

**The dyer's assistant in the art of dyeing wool and woollen goods. Extracted from ... philosophical and chymical works ... Translated from the French. With additions and practical experiments / [James Haigh].**

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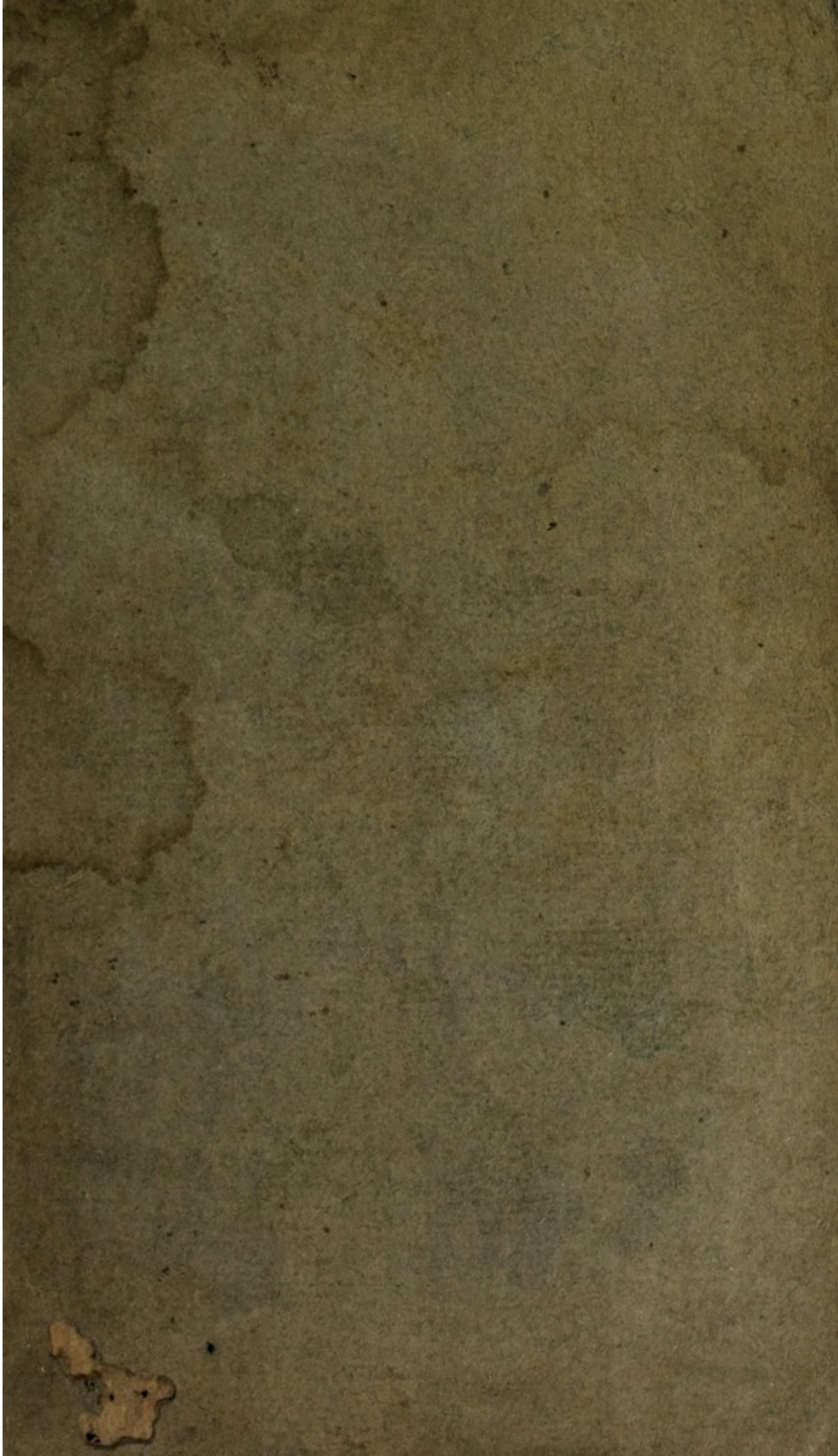
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THE  
DYER'S ASSISTANT

IN THE  
ART of DYING WOOL

AND  
WOOLLEN GOODS.

EXTRACTED FROM

The Philosophical and Chymical Works of those Most  
Eminent AUTHORS,

Mess. FERGUSON, | GEOFFERY,  
DUFAY, | COLBERT,  
HELLOT, | AND

That Reputable FRENCH DYER,  
Monsi. De JULIENNE.

TRANSLATED from the FRENCH.

WITH

A D D I T I O N S

AND

PRACTICAL EXPERIMENTS.

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By JAMES HAIGH,  
Late SILK and MUSLIN DYER, LEEDS.

