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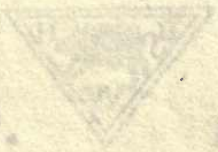
A BOOK ON VEGETABLE DYES

BY

ETHEL M. MAIRET



A.D. 1916

PUBLISHED BY DOUGLAS PEPLER
AT THE HAMPSHIRE HOUSE
HAMMERSMITH

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PUBLISHER'S NOTE

IN PRINCIPIO ERAT VERBUM
ET VERBUM ERAT APUD DEUM
ET DEUS ERAT VERBUM. *Sc. Joannem* I. 1.
VIDITQUE DEUS CUNCTA QUÆ
FECERAT: ET ERANT VALDE BONA.
Genesis. I. 31.

MAN uses these good things, and when MAN first discovers how to make anything, that thing which he makes is good.

For example: this book is printed upon one of the first iron presses to be made in this country. The press is a good press; it would be difficult to make a press which would enable the printer to print more clearly. The wooden press was a good press & the printing from it has not been surpassed.

Further, this quality of goodness of a first discovery may persist for many years.

But there is a tendency to avoid *Quality Street*. We are choosing rather *Quantity Street* & the Bye paths of *Facility & Cleverness*; we have become accustomed to the hum of the *Time & Labour saving* machinery; and we are in danger of forgetting the use of good things: indeed the tradition & practice of goodness has been lost in a considerable number of trades.

For instance: a carpenter has become so used to buying his timber in planks from a yard that he has nearly forgotten its relation to the tree. The man who works to designs conceived by somebody else with wood sawn by another man's machine must be deprived of the natural strength of the tree.

And this is not an exception to, but an example of, the way we are choosing to do things.

It is impossible to buy linen as good as that normally used by every tradesman in the XVIII century. It is nearly impossible to get cloth, paper, bread, beer, bacon and leather equal to that in common use 150 years ago.

IN VIEW OF THE BEGINNING it is desirable to record what still survives of the traditions of making good things; and I shall endeavour to publish the instructions & advice of men & women who still follow these good traditions.

Douglas Pepler.

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CHAPTER I.

DYEING has almost ceased to exist as a traditional art. In this 20th century the importance of colour in our lives seems to be realized less and less. It has been forgotten that strong and beautiful colour, such as used to abound in all every day things, is an essential to the full joy of life. A sort of fear or nervousness of bright colour is one of the features of our age, it is especially evident in the things we wear.

There is unfortunately good reason for it. We fear bright colour because our modern colours are bad, and they are bad because the tradition of dyeing has been broken. The chemist has invaded the domain of the dyer, driven him out and taken over his business, with the result that ugly colour has become the rule for the first time in the history of mankind. It is not that chemists never produce

beautiful colour. Dyeing as a chemical science has not been studied for the last 50 years without producing good results. But there is this great difference between the chemical commercial dyes and the traditional dyes — that with the commercial dyes it is very easy to produce ugly colours, the beautiful colour is rare ; but with traditional dyes it is difficult to make an ugly colour, and good colour is the rule.

It was in 1856 that mauve was produced from coal tar by an English chemist, and this began a new era in dyeing. The discovery was developed in Germany, and the result was the creation of a science of chemical colouring.

The advantages of the new colours were ease and simplicity of use, general reliability with regard to strength and composition, and certainty in reproducing the same colour again without trouble. With regard to fastness, to light and to washing there is practically little difference between the two. It is more the method by which they are dyed and not the dye itself (although of course in

some cases this is not so) that determines their fastness. The natural dyes are more trouble and take longer time to prepare. Chemical colours can be dyed now as fast as the natural colours, although at first this could not be done. Some of the chemical colours as well as the natural, are not fast to light and washing, and ought never to be used ; but there are natural colours, such as madder, some of the lichens, catechu etc., which are as fast as any chemical dye, if not more so. BUT there is this general difference between the results of the two methods, - that when a chemical colour fades it becomes a different colour and generally a bad one : when a natural colour fades, it becomes a lighter tone of the same colour.

Since the middle of the 19th century our colour sense has been getting rude shocks. At first came the hideous aniline colours, crude and ugly, and people said, "How wonderful, are they really made out of coal!" They were told to like them and they did, and admired the chemists who made them. Then came more discoveries, and colour began to go to the opposite extreme, and the fashion was

muddy indeterminate colours—'art' colours as they were called, just as remote from pure good colouring in one direction as the early aniline colours were in the other. We are now emerging from the mud colours, as I would call them, to the period of the brilliant colouring of the Futurist. Here we have scientific colouring used with real skill. The Futurist has perhaps indicated a possible way in which chemical colours may be used by the artist and is teaching people the value of simple combinations of brilliant colour.

And yet do they satisfy the artist? Are they as beautiful as the colours in a Persian Khelim? Is there a blue in the world as fine as the blue in a Bokhara rug, or a red to touch the red of a Persian brocade or Indian silk?—the new fresh colours as they come out of the dyer's vat, not as they are after years of wear and tear, though that is beautiful enough. And yet they are not more beautiful than the colours once made by dyers in England. They are as brilliant as the chemical colours, but they are not hard and unsympathetic

and correct. They are alive and varied, holding the light as no chemical colour can hold it; and they are beautiful from their birth to their old age, when they mellow, one with the other, into a blend of richness that has never yet been got by the chemical dyer and never will be.

Perhaps it is the scientific method that kills the imagination. Dealing with exactly known quantities, and striving for precise uniformity, the chemist has no use for the accidents and irregularities which the artist's imagination seizes and which the traditional worker well knew how to use.

William Morris says that "all degradation of art veils itself in the semblance of an intellectual advance." and nothing is truer than this with regard to the art of dyeing. As a tradition it is practically dead in Britain, and is threatened with gradual extinction all over the world. It will not recover itself as an art till individual artists set themselves to make beautiful colours again, and ignore the colour made for them by commerce and the chemists.

Handicraft workers should make their own

colours. Leather workers should dye their own leather, the embroiderers their own silks and wools, the basket makers their own materials, the weavers and spinners their own flax, cotton and wool; and until they do this the best work will not be done. This is the necessity for the present. *If any craft worker wants sound colour he must make it for himself, he cannot get it done for him by artists.* The hope for the future is that dyeing may be reinstated as a craft, co-operating with the other crafts and practiced by craftsmen.

The way to beauty is not by the broad and easy road; it is along difficult and adventurous paths. Every piece of craft work should be an adventure. It cannot be an adventure if commerce steps in and says "I will dye all your yarn for you; you will always then be able to match your colour again; there need be no variation; every skein shall be as all the others; you can order so many pounds of such a number and you can get it by return of post; and you can have six or seven hundred shades to choose from." It is all so easy, so temptingly easy,—but

how DULL! the deadly yards of stuff all so even and so exactly dyed; so perfect that the commerce-ridden person says, "this is almost as good as the stuff you can buy in a shop, it is as perfect as machine made stuff."

What would have been the use of all this to the great colourists of the world, the ancient Egyptians, the mediæval Italians or the great Oriental dyers? They could not get six hundred shades to order; six was more like their range, they did not need more, and in those they could not command precise uniformity. They knew that the slight variations caused by natural human methods add to the beauty and interest of a thing, and that a few good colours are worth any number of indifferent ones.

It is quite certain that a great many of the handicrafts that have depended upon commercial dyes would produce *infinitely better work* if they dyed their raw material themselves.

It may be objected that life is not long enough; but the handicrafts are out to create more life, not out to produce quantity nor to save time.

The aim of commerce is material gain; the aim of the crafts is to make life, and no trouble must be spared to reach that end. It must always be before the craft worker. Dyeing is an art; the moment science dominates it, it is an art no longer, and the craftsman must go back to the time before science touched it, and begin all over again.

The tradition is nearly lost in England.

It lingers in a few places in Scotland and Ireland. In Norway, Russia, Central Asia, India and other places where science has not entered too much into the life of the people, it is still practiced. Is dyeing as a tradition to be doomed, as traditonal weaving was doomed? Yes, unless it be consciously studied again and remade into an art.

This book is intended for the use of craftsmen and others who are trying to dye their materials by hand and on a small scale. Information and recipes, useful to such workers, are to be found in books and pamphlets dating onwards from the 17th century, and in this book I have drawn largely upon these

sources of dyeing knowledge, as well as upon the traditions still followed by present workers, and upon the experience of my own work.

All dyeing recipes, however, should guide rather than rule the worker; they are better applied with imagination and experience than with the slavishness of minute imitation. Every dyer should keep a record of his experiments, for this will become invaluable as it grows, and as one thing is learnt from another. The ideal way of working is not by a too rigid accuracy nor by loose guess-work, but by the way which practice has proved best: nevertheless, some of the greatest dyers have done their work by rule-of-thumb methods just as others have certainly worked with systematic exactness.

The dyer, like any other artist, is free to find his own methods, subject to the requirements of good and permanent craftsmanship, provided that he achieves the effects at which he aims. But it is supremely important that he should aim at the right effects; or, rather, at the use of the right materials, for if these are right the effects may safely be left to

take care of themselves. In order to develop the taste and temperament of a good colourist, is is necessary to use good colour and to live with good colour. In this book I attempt to show where good colour can be obtained. But one may begin to live with good colour which has been found by others.

This part of the dyer's education is not prohibitively costly, even in these days of inferior colour. Indian and Persian embroideries are still to be obtained, though care must be taken in their selection, as most modern pieces are dyed with chemical dyes and are very ugly. Persian Khelim rugs are cheap and often of the most beautiful colours. Russian embroideries and woven stuffs, both old and new, are obtainable, and are good in colour, as are most of the embroideries and weavings of Eastern Europe and the East. What are popularly known as "coffee towels" are often embroidered in the finest coloured silks. Bokhara rugs and embroideries are still to be purchased, and many of the weavings of the far East, although, alas, very few of the modern ones are of good colour. I would say to dyers, do not be satis-

fied with seeing beautiful coloured stuffs in museums. It is possible still to get them, and to live with a piece of good colour is of much more use than occasional hours spent in museums.

CHAPTER II.

WOOL SILK COTTON LINEN

Various kinds of wool. Wool from goats. Fleeces. Wool dyeing. Scouring of wool. Silk, preparation for dyeing. Cotton, cleansing and galling of. Indian methods of preparing cotton and linen for dyeing. BANCROFT on the preparing of cotton and linen for dyeing. Linen. On water for dyeing.

ON WOOL.—The quality of wool varies considerably. British wools are of various kinds :—

Highland, Welsh and Irish wools are from small sheep, not far removed from the wild state, with irregular short stapled fleeces.

Forest or Mountain sheep (Herdwick, Exmoor, Blackfaced, Limestone, Cheviot) have better wool, especially the Cheviot which is very thick & good for milling.

Ancient Upland, such as South Down, are smaller sheep than the last named, but the wool is softer and finer.

Long Woolled sheep, (Lincolns, Leicester) with long staple wool (record length, 36 in.) and the fleeces weighing up to 12 lbs. The Leicester fleece is softer, finer and better than the Lincoln.

To the end of the 18th century *Spanish wool* was the finest and best wool in the world. Spanish sheep have since been introduced into various countries, such as Saxony, Australia, Cape Colony, New Zealand, and some of the best wools now come from the colonies.

Alpaca, *Vicuna and Llama* wools are obtained from different species of South American goats.

Mohair is obtained from the Angora goat of Asia Minor.

Kashmir wool is got from the Thibetan goat.

Camel hair is the soft under wool of the camel, which is shed annually. It is of a brown colour.

The colour of wool varies from white to a very dark brown black, with all shades of fawn, grey and brown in between. The natural colours are not absolutely fast to light but tend to bleach slightly with the sun.

Fleeces are of various kinds, the principal being: *Lambs*, 3 to 6 months growth, the finest, softest and most elastic of wool. *Hogs and Tegs* : the first shearing of sheep that have not been shorn as lambs. *Wethers* : all clips succeeding the first shearing.

Wool comes into the market in the following condition. 1) *In the grease*, not having been washed and containing all impurities. 2) *Washed*, with some of the grease removed and fairly clean. 3) *Scoured*, thoroughly cleaned & all grease removed.

ON WOOL DYEING.—There are four principal methods of dyeing wool.

1st.—The wool is boiled first with the mordant and then in a fresh bath with the dye. This method of dyeing is the most satisfactory and gives brighter and faster colours than the other methods. It is not necessary to throw away the solution after the mordanting has been done, but it can be replenished

for a fresh lot of wool ; a separate bath is used for the dye.

2nd. — The wool is boiled first with the dye and, when it has absorbed as much of the colour as possible, the mordant is added to the same bath, thus fixing the colour. This is called the "stuffing" and "saddening" method ; the "stuffing" being the boiling of the wool with the dye stuff and the "saddening" the fixing the colour by the mordant.

A separate bath can be used for each of these processes, in which case each bath can be replenished and used again for a fresh lot of wool.

3rd.—The wool is boiled with the mordant and dye in the same bath together. The colour, as a rule, is not so fast & good as with a separate bath, though with some dyes a brighter colour is obtained.

4th. — The wool is mordanted, then dyed, then mordanted again (saddened). This method is adopted to ensure an extremely fast colour. The mordant in this case should be used rather sparingly.

Wool can be dyed either in the fleece, in the yarn or in the woven cloth. Raw wool always contains a certain amount of natural grease. This should not be washed out until it is ready for dyeing, as the

grease keeps the moth out to a considerable extent. Hand spun wool is always spun in the oil to facilitate spinning. All grease and oil must be scoured out before dyeing is begun, and this must be done very thoroughly or the wool will take the colour unevenly.

The principal detergent known from earliest times is stale urine. In the Highlands this is used in the proportion of 1 part to 5 of water. It is the best scouring agent and leaves the wool soft and elastic. Carbonate of soda is also used. But a good pure soap is the most convenient scouring agent. A suds should be made with hot water, and the wool, which has been soaked in warm water previously, should be well squeezed and worked in the suds till all the grease is removed. This should be done two or three times if needed, and then the wool rinsed out thoroughly in clean water. Soda is apt to make the wool harsh and should be avoided. A little Ammonia added to the washing water helps.

To prevent yarn felting when it is scoured, it should be first steeped in hot water and left to cool. Soft soap is best for long fine wool. Urine for short wools; or urine and soda ash.

Another way of cleansing wool. Make a hot bath of 4 parts water and 1 part urine, enter wool, teasing it and opening it out to admit the full action of the liquid. After 20 minutes immersion, remove and allow to drain. Then rinse in clear running water and allow to dry. Use no soap. The liquid can be used again. The wool often loses one fifth of its weight in the process of washing.

To soften yarn—In a gallon of hot water dissolve half pound of common soda, then add half-pint of sweet oil and stir well. A little of this added to the washing water, for some colours, will soften the yarn.

To bleach wool—The wool is suspended in a closed room on hoops, and under the wool chafing dishes are placed with lighted coals on which powdered sulphur is cast. The room door is afterwards shut so that the smoke may be the longer retained to act on the wool, which is to remain until it is entirely whitened.

ON SILK.—There are two kinds of silk, 1) *raw silk* (reeled silk, thrown silk, drawn silk), and 2) *waste silk*, or spun silk.

Raw silk is that directly taken from the cocoons. Waste silk is the silk from cocoons that are dam-

aged in some way so that they cannot be reeled off direct. They are therefore carded and spun, like wool or cotton.

Silk in the raw state is covered with a silk gum which must be boiled off before dyeing is begun. It is tied up in canvas bags and boiled up in a strong solution of soap for three or four hours until all the gum is boiled off. If it is yellow gum, the silk is wrought first in a solution of soft soap at a temperature just below boiling point for about an hour, then put into bags and boiled. After boiling, the soap is well washed out.

Generally speaking, the affinity of silk for dyes is similar but weaker in character to that of wool. The general method for dyeing is the same as for wool, except that in most cases lower temperatures are used in the mordanting. In some cases, soaking in a cold concentrated solution of the mordant is sufficient. The dyeing of some colours is also at a low temperature.

Of the preparation of raw silk. For every pound of raw silk, take $\frac{1}{4}$ lb. of soap; first put the silk into a bag, or so make it up that tangling may be prevented, then let it boil together for 2 hours, after which

it must be very well cleansed, and so it is ready to dye all sorts of colours, being first allomed.*

How the boiled silk must be allomed. In proportion to every pound of silk, take $\frac{1}{4}$ lb. of Allom, melt in a little kettle or skillet, and when melted, throw it in to a tub of water, into which put the silk to steep, where let it lie a whole night.*

To soften silk after dyeing. Into a large vessel nearly full of water, a solution of soap is poured, in the proportion of from 4 to 5 lbs. of soap for every 1 10 lbs. of silk. The solution of soap is strained through a cloth into the water and well mixed. The silk is then introduced & left for about quarter of an hour after which it is wrung out and dried.

ON COTTON.—Cotton is the down surrounding the seeds in pods of certain shrubs and trees growing in tropical and semi-tropical countries. It was first introduced into Europe by the Saracens and was manufactured into cloth in Spain in the early 13th century. Cotton cloth was made in England in the early 17th century. The colour of cotton varies from deep yellow to white. The

*From a dye book of 1705.

fibre differs in length, the long stapled being the most valued. Cotton is difficult to dye and requires a special preparation. It is first boiled with water till thoroughly softened and wetted. Then alumed in the proportion of 1 of alum to 4 of the cotton (see page 28). It is then galled. The galling is done with different proportions of gall-nuts and other astringents (such as tannic acid, myrobalams, sumach, catechu) according to the quality of the astringents and the effect wished to be obtained. If gall-nuts are used they are bruised, then boiled for about two hours in a quantity of water. The bath is then allowed to cool till the hand can bear it. The cotton is worked well in this solution and then left for 24 hours. After which it is wrung out and dried.

