 minutes. After the liquor has cooled, remove the wool, rinse it thoroughly with water and dry it in the air.

Literature: 18

Logwood

Logwood is obtained from a tree with the same name (bot.: Haematoxylon campechianum L.) that grows in Central America, Mexico, and the Antilles. It was used in the past on a large scale for dyeing silk with iron mordant, and somewhat less extensively for dyeing wool and cotton.

Logwood dyes wool on a chrome mordant in black-blue shades, on an alum mordant in blue shades, on a tin mordant in violet shades, on a copper mordant in greenish black shades, and on an iron mordant in black shades.

C.I. Natural Black 1

Recipe 29

Preparing the dyeing liquor

Soak 120 grams of logwood powder, wrapped in a cotton cloth, overnight in 4 liters of water. The next day, boil the bath for 60 minutes, then remove the bundle with the logwood powder, and make up the bath again with water to 4 liters. Divide the bath into two portions of 2 liters each for two dyeings.

Violet with logwood and tin salt

Place 60 grams of thoroughly wetted, unmordanted wool (12 skeins of 5 grams each, previously tied together with a cord, see page 2) in 2 liters of the prepared dyeing liquor. Heat to 90 °C, and let the wool draw for 30 minutes at this temperature. Then remove the wool and place it at one side. Now dissolve 5 grams of tin-II-chloride in 150 milliliters of water, and add this solution to the dyeing liquor, with stirring. Enter the wool into the liquor again, treat for 15 minutes at 90 °C, and then let it cool in the dyeing liquor. Then take the wool out and wash it, first with addition of a little soap, and then with plain water.

Literature: 18

Recipe 30

Black with logwood and copper sulfate

Place 100 grams of thoroughly wetted, unmordanted wool (12 skeins of 5 grams each, previously tied together with a cord, see page 2) in 2 liters of the prepared dyeing liquor, and let it draw for 30 minutes at 90 °C. Then take the wool out of the bath and place it on one side. Dissolve 5 grams of copper sulfate in 150 milliliters of water, and add the solution to the dyeing liquor, with stirring. Place the wool in the liquor again, treat it for 15 minutes at 90 °C, and let it cool in the bath. Finally, wash it thoroughly with water.

Literature: 18

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Additions & Revisions by Dr. H. Schweppe to

Practical hints on dyeing with natural dyes by Helmut Schweppe (1986)

p.6a: #4a Iron mordant (iron-III-sulfate, $Fe_2(SO_4)_3$)
p. 13a: Chinese Yellow Pods
p.14: [Recipe 4 for Saffron is the same] Chinese Yellow Berries
p. 15: Recipe 5 (Chinese Yellow Berries)
p. 17a: Recipe 7a
p. 22a: Recipe 12a, Recipes 12b and 12c
p. 28a: Recipe 17a Violet with madder on iron-III-sulfate mordant
p. 31a: Recipe 18a Violet on alkanna on wool
p. 41: Recipe 26 Young Fustic
p. 42: Recipe 27a Cutch on cotton with copper sulfate
pp. 44 and 45: Recipes 29a and 30a

4a) Iron mordant (iron-III-sulfate, $Fe_2(SO_4)_3$)

To get a violet tint at dyeing with madder, iron-III-sulfate seems to be the best mordant.
(Information of Dr.Harald Böhmer, Istanbul, Marmara University)

Mordanting directions for 100 grams of commercial hank wool:

3 grams of iron-III-sulfate and 1 gram of cream of tartar or (better) citric acid are dissolved in 3 liters of soft water. Enter the thoroughly wetted wool into the mordant solution at room temperature an heat it for 1 h to 100° C. Then let the solution cool down, squeeze the wool carefully and let dry it in the air for at least one day, the longer, the better.
Before dyeing, the mordanted wool has to be rinsed with cold water.

Chinese Yellow Pods, 'Wongsky', 'Unki'

In former times the fruits of Gardenia jasminoides LOUR. (China, Japan) have been an important natural dye in East Asia and were called 'Wongsky' or Chinese Yellow Pods.
The fruits of Gardenia jasminoides ELLIS (former name: Gardenia florida L.), indigenous in China, Japan, and India, were formerly used as 'Unki' for dyeing silk in yellow and orange tones with a good fastness to light.
This dye also was used as a constituent of scarlets.
Both fruits contain the main dye crocin, the digentiobiose ester of crocetin (CI 75100), and are specified in the Colour Index with the same 'Generic Name' CI Natural Yellow 6 as saffron, which contains also the main dye crocin.
Because of the high price of saffron it is efficient, to substitute it by the cheaper fruits of Gardenia jasminoides ELLIS for making reference dyeings. You can get the dried fruits at dealers of natural drugs or dyes.*

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* Supplier: Mann, Teppichkunst - Naturfarbstoffe, Im Dorngarten 6, D-6719 Lautersheim Tel: 06351/6869.