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Y O R K:

PRINTED BY CRASK AND LUND, FOR R. BALDWIN,  
LONDON; AND J. TODD, AND R. SPENCE, YORK.

M, DCC, LXXXVII.

THE  
DYER'S ASSISTANT  
IN THE  
ART OF DYING WOOL  
AND  
WOOLLEN GOODS

[This Work is entered in the  
Hall-Book of the Company of  
Stationers.]

BY  
JAMES HAYDON  
LONDON  
ADDITIONS  
AND  
EXPERIMENTAL  
BY JAMES HAYDON  
LONDON



Y O R  
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T H E  
P R E F A C E.

**T**HERE are very few arts so extensive as that of dying; and, altho' those principal commodities, cloathing and furniture, receive their chief improvement and value therefrom, it is nevertheless very far from being brought to perfection. A long practice, sound judgment, and great attention will form a good and expert Dyer. Many Dyers can work with success in a number of colours only which depend on each other, and are entirely ignorant of the rest, or have but a very imperfect idea of them.

A Philosopher, who studies the art of dying, is in some measure astonished at the multiplicity of new objects which it affords; every step presents new difficulties and obscurities, without hopes

of any instruction from the common workmen, who seldom know more than facts and custom. Their manner of explaining themselves, and their common terms, only afford more darkness, which the uncommon and often useless circumstances of their proceedings render more obscure.

Before we enter into the particulars of dying wool, it is necessary to give an idea of the primary colours, or rather of those which bear this name by the artists; for it will appear by reading the celebrated works of Sir Isaac Newton on Light and Colours, that they bear no affinity with those which the Philosophers call by that name. They are thus named by the workmen, because, by the nature of the ingredients of which they are composed, they are the basis from whence all others are derived. This division of colours, and the idea which I intend to give of them, are also common to the different kinds of dying.

The five primary colours are blue, red, yellow, brown, and black. Each  
of

of these can furnish a great number of shades, from the lightest to the darkest; and from the combination of two or more of these different shades, arise all the colours in nature. Colours are oftentimes darkened, or made light, or considerably changed, by ingredients that have no colour in themselves; such are the acid, the alkalis, and the neutral salts, lime, urine, arsenic, allum, and some others: and in the greatest part of dyes, the wool and woollen goods are prepared with some of these ingredients, which of themselves give little or no colour. It may easily be conceived what an infinite variety must arise from the mixture of these different matters, or even from the manner of using them; and what attention must be given to the minutest circumstances, so as perfectly to succeed in an art so complicated, and in which there are many difficulties.

It is not needful to be very particular in describing the utensils of a dye-house, as they are commonly known; this work being designed for the expe-

rienced Dyer. A dye-house should, however, be erected on a spacious plan, roofed over, but admitting a good light, and as nigh as possible to a running water, which is very necessary, either to prepare the wool before it is dyed, or to wash it afterwards. The coppers should be set at the distance of eight or ten feet, and two or more vats for the blue, according to the quantity of work that is to be carried on.

The most important point in dying the primitive blue is to set the vat properly at work, and conduct her till she is in a state to yield her blue. The size of the woad vat is not fixed, as it depends upon necessity or pleasure. A vat containing a hoghead, or half that quantity, has often been used with success; but then they must be prevented by some means from cooling too suddenly, otherwise these small vats will fail.

Another kind of vat is prepared for blue: this is called the indigo vat, because it is the indigo alone that gives it  
the

the colour. Those that use the woad vat do not commonly use the indigo one.

There are two methods of dying wool of any colour; the one is called dying in the great, the other in the lesser dye. The first is done by means of drugs or ingredients that procure a lasting dye, resist the action of the air and sun, and are not easily stained by sharp or corrosive liquors. The contrary happens to colours of the lesser dye. The air fades them in a short time, more particularly if exposed to the sun; most liquors stain them, so as to make them lose their first colour. It is extraordinary that, as there is a method of making all kinds of colours by the great dye, the use of the lesser should be tolerated; but three reasons make it difficult, if not impossible to prevent this practice.

1st, The work is much easier. Most colours and shades which give the greatest trouble in the great, are easily carried on in the lesser dye.

2d, Most colours in the lesser are more bright and lively than those of the great.

3d, For this reason, which carries more weight, the lesser dye is carried on much cheaper than the great. This is sufficient to determine some men to do all in their power to carry it on in preference to the other. Hence it is that the true knowledge of chymistry, to which the art of dying owes its origin, is of so much use.

It may be observed, that all lasting colours are called colours of the great, and the others of the lesser dye. Sometimes the first are called fine, and the latter false colours; but these expressions are equivocal, for the fine are sometimes confounded with the high colours, which are those in whose composition cochineal enters; therefore, to avoid all obscurity, I shall call the first colours of the great, and the latter colours of the lesser dye.