Cotton is sometimes boiled in sour water in order to cleanse it: sometimes an alkaline ley is used: the cotton must be boiled in it for 2 hours, then wrung out and rinsed in clean water and dried. Cotton dyeing has been carried on for centuries in the East. In India "before a cloth is ready to be dyed with a fast colour, it has generally to undergo a preliminary process of preparation more or less elaborate, the different stages of which may be recited as washing,

bleaching, dunging, galling, aluming, or mordanting, and again washing." *(A Monograph on dyes and dyeing in the Bombay Presidency, by C.G.H. Fawcett*, 1896.) It is washed first of all to remove all impurities, whether those naturally belonging to the fibre or those purposely introduced during the processes of spinning and weaving. The bleaching removes grease, etc. This is done in India by the sun, air and moisture. The dunging process consists of passing the cotton through a hot solution of cow dung, which renders the dye fast. This is sometimes replaced by substitutes, such as the phosphates of soda and lime, silicates of soda, etc. The next operation of galling is an important step in the Indian process of dyeing. It is applied to cotton, linen and silk. Vegetable infusions containing tannin are applied to the cloth. Those mostly used are myrobalams, pomegranate rind, tamarisk galls, and pistachio galls. The cloth is then alumed, washed, and is then ready to be dyed.

Bancroft says :—"The fibres of linen or cotton when spun or woven are prepared for the dyer by being first boiled in water with a suitable proportion of potash (which for linen should be made caustic, in order that it may act more strongly upon the oily

and resinous matters abounding in flax) and afterwards bleached by exposure upon the grass to sun and air. But as this operation commonly leaves a portion of earthy matter in the linen or cotton, it ought to be soaked or steeped in water soured by sulphuric acid, to dissolve and remove this earthy matter, taking care afterwards to wash or rinse off the acid."

A few of the natural dye stuffs are capable of dyeing cotton direct, without a mordant, such as Turmeric, Barberry bark, safflower, annatto. For other dyes cotton has a special attraction, such as catechu, fustic, logwood.

ON LINEN.—Linen is flax, derived from the decomposed stalks of a plant of the genus of Linum. It grows chiefly in Russia, Belgium, France, Holland, and Ireland. The plants after being gathered are subjected to a process called "retting", which separates the fibre from the decaying part of the plant. In Ireland and Russia this is usually done in stagnant water, producing a dark coloured flax. In Belgium, Holland and France, retting is carried out in running water, and the resulting flax is a lighter colour. Linen is more difficult to dye than cotton, probably on account of the hard nature of the fibre.

The same processes are used for dyeing linen as for cotton.

"Linen thread is dyed in the same manner as cotton, only, that previous to its being purged like cotton thread, it is usual to boil it in water, adding for every pound of thread a quarter pound of chopped sorrel. Oil of vitriol is, however, more convenient and better than sorrel."—*D'Apligny*

To Bleach Linen.—(For 13 to 15 yards linen) Boil ½ lb. soap and ½ lb. soda in a gallon of water. Put it in a copper and fill up with water, leaving room for the linen to be put in. Put in the linen and bring to the boil. Boil for 2 hours, keeping it under the water and covered. Stir occasionally. Then spread out on the grass for 3 days, watering it when it gets dry. Repeat this boiling and grassing for 3 weeks. Your linen is then pure white.

To bleach linen a cream colour.—Boil ½ lb. soap and ½ lb. soda in a gallon of water. Fill copper up with water and put in linen. Boil for 2 hours. Repeat this once a day for 4 days. The linen should not be wrung out but kept in the water till ready to be put into the fresh bath.

ON WATER.—A constant supply of clean soft water is a necessity for the dyer. Rain water should be collected as much as possible, as this is the best water to use. The dye house should be by a river or stream, so that the dyer can wash with a continuous supply. Spring and well water is as a rule hard, and should be avoided. In washing, as well as in dyeing, hard water is altogether injurious for wool. It ruins the brilliancy of colour, and prevents the dyeing of some colours. Temporary hardness can be overcome by boiling the water (20 to 30 minutes) before using. An old method of purifying water, which is still used by some silk and wool scourers, is to boil the water with a little soap, skimming off the surface as it boils. In many cases it is sufficient to add a little acetic acid to the water.

Berthollet says,—"Whenever, therefore, a water is limpid, when its flow is constant, when it has no sensible taste, and dissolves soap well, it may be regarded as very proper for dyeing." He also goes on to say that for correcting water that is bad, sour water is principally used, that is, water in which bran has been fermented.

CHAPTER III.

MORDANTS

Definition of mordant. The principal mordants. The mordanting of silk and wool. Of linen and cotton. Astringents for cotton. Alum. Various examples of using alum for wool, silk, cotton and linen. Iron. Examples of iron mordants. Tin. Examples of tin mordants. Chrome. Examples of chrome mordants. Copper. Examples of copper mordants. General observations. Tannin and the galling of cotton and linen. Examples of various galling processes.

MORDANTS.—Dyes are divided into two classes. First, the *substantive* dyes, which give their colour directly to the material with which they are boiled: and second, the *adjective* dyes, as they are sometimes called. These latter include the greater number of dyes and require the use of a mordant to bring out their colour.

There are thus two processes concerned with the dyeing of most colours; the first is mordanting and

the second is the colouring or actual dyeing. The mordanting prepares the stuff to receive the dye—(*mordere*, to bite.) The early French dyers thought that a mordant had the effect of opening the pores of the fibres, so that the dye could more easily enter; but according to Hummel and later dyers the action of the mordant is purely chemical; and he gives a definition of a mordant as "that body, whatever it may be, which is fixed on the fibre in combination with any given colouring matter." The mordant is first precipitated on to the fibre and combines with the colouring matter in the subsequent dye bath. But, whether the action is chemical or merely physical, the fact remains that all adjective dyes need this preparation of the fibre before they will fix themselves on it. The use of a mordant, though not a necessity, is sometimes an advantage when using substantive dyes.

In early days the leaves and roots of certain plants were used. This is the case even now in India and other parts where primitive dyeing methods are still carried on. Alum has been known for centuries in Europe. Iron and tin filings have also been used. Alum and copperas have been known in the High-

lands for long ages. Stale urine is also much used in Scotland and Ireland, but perhaps more as a clearing agent than as an actual mordant.

Silk and wool require very much the same preparation except that in the case of silk high temperatures should be avoided. Wool is generally boiled in a weak solution of whatever mordant is used. With silk, as a rule, it is better to use a cold solution, or a solution at a temperature below boiling point. Cotton and linen are more difficult to dye than wool or silk. Their fibre is not so porous and will not hold the dye stuff without a more complicated preparation. The usual method of preparing linen or cotton is to boil it first with some astringent. The use of astringents in dyeing depends upon the tannic acid they contain. In combination with ordinary mordants, tannic acid aids the attraction of the colouring matter to the fibre and adds brilliancy to the colours. The astringents mostly used are tannic acid, gall nuts, sumach and myrobalams. Cotton has a natural attraction for tannic acid, so that when once steeped in its solution it is not easily removed by washing.

ALUM. (*Aluminium sulphate.*)-This is the most

generally used of all the mordants, and has been known as such from early times in many parts of the world. For most colours a certain proportion of cream of tartar should be added to the alum bath as it helps to brighten the ultimate colour. The usual amount of alum used is a quarter of a pound to every pound of wool. As a rule, less mordant is needed for light colours than for dark. An excess of alum is apt to make the wool sticky.

"For dyeing worsted and stuffs yellow, you make use of the usual preparation, viz., of tartar and alum. You allow four ounces of alum to every pound of wool, or twenty-five pounds to every hundred. With regard to the tartar, one ounce to every pound is sufficient for yellow, though it requires two for red."—*Hellot.*

The usual length of time for boiling with alum is from $\frac{1}{2}$ an hour to 1 hour; but some dyers give as much as $2\frac{1}{2}$ hours.

Various examples of mordanting with alum.—

For silk. Wet out the silk thoroughly with water and wring out. Then work it about a little in a strong solution of alum, previously dissolved in hot

water, and steep for several hours (or over night). Then wash well. It should not be allowed to dry before dyeing. "Silks are always alumed in the cold, because when they are alumed in a hot bath, they are apt to lose a portion of their lustre." *Berthollet.*

For wool. $\frac{1}{4}$lb. of Alum and 1 oz. Cream of tartar for every pound of wool. This is dissolved and when the water is warm the wool is entered. Raise to boiling point and boil for one hour. The bath is then taken off the fire and allowed to cool over night. The wool is then wrung out (not washed) and put away in a linen bag in cool place for four or five days, when it is ready for dyeing.

For cotton and linen. After boiling in water (some use a sour water, some an alkaline ley) the cotton is put into the alum bath. $\frac{1}{4}$lb. of Alum to 1 lb. of cotton. The alum is dissolved in hot water with soda in the proportion of 1 part soda to 16 of alum. (Some add a small quantity of tartar and arsenic). The cotton is well worked in this solution and left 24 hours. It is then washed, and afterwards galled.

For linen. $\frac{1}{4}$lb. alum for every pound of linen. Boil for $2\frac{1}{2}$ hours and immediately put into the dye bath.

For wool. 6 to 8 per cent. of alum and 5 to 7 per cent. of tartar of the weight of wool.

IRON. *(Ferrous Sulphate, copperas, green vitriol)*

Iron is one of the oldest mordants known and is largely used in wool and cotton dyeing. It is almost as important as alum. With wool it should be used in combination with cream of tartar. The temperature of the mordanting bath must be raised very gradually to boiling point or the wool will dye unevenly. A general method of dealing with copperas is to boil the wool first in a decoction of the colouring matter and then add the mordant to the same bath in a proportion of 5 to 8 per cent. of the weight of wool: and continue boiling for half an hour or so longer. With some dyes a separate bath is needed, such as with Camwood or Catechu. If used for cotton, the cotton is first dyed in a boiling decoction of the dye stuff and then passed through a cold solution of ferrous sulphate. Probably the commonest way of applying copperas in cotton dyeing is to prepare the cotton with tannin, pass through clear lime water and then through a copperas solution. Great care is needed in the using of

copperas, as, unless it is thoroughly dissolved and mixed with the water before the wool is entered, it is apt to stain the wool. It also hardens wool if used in excess, or if boiled too long.

Copperas is mostly used for the fixing of wool colours (Fustic etc.) to produce brown shades by the "stuffing and saddening" method (see page 14), the wool being boiled first in a decoction of the dye for about an hour, and then for ½ an hour with the addition of 5 to 8 per cent. of copperas. If used for darkening colours, copperas is added to the bath, after the dyeing, and the boiling continued for 15 to 20 minutes.

Examples of various proportions for Mordanting.—

8 per cent. of copperas and 20 per cent of cream of tartar is a mordant used for some colours.

4 per cent. copperas 10 per cent. cream of tartar gives good olive colours with weld.

8 per cent. copperas without tartar with single bath method, for dark olive brown with old fustic.

2 oz. copperas and 2 oz. cream of tartar to 2½ lbs. wool.

2 oz. copperas, 1½ oz. oxalic acid to 2½ lbs. wool.

TIN.— (*Stannous chloride, tin crystals, tin salts, muriate of tin.*)

Tin is not so useful as a mordant in itself, but as a modifying agent with other mordants. It must be always used with great care, as it tends to harden the wool, making it harsh and brittle. Its general effect is to give brighter, clearer and faster colours than the other mordants. When used as a mordant before dyeing, the wool is entered into the cold mordanting bath, containing 4 per cent. of stannous chloride and 2 per cent. oxalic acid: the temperature is gradually raised to boiling, and kept at this temperature for 1 hour. It is sometimes added to the dye bath towards the end of dyeing, to intensify and brighten the colour. It is also used with cochineal for scarlet on wool, in the proportion of 6 per cent. of stannous chloride and 4 per cent. of cream of tartar. Boil for 1 to 1 $\frac{1}{2}$ hours. Then wash well. The washing after mordanting is not always essential. Also 6 to 8 per cent. of oxalic acid and 6 per cent. of stannous chloride, for cochineal on wool. This mordant produces bright fast yellows from old fustic, by boiling the wool from 1 to 1 $\frac{1}{4}$ hours, with 8 per cent. of stannous chloride and 8 per cent. of

cream of tartar. One recipe gives 2 oz. tin and $4\frac{1}{2}$ oz. cream of tartar to $2\frac{1}{2}$ lbs. wool in 10 gallons of water. It is not a suitable mordant alone for cotton, but can be used to brighten the colour in combination with other mordants. "The nitro-muriate of tin (dyer's spirit) although it produces good yellows with quercitron bark, produces them in a much weaker degree than the murio-sulphate of that metal, which is really the cheapest and most efficacious of all the solutions or preparations of tin for dyeing quercitron as well as the cochineal colours" *Bancroft.*

CHROME. *(Potassium dichromate. Bichromate of Potash.)*

Chrome is a modern mordant, unknown to the dyer of 50 years ago. It is excellent for wool and is easy to use and very effective in its action. Its great advantage is that it leaves the wool soft to the touch, whereas the other mordants are apt to harden the wool. In commercial dyeing it is now almost exclusively used, as it has proved itself the most generally convenient. By some it is said not to be so fast to light as the other mordants, but it produces brighter colours. The wool should be boiled for

one to one & a half hours with bichromate of potash in the proportion of 2 to 4 per cent. of the wool. It is then washed well and immediately dyed. Wool mordanted with chrome should not be exposed to light, but should be kept well covered with the liquid while being mordanted, else it is liable to dye unevenly. An excess of chrome impairs the colour. 3 per cent. of chrome is a safe quantity to use for ordinary dyeing. One recipe gives 1 $\frac{1}{2}$ oz. of chrome to 2 $\frac{1}{2}$ lbs. of wool. It should be dissolved in the bath while the water is heating. The wool is entered and the bath gradually raised to the boiling point, and boiled for three quarters of an hour.

In the dyeing of cotton, it is used for catechu browns and other colours. The cotton is soaked in a decoction of catechu, and afterwards passed through a boiling solution of chrome, or it is worked for half an hour in a bath of chrome at 60° C., and then washed. It is usual to wash wool or cotton after mordanting with chrome, but some dyers do not think it necessary.

COPPER. *(Copper Sulphate, Verdigris, blue vitriol, blue-stone).*

Copper is rarely used as a mordant. It is usually

applied as a saddening agent, that is, the wool is dyed first, and the mordant applied afterwards to fix the colour. With cream of tartar it is used sometimes as an ordinary mordant before dyeing, but the colours so produced have no advantage over colours mordanted by easier methods.

EXAMPLES.—6 per cent of copper is used as a mordant for weld to produce an olive yellow. 4 to 5 per cent. is used with old fustic for yellow. 10 per cent. of copper gives to wool a reddish purple with cochineal.

Mordants should not affect the physical characteristics of the fibres. Sufficient time must be allowed for the mordant to penetrate the fibre thoroughly. If the mordant is only superficial, the dye will be uneven: it will fade and will not be as brilliant as it should be. The brilliancy and fastness of Eastern dyes are probably due to a great extent to the length of time taken over the various processes of dyeing. *The longer time that can be given to each process, the more satisfactory will be the result.*

Different mordants give different colours with the same dye stuff. For example:—Cochineal, if

mordanted with alum, will give a crimson colour; with iron, purple; with tin, scarlet; and with chrome or copper, purple. Logwood, also, if mordanted with alum, gives a mauve colour; if mordanted with chrome, it gives a blue. Fustic, weld, and most of the yellow dyes, give a greeny yellow with alum, but an old gold colour with chrome; and fawns of various shades with other mordants.

TANNIN.—*(Tannic Acid.)*—Tannins are used in the dyeing of cotton and linen. Cotton and linen possess the remarkable power of attracting tannins from their aqueous solution, and when these substances are prepared with tannins, they are able to retain dyes permanently. Cotton saturated with tannin, attracts the dye stuff more rapidly, and holds it. Tannic acid is the best tannin for mordanting cotton and linen, as it is the purest and is free from any other colouring matter. It is, therefore, used for pale and bright shades. But for dark shades, substances containing tannic acid are used, such as sumach, myrobalans, valonia, divi-divi, oak galls, chesnut (8 to 10 per cent of tannin), catechu.

Cotton and linen are prepared with tannin after they have been through the required cleansing, and

if necessary, bleaching operations. A bath is prepared with 2 to 5 per cent. of tannic acid of the weight of the cotton, and a sufficient quantity of water. For dark shades, 5 to 10 per cent. should be used. The bath is used either hot or cold. It should not be above 60° C. The cotton is worked in this for some time, and then left to soak for 3 to 12 hours, while the bath cools. It is then wrung out and slightly washed.

The following gives the relative proportions of the various substances containing tannin :—1 lb. tannin *equals* 4 lbs. sumach, 18 lbs. myrobalans, 14. lbs. divi-divi, 11 lbs. oak galls.

A few examples taken from various recipes of cotton dyeing :—

For 10 lbs. cotton use 12 oz. tannin.
„ 50 „ „ „ 10 lbs. sumach.
„ 40 „ „ „ 10 lbs. „
„ 20 „ „ „ 2 lbs. yellow catechu or black catechu.
„ 20 „ „ spend 3 lbs. of catechu with 3 oz. of blue vitriol.

Some recipes soak the cotton for 24 hours, others for 48 hours.

CHAPTER IV

BRITISH DYE PLANTS

The introduction of foreign dye woods and other dyes during the 17th and 18th centuries rapidly displaced the native dye plants, except in certain out of the way places such as the Highlands and parts of Ireland. Some of these British dye plants had been used from early historical times for dyeing. Some few are still in use in commercial dye work (pear, sloe, and a few others); but their disuse was practically completed during the 19th century when the chemical dyes ousted them from the market.