C.I. Natural Yellow 6

Recipe 4 a

Preparing the dyeing liquor

Grind 100 grams of dried fruits of Gardenia jasminoides ELLIS in a cross-beater mill and soak overnight with 3 liters of water. Then boil it for 30 minutes, filter through a cotton cloth, an rinse with water, until the filtrate has a volume of 3 liters.

Brilliant orange yellow with 'Unki' on alum mordant:

Bring the prepared dyeing liquor to about 40 °C. Enter 100 grams of wool hanks (20 skeins of 5 grams each, previously tied together with a cord, see page 2), which have been mordanted with 25% of alum and 6% of cream of tartar (see page 6), into the liquor and heat slowly to 80 - 90 °C. Let it draw for one hour at this temperature. Then allow the wool in the dyeing liquor to cool. Remove the wool, rinse it thoroughly with water, and let it dry in the air.

Literature: No literature (my own recipe)

Recipe 4

Preparing the dyeing liquor

Wrap 5 grams of saffron in a loosely woven cotton cloth, and soak the bundle overnight in 600 milliliters of water. The next day, bring the water to the boil and let the dyebath draw for 30 minutes at about 70 °C. Then remove the bundle from the bath, and make up if necessary with water to 600 milliliters.

Brilliant yellow with saffron on unmordanted wool

Wet thoroughly under the water tap at about 40 °C 20 grams of unmordanted wool hanks (10 skeins of 2 grams each, previously tied together with a cord, see page 2), and enter into the dyeing liquor. Heat the liquor to 80 °C and let it draw at this temperature for about 30 minutes.
When the bath has cooled, remove the wool, rinse it thoroughly with water, and let it dry in the air.

Literature: 18

Chinese Yellow Berries

These yellow buds from the Chinese pagoda-tree (bot.: Sophora japonica L.) were used in China in the past for dyeing silk on alum mordant for mandarins' robes. In Japan, this dye was used exclusively for dyeing imperial robes.
Chinese yellow berries contains rutin (C.I. 75739), a quercetin glucoside. Rutin does not hydrolyse on dyeing and yields yellow oranges on alum-mordanted wool.

Recipe 5

Preparing the dyeing liquor

Soak 200 grams of ground Chinese yellow berries overnight in 3 liters of water. The next day, let the infusion draw for 45 minutes at about 80 °C, and then filter through a cotton cloth. If necessary, make up the filtrate to 3 liters again.

Yellow Orange with Chinese yellow berries on alum mordant

Bring the prepared dyeing liquor to about 40 °C. Enter 100 grams of wool hanks (20 skeins of 5 grams each, previously tied together with a cord, see page 2), which have been mordanted with 25% of alum and 6% of cream of tartar (see page 6), into the liquor and heat slowly to 80 °C. Let it draw for one hour at this temperature. Then allow the wool in the dyeing liquor to cool. Remove the wool, rinse it thoroughly with water, and let dry it in the air.

Literature: No literature (my own recipe)

Recipe 7a

Yellow with quercitrin and alum mordant

Since quercitrin is the main dye in quercitron bark, it is possible to dye with pure quercitrin*.
Dissolve 5 grams of quercitrin in 3 liters of warm water and dye as described in recipe 7.

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* Supplier: Carl Roth GmbH + Co,Chemische Fabrik, Postfach 21 11 62, D-7500 Karlsruhe 21, Federal Republic of Germany

Recipe 12a

Orange with bixin on alum mordant

Since bixin is the main dye in orlean seeds, it is possible to dye with pure bixin, a commercial food dye, instead of orlean.
Dissolve 20 grams of bixin in 3 liters of water containing 20 grams of soda and dye as described in recipe 12.

Recipe 12b and 12c

The dye bath of the recipe 12 can be taken for a second dyeing on wool (alum mordant) and on cotton (unmordanted). Divide the rest of the dye bath in two equal parts.