Experiments (which are the best guides in natural philosophy as well as arts)

arts) plainly shew, that the difference of colours, according to the foregoing distinction, partly depends on the preparation of the subject that is to be dyed, and partly on the choice of the ingredients which are afterwards used to give it the colour. I therefore think it may be laid down as a general principle, that all the invisible process of dying consists in dilating the pores of the body that is to be dyed, and depositing therein particles of a foreign matter, which are to be detained by a kind of cement which prevents the sun or rain from changing them. To make choice of the colouring particles of such a durability that they may be retained, and sufficiently set in the pores of the subject opened by the heat of boiling water, then contracted by the cold, and afterwards plaistered over with a kind of cement left behind with the salts used for their preparation, that the pores of the wool or woollen stuff ought to be cleansed, enlarged, cemented, and then contracted, that the colouring atom may be contained in a lasting manner.

Experiments.

Experiments also shew that there is no colouring ingredient belonging to the great dye which has not more or less an astringent and precipitant quality. That this is sufficient to separate the earth of the allum; this earth, joined to the colouring atoms, forms a kind of laque, similar to that used by the painters, but infinitely finer. That in bright colours, such as scarlet, where allum cannot be used, another body must be substituted to supply the colouring atoms (block-tin gives this basis to the scarlet dye). When all these small atoms of earthy-coloured laque have insinuated themselves into the pores of the subject that is dilated, the cement which the tartar leaves behind serves to masticate these atoms; and lastly, the contracting of the pores, caused by the cold, serves to retain them.

It is certain that the colours of the false dye have that defect only because the subject is not sufficiently prepared; so that the colouring particles being only deposited on its plain surface, it

is impossible but the least action of the air or sun must deprive them of part, if not of the whole. If a method was discovered to give to the colouring parts of dying woods the necessary attraction which they require, and if the wool at the same time was prepared to receive them (as it is the red of madder) I am convinced, by thirty experiments, that these woods might be made as useful in the great as they have hitherto been in the lesser dye.

What I have said shall be applied in the sequel of this treatise, where I shall shew what engaged me to use them as general principles.

I should have been glad to have seen a work of this sort (knowing the great need there is of a chymical understanding of this art) signed with the name of some person of distinction, to have given it a better face; yet, in defect of that, I was prevailed upon to undertake the tedious task. I dare not flatter myself to have brought it to its last perfection, as arts daily improve, and this  
in

in particular; but I hope some acknowledgement will be due to me for bringing this matter a little further out of that obscurity in which it has laid, and for assisting the Dyers in making discoveries to help to perfect this most useful art.

I shall now proceed to examine the five primary colours above-mentioned, and give the different methods of preparing them after the most solid and permanent manner.

JAMES HAIGH.

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F I N I S.



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T H E

I N T R O D U C T I O N .

**T**HE materials of which cloths are made, for the most part are naturally of dull and gloomy colours. Garments would consequently have had a disagreeable uniformity, if this art had not been found out to remedy it, and vary their shades. The accidental bruising of fruits or herbs, the effect of rain upon certain earths and minerals might suggest the first hint of the art of dying, and of the materials proper for it. Every climate furnishes man with ferruginous earths, with boles of all colours, with saline and vegetable materials for this art. The difficulty must have been to find the art of applying them. But how many trials and essays must have been made, before they found out the most proper methods of applying them to stuffs, so as to stain them with beautiful and lasting colours? In this consists the principal excellence of the Dyer's art,

art, one of the most ingenious and difficult which we know.

Dying is performed by means of limes, salts, waters, leys, fermentations, macerations, &c. It is certain that dying is very ancient. The Chinese pretend that they owe the discovery of it to Hoan-ti, one of their first sovereigns.

One of the most agreeable effects of the art of dying, is the diversifying the colours of stuffs. There are two ways by which this agreeable variety is produced, either by needle-work with threads of different colours, on an uniform ground, or by making use of yarn of different colours in the weaving.

The first of these inventions is attributed to the Phrygians, a very ancient nation; the last to the Babylonians. Many things incline us to think that these arts were known even in the times of which we are now treating. The great progress these arts had made in the days of Moses, supposes that they had been discovered long before. It appears to me certain, then, that the arts of embroidery and weaving stuffs of various colours, were invented in the ages we  
are

are now upon. But I shall not insist on the manner in which they were then practised, as I can say nothing satisfactory upon that subject.