The majority of these plants are not very important as dyes, and could not probably now be collected in sufficient quantities. Some few however are important, such as woad, weld, heather, walnut, alder, oak, some lichens; and many of the less

important ones would produce valuable colours if experiments were made with the right mordants. Those which have been in use in the Highlands are most of them good dyes. Among these are Ladies Bedstraw, whortleberry, yellow iris, bracken, bramble, meadow sweet, alder, heather and many others. The yellow dyes are the most plentiful, and many of these are good fast colours. Practically no good red, in quantity, is obtainable. Madder is the only reliable red dye among plants, and that is no longer indigenous in England. Most of the dye plants require a preparation of the material to be dyed, with alum, or some other mordant, but a few, such as Barberry, and some of the lichens, are substantive dyes, and require no mordant.

PLANTS WHICH DYE RED.—

Potentil. *Potentilla Tormentilla.* Roots.
Wild Madder. *Rubia peregrina.*
Lady's Bedstraw. *Galium verum.* Roots.
Gromwell. *Lithospermum arvense.*
Marsh Potentil. *Potentilla Comarum.* Roots.
Birch. *Betula alba.* Fresh inner bark.
Bed-straw. *Gallium boreale.* Roots.

Common Sorrel. *Rumex acetosa.* Roots.
Evergreen Alkanet. *Anchusa sempervirens.*
With chloride of tin.
Dyer's Woodruff. *Asperula tinctoria.* Roots.

PLANTS WHICH DYE BLUE.—

Woad. *Isatis Tinctoria.*
Whortleberry or blaeberry. *Vaccinium Myrtillus.* Berries.
Elder. *Sambucus nigra.* Berries.
Privet. *Ligustrum vulgare.* Berries, with alum and salt.
* Sloe. *Prunus communis.* Fruit.
Red bearberry. *Arctostaphylos Uva-Ursi.*
Dogs Mercury. *Mercurialis perennis.*
Yellow Iris. *Iris Pseudacorus.* Root.
Devil's Bit. *Scabiosa succisa.* Leaves prepared like woad.

PLANTS WHICH DYE YELLOW.—

Weld. *Reseda luteola.*

* "On boiling sloes, their juice becomes red, and the red dye which it imparts to linen changes, when washed with soap, into a bluish colour, which is permanent."

Meadow Rue. *Thalictrum flavum.* Roots.
Marsh Marigold. *Caltha palustris.* Flowers.
S. John's Wort. *Hypericum perforatum.*
Heath. *Erica vulgaris.* With Alum.
Spindle tree. *Euonymus Europæus.*
Buckthorn. *Rhamnus frangula* and *R. cathartica.* Berries and Bark.
† Dyer's Greenwood. *Genista tinctoria.* Young shoots and leaves.
Kidney Vetch. *Anthyllis Vulnararia.*
Marsh Potentil. *Potentilla Comarum.*
Ling. *Calluna vulgaris.*
Yellow Centaury. *Chlora perfoliata.*
Hornbeam. *Carpinus Betulus.* Bark.
Hedge stachys. *Stachys palustris.*
Polygonum Persecaria.
Polygonum Hydropiper.
Hop. *Humulus lupulus.*
Stinking Willy, or Ragweed. *Senecio Jacobæa*
Yellow Camomile. *Anthemis tinctoria.*
Common dock. *Rumex obtusifolius.* Root.

† "For giving very inferior yellow upon coarser woollens, the dyer's broom, *genista tinctoria*, is sometimes employed, with the common preparation of alum and tartar."

‡‡ Sawwort. *Serratula tinctoria.*

Gorse. *Ulex Europæus.* Bark, flowers and young shoots.

Broom. *Sarothamnus scoparius.*

Bracken. *Pteris aquilina.* Roots. Also young tops.

Way-faring tree. *Viburnum lantana.* Leaves, with alum.

Bramble. *Rubus fructicosus.*

Nettle. *Urtica.* With alum.

Bog Myrtle or Sweet Gale. *Myrica Gale.*

Teasel. *Dipsacus Sylvestris.*

Sundew. *Drosera.*

Barberry. *Berberis vulgaris.* Stem and root.

Bog asphodel. *Narthecium ossifragum.*

Agrimony. *Agrimonia Eupatoria.*

Yellow corydal. *Corydalis lutea.*

Privet. *Ligustrum vulgare.* Leaves.

Crab Apple. *Pyrus Malus.* Fresh inner bark.

Ash. *Fraxinus excelsior.* Fresh inner bark.

Pear. Leaves.

‡ Sawwort which grows abundantly in meadows affords a very fine pure yellow with alum mordant, which greatly resembles weld yellow. It is extremely permanent."

Poplar. Leaves.
Plum. „
Birch. „
§ Willow. „

PLANTS WHICH DYE GREEN.—

Privet. *Ligustrum vulgare.* Berries and leaves, with alum.

Flowering reed. *Phragmites communis.* Flowering tops, with copperas.

Elder. *Sambucus nigra.* Leaves with alum.

Nettle. *Urtica dioica* and *U. Urens.*

§ "The leaves of the sweet willow, *salix pentandra*, gathered at the end of August and dried in the shade, afford, if boiled with about one thirtieth potash, a fine yellow colour to wool, silk and thread, with alum basis. All the 5 species of Erica or heath growing on this island are capable of affording yellows much like those from the dyer's broom; also the bark and shoots of the Lombardy poplar, *populus pyramidalis.* The three leaved hellebore, *helleborus trifolius*, for dyeing wool yellow is used in Canada. The seeds of the purple trefoil, lucerne, and fenugreek, the flowers of the French marigold, the chamomile, *antemis tinctoria*, the ash, *fraxinus excelsior*, fumitory, *fumaria officinalis*, dye wool yellow." "The American golden rod, *solidago canadensis*, affords a very beautiful yellow to wool, silk and cotton upon an aluminous basis."—*Bancroft.*

Lily of the valley. *Convalaria majalis.* Leaves.
Larch. Bark, with alum.

PLANTS WHICH DYE BROWN.—

Whortleberry. *Vaccinium Myrtillus.* Young shoots, with nut galls.
Larch. Pine needles, collected in Autumn.
Walnut. Root and green husks of nut.
Water Lily. *Nymphæa alba.* Root.
Alder. *Alnus glutinosa.* Bark.
Birch. *Betula alba.* Bark.
Oak. *Quercus Robur.* Bark.
Red currants, with alum.
Hop. *Humulus lupulus.* Stalks give a brownish red colour.

PLANTS WHICH DYE PURPLE.—

Whortleberry or blaeberry. *Vaccinium myrtillus.* Berries. "It contains a blue or purple dye which will dye wool and silk without mordant."
Deadly nightshade. *Atropa Belladonna.*
Sundew. *Drosera.*
Bryony. *Bryonia dioica.* Berries.
Danewort. *Sambucus Ebulus.* Berries.

Elder. *Sambucus nigra.* Berries, with alum, a violet; with alum and salt, a lilac colour.

Dandelion. *Taraxacum Dens-leonis.* Roots. Dyes a magenta colour.

Damson. Fruit, with alum.

PLANTS WHICH DYE BLACK.—

Alder. *Alnus glutinosa.* Bark with copperas.

Blackberry. *Rubus fruticosus.* Young shoots, with salts of iron.

Dock. *Rumex.* Root.

Iris. *Iris Pseudacorus.* Root.

Meadowsweet. *Spirea Ulmaria.*

Oak. Bark and acorns.

Elder. Bark, with copperas.

CHAPTER. V.

THE LICHEN DYES.

Some of the most useful dyes and the least known are to be found among the Lichens. They seem to have been used among peasant dyers from remote ages, but apparently none of the great French dyers used them, nor are they mentioned in any of the old books on dyeing. The only Lichen dyes that are known generally among dyers are Orchil and Cudbear, and these are preparations of lichens, not the lichens themselves. They are still used in some quantity and are prepared rather elaborately. But a great many of the ordinary Lichens yield very good and permanent dyes. The Parmelia saxatilis and P. omphaloides, are largely used in the Highlands & West Ireland, for dyeing brown of all shades. No

mordant is needed, and the colours produced are the fastest known. "Crottle," is the general name for Lichens, in Scotland. They are gathered off the rocks in July and August, dried in the sun, and used to dye wool, without any preparation. The crottle is put into the dye bath with a sufficient quantity of water, boiled up and allowed to cool and then boiled up with the wool until the shade required is got. This may take from one to three or four hours, as the dye is not rapidly taken up by the wool. Other dyers use it in the following way :—A layer of crottle, a layer of wool, and so on until the bath is full; fill up with cold water and bring to the boil, and boil till the colour is deep enough. Some of the finest browns are got in this way. The wool does not seem to be affected by keeping it in the dye a long time. A small quantity of acetic acid put in with the Lichen is said to assist in exhausting the colour.

The grey Lichen *Ramalina scopulorum*, dyes a fine shade of yellow brown. It grows very plentifully on old stone walls, especially by the sea, and in damp woods, on trees, and on old rotten wood. Boil the Lichen up in sufficient water one day, and the next day put in the wool, and boil up again till the right

colour is got. If the wool is left in the dye for a day or more after boiling, it absorbs more colour, and it does not hurt the wool, but leaves it soft and silky to the touch, though apt to be uneven in colour. Some mordant the wool first with alum, but it does not seem to need it.

The best known of the dye Lichens are Parmelia saxatilis, and Parmelia omphalodes, which are still largely used in Scotland and Ireland for dyeing wool for tweeds. The well known Harris tweed smell is partly due to the use of this dye.

Other Lichens also known for their dyeing properties are :—Parmelia caperata or Stone Crottle which contains a yellow dye, P. ceratophylla, or Dark Crottle, and P. parietina, the common wall lichen, which gives a colour similar to the colour of the lichen itself, yellowish brown. In *Bancroft's* "Philosophy of Permanent Colours" is to be found the following—"Besides the lichens, whose colour depends upon a combination with the ammonia, there are some which afford substantive colours, less beautiful indeed, but more durable, by merely boiling with water. One of these is the muscus pulmonarius of Caspar Bauhine, or the lichenoides pulmo-

nium reticulatum vulgare marginibus peltiferus of Dillenius, called Rags and Stone Rags, in the northern parts of England, which, without any mordant, dyes a very durable dark brown colour upon white wool or cloth, and a fine lasting black upon wool or cloth which has previously received a dark blue from Indigo." The following occurs in an old Scottish history.—"There is one excresence gotton off the craigs which they call cork-lit, and make use thereof for litting, or dyeing a kind of purple colour." Another lichen, taken from trees in Scotland, was used for producing an orange tint, called Philamort. The tree lichen was called wood-raw, or rags, to distinguish it from stone lichen, or stone-raw. A deep red colour was got from the dull grey friable lichen, common on old stone walls, which was scraped off, with a metal scraper. The bright yellow lichen, growing on rocks and walls, and old roofs, dyes a fine plum colour, if the wool is mordanted first with Bichromate of Potash. There is a difficulty, however, in getting enough of this lichen to make the dyeing with it practicable.

The colour of the plant is no indication of the colorific power. That is often greatly modified by

the conditions of its growth,—such as climate, elevation above the sea, nearness or distance from the sea, age, season when gathered, habitat. The best season for gathering most lichens, is late summer and autumn.

In Sweden, Scotland and other countries, the peasantry use a lichen, called *Lecanora tartarea*, to furnish a red or crimson dye.

In Shetland, the *Parmelia saxatilis* (Scrottyie) is used to dye brown. It is found in abundance on argillaceous rocks. It is considered best if gathered late in the year, and is generally collected in August. Immediately after being collected, an iron vessel is filled with it, and stale urine then poured over it, till the vessel is full. This is slowly boiled until the plant begins to assume a mucillaginous appearance, which generally takes place in about 2 hours. When taken off the fire, it has the consistence of a thin jelly, but it speedily hardens until it is nearly as thick as porridge, and its colour becomes a dark rusty grey. It is then folded in the cloth, layer by layer of Scrottyie and cloth alternately, and all is boiled for about 20 minutes, in soft water, in which a little alum has been dissolved. It is then taken off

the fire and the cloth washed in cold water, when the process of dyeing is complete. The Scrottyie, taken from between the folds of the cloth, is used several times for dyeing, on being treated again in the same manner.

The plant used in Shetland for the red dye is the *Lecanora tartarea*. It is found abundantly on almost all rocks and also grows on dry moors, along with *Cladonia sangiferina*. (If a particle of the latter is allowed to be intermixed with the dye, it is supposed to be spoiled.) The lichen, and the dye made from it, are called Korkalett. This lichen is collected in May and June, and steeped in stale urine for about 3 weeks, being kept at a moderate heat all the time. The substance having then a thick and strong texture, like bread, and being of a bluish black colour, is taken out and made into small cakes of about $\frac{3}{4}$ lb. in weight, which are wrapped in dock leaves and hung up to dry in peat smoke. When dry it may be preserved fit for use for many years; when wanted for dyeing it is partially dissolved in warm water till of the consistence of Scrottyie, the dyeing proceeds in the same manner; 5 lbs. of korkalett being considered sufficient for about 4 Scotch

ells of cloth. The colour produced is a light red. It is much used in the dyeing of yarn as well as cloth. The yarn is simply boiled in it without folding as in the case of cloth.*

Linnæus mentions that a beautiful red colour may be prepared from Lichen pustulatus, *Gyrophora pustulata*. *G. cylindrica* is used by Icelanders for dyeing woollen stuffs a brownish green colour. In Sweden and Norway, *Evernia vulpina* is used for dyeing woollen stuffs yellow. Iceland moss, *Cetraria Islandica*, is used in Iceland for dyeing brown. *Usnea barbata* is collected from trees in Pennsylvania & used for an orange colour for yarn.

Lecanora tartarea (corcur of the Scottish Highlanders) dyes a claret. It is usually prepared by pounding the lichen and mixing it with stale chamberley, to which a little salt or kelp is added; this mixture is kept for several weeks, and frequently stirred; being then brought to the consistence of coarse paste, it is made up into balls, with a little lime or burnt shells, and is kept ready for use. When used, it is coarsely powdered and a small portion of alum is generally added.

*T. Edmonston. *On the Native Dyes of the Shetland Islands* 1841.

A general method for using lichens is suggested by Dr. Westring of Sweden, in his "Experiments on Lichens for Dyeing Wools and Silks." He says:

"The Lichens should be gathered after some days of rain, they can then be more easily detached from the rocks. They should be well washed, dried and reduced to a fine powder: 25 parts pure river water are added to 1 of powdered lichen, and 1 part of fresh quick lime to 10 parts powdered lichen. To 10 lbs. lichen ½lb. sal ammoniac is sufficient when lime and sal ammoniac are used together. The vessel containing them should be kept covered for the first 2 or 3 days. Sometimes the addition of a little common salt or salt-petre will give greater lustre to the colours."*

This method can be followed by anyone wishing to experiment with Lichens. Dr. Westring did not use a mordant as a rule. Where the same species of Lichen grows on both rocks and trees, the specimens taken from rocks give the better colours.

ORCHIL OR ARCHIL AND CUDBEAR are substantive or non mordant dyes, obtained from Lichens of

* The *Annales de Chimie.* Stockholm Transactions 1792.

various species of Roccella growing on rocks in the Canary Islands and other tropical and sub-tropical countries. They used to be made in certain parts of Great Britain from various lichens, but the manufacture of these has almost entirely disappeared. They have been known from early times as dyes. They give beautiful purples and reds, but the colour is not very fast. The dye is produced by the action of ammonia and oxygen upon the crushed Lichens or weeds as they are called. The early way of producing the colour was by treating the Lichen with stale urine and slaked lime, and this method was followed in Scotland. Orchil is applied to wool by the simple process of boiling it in a neutral or slightly acid solution of the colouring matter. 3 % Sulphuric acid is a useful combination. Sometimes alum and tartar are used. It dyes slowly and evenly. It is used as a bottom for Indigo on wool and also for compound shades on wool and silk. For cotton and linen dyeing it is not used. It is rarely used by itself as the colour is fugitive, but by using a mordant of tin, the colour is made much more permanent.

"Archil is in general a very useful ingredient in dyeing; but as it is rich in colour, and communi-

cates an alluring bloom, dyers are often tempted to abuse it, and to exceed the proportions that can add to the beauty, without, at the same time, injuring in a dangerous manner the permanence of the colours. Nevertheless, the colour obtained when solution of tin is employed, is less fugitive than without this addition."†

Many of the British lichens produce colours by the same treatment as is used for producing Orchil. Large quantities were manufactured in Scotland from lichens gathered in the Shetland Islands and Western Highlands. This was called Cudbear. The species used by the Scottish Cudbear makers were generally *Lecanora tartarea* and *Urceolaria calcarea*; but the following lichens also give the purple colour on treatment with ammonia.—*Evernia prunastri*, *Lecanora pallescens*, *Umbilicaria vellea* *U. pustulata*, *Parmelia perlata*; whilst several others give colours of similar character, but of little commercial value. The manufacture of Archil and Cudbear from the various lichens is simple in principle. In all cases the plant is reduced

† The Art of Dyeing. *Berthollet.* He gives minute directions for the preparation of Archil. see page 365.

to a pulp with water and ammonia, and the mass kept at a moderate heat and allowed to ferment, the process taking two or three weeks to complete. The ammonia used to be added in the form of stale urine, and additions of slaked lime were made from time to time. § The general mode of treatment for the development from the dye lichens of orchil and cudbear consists of the following steps :—

1.—Careful washing, drying and cleaning, to separate earthy and other impurities.

2.—Pulverisation into a coarse or fine pulp with water.

3.—Regulated addition of ammonia of a certain strength and derived from various sources (putrid urine, gas liquor, etc.)

4.—Frequent stirring of the fermenting mass so as to ensure full exposure of every part thereof to the action of atmospheric oxygen.