Recipe 12b (Orange with bixin on alum mordanted wool)

Make up the one part of the rest of the dye bath with water to 3 liters and dye on 100 grams of wool as described in recipe 12.

Recipe 12c (Red orange with bixin on cotton)

Make up the other part of the dye bath with water to 2 liters an dye on 50 grams of cotton (10 skeins of 5 grams each) as described in recipe 12.

Recipe 17a

Violet with madder on iron-III-sulfate mordant *

Preparing the dyeing liquor

Soak 200 grams of pulverized madder for 12 hours in 6 liters of water.

Dyeing violet with madder on iron-III-sulfate mordant

100 grams of wool (20 skeins of 5 grams each, previously tied together with a cord, see page 2, mordanted with 3% of iron-III-sulfate and 1% of cream of tartar or (better) citric acid (see page 6a), is thoroughly rinsed with cold water. Enter the wool into the prepared dyeing liquor at room temperature and dye 30-60 minutes at 40-50° C. At once after dyeing the wool is to be rinsed with cold water. Then the dyed wool is aftertreated with a cold solution of 1% potassium carbonate in water for 10-60 minutes.

Recipe 17b *

1st Dyeing with the remaining dyeing liquid of recipe 17a to get a beautiful red on wool, mordanted with 25% alum and 6% of cream of tartar.

Enter 100 grams of wool, mordanted with 25% of alum and 6% of cream of tartar, into the remaining dyeing liquor of recipe 17a at room temperature and dye 1 hour or longer at 85° C (for a short time 100° C is allowed).

2nd Dyeing with the remaining dyeing liquid of recipe 17a

Enter 100 grams of wool, mordanted with 25% of alum and 6% of cream of tartar into the remaining dyeing liquor of the 1st dyeing of recipe 17b at room temperature and dye 2-3 hours at 90-100° C. Then let the solution cool down, rinse the dyeing and let dry it in the air.
The dyeing has a brownish red tint.

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* Recipes of Dr. Harald Böhmer, Istanbul, Marmara Univer-

Recipe 18a

Violet with alkanna on wool mordanted with alum and cream of tartar

Because the violet,getting with the recipe 18, is very dark (a black violet), it is better to take 50 grams of alkanet roots in stead of 100 grams. You will get a finer violet. For dyeing you can use the recipe 18.

Recipe 26

Correction:

Preparing the dyeing liquor

Dissolve 20 grams of young fustic extract* in in 3 liters of water and warm to 40° C.

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* Supplier: Compagnie Francaise des Extraits Maison Westphalen, B.P.1375, 20, Rue de Pressencé, 76 Le Havre-graneville, France.

Taking young fustic wood instead of young fustic extract, prepare the dye liquor using 100 grams of young fustic chips according to recipe 8.

Recipe 27a

Red brown on cotton with cutch and copper sulfate

Taking unmordanted cotton you get a red brown color tone using recipe 27.

Recipe 29a and 30a

(Improved recipes 29 and 30)

Preparing the dyeing liquor

Soak 100 grams of logwood powder, wrapped in a cotton cloth, overnight in 4 liters of water. The next day, boil the bath for 60 minutes, then remove the bundle with the logwood powder, and make up the bath with water to 6 liters.

Violet with logwood on alum mordant

Enter 200 grams of wool (40 skeins of 5 grams each, previously tied together with a cord, see page 2), which has been mordanted with 25% alum and 6% cream of tartar (see page 6), thoroughly wetted with water, into the dyebath at about 40°C. Heat slowly to about 90°C and leave standing for 30 minutes at this temperature. After cooling the dyeing liquor, remove the wool and rinse it thoroughly.

Recipe 29a. Violet with logwood and tin salt

Treat 100 grams of the wool, dyed with logwood on alum mordant, with a solution of 10 grams tin-II-chloride and 10 milliliters of conc.hydrochloric acid in 3 liters of water, for 30 minutes at 90°C. After cooling the dyeing liquor, remove the wool and wash it, first with addition of a tenside, and then with plain water.

Recipe 30a.Black with logwood and copper sulfate

Treat 100 grams of the wool, dyed with logwood on alum mordant, with a solution of 5 grams copper sulfate in 3 liters of water, for 30 minutes at 90°C. After cooling the dyeing liquor, remove the wool and wash it, first with addition of a tenside, and then with plain water.