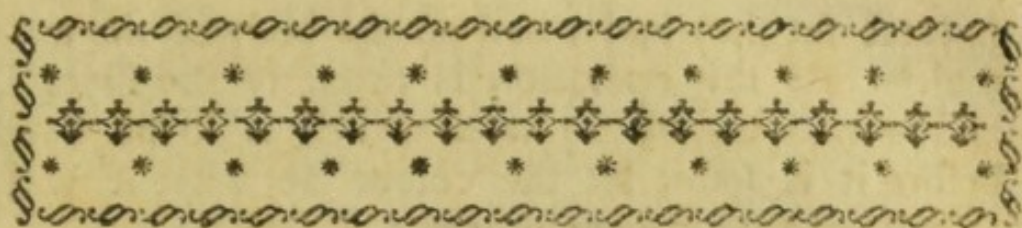
Another art nearly related to that of dying, is that of cleaning and whitening garments, when they have been stained and fullied. Water alone is not sufficient for this. We must communicate to it, by means of powders, ashes, &c. that deterfive quality which is necessary to extract the stains which they have contracted. The ancients knew nothing of soap, but supplied the want of it by various means. Job speaks of washing his garments in a pit with the herb borith. This passage shews that the method of cleaning garments in these ages, was by throwing them into a pit full of water, impregnated with some kind of ashes; a method which seems to have been very universal in these first times. Homer describes Nausicaa and her companions washing their garments, by treading them with their feet in a pit.

With respect to the herb which Job calls borith, I imagine it is salworth.

This

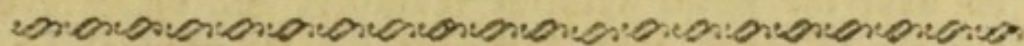
This plant is very common in Syria, Judea, Egypt, and Arabia. They burn it, and pour water upon the ashes. This water becomes impregnated with a very strong lixivial salt, proper for taking stains or impurities out of wool or cloth.

The Greeks and Romans used several kinds of earths and plants instead of soap. The Savages of America make a kind of soap-water of certain fruits, with which they wash their cotton-beds and other stuffs. In Iceland the women make a ley of ashes and urine. The Persians employ boles and marls. In many countries they find earths, which, dissolved in water, have the property of cleaning and whitening cloth and linen. All these methods might perhaps be practised in the primitive ages. The necessities of all mankind are much the same, and all climates present them with nearly the same resources. It is the art of applying them, which distinguishes polite and civilized nations from Savages and Barbarians.



T H E

DYER'S ASSISTANT.



C H A P. I.

*Of* B L U E.

**W**OOL and woollen stuffs of all kinds, are dyed blue without any other preparation than wetting them well in luke-warm water, squeezing them well afterwards, or letting them drain: this precaution is necessary, that the colour may the more easily insinuate itself into the body of the wool, that it may be equally dispersed throughout; nor is this to be omitted in any kind of colours, whether the subject be wool or cloth.

As to wool in the fleece, which is used in manufacturing cloth, as well the mixt as other sorts, and which they are obliged to dye before they are spun, they are prepared in another manner, viz. They are scoured, and thereby divested of the  
A natural

natural fat they had when on the body of the animal.\* As this operation is properly the Dyer's, and is indispensable in wool which is to be dyed before it is spun, let the colour be what it will, I shall give the proper process:

This operation is not every where alike, but this is the method followed in the manufactory of Audly in Normandy, where cloths are most beautifully manufactured:

A copper containing twenty pails is used for this purpose; they put twelve pails of water, and four of urine, (which is generally fermented) the copper is heated, and when the liquor is so hot as to bear the hand without scalding, ten or twelve pounds of wool, that still contains its natural fat, are put in and left in the copper about a quarter of an hour, stirring from time to time with sticks; it is then taken out and put to drain on a scray; from thence it is carried in a large square basket, and placed in running water, two men stirring it to and fro for a considerable time with long poles, till it is entirely cleansed of its fat; then it is taken out and placed in a basket to drain: while this wool is thus preparing, a like quantity may be put into the copper, and thus proceed till the whole is scoured. If the liquor is too much wasted, fresh is to be added, made up of one part urine and three parts water. They generally scour a bale of wool at once; if it weighed 250lb. in the fat, it generally loses 60lb. in scouring; but this diminution of weight varies in proportion to the wool being more or less scoured, and in proportion to the more or less fat contained therein. Too much attention cannot be paid to the scouring, as it is thereby better disposed for the reception of the dye.

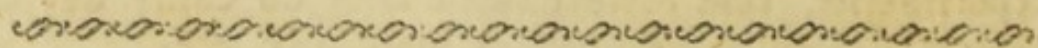
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\* The natural fat adhering to the wool preserves it in the warehouse, and also from moths.