5.—Addition of alkalis in some cases (e.g. potash or soda) to heighten or modify the colour ; and of chalk, gypsum and other substances, to

§ Some British Dye Lichens. *Alfred Edge.*

impart consistence. Various accessories are employed, e.g. the application of continued, moderate and carefully regulated heat during the process of fermentation.‡

RECIPES FOR DYEING WITH LICHENS.

To dye Brown with Crotal.

For 6¼ lbs. (100 oz.) of wool. Dye baths may be used of varying strengths of from 10 to 50 oz. of Crotal. Raise the bath to the boil, and boil for an hour. A light tan shade is got by first dipping the wool in a strong solution of Crotal, a darker shade by boiling for half-an-hour, and a dark brown by boiling for two hours or so. It is better, however, to get the shade by altering the quantity of Crotal used. The addition of sufficient oil of vitriol to make the bath slightly acid will be an improvement. (A very small quantity should be used).

To Dye Red with Crotal.—

Gather the lichen off the rocks—it is best in winter. Put layers of lichen and wool alternately in a

‡ From Dr. W. L. Lindsay, On Dyeing Properties of Lichens.

pot, fill up with water and boil until you get the desired tint. Too much crotal will make the wool a dark red brown, but a very pretty terra cotta red can be got. No mordant is required.

To Dye Pink from a bright yellow Lichen. (Parmelia parietina).

Mordant the wool with 3 % of Bichromate of Potash, then boil with the lichen for 1 hour or more.

To Dye Brown from Crotal.

Boil the wool with an equal quantity of lichen for 1 or 1½ hours. No mordant is required.

To dye red purple from Cudbear & Logwood.

Dye with equal quantities of Cudbear and Logwood, the wool having been mordanted with chrome. A lighter colour is got by dyeing with 8 lbs. cudbear and ½ lb. logwood (for 30 lbs. wool).

To Dye Yellow on Linen with the Lichen Peltigera canina (a large flat lichen growing on rocks in woods).

Mordant with alum, (¼ lb. to a lb. of linen) boil for 2 hours. Then boil up with sufficient quantity of the lichen till the desired colour is got.

LIST OF LICHENS USED BY THE PEASANTRY OF DIFFERENT COUNTRIES FOR WOOL DYEING.*

Shades of Red, Purple and Orange.

Roccella tinctoria. Orseille. Grows in the South of France, on rocks by the sea.

Lecanora tartarea. Crotal, Crottle, Corkur, Corcir, Korkir. Found in the Scotch Highlands and Islands, growing on rocks; used for the manufacture of Cudbear in Leith & Glasgow.

L. parella. Light Crottle, Crabs Eye Lichen. Found in Scotland, France, and England, on rocks and trees, formerly celebrated in the South of France in the making of the dye called Orseille d'Auvergne.

L. hæmatomma.—Bloody spotted lecanora, Black lecanora. Found in Scotland on rocks and trees.

* From an article by Dr. Lauder Lindsay on the "Dyeing Properties of Lichens," in the *Edinburgh Philosophical Journal.* July to October 1855.

Umbilicaria pustulata.—Blistered umbilicaria. Found on rocks in Norway and Sweden.

Isidium corallinum. White crottle. Found on rocks in Scotland.

I. Westringii. Westring's Isidium. Norway and Sweden.

Urceolaria calcarea. Corkir, Limestone Urceolaria. Found in Scotland, Western Islands, Shetland and Wales, growing on limestone rocks.

U. Scruposa. Rock Urcolaria. Grows on rocks in hilly districts in England.

U. cinerea. Greyish Urceolaria. In England, on rocks.

Parmelia saxatilis. Crottle, stane-raw, Staney-raw, (Scotland). Scrottyie, (Shetland). Sten-laf, Sten-mossa, (Norway and Sweden). Found on rocks and stones in Scotland, Shetland, and Scandinavia. In winter the Swedish peasantry wear home made garments dyed purple by this lichen. By the Shetlanders it is usually collected in August, when it is considered richest in colouring matter.

P. omphalodes. Black Crottle, Cork, Corker, Crostil or Crostal, (Scotch Highlands). Arcel, Ireland). Kenkerig, (Wales). Alaforel-leaf, (Sweden). Found on rocks, especially Alpine, in Scotland, Ireland, Wales and Scandinavia. One of the most extensively used dye-lichens. It yields a dark brown dye readily to boiling water, and it is easily fixed to yarns by simple mordants. It is stated to yield a red, crimson or purple dye.

P. caperata. Stone crottle, Arcel. Found in North of Ireland and Isle of Man, on trees. Said to dye yarn brown, orange and lemon yellow.

P. conspersa. Sprinkled parmelia. Found growing on rocks in England.

Evernia prunastri. Ragged hoary lichen. Stag's horn lichen. Found in Scotland, on trees.

Ramalina scopulorum. Ivory-like ramalina. Scotland, on maritime rocks. A red dye.

R. farinacea. Mealy ramalina. On trees in England.

Borrera ashney. Chutcheleera. India.

Solorina crocea. Saffron yellow solorina. In Scotland, on mountain summits. The colouring matter is ready formed and abundant in the thallus.

Nephroma parilis. Chocolate colored nephroma. Scotland, on stones, Said to dye blue.

Sticta pulmonacea. On trees.

Lecidea sanguinaria. Red fruited lecidea. In Scotland, on rocks.

Conicularia aculeata. var. *spadicea.* Brown prickly cornicularia. Canary Islands, Highland Mountains.

Usnea barbata. Bearded Usnea. Pennsylvania and South America. On old trees. Stated to dye yarn orange.

U. florida. Flowering lusnea. Pale greenish yellow or reddish brown.

U. plicata. Plaited usnea. On trees.

SHADES OF BROWN

Cetraria Islandica. Iceland moss. Iceland heaths, and hills. It yields a good brown to boiling

water, but this dye appears only to have been made available to the Icelanders.

Parmelia physoides. Dark crottle, Bjork-laf. Found in Sweden, Scotland & Scandinavia, on rocks and trees.

P. omphalodes. In Scandinavia and Scotland. Withering asserts that it yields a purple dye paler, but more permanent, than orchil; which is prepared in Iceland by steeping in stale lye, adding a little salt and making it up into balls with lime.

Sticta pulmonacea. Oak lung, Lungwort, Aikraw, Hazel-raw, Oak rag, Hazel rag, Hazel crottle, Rags. Found on trees in England, Scotland, North of Ireland, Scandinavia. It dyes wool orange and is said to have been used by the Herefordshire peasantry to dye stockings brown. Some species yield beautiful saffron or gamboge coloured dyes. e.g. *S. flava, crocata, aurata.*

For continuation of list see Appendix.

CHAPTER VI.

*BLUE

INDIGO, WOAD, LOGWOOD.

"Notwithstanding the very great facility of dyeing wool blue, when the blue vat is once prepared, it is far otherwise with regard to the preparation of this vat, which is actually the most difficult operation in the whole art of dyeing."—*Hellot.*

INDIGO

INDIGO is the blue matter extracted from a plant, *Indigofera tinctoria* & other species, growing in Asia,

* Early dyers were particular as to the naming of their colours. Here is a list of blues, published in 1669.—"White blue, pearl blue, pale blue, faint blue, delicate blue, sky blue, queen's blue, turkey blue, king's blue, garter blue, Persian blue, aldego blue, and infernal blue."

South America and Egypt. It reaches the market in a fine powder, which is insoluble in water. There are two ways of dyeing with indigo. It may be dissolved in sulphuric acid or oil of vitriol, thereby making an indigo extract. This process was discovered in 1740. It gives good blue colours, but is not very permanent. Darker colours by this method are more permanent than the paler ones. It does not dye cotton or linen.

The other method is by the indigo vat process, which produces fast colours, but is complicated and difficult. In order to colour with indigo, it has to be deprived of its oxygen. The deoxydised indigo is yellow, and in this state penetrates the woollen fibre; the more perfectly the indigo in a vat is deoxydised, the brighter and faster will be the colour. For the dyeing of wool, the vats are usually heated to a temperature of 50° C. Cotton and linen are generally dyed cold.

Hellot says "when the vat, of whatsoever kind it be, is once prepared in a proper state, there is no difficulty in dyeing woollens or stuffs, as it is requisite only to soak them in clean warm water, to wring them, and then to immerse them in the vat, for a

longer or shorter time, according as you would have the colour more or less deep. The stuff should be from time to time opened, that is to say, taken out and wrung over the vat and exposed to the air for a minute or two, till it becomes blue. For let your vat be what it will, the stuff will be green when taken out and will become blue when exposed to the air. In this manner it is very proper to let the colour change before you immerse your stuffs a second time, as you are thereby better enabled to judge whether they will require only one or several dips." —"The Art of Dyeing Wool," by *Hellot.*

The colour of the blue is brightened by passing the wool through boiling water after it comes out of the dye. Indigo is a substantive dye and consequently requires no mordant.

† 1). To Make Extract of Indigo.—

Put 2 lbs. of oil of vitriol into a glass bottle or jar, stir into it 8 oz. of powdered indigo, stirring briskly

† I give here recipes for the simpler vats which can be used on a small scale. The more complicated recipes can only be done in a well-fitted dye house. I would refer the reader to those in "The Art of Dyeing" by Hellot, Macquer and D'Appligny, and "Elements of the Art of Dyeing" by Berthollet.

for ½ hour, then cover up and stir 4 or 5 times a day for a few days, then add a little powdered chalk to neutralise the acid. It should be added slowly, little by little, as the chalk makes the acid bubble up. Keep it closely corked.

2). To Make Extract of Indigo.—

4 oz. sulphuric acid, ½ oz. finely ground Indigo. Mix like mustard, and leave to stand over-night. Prepare the wool by mordanting with 5 oz. alum to 1 lb. wool. Boil for ½ hour and dye without drying.

3). To Dye Wool with Indigo Extract

For 4 to 6 lbs. of wool. Stir 2 to 3 oz. of Indigo extract into the water of the dye bath. The amount is determined by the depth of shade required. When warm, enter the wool, and bring slowly to boiling point (about ½ hour) and continue boiling for another ½ hour. By keeping it below boiling point while dyeing, better colours are got, but it is apt to be uneven. Boiling levels the colour but makes the shade greener. This is corrected by adding to the dye bath a little logwood, 10 to 20 per cent. This should be boiled up separately, strained, and put in the bath before the wool is entered. Too

much should be avoided however, as it dims the colour. It can be done in the same bath, but better results are got by separate baths. Instead of log-wood a little madder is sometimes used; also Cud-bear or Barwood.

4). To Dye Silk with Indigo Extract.

Dye at a temperature of 40 to 50° C. in a bath with a little sulphuric acid and the amount of indigo as is needed for the colour. Another method is to mordant the silk first with alum by steeping it for 12 hours in a solution of 25 per cent. and then, without washing, to dye with the Indigo Extract and about 10% of alum added to the dye bath. By this means compound colours can be made by the addition of cochineal, for purple, or old Fustic, Log-wood, etc., for greys browns and other colours.

5). Saxon Blue.—

Put into a glazed earthen pot 4 lbs. of good oil of vitriol with 12 oz. of choice Indigo, stir this mixture very hastily and frequently in order to excite a fermentation. It is customary with some Dyers to put into this composition a little antimony or salt-petre, tartar, chalk, alum and other things, but I find

it sufficient to mix the oil and Indigo alone, and the colours will be finer, for those neutral salts destroy the acid of the vitriol and sully the colour. In 24 hours it is fit for use. Then a copper of a good size is to be filled with fair water (into which one peck of bran is put in a bag) and made pretty warm, the bran after yielding its flower must be taken out, and the Chymie, (Indigo Extract) mixed well with water in a Piggin, (a small pot) is put in according to the shade required, having first put in a hand-ful of powdered tartar; the cloth is to be well wet and worked very quick over the winch (stick on which it is hung) for half an hour. The liquor must not be made hotter than for madder red (just under boiling point). The hot acid of the vitriol would cause the blue to incline to green if too much heat was given. (From an old Dye Book).

6). To Make up a Blue Vat.—

Take 1 lb. Indigo thoroughly ground, put this into a deep vessel with about 12 gallons of water, add 2lbs. copperas, and 3 lbs. newly slaked lime, and stir for 15 minutes. Stir again after 2 hours and repeat every 2 hours for 5 or 6 times. Towards the

end, the liquor should be a greenish yellow colour, with blackish veins through it, and a rich froth of Indigo on the surface. After standing 8 hours to settle, the vat is fit to use.

7). TURQUOISE FOR WOOL.—

Mordant with alum. For a pale shade use 1 teaspoonful of Indigo Extract (see No. 2) for 1 lb. of wool. Boil $\frac{1}{4}$ hour.

8). BLUE FOR WOOL. (Highlands).

Take a sufficiency of Indigo. (For medium shade about 1 oz. to every pound of wool). Dissolve it in about as much stale urine (about a fortnight old) as will make a bath for the wool. Make it lukewarm. Put in the wool and keep it at the same temperature till the dyeing is done. For a deep navy blue it will take a month, but a pale blue will be done in 3 or 4 days. Every morning and evening the wool must be taken out of the dye bath, wrung out and put back again. The bath must be kept covered and the temperature carefully attended to. Some add a decoction of dock roots the last day, which is said to fix the blue. The wool must then be thoroughly washed. This is a fast dye.

9). INDIGO VAT. (For small dyers).

Add to 500 litres of stale urine 3 to 4 kilos of common salt and heat the mixture to 50° to 60° C., for 4 to 5 hours with frequent stirring, then add 1 kilo of madder, 1 kilo of ground Indigo, stir well, and allow to ferment till the Indigo is reduced.

10). SAXON BLUE. (*Berthollet*).

Prepare the wool with alum and tartar. A smaller or greater proportion of the Indigo solution is put into the bath, (1 part of Indigo with 8 parts of sulphuric acid, digested for 24 hours), according to the depth of shade wished to be obtained. For deep shades it is advantageous to pour in the solution by portions, lifting out the wool from the bath while it is being added. The cold bath acts as well as the hot.

11). THE COLD INDIGO VAT WITH URINE.

Take 4 lbs. of powdered Indigo and put it into a gallon of vinegar, leaving it to digest over a slow fire for 24 hours. At the end of this time the Indigo should be quite dissolved. If not dissolved pound it up with some of the liquor adding a little urine. Put into it $\frac{1}{2}$ lb. madder, mixing it well. Then pour

it into a cask containing 60 gallons of urine (fresh or stale). Mix and stir the whole together; this should be done morning and evening for 8 days or until the surface becomes green when stirred, and produces froth. It may be worked immediately without any other preparation than stirring it 3 or 4 hours before-hand. This kind of vat is extremely convenient, because when once prepared it remains so always until it is entirely exhausted. According as you would have your vat larger or smaller you reduce or enlarge the amount of the ingredients used in the same proportion as the original. This vat is sooner prepared in summer than in winter.

12). INDIGO VAT ON A SMALL SCALE FOR WOOLLENS AND COTTONS.—

Have a strong 9 gallon cask, put into it 8 gallons of urine, have a 4 quart pickle jar, into which put 1 lb. ground Indigo and 3 pints of best vinegar; put the jar into a saucepan filled with water, and make it boil well for 2 hours, stirring it all the time. Let it stand in a warm place for 3 days, then pour it into the cask; rake it up twice a day for a month. It must be covered from the air.

13). Blue Vat for Woollens.—

For every 20 gallons of water add 5 oz. ground Indigo, 8 oz. of potash, 3 oz. madder, and 4 oz. bran. Keep the solution at 140° F.; after 24 hours the whole will have begun to ferment, then add 2 oz. madder, stir and allow the whole to settle, after which the vat is ready for use.

14). To Dye Indigo Blue. Urine Vat.—

Prepare vat as follows:—To 3½ gallons of stale urine add 4½ oz. of common salt, and heat the mixture to 125° F. (as hot as the hand can bear). Keep at this heat for 4 to 5 hours, frequently stirring, then add 1¼ oz. thoroughly ground Indigo and 1¼ oz. Madder, stir well and allow to ferment till the Indigo is reduced. This is recognized by the appearance of the vat, which should be of a greenish yellow colour, with streaks of blue. Allow the vat to settle, when you can proceed with dyeing. Process of dyeing the same as in No. 15.

15). To Dye Indigo Blue.—Potash Vat.—

Into a pot 3 parts full of water put 1½ oz. Madder and 1½ oz. bran. Heat to nearly boiling, and keep at this heat for 3 hours. Then add 5 oz. Carbonate

of Potash; allow Potash to dissolve and let the liquor cool down till luke-warm. Then add 5 oz. thoroughly ground Indigo, stir well and leave to ferment for two days, occasionally stirring, every 12 hours or so. Wool dyed in this vat must be thoroughly washed after the colour is obtained.

Process of Dyeing.—Into a vat prepared as above, dip the wool. Keep it under the vat liquor, gently moving about a sufficient time to obtain the colour required. A light blue is obtained in a few seconds, darker blues take longer. Take out wool, and thoroughly squeeze out of it all the dye liquor back into the vat. Spread out the wool on the ground, exposed to the air till the full depth of colour is developed. The wool comes out of the vat a greenish shade, but the oxygen in the air darkens it, through oxydation, to indigo blue. The wool should now be washed in cold water with a little acid added to it, and again thoroughly rinsed and dried.

16). Blue Vat for Cotton.—

In a clean tub put 10 pails of water, slacken 1 bushel of lime into it, and cover while slackening; put 6 lbs. ground Indigo in a pot and mix it into a

paste with hot water and then put 4 pails of boiling water on to it, stir it, cover it, and leave it. In another pot, put 20 lbs. copperas, pour 4 pails of water on this, stir it and leave it covered. Pour 4 pails of water on the top of the lime that is slackening, rake it up well and put in the melted copperas; rake it well and put in the Indigo; stir well and leave covered for a couple of days, stirring occasionally. Half fill a new vat with the mixture. Rake it well and while you are raking, fill it up with clean water, continue raking for an hour. Cover it over; it can be used the next day. This is a colour that never washes out.