The fat, which is an oily transudation, and slightly partaking of the quality of urine retained by the fleece, which is too thick to let it out, is soluble in water, consequently, as water alone could not separate it, a fourth part of urine is put into the copper, which must have been kept some days, in order to separate its volatile salts by fermentation; (I mean that it is necessary this urine should begin to acquire a strong smell) this volatile salt, being an alkali, forms with the fat a kind of soap, which is always the result of all oils and alkalis whatsoever mixed together. As soon as soap is formed by the combination of these two principles, it becomes soluble in water, and is consequently easily carried off. A proof that a true soap has been formed in this operation, is, that the water which carries it away, whitens as long as any fat is separated from the wool: if there was a sufficient quantity of fermented urine in the copper, the wool will be well scoured; if it was not, all the fat would not be changed into soap, and consequently the wool will remain greasy. The same operation might be performed with fixed alkalis, as with the lee of pot-ash or pearl-ashes: but as this lee would not only come dearer than urine, it might also damage the wool, if the exact proportion was not applied. I am convinced by several experiments, that these caustic salts do easily destroy all animal substances, as wool, silk, &c.

I beg the reader may take notice, that tho' in the sequel I do not mention this operation of scouring, 'tis nevertheless necessary for all wool that is to be dyed before it is spun, as also that it is necessary to wet those that are spun, and stuffs of all kinds, that the colour may be the more equally diffused throughout.

Of the five primary colours mentioned in the Preface, two of them require a preparation given by noncolouring ingredients, which, by the acidity and fineness of their earth, dispose the pores of the wool to receive the colour. This is called the preparation; it varies according to the nature of shades and colours: the red, the yellow, and the colours derived from them must be so treated; black must have a preparation peculiar to itself; blue and brown require none; it is sufficient that the wool be thoroughly scoured and wetted; and even for blue, it suffices to dip it into the vat, stirring it well, and letting it remain, more or less, according as the ground of the colour is wanted. For this reason, and also that many colours previously require a blue shade to be given to the wool, I shall begin with it, and give thereon the most exact rules in my power. It is an easy matter to dye wool blue, when the vat is once prepared, but it is not so easy to prepare the vat, which is the most difficult part of the Dyer's art. In all the other processes, it is sufficient to follow the simple operations transmitted from masters to apprentices. Three ingredients are used in the blue dye, viz. Garden-woad or pastel, the woad, and the indigo. I shall give the preparation of each, beginning with the garden-woad.



## C H A P. II.

### *Of the* GARDEN-WOAD, *or* PASTEL-VAT.

**T**HE garden-woad is a plant cultivated in many parts of Holland and France, and might be in England or Ireland, to the great advantage of the husbandman; it is made up in bales, generally

generally weighing from one hundred and fifty pounds to two hundred; it resembles little clods of dried earth, interwoven with the fibres of plants; it is gathered at a proper season, and laid up to rot, and then made into small balls to dry. Several circumstances are to be observed in its preparation; on this you may see the regulatious of Mons. Colbert on Dyes; the best prepared comes from the diocese of Alby in France.

*The Vat set to Work.*

A copper, as near as possible to the vat, is filled with water that has stood some time, or, if such water is not at hand, a handful of Dyer's woad or hay is added to the water, with eight pounds of crust of fat madder. If the old liquor from a vat that has been used in dying from madder can be procured, it will save the madder, and produce a better effect.

The copper being filled, and the fire lighted about three in the morning, it must boil an hour and a quarter (some Dyers boil it from two hours and a half to three); it is then conveyed by a spout into the woad vat, in which has been previously put a peck of wheaten bran. Whilst the boiling liquor is emptying into the vat, the balls of woad must be put one after the other into the vat, that they may be the easier broken, raked, and stirred; this is to be continued till all the hot liquor from the copper is run into the vat, which, when little more than half full, must be covered with cloths somewhat larger than its circumference, so that it may be covered as close as possible, and left in this state for four hours. Then it must be aired, that is, uncovered to be raked, and fresh air let into it; and to each bale of woad a good measure of ware

flung in; this is a concealed name for lime that has been slacked. This measure is a kind of wooden shovel, which serves to measure the lime grossly; it is five inches broad and three inches and a half long, containing near a good handful; the lime being scattered in, and the vat well raked, it must be again covered, leaving a little space of about four fingers open, to let in air. Four hours after, she must be raked, without serving her with lime; the cover is then put on, leaving, as before, an opening for the air; in this manner she must be let to stand for two or three hours. Then she may be raked well again, if she is not yet come to work; that is, if she does not cast blue at her surface, and that she works or ferments still, which may be known by raking and plunging with the flat of the rake in the vat; being well raked, she is to remain still for one hour and a half more, carefully observing whether she casts blue. She is then to be served with water, and the quantity of indigo judged necessary is to be put in: it is commonly used in a liquid state, the full of a dye-house kettle for each bale of woad; the vat being filled within six finger-breadths of her brim, is to be raked and covered as before; an hour after filling her with water, she must be served with lime, viz. Two measures of lime for each bale of woad, giving more or less according to the quality of the woad, and what may be judged it will spend or take of lime.

I hope the reader will excuse my plainness; this treatise being wrote for the Dyer, I must speak the language he is used to; the Philosopher will easily substitute proper terms, which perhaps the workman would not understand. There are kinds of woad readier prepared than others, so that general and precise rules cannot be given on this head. It  
must

must also be remarked, that the lime is not to be put into the vat till she has been well raked.

The vat being again covered, three hours after a pattern must be put in, and kept entirely covered for an hour; it is then taken out to judge if she be fit to work. If she is, the pattern must come out green, and on being exposed a minute to the air, acquire a blue colour. If the vat gives a good green to the pattern, she must be raked, served with one or two measures of lime, and covered.

Three hours after, she must be raked, and served with what lime may be judged necessary; she is then to be covered, and one hour and a half after, the vat being pitched or settled, a pattern is put in, which must remain an hour to see the effects of the woad. If the pattern is of a fine green, and that it turns to a deep blue in the air, another must be dipt in to be certain of the effect of the vat. If this pattern is deep enough in colour, let the vat be filled up with hot water, or, if at hand, with old liquor of madder, and rake her well. Should the vat still want lime, serve her with such a quantity as you may judge sufficient by the smell and handling. This done, she must be again covered, and one hour after put in your stuffs, and make your overture. This is the term used for the first working of wool or stuffs in a new vat.

*Marks by which you may know how to conduct a Vat regularly.*

A vat is fit to work when the grounds are of a green brown, when it changes, on its being taken out of the vat, when the flurry is of a fine Turkish or deep blue, and when the pattern, which has been dipt in it for an hour, comes out of a fine deep grass green. When she is fit to work, the  
bever

bever has a good appearance, clear and reddish, and the drops and edges that are formed under the rake in lifting up the bever are brown. Examining the appearance of the bever, is lifting up the liquor with the hand or rake, to see what colour the liquor of the vat has under its surface. The sediment or grounds must change colour (as has been already observed) at being taken out of the bever, and must grow brown by being exposed to the external air. The bever or liquor must feel neither too rough nor too greasy, and must not smell either of lime or lee. These are the distinguishing marks of a vat that is fit to work.

*How to know when a Vat is cracked by too great or too small a Quantity of Lime; Extremes which must be avoided.*

When more lime has been put in than was sufficient for the woad, it is easily perceived by dipping in a pattern, which instead of turning to a beautiful grass green, is only daubed with a steely green. The grounds do not change, the vat gives scarcely any flurry, and the bever has a strong odor of quick lime, or its lees.

This error is rectified by thinning the vat, in which the Dyers differ; some use tartar, others bran, of which they throw a bushel into the vat, more or less in proportion to the quantity of lime used, others a pail of urine. In some places a large iron chafing-dish is made use of, long enough to reach from the ground to the top of the vat, this chafing-dish or furnace has a grate at a foot distance from its bottom, and a funnel coming from under this grate, and ascending to the top of the chafing-dish, which is to give air to, and kindle the coals which are placed on the grate. This furnace is  
sunk

lunk in the vat, near to the surface of the grounds, so as not to touch them, and is fastened with iron bars to prevent its rising. By this method the lime is raised to the surface of the liquor, which gives an opportunity to take off with a sieve what is thought superfluous; but when this is taken out, the necessary quantity of ware must be carefully restored to the vat. Others again thin the vat with pearl ashes, or tartar boiled in stale urine; but the best cure, when she is too hard, is, to put in bran and madder at discretion; and if she be but a little too hard, it will suffice to let her remain quiet four, five, or six hours, or more, putting in only two hats full of bran and three or four pounds of madder, which are to be lightly strewed on the vat, after which it is to be covered. Four or five hours after, she is to be raked and plunged, and according to the colour, that the flurry which arises from this motion, assumes and imprints on the whole liquor, a fresh proof is made by putting in a pattern.

If she is cracked, and casts blue only when she is cold, she must be left undisturbed, sometimes whole days without raking; when she begins to strike a tolerable pattern, her liquor must be reheated or warmed; then commonly, the lime, which seemed to have lost all power to excite a fermentation, acquires new strength, and prevents the vat from yielding its dye so soon. If she is to be hastened, some bran and madder are to be thrown on, as also one or two baskets of new woad, which helps the liquor that has been reheated to spend its lime.