17). GLOUCESTERSHIRE INDIGO VAT.

Size 5 feet over the top: 7 feet deep, 6 to 7 feet at the bottom.

Take $\frac{1}{2}$ cwt. bran, $\frac{1}{4}$ peck lime and 40 lbs. indigo. Warm up to 180 to 200° F., rake it 4 times a day. If it ferments too much add more lime: if not enough, more bran. An experienced eye or nose will soon tell when it is ripe or fit to use, which should be in about 3 days. Regulate the strength of the vat from time to time to the colour required. No madder or woad is used when much permanency is wanted.

18). Cold Indigo Vat for Dyeing Wool, Silk, Linen and Cotton.

1 part Indigo, 3 parts good quicklime, 3 parts English vitriol, and 1½ parts of orpiment. The Indigo is mixed with water, and the lime added, stirred well, covered up, and left for some hours. The powdered vitriol is then added, and the vat stirred and covered up. After some hours the orpiment powder is thrown in and the mixture is left for some hours. It is then stirred well and allowed to rest till the liquid at the top becomes clear. It is then fit for dyeing.

WOAD

Woad is derived from a plant, *Isatis tinctoria*, growing in the North of France and in England. It was the only blue dye in the West before Indigo was introduced from India. Since then woad has been little used except as a fermenting agent for the indigo vat. It dyes woollen cloth a greenish colour which changes to a deep blue in the air. It is said to be inferior in colour to indigo but the colour is much more permanent. The leaves when cut are reduced to a paste, kept in heaps for about fifteen

days to ferment, and then formed into balls which are dried in the sun; these have a rather agreeable smell and are of a violet colour. These balls are subjected to a further fermentation of 9 weeks before being used by the dyer. When woad is now used it is always in combination with Indigo, to improve the colour. Even by itself, however, it yields a good and very permanent blue.

It is not now known how the ancients prepared the blue dye, but it has been stated (Dr. Plowright) that woad leaves when covered with boiling water, weighted down for half-an-hour, the water then poured off, treated with caustic potash and subsequently with hydrochloric acid, yield a good Indigo blue. If the time of infusion be increased, greens and browns are obtained. It is supposed that woad was "vitrum," the dye with which Cæsar said almost all the Britons stained their bodies. It is said to grow near Tewkesbury, also Banbury. It was cultivated till quite lately in Lincolnshire. There were four farms in 1896; one at Parson Drove, near Wisbech, two farms at Holbeach, and one near Bos-

ton. Indigo has quite superseded it in commerce.*

"It is like the Indigo plant, but less delicate and rich. It is put in vats with Indigo and madder to dye a never-fading dark blue on wool, and was called woad-vats before Indigo was known." (Thomas Love). And again "Woad, or what is much stronger, pastel, always dyed the blue woollens of Europe until Indigo was brought over here."

Bancroft says "Woad alone dyes a blue colour very durable, but less vivid and beautiful than that of Indigo."

LOGWOOD

(Bois de Campêche, Campeachy Wood)

Logwood is a dye wood from Central America, used for producing blues and purples on wool, black on cotton and wool, and black and violet on silk. It is called by the old dyers, one of the Lesser Dyes, because the colour loses all its brightness when exposed to the air. But with proper mordants and with careful dyeing this dye can produce fast and

* Woad, pastel and Indigo are used in some dye books to mean the same dye, and they evidently have very much the same preparation in making.

good colours. Queen Elizabeth's government issued an enactment entirely forbidding the use of logwood. The act is entitled "An Act for the abolishing of certeine deceitful stuffe used in the dyeing of clothes," and it goes on to state that "Whereas there hath been brought from beyond the seas a certeine kind of stuff called logwood, alias blockwood, wherewith divers dyers," etc., and "Whereas the clothes therewith dyed, are not only solde and uttered to the great deceit of the Queene's loving subjects, but beyond the seas, to the great discredit and sclaunder of the dyers of this realme. For reformation whereof, be it enacted by the Queene our Soveraygne Ladie, that all such logwood, in whose handes soever founde, shall be openly burned by authoritie of the maior." The person so offending was liable to imprisonment and the pillory. This is quoted from "The Art of Dyeing," by James Napier, written in 1853. He goes on to say, "Upwards of eighty years elapsed before the real virtues of this dyeing agent were acknowledged; and there is no dyewood we know so universally used, and so universally useful." The principal use for logwood is in

making blacks and greys. The logwood chips should be put in a bag and boiled for 20 minutes to ½ hour, just before using. "Logwood is used with galls and copperas for the various shades of greys, inclining to slate, lavender, dove, and lead colour, etc. For this purpose you fill a cauldron full of clean water, putting into it as much nut galls as you think proper. You then add a bag of logwood, and when the whole is boiled, having cooled the liquor, you immerse the stuff, throwing in by degrees some copperas, partly dissolved in water." —Hellot. Hellot is very scornful of logwood, naming it as one of the lesser dyes, and not to be used by good dyers.

RECIPES FOR DYEING with LOGWOOD.

1). BLACK FOR COTTON.—

After washing, work the cotton in a cold infusion of 30 % to 40 % of Sumach, or its equivalent in other tannin matter* (ground gall nuts, myrobalans, etc.) and let steep over-night. Squeeze out and without washing pass through a bath containing a diluted solution of lime water, or soda. Work in a cold solution of copperas for ½ hour, then back into

* See page 36

the soda for a $\frac{1}{4}$ hour at a temperature of 50° to 60° C. Then wash. Dye in a freshly made bath of logwood with a small proportion of old Fustic or Quercitron Bark. The cotton is introduced into the cold dye liquor and the temperature gradually raised to boiling. Boil for $\frac{1}{2}$ an hour. After dyeing, the cotton should be passed through a warm solution of Bichromate of Potash. (5 grains per litre). It is then washed and worked in a warm solution of soap and dried. More Fustic makes a greener black.

When catechu is the tanning matter employed, the cotton should be worked in a boiling decoction of it and allowed to steep till cold.

2). Grey Drab for Wool.

(10 lbs.) Dissolve $\frac{1}{2}$ oz. Bichromate of Potash in water, and then boil for $\frac{1}{2}$ hour; lift the wool and add 1 oz. logwood: boil for $\frac{1}{2}$ hour. Lift out, wash and dry.

3). Logwood Grey on Cotton.

The cotton is worked in a weak decoction of logwood at 40° to 50° C., and then in a separate bath containing a weak solution of ferrous sulphate or Bichromate of Potash. Wash.

4.) GREEN BLACK FOR WOOL.—

Mordant wool with 3 % Bichromate of Potash and 1 % Sulphuric acid (or 4 % Tartar) for 1 to 1½ hours. Then wash and dye with 35 % to 50 % of Logwood. This gives a blue black. It is greened by adding 5 % old Fustic to the dye bath. The more Fustic the greener the black becomes. If 3 % to 4 % alum is added to the mordanting bath, a still greener shade is obtained. Sulphuric acid in the mordant produces a dead looking blue black. Tartar yields a bright bluish black.

5). LOGWOOD BLUE FOR WOOL.

Mordant the wool for 1 to 1½ hours at 100° C., with 4 % alum and 4 to 5 % cream of Tartar. Wash well and dye for 1 to 1½ hours at boiling point with 15 to 30 % logwood and 2 to 3 % chalk. This colour is not very fast, but can be made faster by adding 1 to 3 % bichromate of potash and 1 % sulphuric acid. The brightest logwood blues are obtained by dyeing just below boiling point. Long boiling dulls the colour.

6). GREEN BLACK FOR WOOL.

Mordant with 2 % Chrome and 25 % sulphuric

acid. Boil 1½ hours and leave over night. Dye with 40 % logwood and 10 % Fustic. Boil 1 hour.

7). Logwood Blue for Wool.

Chrome 1 %, Alum 3 %, Tartar 1½ %. Boil 1½ hours and leave over-night. Dye with logwood 20 % and Cudbear 1 %. Boil one hour, then throw in 20 quarts of single muriate of tin, diluted with 20 to 30 gallons of water. Immerse 15 minutes and wash.

8). Fast Purple for Cotton.

(For 20 lbs. cotton.) Mordant with copperas. Wash slightly; then a bath of muriate of tin. Dye with 4 to 5 lbs. logwood.

9). Fast Black on Wool.—

Put wool into a strong logwood bath, the stronger the better, and boil for 1 hour. Take out and drain, and put into a Bichromate of Potash bath and keep at 150° F. for about 5 minutes. Then a bath of Fustic or Quercitron. After which wash well in cold water.

10). Black for Cotton.—

(For 10 lbs.) Steep cotton in hot decoction of 3

lbs. Sumach and let stay over night. Wring out and work for 10 minutes through lime water: then work for ½ hour in a solution of 2 lbs. copperas. It may be either washed from this, or worked again through lime water for 10 minutes. Dye for ½ hour in a warm decoction of 3 lbs. logwood adding ½ pint chamber lye. Take out cotton and add to the same bath 2 oz. copperas. Work 10 minutes, then wash and dry. 1 lb. Fustic is added for jet black.

11). FAST BLACK FOR WOOLLENS.—

(For 50 lbs.) Mordant with 2 lbs. chrome, 1 lb. Tartar, 1 quart Muriate of Tin. Boil 1 hour and wash well. Dye with 25 lbs. logwood and 3 lbs. Fustic. Boil 30 minutes. Take out and add 1 pint Vitriol. Return for 10 minutes, wash and dry.

12). JET BLACK FOR SILK.

(For 50 lbs.) Mordant in hot solution of Nitro-Sulphate of Iron at 150° F., work for ½ hour. Wash well, then boil up 18 lbs. Fustic. Put off the boil, enter silk and work for 30 minutes. Take out. Boil 16 lbs. logwood, put off the boil and decant the liquor into fresh bath, add 1 lb. white soap, enter and work from 30 to 40 minutes. Wash well.

13). LAVENDER FOR WOOL.

(For 6¼ lbs.) Mordant with 3 oz. Bichromate of Potash, for 45 minutes and wash. Dye with 2 oz. madder, 1 oz. logwood. Enter the wool, raise to the boil and boil for 45 minutes. The proportion of logwood to madder can be so adjusted as to give various shades of claret to purple.

14). BLACK FOR WOOL.

Mordant 6¼ lbs. wool with 4 oz. Chrome. Boil for 45 minutes. Dye with 50 oz. logwood, 1 oz. Fustic. Raise to boil and boil for 45 minutes.

15). FAST CHROME BLACK FOR WOOL.

(For 40 lbs. wool.) Dissolve 3 lbs. copperas and boil for a short time. Then dip the wool in this for ¾ hour, airing frequently. Take out wool and make dye with 24 lbs. logwood. Boil for ½ hour. Dip ¾ hour, air wool, dip ¼ hour longer and then wash in strong soap suds.

16). LIGHT SILVER DRAB FOR WOOL.

(For 50 lbs. wool). ½ lb. logwood, ½ lb. alum. Boil well and enter wool and dip for 1 hour.

17). A FAST LOGWOOD BLUE FOR WOOL.

(Highland recipe). Mordant with 3 % Bichromate of Potash and boil wool in it for 1½ hours. Wash and dry wool. Make a bath of 15 to 20 % logwood with about 3 % chalk added to it. Boil the wool for 1 hour, wash and dry. The wool can be greened by steeping it all night in a hot solution of heather, or boiling it in heather till the desired tint is obtained.

18). GREEN BLACK FOR WOOL.

(For 50 lbs. wool). Boil 20 minutes with 1 lb. chrome. Dye with 20 lbs. Fustic, 8 lbs. logwood. Boil for ½ hour.

19). SLATE PURPLE.

(For 80 lbs. yarn). Mordant with 2 lbs. chrome for 20 minutes. Dye with 10 lbs. logwood & 1 lb. Cudbear. Boil for ½ hour.

20). RAVEN GREY FOR WOOL.

(For 60 lbs.) Dissolve 8 oz. Alum and work the wool very quickly for ½ hour at boiling heat; then take it out and add to the same liquor 3 or 4 lbs. copperas, & work it at boiling heat for ½ hour. Then

wash. In another copper, boil 1 pailfull of logwood chips for 20 minutes. Put the wool into this for ½ hour; then return it into the alum and copperas for 10 to 15 minutes.

21). Dark Red Purple with Logwood for Wool.—(For 2½ lbs.) Mordant with 10 oz. alum and 2½ oz. cream of tartar for 1 hour. Let cool in the mordant, then wring out and put away for 4 or 5 days in a linen (or other) bag in the dark.

Dye with 1 lb. logwood, and ½ lb. madder. Boil up the logwood and madder in a separate bath and pour through a sieve into the dye bath. Enter the wool when warm and bring to boil. Boil from ½ hour to 1½ hours. Wash thoroughly.

22). Violet with Logwood for Silk.

The silk is washed from the soap and drained. For every pound of silk, dissolve in cold water 1 oz. verdigris; when it is well mixed with the water, the silk is immersed and kept in this liquor for an hour. This does not give colour. It is then wrung & aired. A logwood liquor is then made; the silk dipped in it when cold; it takes a blue colour sufficiently dark. The silk is taken out and dipped in a clear solution of

alum; it acquires a red which produces a violet on the silk just dyed blue. The quantity of alum is undetermined; the more alum the redder the violet. The silk is then washed.

23). ORDINARY LOGWOOD PURPLE FOR WOOL.

(For 1lb.) Mordant wool with $\frac{1}{4}$ lb. alum and $\frac{1}{2}$ oz. tartar for 1 hour; wring out and put away in a bag for some days. Dye with $\frac{1}{4}$ lb. logwood for 1 hour.

CHAPTER VII.

RED.

KERMES, COCHINEAL, LAC-DYE, MADDER.

KERMES.

Kermes, or Kerms, from which is got the "Scarlet of Grain" of the old dyers, is one of the old insect dyes. It is considered by most dyers to be the first of the red dyes, being more permanent than cochineal and brighter than madder. In the 10th century it was in general use in Europe. The reds

of the Gothic tapestries were dyed with it, and are very permanent, much more so than the reds of later tapestries, which were dyed with cochineal. Bancroft says "The Kermes red or scarlet, though less vivid, is more durable than that of cochineal. The fine blood-red seen at this time on old tapestries in different parts of Europe, unfaded, though many of them are two or three hundred years old, were all dyed from Kermes, with the aluminous basis, on woollen yarn."

Kermes consists of the dried bodies of a small scale insect, *Coccus ilicis*, found principally on the ilex oak, in the South of Europe. It is said to be still in use in Italy, Turkey, Morocco and other places.

William Morris speaks of the "Al-kermes or coccus which produces with an ordinary aluminous mordant a central red, true vermilion, and with a good dose of acid a full scarlet, which is the scarlet of the Middle Ages, and was used till about the year 1656, when a Dutch chemist discovered the secret of getting a scarlet from cochineal by the use of tin, and so produced a cheaper, brighter and uglier scarlet."

Kermes is employed exactly like cochineal. It has a pleasant aromatic smell which it gives to the wool dyed with it.

The following recipe for its use is from an old French dye book:—

20 lbs. of wool and $\frac{1}{2}$ a bushel of bran are put into a copper with a sufficient quantity of water, and suffered to boil half-an-hour, stirring every now and then. It is then taken out to drain. While the wool is draining the copper is emptied and fresh water put in, to which is added about a fifth of sour water, four pounds of Roman Allum grossly powdered and two pounds of red Tartar. The whole is brought to boil, and that instant the hanks are dipped in, which are to remain in for two hours, stirring them continually. When the wool has boiled two hours in this liquor, it is taken out, left to drain, gently squeezed and put into a linen bag in a cool place for five or six days and sometimes longer. This is called leaving the wool in preparation. After the wool has been covered for five or six days, it is fitted to receive the dye. A fresh liquor is then prepared, and when it begins to be lukewarm, take 12 oz. of powdered Kermes for each pound of wool to

be dyed, if a full and well coloured scarlet is wanted. If the Kermes was old and flat, a pound of it would be required for each pound of wool. When the liquor begins to boil, the yarn, still moist, (which it will be, if it has been well wrapped in a bag and kept in a cool place) is put in. Previous to its being dipped in the copper with the Kermes, a handful of wool is cast in, which is let to boil for a minute. This takes up a kind of scum which the Kermes cast up, by which the wool that is afterwards dipped, acquires a finer colour. The handful of wool being taken out, the prepared is put in. The hanks are passed on sticks continually stirring and airing them one after the other. It must boil after this manner an hour at least, then taken out and placed on poles to drain, afterwards wrung and washed. The dye still remaining in the liquor may serve to dip a little fresh parcel of prepared wool; it will take some colour in proportion to the goodness and quality of the Kermes put into the copper.

Another Recipe for Dyeing with Kermes.—The wool is first boiled in water along with bran for half-

an-hour ($\frac{1}{2}$ bushel of bran for 20 lbs. of wool) stirring it from time to time. Drain. Next boil for 2 hours in a fresh bath with a fifth of its weight of alum and a tenth of Tartar. Sour water is usually added. It is then wrung, put into a bag and left in a cool place for some days. The Kermes is then thrown into warm water in the proportion of 12 oz. to every pound of wool. When the liquor boils, a handful of waste wool is thrown in, to take up the dross of the Kermes, and removed. The wool is then put in and boiled for an hour. It is afterwards washed in warm water in which a small quantity of soap has been dissolved. Then washed and dried.

"To prepare wool for the Kermes dye, it is to be boiled in water with about $\frac{1}{5}$ of its weight in alum, and half as much of Tartar, for the space of two hours and afterwards left in the same liquor four or five days, when being rinsed, it is to be dyed in the usual way with about 12 oz. of Kermes for every pound of wool. Scarlets, etc., given from Kermes, were called grain colours, because that insect was mistaken for a grain. Wool prepared with a nitro-muriatic solution of tin (as is now practised for the cochineal scarlet) and dyed with Kermes takes a kind of aurora, or reddish orange colour."—Bancroft.

COCHINEAL

The dried red bodies of an insect (*Coccus Cacti*) found in Mexico are named Cochineal.

Recipes for Dyeing.

1). Scarlet for Wool.

For each pound of wool put 20 quarts of water. When the water is warm, add 2 oz. Cream of Tartar, 1½ drachms of powdered Cochineal. When the liquor is nearly boiling, put in 2 oz. of Solution of Tin (which the Dyers call Composition for Scarlet). As soon as it begins to boil, the wool, which has been wetted, is dipped and worked in the liquor for an hour and a half. A fresh liquor is then prepared, 1½ oz. of starch is put in and when the water is warm 6½ drachms of Cochineal. When nearly boiling 2 oz. of solution of tin is put in. It must boil, and then the wool is put in and stirred continually for 1½ hours. It is then taken out, wrung and washed. The Scarlet is then in its Perfection.

2). Cochineal for Cotton.

Prepare 50 lbs. of cotton with 15 lbs. Sumach, 10 lbs. Alum. Dye with 2¼ lbs. of Cochineal. Leave

for 24 hours in the Sumach; lift; winch 2 to 3 hours in a hot solution of Alum; wash in two waters, then boil up the cochineal; put off the boil, enter cotton & winch till colour be full enough; then wash and dry.

3). ORANGE RED FOR WOOL.

1). Mordant wool with Alum.

2). Dye in a bath of weak Fustic. Wash and Dry.

3). Put into cold water, Cream of Tartar, Tin, Pepper and Cochineal. When warm, enter the wool and boil.

4). PINK WITH COCHINEAL FOR WOOL.

(For 60 lbs. wool). 5lbs. 12 oz. alum. Boil and immerse wool for 50 minutes. Then add 1 lb. Cochineal and 5 lbs. cream of tartar. Boil and enter wool while boiling, till the required colour is got.

5). SCARLET FOR WOOL.

(For 100 lbs.) 6 lbs. of Tartar are thrown into the water when warm. The bath is stirred briskly and when hot $\frac{1}{2}$ lb. powdered cochineal is added and well mixed. Then 5 lbs. of clear solution of Tin is carefully mixed in. When it is boiling the wool is

put in and moved briskly. After 2 hours it is taken out, aired and washed.

The second bath. When the water is nearly boiling $5\frac{3}{4}$ lbs. of powdered cochineal is put in. A crust will form on the surface which will open in several places. Then 13 to 14 lbs. of solution of tin is poured in. After this is well mixed, the wool is entered and stirred well. Boil for an hour, then wash and dry.

These two processes can be done together with good result. The colour can be yellowed by fustic or turmeric. More tartar in the second bath increases the colour. The scarlet may be brightened by common salt. Alum will change the scarlet to crimson, the wool being boiled in a solution of it for one hour.

6). Crimson for Wool.

Mordant with $2\frac{1}{2}$ oz. alum and $1\frac{1}{2}$ oz. tartar for every lb. of wool. Then dye with 1 oz. cochineal. Solution of tin is sometimes added. Also salt.

7). Violet for Wool.

Mordant with 2 oz. alum for 1 lb. wool. Dye with 1 oz. cochineal and 1 oz. of solution of iron in which the wool is kept till the shade is reached.

8). SCARLET WITH COCHINEAL, FOR WOOL.

(For 100 oz. clean wool). Put 6 oz. Oxalic acid, 6 oz. Stannous Chloride (Tin Crystals), 8 oz. powdered cochineal in a bath containing about half the quantity of water required to cover wool. Boil 10 minutes, then add sufficient water to cover wool. Enter the wool, work well in the dye and boil for $\frac{3}{4}$ hour, after which take out the wool, wash and dry.

9). PURPLE, FOR WOOL.

(For $2\frac{1}{2}$ lbs. wool). Mordant with Bichromate of Potash, $1\frac{1}{2}$ oz. in 10 gallons of water. Dye with 6 to 8 oz. cochineal. With alum mordant (4 oz.) a crimson colour is got. With tin mordant (2 oz.) a scarlet. With iron mordant (2 oz.) a purplish slate or lilac.

10). SCARLET, FOR WOOL.

Mordant the wool for 1 to $1\frac{1}{2}$ hours with 6 % stannous chloride and 4 % cream of tartar. Wash. Dye with 5 to 12 % of ground cochineal for 1 to $1\frac{1}{4}$ hours. To dye the wool evenly, enter it in both the mordant and the dye when the water is warm, and raise gradually to boiling.

11). Scarlet, for Wool.

Fill the dye bath half full of water, add 6 to 8 % of Oxalic acid, 6 % of stannous chloride and 5 to 12 per cent. ground cochineal, boil up for 5 to 10 minutes, then fill up the dye bath with cold water. Introduce the wool, heat up the bath to the boiling point in the course of $\frac{3}{4}$ to 1 hour and boil $\frac{1}{2}$ hour. Washing between mordanting and dyeing is not absolutely essential. The addition of tartar up to 8 per cent. increases the intensity and yellowness of the colour.

In order to obtain bright yellow shades of scarlet it is usual to add a small proportion of some yellow dye to the bath.

Wool mordanted with 10 per cent. of Copper sulphate and dyed in a separate bath with cochineal gives a reddish purple, or claret colour.

With ferrous sulphate as mordant very good purplish slate or lilac colours can be got. Mordant and dye in separate baths. Use 8 per cent. of ferrous sulphate and 20 per cent. of tartar.

12). Crimson for Silk.

Mordant the silk by working for $\frac{1}{2}$ hour in a concentrated solution of alum, then leave to steep over

night. Wash well and dye in a fresh bath containing 40 per cent. of cochineal. Enter the silk at a low temperature and heat gradually to boiling.

13). Scarlet for Silk.

After boiling and washing, the silk is first slightly dyed with yellow by working it for $\frac{1}{4}$ hour at 50° C., in a weak soap bath containing about 10 per cent. of Annatto; it is then well washed. Mordant the silk by working it for $\frac{1}{2}$ hour, then steeping it over night in a cold solution of 40 per cent. of nitro-muriate of tin. Wash and dye in a fresh bath with a decoction of 20 to 40 per cent. of cochineal and 5 to 10 per cent cream of tartar. Enter the silk at a low temperature and heat gradually to boiling. Brighten in a fresh bath of cold water, slightly acidified with tartaric acid. Good results can also be obtained with the single bath method with cochineal, stannous chloride and oxalic acid.

With the use of iron mordants very fine shades of lilac may be obtained on silk with cochineal.

LAC DYE

Like Cochineal and Kermes, Lac is a small scale insect, *Coccus lacca*. It is found in India, Burmah

and other Eastern countries; it was introduced into England in 1796.

The method of dyeing with lac is very much the same as with cochineal; it yields its colour less readily however, and should be ground into a paste with the tin solution employed and a little hydrochloric acid and allowed to stand for a day before using. It is said to be a faster dye than cochineal, but is often used in combination with it, being a fuller colour though not so bright.

A good fast scarlet is produced by the following recipe:—For 100 lbs. wool. 8 lbs. lac, previously ground up with part of the tin spirits, 5 lbs. cochineal, 5 lbs. tartar, 20 lbs. tin spirit.

MADDER.

MADDER consists of the ground up dried roots of a plant, (Rubia tinctorum) cultivated in France, Holland, and other parts of Europe, as well as in India. Madder is not much used for silk dyeing, but for wool, linen and cotton it is one of the best dyes. It is also used largely in combination with other dyes to produce compound colours. When used for cotton the colour is much improved by boiling in a weak solution of soap after the dyeing. The grad-

ual raising of the temperature of the dye bath is essential in order to develop the full colouring power of madder; long boiling should be avoided, as it dulls the colour. If the water is deficient in lime, brighter shades are got by adding a little ground chalk to the dye bath, 1 to 2 per cent.

Berthollet distinguishes two kinds of madder red on cotton, one of which is given in No. 4. The other is the well-known Turkey red or Adrianople red, a very difficult and complicated dye, but one of the most permanent dyes known. Madder reds are said to be not so beautiful as those from Kermes, lac or cochineal, but my experience has been that with care, the finest reds can be got with madder.

Birch leaves are used in Russia to improve the colour of madder. They are added to the dye bath.

Recipes for use of Madder.

1). Red for Wool.

For 100 oz. ($6\frac{1}{4}$lbs.) wool.

Mordant 8 oz. Alum and 2 oz. Tartar. Boil the wool in the mordant for one hour and wash in cold water. Dye: 50 oz. Madder. Enter the mordanted wool, raise to boil and boil gently for one hour.

Wash thoroughly in cold water and dry. If the water is very soft, a small quantity of lime or chalk added to the dye bath improves the shade. Alder bark or alder leaves added to the dye bath darkens the colour. The best results are obtained when the dye bath is maintained just under the boiling point.

2). REDDISH BROWN FOR WOOL.

Mordant with 3 % bichromate of potash and dye with Madder. Good results can be got by the single bath method. (see page 14, No. 3).

3). BROWNISH RED FOR WOOL.

Mordant the wool with 6 to 8 per cent. of alum and 5 to 7 per cent. of tartar. Dye with 60 to 80 % of Madder. Begin the dyeing at about 40° C., and raise the temperature of the bath gradually to 80° to 100° C., in the course of an hour, and continue the dyeing about an hour. Wash and dry. The colour can be brightened by adding a small proportion of stannous chloride to the mordant or it can be added to the dye bath towards the end of the dyeing.

Brighter shades are got by keeping the temperature at about 80° C., and prolonging the dyeing process. After dyeing, the colour can be brightened

by working the wool at 70° C., in a weak soap bath, or a bath containing bran.

4). BRIGHT RED FOR COTTON.*

(For 22 lbs). The cotton must be scoured, then galled in the proportion of 1 part of nut galls to 4 of cotton, and lastly alumed in the proportion of 1 of alum to 4 of cotton. To the solution of alum is added one twentieth of solution of soda ley ($\frac{1}{2}$ lb. ordinary soda to 1 $\frac{3}{4}$ pints water). It is then dried slowly and alumed again. Then dried slowly again. The more slowly the drying takes place the better the colour. The cotton is then ready to be dyed.

Heat the water of the dye bath as hot as the hand can bear; mix in 6 $\frac{1}{2}$ lbs. madder and stir carefully. When thoroughly mixed, put in the cotton & work for $\frac{3}{4}$ hour without boiling. Take it out & add about a pint of soda ley. The cotton is then returned to the bath and boiled for 15 to 20 minutes. It is then brightened by passing it quickly thro' a tepid bath with a pint of ley in it. It is then washed and dried.

* This recipe can also be used for linen, but linen takes the colour less easily than cotton, and should have the various operations repeated as much as possible.

5). Bright Orange red for Wool.

For 1 lb. scoured fleece, mordant with 4 oz. alum and 1 oz. cream of tartar. Dissolve the mordant, enter the wool and raise to boiling point and boil for 1 hour. Allow the wool to cool in the mordant. Then wring out and put in a linen bag in a cool place for 4 or 5 days. Soak 8 oz. madder over night in water and boil up before using. Put into dye bath, enter wool when warm, bring gradually to the boil and boil for $\frac{3}{4}$ hour.

6). Bright Red For Wool.

Mordant 1 lb. wool with 5 oz. of Alum, and 1 oz. of Tartar; leave to drain and then wring out; put into a linen bag and leave in a cool place for several days. (The wool should still be damp when taken out to dye; if it is dry, damp with warm water). If the Tartar is increased a cinnamon colour is got. Dye with $\frac{1}{2}$ lb. of madder for every pound of wool. The water should not boil, but kept just below boiling for an hour; then boil up for 5 minutes before taking out and washing.

With sulphate of copper as a mordant, madder gives a clear brown bordering on yellow (one part of sulphate of copper and 2 parts of madder).

7). Red for Silk.

The silk is mordanted over night with alum, by steeping it in a cold concentrated solution; wash well and dye in a separate bath with 50 per cent. of madder. Begin dyeing at a low temperature and gradually raise to 100° C. The addition of bran tends to give brighter colours. A small quantity of Sumach could be added if a fuller colour is wanted. After dyeing, wash and then brighten in a boiling solution of soap, to which a small percentage of stannous chloride has been added. Afterwards wash well.

By mordanting with Copperas, either alone or after an Alum bath, violet and brown shades can be got.

8). Red with Madder for Wool.

Pound up carefully without heating some roots of madder. Mordant the wool with Alum, adding some cayenne pepper. Dye with the madder, adding cream of tartar to the dye bath. Birch leaves improve the colour.

9). Madder Red for Cotton.

Take a piece of white cotton, about 20 yards. Melt in some water 1 lb. of potash; boil the cotton

in this for 20 minutes, then rinse it. Put 4 lbs. of the best Sumach in the copper and fill it up with boiling water, and boil for 10 minutes. Put to cool and work the cotton well in this for an hour. Take it out and give it a scalding hot alum and sugar of lead bath for half-an-hour; rinse in two waters; put it back in the sumach for half-an-hour; then alum again for 20 minutes. Rinse. Put 2 lbs. of madder into hot water and boil gently for a few minutes. Put in the cotton, work well and boil for half-an hour gently. After, give it a hot alum for 20 minutes, and rinse. Put 1 lb. fresh madder in the copper, put in the cotton and boil for 20 minutes. Then wash.

10). RED FOR COTTON.

Scour the cotton. Then gall in the proportion of 1 of gall nuts to 4 of cotton. Then alum in the proportion of 1 of alum to 4 of cotton, with a little soda and tartar added. Dissolve the alum, etc., and put in the cotton, and boil half-an-hour. Cool down and ring out. Then dry slowly. Repeat the aluming. Put madder into water and when hot dip in cotton for $\frac{1}{2}$ hour, keeping it under boiling point, then boil up for $\frac{1}{4}$ hour and wash. Dry.

11). MADDER RED FOR COTTON & LINEN.

(For 1 lb.) 1st Mordant.—Boil 1 oz. ground gall nuts in 5 quarts of water for ½ hour. Put in thread and soak for 24 hours. Dry.

2nd Mordant.—Melt 2 oz. of alum, ⅛ oz. of Turmeric, and ½ oz. of gum Arabic in two quarts of water, over a slow fire. Let cool. Melt 1 oz. soda, 1 oz. arsenic, ¼ oz. potash (crushed) in a bath, and when dissolved, add the alum, turmeric and gum Arabic mixture. Stew ½ hour. Put in thread, which should be covered with the liquid, and let it soak for 24 hours. Dry.

1st. Bath.—Put 2 oz. Madder into 10 quarts of water, heat up to boiling but do not let it boil. Put in thread and stir well for 1 hour.

2nd. Bath.—Put 3 oz. Madder in 10 quarts of water; treat as in first bath, from which the thread should be taken and put straight into the 2 nd. bath. Stir for 1 hour. Soak for 24 hours; wash and dry.

3rd. Bath.—Put 3 oz. Madder in 10 quarts water; repeat the process described for 2nd. bath.
The thread should be washed in cold water & lastly in warm water in which a little soft soap has been

dissolved. When drying do not wring the skeins as this is likely to make the colour uneven.

There are a few other red dyes of minor importance which should be mentioned.

BRAZIL WOODS, various leguminous trees, including lima, sapan and peach wood, dye red with alum and tartar, and a purplish slate colour with bichromate of potash. They are not fast colours.

Some old dyers used Brazil wood to heighten the red of madder.

CAMWOOD, BARWOOD, SANDALWOOD or SANDERSWOOD, are chiefly used in wool dyeing, with other dye woods such as Old Fustic, and Logwood for browns. They dye good but fugitive red with bichromate of potash, or alum.

RED from LADIES BEDSTRAW.

The crushed roots of this plant are used. Mordant the wool with either alum or bichromate of potash. The red with alum is an orange red, with chrome, a crimson red. Make the dye bath with 30 to 50 % of bedstraw roots and boil the mordanted wool in it for an hour.

RED for COTTON

For 10 lbs. cotton boil 3 lbs. Sumach, let the cotton steep in this over night: wring out and work in red spirits (1 gill to a gallon of water). Wring out and wash well. Boil up 3 lbs. limawood (or Brazil or Peach wood) and 1 lb. fustic. Work the cotton in this ½ hour, as warm as the hand can bear; add 1 gill red spirits and work 15 minutes longer. Wash.

CHAPTER VIII.

YELLOW.

WELD. OLD FUSTIC. TURMERIC. QUERCITRON. DYER'S BROOM. HEATHER, AND OTHER YELLOW DYES.

"There are ten species of drugs for dyeing yellow, but we find from experience that of these ten there are only five fit to be used for the good dye—viz. Weld, savory, green wood, yellow wood and fenu-

grec". "Weld or wold yields the truest yellow, and is generally preferred to all the others. Savory and green wood, being naturally greenish, are the best for the preparation of wool to be dyed green: the two others yield different shades yellow".—*Hellot.*

WELD

Weld, *Reseda luteola*, an annual plant growing in waste sandy places. The whole plant is used for dyeing except the root. It is the best and fastest of the yellow natural dyes.

Hellot's directions for dyeing with weld are the following:—"Allow 5 or 6 lbs. of weld to every pound of stuff: some enclose the weld in a clean woollen bag, to prevent it from mixing in the stuff; and to keep the bag down in the copper, they put on it a cross of heavy wood. Others hold it in the liquor till it has communicated all its colour, and till it falls to the bottom: the stuff is then suspended in a net, which falls into the liquor, but others, when it has boiled, take out the weld with a rake and throw it away."