Care must be taken to put patterns in each hour, in order to judge, by the green colour which they acquire, how the lime is worked on. By these trials she may be conducted with more exactness,  
for

for when once a vat is cracked, by too great or too small a quantity of lime, she is brought to bear with much more difficulty. If while you are endeavouring to bring her to work, the bever grows a little too cold, it must be heated by taking off some of the clear, and instead thereof, adding some warm water; for when the bever is cold, the woad spends little or no lime; when it is too hot, it retards the action of the woad, and prevents it from spending the lime; therefore it is better to wait a little, than to hasten the vats to come to work when they are cracked. A vat is known not to have been sufficiently served with lime, and that she is cracked, when the bever gives no flurry, but instead thereof gives only a scum, and when she is plunged or raked, she only works, ferments and hisses, (this noise is made by a great number of air bubbles that burst as soon as they form) the liquor has also the smell of a common sewer or sink, or rotten eggs; it is harsh and dry to the touch: the grounds when taken out do not change, which generally happens when a vat is cracked for want of lime. This accident is chiefly to be apprehended when a vat is opened and a dip made in her; for if her state has not been looked into, both in regard to the smell as well as raking and plunging, and that the stuffs be imprudently put in when the woad has spent its lime, it is to be feared the vat may be lost; for the stuffs being put in, the small quantity of lime that still remains in a state to act, sticks to them, the bever is divested of it, and the stuffs only blotted; these must be immediately taken out, and a quick remedy applied to the vat, to preserve the remaining part of the dye, which is done by putting in three or four measures of lime, more or less, according as the vat is cracked, and that without raking her bottom.

It is also to be observed, that if in raking and plunging the fermentation ceases, and the bad smell change, it is then to be supposed that the bever or liquor alone has suffered, and that the grounds are not yet in want. When the fermentation is in part or totally abated, and the bever has a smell of lime, and feels soft to the touch, the vat is to be covered and left at rest; and if the flurry still remains on the vat an hour and a half, a pattern is to be put in, which must be taken out one hour after, and you are to be guided according to the green-ground it will take. But generally vats that are thus cracked, are not so soon brought to a state fit for dying.

*The Opening of the Vat.*

The vat being come to work, the cross must be let down, and about thirty ells of cloth, or the equivalent of its weight of wool well scoured, (which is first intended to be dyed of a Persian blue to make a black afterwards) having returned this stirring several times, which must have always been covered with the liquor, the cloth must be twisted on the rings fastened to the jack at the top of the vat; if it be wool, it is to be dipt with a net, which will serve to wring it: the cloth must be opened by its lifts to air it, and to cool the green, that is, to make it lose the green colour it had coming out of the vat, and take the blue. If this cloth or wool was not deep enough for a mazarine blue by the first dipping, it must get another, by returning into the vat the end of the piece of cloth which first came out; and according to the strength of the woad, you must give to this striking two or three returns, as may be thought necessary for the intensity of the blue required. If the woad be good,  
such

such as the true l'auragais is commonly, after taking out the first stirring, a second may be put in at this first opening of the vat. After making this opening, which is also called the first raking, the vat is to be again raked, and served with lime at discretion, observing that it has the smell and touch conformable to what has been laid down before, and taking notice, that in proportion as the dye diminishes, so does the strength of the woad.

If the vat be in good order at the first opening, three or four stirrings may be made, and the next day, two or three more, only observing not to hurry her, or to work her as strong as at first. That the vat may turn to as much profit as possible, for the shades of blue; first, all stuffs intended to be black, are dyed; then the king's blue; after these the green brown: the violets and Turkish blues are commonly done in the last rakings of the second day of the opening. The third day, if the vat appears much diminished, she must be filled with hot water within four inches of the brim. This is called filling the vat.

The latter end of the week, the light blues are made, and on Saturday night, having raked the vat, she is to be served a little more than the preceding day, that she may keep till Monday.

Monday morning the bever is put on the fire, by passing it from the vat into the copper by a trough, which rests on both; this clear bever is emptied to the grounds, and when it is ready to boil it must be returned into the vat, raking the grounds, as the hot liquor falls from the trough; at the same time may be added a kettleful of prepared indigo.

When the vat is filled within four inches of the brim, and well raked, she must be covered, and two hours after a pattern put in, which must remain

main not more than an hour; lime must be added according to the shade of the green, which this proof pattern shall have taken, and at the expiration of an hour or two, if the vat has not suffered, the stuff is to be put in; having conducted it between two waters for about half an hour, it is wrung, and a dip is again given to it, as was done in the new vat. This vat heated again, is conducted in the same manner, that is, three rakings are made the first day, observing at each raking, whether she wants lime; for in this case, the quantity judged necessary must be given.