The plant is gathered in June and July, it is then carefully dried in the shade and tied up into bundles. When needed for dyeing it is broken up into pieces or chopped finely, the roots being discarded and a decoction is made by boiling it up in water for about

¾ hour. It gives a bright yellow with alum and tartar as mordant. With chrome it yields an old gold shade; with tin it produces more orange coloured yellows; with copper and iron, olive shades. The quantity of weld used must be determined by the depth of colour required. The dye bath is prepared just before dyeing, the chopped weld being put into weighted bags and boiled in soft water for ½ to 1 hour. 2 % of Stannous chloride added to the mordant gives brilliancy and fastness to the colour. Bright and fast orange yellows are got by mordanting with 8 % Stannous chloride instead of alum. With 6 % copper sulphate and 8 % chalk, weld gives a good orange yellow. Wool mordanted with 4 % of ferrous sulphate and 10 % tartar and dyed in a separate bath with weld with 8 % chalk, takes a good olive yellow. 8 % of alum is often used for mordant for weld. The dye bath should not be above 90° C. It is good to add a little chalk to the dye bath as it makes the colour more intense, while common salt makes the colour richer and deeper.

"Woollen dyers frequently add a little stale urine or lime and potash to the water in which it is boiled. They commonly

employ 3 or 4 oz. of alum and one of tartar for each pound of the wool. Tartar is supposed to render the yellow colour a little more clear and lively."—*Bancroft.*

Weld is of greater antiquity than most, if not all other natural yellow dyes. It is cultivated for dyeing in France, Germany and Italy. It is important for the silk dyer, as it dyes silk with a fast colour. The silk is mordanted in the usual way with alum, washed and dyed in a separate bath of 20 to 40 % weld, with a small quantity of soap added. After dyeing, the colour is brightened by working the silk for 10 minutes in a fresh soap bath with a little weld added to it. Wring out without washing.

Recipes for Dyeing with Weld.

1). Yellow for Silk.

Scour the silk in the proportion of 20 lbs. soap to 100 lbs. of silk. Afterwards alum and wash. A bath is made of 2 parts weld for 1 of silk, and after $\frac{1}{4}$ hour's boiling, it is filtered through a cloth into another bath. When this bath is cooled a little, the silk is immersed and turned about till dyed. The weld is in the meantime boiled up again with a little pearl

ash, and after being strained, it is added to the first bath (part of the first bath having been thrown away) until the desired colour is got. The bath must not be too hot. If more golden yellows are wanted, add some annotto to the second bath.

2). Yellow for Cotton.

Scour the cotton in a lixivium of wood ashes, wash and dry. It is alumed with $\frac{1}{4}$ of its weight of alum. After 24 hours it is taken out of the bath and dried without washing. A weld bath is prepared with $1\frac{1}{4}$ parts weld to 1 of cotton, and the cotton dipped in till the shade is got. It is then worked in a bath of sulphate of copper ($\frac{1}{4}$ copper to 1 of cotton) for $1\frac{1}{2}$ hours. It is next thrown, without washing, into a boiling solution of white soap. ($\frac{1}{4}$ soap to 1 cotton). It is boiled for 1 hour, then washed and dried.

3.) Deep Yellow for Cotton or Linen.

$2\frac{1}{2}$ parts of weld for 1 of cotton, with a little copper sulphate added to the bath. The cotton is well worked in this till the cotton has the desired colour. It is then taken out and a little soda ley is poured in.

It is returned and worked in this for $\frac{1}{4}$ hour, then washed and dried.

4). Old Gold for Wool.

Mordant with 2 % chrome and dye with 60 % of weld in a separate bath. 3 % of chalk adds to the intensity of colour.

5). Yellow for Wool.

Boil wool with 4 % of alum for 1 to 2 hours, and dye in a separate bath of 50 to 100 % weld for 20 minutes to an hour at 90° C.

6). Yellow for Wool.

Mordant with alum and tartar, and dye with 5 or 6 lbs. of weld for every lb. of wool. Common salt deepens the colour. If alum is added to the dye bath, the colour becomes paler and more lively. Sulphate of iron inclines it to brown.

7). Weld Yellow for Silk.

Work the silk (1 lb.) for an hour in a solution of alum, 1 lb. to the gallon, wring out and wash in warm water. Boil 2 lbs. weld for $\frac{1}{2}$ hour; strain and work the silk in this for $\frac{1}{2}$ hour. Add 1 pint alum solution to the weld bath and return the silk; work ten minutes, wring out and dry.

OLD FUSTIC.

Fustic is the wood of *Morus tinctoria*, a tree of Central America. It is used principally for wool. It does not produce a fast dye for cotton. With Bichromate of Potash as mordant, Old Fustic gives old gold colour. With alum it gives yellow, inclining to lemon yellow. The brightest yellows are got from it by mordanting with Tin. With copper sulphate it yields olive colours. (4 to 5 % copper sulphate and 3 to 4 % tartar). With ferrous sulphate, darker olives are obtained (8 % ferrous sulphate). For silk it does not produce as bright yellows as weld, but can be used for various shades of green and olive. Prolonged dyeing should always be avoided, as the yellows are apt to become brownish and dull. The chips should be tied up in a bag and boiled for ½ hour before using. It is still better to soak the wood over-night, or boil up in a small vessel and strain into the dye bath. The proportion of Fustic to be used for a good yellow is 5 to 6 parts to 16 parts of wool.

Recipes for dyeing with Old Fustic.

1). Old Gold for Wool. Boil the wool with 3 to 4 % Chrome for 1 to 1½ hours. Wash, and

dye in a separate bath for 1 to 1½ hours at 100° C. with 20 to 80 % of Old Fustic.

2). Light Yellow for Silk. Work the silk for ¼ to ½ hour at 50° to 60° C. in a bath containing 16 % alum and a decoction of 8 to 16 % of old Fustic. For dark yellow the silk is mordanted with alum, washed and dyed for about an hour at 50° C., with 50 to 100 % of Fustic. The colour can be made faster and brighter by working the silk in a cold solution of nitro-muriate of Tin for an hour.

3). Bright Yellow for Wool. Mordant wool with 8 % of stannous chloride for 1 to 1½ hours, and 8 % of tartar. Wash, and dye with 20 to 40 % of Fustic at 80° to 100° C. for 30 to 40 minutes.

4). Old Gold for Wool. Mordant 6¼ lbs. (100 oz.) wool with 3 oz. chrome, for ¾ hour and wash. Dye with 24 oz. Fustic & 4 oz. madder for 45 minutes.

5). Yellow for Wool. Mordant 6¼ lbs. wool with 3 oz. chrome, for ¾ hour and wash. Dye with 6 oz. Fustic, 2 drachms logwood. Boil ¾ hour.

6). Bright Yellow for Wool. (Single bath method). Fill the dye bath ½ full of water, add 2 %

oxalic acid, 8 % stannous chloride, 4 % tartar and 40 per cent. of Fustic. Boil up for 5 or 10 minutes, then fill the bath with cold water. Put in the wool & heat up the bath to boiling in the course of $\frac{3}{4}$ to 1 hour, & boil for $\frac{1}{2}$ hour.

7). YELLOW FOR WOOL. (Single bath). 4 % stannous chloride, 4 % oxalic acid and 50 % Fustic.

8). YELLOW FOR SILK. (5 lbs.) Work the silk through an alum solution of 1 lb, to a gallon of water. Wash in warm water. Boil 2 lbs. Fustic for $\frac{1}{2}$ hour in water and in this work the silk for $\frac{1}{2}$ hour. Lift and add 1 pint of the alum solution. Work 10 minutes longer, then wash and dry.

9). FUSTIC YELLOW FOR SILK. (5 lbs.) Alum the silk. Boil up 3 lbs. Fustic and work silk in it while hot for $\frac{1}{2}$ hour. Lift, add 2 oz. red spirits. Work for 15 minutes. Wash out in cold water. Work 10 minutes in a soap solution. Wring out and dry.

10). BUFF COLOUR ON WOOL. (45 lbs.) Boil $4\frac{1}{2}$ lbs. Fustic and $1\frac{1}{2}$ lbs. madder. Add 7 lbs. alum and boil up together. Allow to cool a little, enter wool and boil for $\frac{1}{2}$ hour.

11). YELLOW FOR WOOL. Mordant with alum and tartar. Solution of tin increases the colour; salt makes it deeper. 5 or 6 oz. Fustic for every pound of wool.

TURMERIC

Turmeric is a powder obtained from the ground up tubers of *Curcuma tinctoria*, a plant found in India and other Eastern countries. It gives a brilliant orange yellow, but it has little permanence. It is one of the substantive colours and does not need any mordant. Cotton has a strong attraction for it, and is simply dyed by working in a solution of Turmeric at 60°C. for about ½ hour. With silk and wool it gives a brighter colour if mordanted with alum or tin. Boiling should be avoided. It is used sometimes for deepening the colour of Fustic or Weld, but its use is not recommended as although it gives very beautiful colours, it is a fugitive dye. As Berthollet says "The shade arising from the Turmeric is not long of disappearing in the air."

QUERCITRON.

Quercitron is the inner bark of the *Quercus nigra* or *Q. tinctoria* a species of oak growing in the United

States and Central America. It was first introduced into England by Bancroft in 1775 as a cheap substitute for weld. He says, "The wool should be boiled for the space of 1 or $1\frac{1}{4}$ hours with one sixth or one eighth of its weight of alum; then without being rinsed, it should be put into a dyeing vessel with clean water and also as many pounds of powdered bark (tied up in a bag) as there were used of alum to prepare the wool, which is to be then turned in the boiling liquor until the colour appears to have taken sufficiently: and then about 1 lb. clean powdered chalk for every 100 lbs. of wool may be mixed with the dyeing liquor and the operation continued 8 or 10 minutes longer, when the yellow will have become both lighter and brighter by this addition of chalk."

QUERCITRON FOR SILK. *Bancroft.*

1 to 2 lbs. of bark to every 12 lbs. silk according to shade required. The bark, tied up in a bag, should be put into the dyeing vessel whilst the water is cold, as soon as it gets warm the silk, previously alumed, should also be put in and dyed as usual. A little chalk should be added towards the end of the operation.

A little murio sulphate of tin is used where more lively shades of yellow are wanted.

Boil at the rate of 4 lbs. bark to every 3 lbs. of alum & 2 lbs. murio sulphate of tin with a suitable quantity of water, for 10 to 15 minutes. Reduce the heat so that the hand can bear it, put in the silk and dye till it has acquired the shade. By adding suitable proportions of sulphate of indigo to this yellow liquor and keeping it well stirred, various and beautiful shades of Saxon green may be dyed.

By dissolving different proportions of copperas or copperas and alum in the warm decoction of bark, silk may in the same way be dyed of all the different shades of olive and drab colours.

For Cotton and Linen. Soak the yarn in a liquor made by dissolving $\frac{1}{4}$ of its weight of alum in the necessary water, to which it will be highly advantageous to add at the rate of 1 lb. potash or 10 oz. chalk for every 6 or 7 lbs. alum. The yarn is taken out and dried well: being afterwards rinsed, it is to be dyed in cold liquor made by boiling 1 $\frac{1}{4}$ lbs. of the plant for each lb. of yarn, which, after having received a sufficient body of colour, is to be taken out of the dyeing liquor and soaked for an hour and more in a

solution of sulphate of copper (blue vitriol) containing at the rate of 3 or 4 oz. for every pound of yarn: it is then removed without being washed, put into a boiling solution of hard soap, containing 3 or 4 oz. soap for each pound of yarn. Stir well and boil for about ¾ hour or more. Then wash and dry.

And again, take a sufficient quantity of acetate of alumina. This is made by dissolving 3 lbs. alum in a gallon of hot water, then adding 1 lb. sugar of lead, stirring well for 2 or 3 days, afterwards adding about 2 oz. potash and 2 oz. powdered chalk, (carbonate of lime), mix with warm water and soak linen or cotton well in this for 2 hours, keeping warm; squeeze out, dry; soak again in mordant, squeeze; dry; soak in lime water, dry; this mordanting and liming can be repeated if a fast yellow is required: it should then be well washed. 12 to 18 lbs. of Quercitron bark, for every 100 lbs. cotton or linen, is tied up in a bag and put in cold water, and slightly heated. The cotton is put in, stirring for an hour to an hour and a half while the water gets warm: then the liquor is heated to boiling point and the cotton boiled a few minutes only. Slow raising to boiling point gives the best colour. Instead of using acetate of alumina,

the cotton can be impregnated with some astringent such as galls or myrobalans (1 lb. in 2 or 3 gallons of water with a little soda). Macerate the cotton an hour or two in this and dry, then a solution of alum (8 lbs. alum, 1 lb. chalk, in 6 gallons of water) soak cotton 2 hours, and dry, then soak in lime water and dry. Second time in alum and dry. Then wash and dye slowly in the Quercitron. This is a lasting yellow for cotton or linen.

OTHER YELLOW DYES.

"Root of the dock, bark of the Ash tree, leaves of the almond, peach and pear trees, all give good yellow dyes, more or less fine according to the time they are boiled and in proportion to the Tartar and alum used. A proper quantity of alum brings these yellows to the beautiful yellows of the weld. If the Tartar is in greater quantity, these yellows will border on the orange, if too much boiled they take brown shades." From a dyeing book, 1778.

BARBERRY. The roots and bark of *Berberis Vulgaris*, used principally for silk dyeing, without a mordant. The silk is worked at 50° to 60° C. in a solution of the dye wood slightly acidified with sulphuric, acetic or tartaric acid. For dark shades, mordant with stannous chloride.

DYERS BROOM. *Genista tinctoria.*
The plant grows on waste ground. It should be picked in June or July & dried. It can be used with an alum and tartar mordant and gives a good bright yellow. It is called greening weed and used to be much used for greening blue wool.

PRIVET LEAVES, *Ligustrum vulgare*, dye a good fast yellow with alum and tartar.

HEATHER. Most of the heathers make a yellow dye, but the one chiefly used is the Ling, *Calluna vulgaris.* The tips are gathered just before flowering. They are boiled in water for about half an hour. The wool, previously mordanted with alum, is put into the dye bath with the liquor, which has been strained. It is then covered up closely and left till the morning. Or the wool can be boiled in the heather liquor till the desired colour is obtained.

RECIPES:—1). YELLOW FOR WOOL. For $6\frac{1}{4}$ lbs. mordant with 5 oz. alum for 1 hour and wash. Boil up 8 oz. heather twigs leaves and flowers. Enter the wool and boil for 1 hour. Wash in cold water & dry.

2). GOLDEN YELLOW FOR WOOL. For $6\frac{1}{4}$ lbs. mordant with 3 oz. bichromate of potash for $\frac{3}{4}$ hour

Wash in cold water. Dye with 50 oz. heather and boil for 45 minutes.

CHAPTER IX

BROWN AND BLACK.

CATECHU. ALDER BARK. SUMACH. WALNUT. PEAT SOOT. LOGWOOD, AND OTHER DYES

CATECHU.

Catechu, (Cutch) is an old Indian dye for cotton. It can be used for wool, and gives a fine rich brown. It is obtained from the wood of various species of Areca, Acacia, and Mimosa trees. Bombay Catechu is considered the best for dyeing purposes.

Catechu is soluble in boiling water. It is largely used by the cotton dyer for brown, olive, drab, grey, and black. The ordinary method of dyeing cutch brown on cotton is to steep the cotton in a hot solu-

tion of catechu, containing a small addition of copper sulphate, and leave it in the solution for several hours. To 7 or 8 gallons of water put 1 lb. catechu and boil till all is dissolved, then add 1 to 2 ozs. of sulphate of copper and stir. It is then put into a boiling chrome bath (3 %) for ½ hour. For deep shades the dyeing and chroming operations are repeated, With alum mordanted cotton, the colour is a yellowish brown, with tin it becomes still yellower. With iron it is brownish or greenish grey. When catechu only is used, a darker shade of brown is got by adding to the catechu 6 % of its weight of copper sulphate. When mordants are used, they may be applied before or after the chrome bath, the cotton being worked in their cold solution.

1). Catechu Brown for Cotton. (10 lbs.) Work the cotton at a boiling heat for 2 hours, or steep for several hours in a cool liquid, in 2 lbs. catechu. (To each 7 or 8 gallons of water put 1 lb. of catechu, and boil till all is dissolved, then add 2 oz. sulphate of copper and stir). Wring out and then work for ½ hour in a hot solution of chrome, 6 oz. Wash in hot water. If soap is added the colour is

improved. Any depth of colour can be got by repeating the operations.

2). Brown for Cotton. Soak cotton in warm water. Boil for $\frac{1}{2}$ hour in a solution of catechu, in the proportion of 1 oz. of catechu to 5 oz. of cotton. Put it into a 3 % solution of chrome for $\frac{1}{2}$ hour and boil. Then repeat these two operations till the colour is obtained. Then boil in a bath of Fustic.

3). Brown for Cotton. (100 lbs.) Boil 20 lbs. catechu in water: dissolve in the liquid 10 lbs. alum and let it settle: enter the yarn into the hot liquid and after working well take out and enter into a fresh bath of boiling water with 4 lbs. of chrome. Rinse and soften with oil and soap.

4). Cream Colour for Cotton with Catechu. (11 lbs). Boil out $\frac{3}{4}$ oz. of catechu in water, and dissolve 2 lbs. 3 oz. curd soap in the clear liquid. Enter the cotton at 190° F. and work for an hour.

5.) Catechu fast Brown. (50 lbs.) Steep yarn over-night in a decoction of 10 lbs. cutch.

Lift & work in a hot solution of chrome, rinse & dry.

6). Light fast Catechu Brown for Cotton. (50 lbs.) Boil 20 lbs. catechu in one boiler and 5 lbs. chrome in another. Enter in the catechu bath first, work 20 minutes, and wring out: then through the chrome 10 minutes, and wring out. Through catechu again, then chrome. Repeat this till dark enough, finishing with catechu.

7.) Light Catechu Brown for Cotton. (20 lbs). 3 lbs. of catechu and 3 oz. copper sulphate, boil up, and put into a bath of warm water. Enter cotton and work for $\frac{1}{2}$ hour; wring out. In another bath of hot water dissolve 8 oz. of chrome. Enter cotton when boiling, and work for $\frac{1}{2}$ hour. Then wash.

8). Catechu Black for Cotton. Work the cotton in a hot decoction of catechu, allowing it to steep in the bath till cold, then work it in a cold solution of iron. Wash, and dye in a cold or tepid bath of logwood, and finally pass through a solution of chrome.

9). Catechu Brown for Wool. The wool is boiled for 1 to $1\frac{1}{2}$ hours, with 10 to 20 % catechu,

then sadden with 2 to 4 % of copper sulphate, ferrous sulphate, or chrome, at 80° to 100° C., in a separate bath for ½ hour.

10). CATECHU STONE DRAB. (10 lbs. cotton). Work the cotton for ¼ hour with 2 pints catechu (1 lb. catechu to 7 or 8 gallons water; boil and add 2 oz. copper sulphate) in hot water, lift and add 2 oz. copperas in solution. Work for ¼ hour and wash. Add 2 oz. logwood to a bath of warm water & work cotton in this for 10 minutes. Lift and add ½ oz. alum. Work 10 minutes; wring out and dry.

ALDER BARK

The bark and twigs of alder are used for dyeing brown and black. For 1 lb. wool use 1 lb. alder bark. Boil the wool with it for 2 hours, when it should be a dull reddish brown. Add ½ oz. copperas for every pound of wool for black.

SUMACH

Sumach is the ground up leaves and twigs of the *Rhus coriaria* growing in Southern Europe. It dyes wool a yellow and a yellow brown, but it is chiefly used in cotton dyeing.

WALNUT

The green shells of the walnut fruit and the root are used for dyeing brown. The husks are collected when the fruit is ripe, put into a cask and covered with water. In this way they can be kept for a year or more; it is said the longer they are kept the better colour they give. Without a mordant the colour is quite fast, but if the wool is mordanted with alum a brighter and richer colour is got. When used they are boiled in water for $\frac{1}{4}$ hour, then the wool is entered and boiled till the colour is obtained. Long boiling is not good as it makes the wool harsh. It is much used as a "saddening" agent; that is for darkening other colours. William Morris says:—

"The best and most enduring blacks were done with this simple dye stuff, the goods being first dyed in the indigo or woad vat till they were a very dark blue, and then browned into black by means of the walnut root."

"Of all the ingredients used for tbe brown dye, the walnut rind is the best. Its shades are finer, its colour is lasting, it softens the wool, renders it of a better quality, and easier to work. To make use of this rind, a copper is half filled, and when it begins to grow luke-warm. the rind is added in proportion to the quantities of stuffs to be dyed and the colour intended. The copper is then made to boil, and when it has boiled a

quarter-of-an-hour, the stuffs which were before dipped in warm water, are put in. They are to be stirred and turned until they acquire the desired colour."—*James Haigh*, 1797.

PEAT SOOT gives a good shade of brown to wool. Boil the wool for 1 to 2 hours with peat soot. Careful washing is required in several changes of water. It is used sometimes for producing a hazel colour, after the wool has been dyed with weld and madder.

OAK BARK. Mordant with alum and dye in a decoction of oak bark.

ONION SKINS. (Brown.) Mordant the wool with alum and a little cayenne pepper. Boil it up lightly and keep warm for 6 days. Drying 2 or 3 times in between makes the colour more durable. Dry. Boil a quantity of onion skins, and cool; then put in wool and boil lightly for half-an-hour to an hour; then keep warm for a while. Wring out and wash.

MADDER for BROWN. (For 2½ lbs. wool). Mordant with 2 oz. copperas and 2 oz. cream of tartar. Dye with madder.

MADDER, ETC., for FRENCH BROWN. (For 50 lbs. wool.) Mordant with 1 ½ lbs. chrome. Dye with 6 lbs. Fustic, 1 lb. madder, ½ lb. cudbear, 1 lb. Tartar. If not dark enough add 8 oz. logwood. Boil for ½ hour. Wash and dry.

FOR BLACK THREAD. (From an old Dutch book on Dyeing. 1583). "Take a quantity of broken or bruised galls and boil them in water in a small pot and when they have a little boiled, take out all the galls and put into the same pot so much Copperas as ye had of galles and put therewith a little gumme of Arabic and then give it again another boiling. So let it boil a little, and with the said dye ye shall colour therein your thread, then take it forth and ye shall see it a fair shining black."

TAN SHADE. (for 6 ¼ lbs. wool). Mordant with 3 oz. Chrome for 45 minutes and wash in cold water. Boil for ½ hour, in a bag, 5 oz. madder, 4 oz. Fustic, ½ oz. logwood. Enter the wool, raise to the boil, and boil for 45 minutes. By altering the proportions of madder & fustic various shades of brown can be got.

A GOOD BLACK for cotton, (20 lbs.) to stand milling and scouring. Steep all night with 6 lbs. of Sumach, pass through lime liquor and sadden with copperas; repeat in each of the last 2 tubs, adding more lime and copperas to each. Pass through logwood and wash. Soften with a little oil and soda ash.

A GOOD BLACK for cotton, (20 lbs.) In a tub of cold water add 5 lbs. sumach, give a few turns and let it steep in it all night; then in another tub of cold water add a few pails of lime water, wring out; in another tub add 2 lbs. dissolved copperas and a pailful of old Sumach liquor. Enter, give 6 turns, wring out. In lime tub put two pails more lime liquor. Scald 2 lbs. logwood, 1 lb. Fustic in water; enter cotton, give 10 turns, sadden with a little copperas in the same liquor. Soften with a little oil and soda ash.

BLACK FOR LINEN AND COTTON.

The yarn is first of all scoured in the ordinary way, galled, alumed, and then turned through a bath of weld. It is then dyed in a decoction of logwood to which one fourth part of sulphate of copper must be

added for one part of yarn. It is then washed. It is dyed in a bath made with one part of madder for two of yarn. The yarn is then turned through a bath of boiling soap water, washed and dried.

DOESKIN BLACK. (For 100 lbs. wool.) Camwood 8 %. Boil for 50 minutes. Then add Chrome 3 %, Alum 1 %, Argol 1 %. Boil for 50 minutes, take out of dye and allow to stand over-night. Dye in 45 % logwood, 8 % Fustic, 4 % Sumac. Boil for 1½ hours, wash and dry. A fast permanent colour.

GREEN BLACK FOR WOOL. Mordant with 2 % Chrome and 25 % Sulphuric acid. Boil 1½ hours; and leave over-night. Dye with 40 % logwood, and 10 % Fustic. Boil 1 hour. Wash.

BROWNISH BLACK FOR WOOL. (For 1 lb.) Mordant with 3 per cent. Chrome. Dye with 2 oz. Fustic, 2 oz. logwood, 1 oz. madder, and 1 oz. copperas.

BROWN FOR WOOL. Mordant 2½ hours with alum ; dye with pine needles (larch) collected in Autumn when they drop.

"*BLACK* is obtained from the whole plant of *Spirea Ulmaria*, but especially the root. It is gathered then dried in the sun, and a strong decoction made by boiling for some hours, (a large handful to 3 pints of water). After it has boiled slowly for 2 to 3 hours, stale urine is added to supply the loss by evaporation. Then set aside to cool. The cloth to be dyed, is rubbed strongly with bog iron ore, previously roughened and moistened with water. It is then rolled up and boiled in the decoction. This is of a brilliant black. A fine black is said to have been formerly obtained from the roots of *Angelica Sylvestris*."—(Edmonstone on the Native Dyes of the Shetland Islands, 1841.) William Morris says;

"Black is best made by dyeing dark blue wool with brown; and walnut is better than iron for the brown part, because the iron-brown is apt to rot the fibre; as you will see in some pieces of old tapestry, or old Persian carpets, where the black is quite perished, or at least in the case of the carpet—gone down to the knots. All intermediate shades of flesh colour can be got by means of weak baths of madder and walnut "saddening;" madder or cochineal mixed with weld gives us orange, and with saddening (walnut) all imaginable shades between yellow and red, including the ambers, maize-colour, etc."

Note:—For other recipes for Black, see Chapter V on Logwood.

From a Dye Book of 1705.—"Black may be compared to Night and Death, not only because all other colours are deepened and buried in the Black Dye, but that as Death puts an end to all Evils of Life, tis necessary that the Black Dye should remedy the faults of other colours, which have been occasioned by the deficiency of the Dyer or the Dye, or the change of Fashion according to the times and caprice of man."

CHAPTER X

GREEN

Green results from the mixing of blue and yellow in varying proportions according to the shade of colour required. *Berthollet* says:—

"Many different plants are capable of affording green colours; such as, the field broom grass, *Bromus secalinus*; the green berries of the berry bearing alder, *Rhamnus frangula*; wild chervil, *Chærophyllum silvestre*; purple clover, *Trifolium pratense*; common reed *Arundo phragmites*; but these colours have no permanence."*

* Note page 42 on British plants which dye green.

Hellot says:—"It is impossible to obtain more than one colour from a mixture of blue and yellow, which is green; but this colour comprehends an infinite variety of shades, the principal of which are the Yellow green, the Light green, the Gay green, the Grass green, the Laurel green, the Molequin green, the Deep green, the Sea green, the Celadon green, the Parrot green, and, I shall add, the Duck-wing green, and the Celadon green with Blue. All these shades and the intermediate ones are made after the same manner and with the same ease. The stuff or wool dyed blue, light or dark, is boiled with Alum and Tartar, as is usually done to make white stuff yellow, and then with Weld, Savory, or Greening Wood. The Weld and the Savory are the two plants that afford the finest greens."

Another old Dye book says:—

"If you would dye your goods green, you must first dye them yellow with Broom or Dyer's Weed, otherwise Yellow Weed; after which put them into the Blue vat."

Every dyer has his particular yellow weed with which he greens his blue dyed stuff. But the best greens are undoubtedly got from weld and fustic.

The wool is dyed first in the blue vat; then washed and dried; then after mordanting dyed in the yellow bath. This method is not arbitrary as some dyers consider a better green is got by dyeing it yellow before the blue. But the first method produces the fastest and brightest greens as the aluming after the

blue vat clears the wool of the loose particles of indigo and seems to fix the colour.

If a bright yellow green is wanted, then mordant with alum after the indigo bath; if olive green, then mordant with chrome.

The wool can be dyed blue for green in 3 different ways:—1st. in the indigo vat (see page 68 et seq.); 2nd. with Indigo Extract (see pages 65—67); 3rd. with logwood, the wool having been previously mordanted with chrome (see p. 82, No. 7, and p. 85 No. 17). For a good bright green, dye the wool a rather light blue, then wash and dry; green it with a good yellow dye, such as weld or fustic, varying the proportion of each according to the shade of green required. Heather tips, dyer's broom, dock roots, poplar leaves, saw wort are also good yellows for dyeing green. If Indigo Extract is used for the blue, fustic is the best yellow for greening, its colour is less affected by the sulphuric acid than other yellows.

Bancroft gives many recipes for dyeing green with quercitron. He says:—

"Wool which has been first properly dyed blue in the common indigo vat may be made to receive any of the various shades of green which are usually given in this way from weld, by boiling the blue wool (after it has been well rinsed) in water,

with about one eighth of its weight in alum, and afterwards dyeing it unrinsed with about the same quantity of Quercitron bark and a little chalk which should be added towards the end of the process.

In the same way cloth that has previously received the proper shade of Saxon blue, may be dyed to a beautiful Saxon green: it will be proper to add about 3 lbs. chalk with 10 to 12 pounds of alum for the preparation liquor for 100 lbs. weight of wool which is to be turned and boiled as usual for about an hour, and then without changing the liquor, 10 or 12 lbs. of Quercitron bark, powdered and tied up in a bag, may be put into it, and the dyeing continued. When the dyeing has continued about 15 minutes, it will be proper to add another lb. of powdered chalk, stirring it well in, and to repeat this addition once, twice or three times at intervals of 6 or 8 minutes. The chalk does not merely answer the purpose of decomposing the acid left in the wool by the sulphate of indigo, but it helps to raise the colour and to render it more durable."

According to *Bancroft*, Quercitron is the yellow above all others for dyeing greens. He says:—

"The most beautiful Saxon greens may be produced very cheaply and expeditiously by combining the lively yellow which results from Quercitron bark, murio sulphate of tin and alum, with the blue afforded by indigo when dissolved in sulphuric acid, as for dyeing the Saxon blue".

For a full bodied green he says "6 or 8 lbs of powdered bark should be put into a dyeing vessel for every hundred lbs. wool with

a similar quantity of water. When it begins to boil, 6 lbs. muriosulphate of tin should be added (with the usual precaution) and a few minutes afterwards 4 lbs. alum: these having boiled 5 or 6 minutes, cold water should be added, and then as much sulphate of Indigo as needed for the shade of green to be dyed, stirring thoroughly. The wool is then put into the liquor and stirred briskly for about ½ hour. It is best to keep the water just at the boiling point."

Recipes for Dyeing Green.

1). Bottle Green for Silk with Fustic. (5 lbs.) Dissolve 2 lbs. alum and 1 lb copperas in water; work the silk in this for ½ hour; wash in warm water. Work for ½ an hour in a decoction of 6 lbs. Fustic. Lift, and add 2 oz. Indigo Extract, Work 20 minutes. Wash and dry.

2). Green for Wool with Fustic. ½ lb. of wool is mordanted with ⅛ oz. chrome and ⅛ oz. Cream of Tartar for ½ an hour to 1 hour. Soak overnight in water, 3 oz. Fustic and 2½ oz. logwood, and boil for 2 hours. Strain, and enter wool. Boil for 2 hours.

3). Green for Linen with Larch Bark. Mordant 4 lbs. linen with ½ lb. alum. Boil for 2½ hours; wring out but do not dry. Boil up a quantity of of larch bark and boil linen in this for 2½ hours.

4). Fustic Green for Wool. (50 lbs.) Mordant wool with 11 lbs. alum. Soak 50 lbs. Fustic over-night, and boil up. Enter the wool and boil for half-an-hour or more. Add Extract of Indigo in small quantities at a time, till the desired colour is got.

5). Saxon Green for Wool. Mordant the wool with alum and tartar for half-an-hour; it is then taken out and aired, but not washed. The bath is refreshed with cold water, and half the amount of the solution of Indigo which is to be used is well mixed in. The wool is entered and rapidly stirred for 5 or 6 minutes, without boiling. It is taken out and the rest of the Indigo solution is well mixed in. The wool is put in and boiled for ten minutes; then taken out and cooled. The bath is then three-quarters emptied and filled up with a decoction of fustic. When the bath is very hot, the wool is put in until the desired shade of green is got.

6). Green with Quercitron for Wool. Dye the wool blue in the Indigo vat. Wash well. For 100 parts of wool, put 3 parts of chalk and 10 or 12 of alum. Boil the wool in this for 1 hour. Then

to the same bath, add 10 or 12 parts of Quercitron, and continue the boiling for $\frac{1}{4}$ hour. Then add 1 part of chalk, and this addition is repeated at intervals of 6 to 8 minutes till a fine green colour is brought out.

7). GREEN WITH QUERCITRON FOR COTTON. First, the cotton is dyed a sky blue colour by means of indigo dissolved by potash and orpiment; then it is passed through a strong decoction of sumach, in which it is left until well cooled. It is then dried, passed through the mordant of acetate of alumina, dried again, washed, worked for 2 hours in tepid bath of Quercitron, ($26\frac{1}{4}$ lbs. to 110 lbs. cotton).

8). GREEN WITH INDIGO EXTRACT & WELD FOR WOOL. Mordant 1 lb. wool with 4 oz. alum and $\frac{1}{2}$ oz. cream of tartar. Dye blue with sufficient quantity of Indigo Extract. Wash and dry. Prepare a dye bath with weld which has been previously chopped up and boiled. Enter wool and boil for half-an-hour or more.

APPENDIX

LICHENS USED FOR DYEING WOOL BROWN.

Continued from page 62

S. scrobiculata. Aik-raw, Oak rag. Found on trees in Scotland and England.

Gyrophora deusta. Scorched looking gyrophora. Found on rocks in Scandinavia. Linnæus states that it furnishes a paint called "Tousch," much used in Sweden.

G. cylindrica. Cylindrical gyrophora. On rocks in Iceland. Greenish brown. Also G. deusta.

Alectoria jubata. Horse hair lichen, Rock hair. On fir trees in England, pale greenish brown.

Parmelia parietina. Common yellow wall lichen, Wäg-mässa, Wag-laf. England and Sweden on trees, rocks, walls, palings. Used to dye Easter eggs. Used in Sweden for wool dying.

Cetraria juniperina. En-mossa. On trees in Scandinavia

Borrera flavicans. Yellow borrera. On trees in Germany, gamboge yellow.

Lecanora candelaria. Ljus mässa. On trees in Sweden.

Evernia flavicans. Wolf's-bane evernia. On trees in Scandinavia, gamboge yellow.

Lecidea atro-virens. Map lichen. On rocks Scandinavia.

Lepraria chlorina. Brimstone coloured lepraria. Scandinavia, on rocks.

L. Iolithus. Viol-mässa. Sweden, on stones. Gives to stones the appearance of blood stains.

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GLOSSARY AND INDEX.

ERRATA

page 59. Rock Urcolaria shld. be Rock Urceolaria

page 61. Flowering lusnea shld. be Flowering Usnea.

page 144. (printed without being corrected).

Add:—*Alder bark*, 43, 44, 100, 126.

Almond, 120.

Amber, 132.

Argol, 131.

Ash, 41, 120.

Barwood, 67, 106.

Correct:—

authracene to anthracene

anie to *añil*

Roucon to Roucou

sorrounding to surrounding

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