Blue made of woad alone, according to the opinion of some persons prejudiced in the favour of old customs, is much better than that which the woad gives with the addition of indigo. But then this blue would be much dearer, because woad gives much less dye than indigo, and it has been found by repeated experience, that four pounds of fine indigo from Guatimala, produced as much as a bale of Albigeois woad or pastel; and five pounds as much as a bale from L'Auragais, which generally weighs two hundred and ten pounds. So the using of the indigo with the woad is a great saving, as one vat with indigo shall dye as much as three without it.

Indigo is generally put into new vats after the woad yields its blue, and a quarter or half after she is to be served with lime; as this solution of indigo is already impregnated with some of its dissolution, the lime must be given with a more sparing hand than where the woad is used alone. At the re-heating, the indigo is put in on Saturday night, that it may incorporate with the bever, and that it may serve as garnish by its lime. The indigo that is brought from Guatimala in America is the best; it is brought over in the shape of small stones, and

of a deep blue; it must be of a deep violet colour within, and when rubbed on the nail, have a copper hue; the lightest is the best. It is necessary to observe, that for the better conducting of a woad vat, and to prevent accidents, a manufacturer ought to have a good woadman, this is the name given to the Journeyman Dyer, whose principal business is to conduct the woad, practice has taught him more than this treatise can furnish.

I shall make some reflections necessary to attain a more perfect knowledge of this process. The woad vat must never be re-heated but when fit for working; that is, she must have neither too much nor too little lime, but be in such a state as only to want heating to come to work. It is known she has too much lime (as has been before observed) by the quick smell; on the contrary, a want is known by the sweetish smell, and by the scum which rises on the surface by raking, being of a pale blue.

Care must be taken when a vat is intended to be re-heated, not to serve her with lime in the evening, (unless in great want of it) for if she was too much served with it, she might next day be too hard, as the Dyers term it; for by heating her again, a greater action is given to the lime, and makes her spend it the quicker. Fresh indigo is commonly put into the vat, each time she is re-heated, in proportion to the quantity to be dyed. It would be needless to put in any, if there was but little work to do, or only light colours wanted. It was not permitted by the ancient regulations of France, to put more than six pounds of indigo to each bale of woad, because the colour of the indigo was thought not lasting, and that it was only the great quantity of woad which could secure and render it good; but it is now ascertained, both by the experiments of Monsieur Dufay, and those which I have since made,

made, that the colour of indigo, even used alone, is full as good, and resists as much the action of the air, sun, and rain, as that of pastel or woad.

When a vat has been heated two or three times, and a good part has been worked off, the same liquor is often preserved, but part of the grounds are taken out, which is replaced by new woad; (this is called *vamping*); the quantity cannot be prescribed on this occasion, for it depends upon the work the Dyer has to do. Practice will teach all that can be wished for on this head. There are Dyers who preserve liquor in their vats several years, renewing them with woad and indigo in proportion as they work them; others empty the vat entirely, and change the liquor when the vat has been heated six or seven times, and that she gives no more dye. A series of practice alone will shew which of these is preferable. It is however more reasonable to think, that by renewing it now and then, more lively and beautiful colours may be obtained, and the best Dyers follow this method.

In Holland they have vats which do not require to be so often heated. Mr. Van Robbais had some of these made some years since for their royal manufactory at Abbeville. The upper parts of these vats, to the height of three feet, are of copper, and the rest lead: They are also surrounded with a small brick wall, at seven or eight inches from the copper; in this interval embers are put, which keep up the heat of the vat a long time, so that she remains several days together in a condition to be worked, without the trouble of heating her over again. These vats are much more costly than the others, but they are very convenient, especially for the dipping of very light colours; because the vat is always fit to work, though she be very weak; this is not the case of the others, which generally

make the colour a great deal deeper than required, unless they are set to cool considerably, and then it happens that the colour is not so good, nor has it the same brightness. To make these light colours in common vats, it is better to work some purposely that are strong with woad and weak of indigo; such give their colours slower, and light colours are made with greater ease.

As to the vats made after the Dutch fashion, and which have already been mentioned, the four which Mr. Van Robbais has in his manufactory, are six feet in depth, of which three feet and a half in the upper part are copper, and the two feet and a half of the bottom are lead. The diameter at the bottom is four feet and a half, and that at the top five feet four inches.

To return to the observations on heating the common vats. If the vat was heated when crackt, that is, when she has not quite lime enough, she would turn in the heating without being perceived, and perchance be entirely lost, as the heat would soon finish the spending of the lime, which was in too small a quantity. If this is perceived in time, it must be helped by pouring it back into the vat without more heating; then feed her with lime, and not heat her till she is come to work.

On the re-heating, some of the grounds must be put into the copper with the liquor or bever; and great care must be taken not to boil it, because the volatile necessary in this operation would evaporate. There are some Dyers, who, in heating their vats, do not put in the indigo immediately after the liquor is poured from the copper into the vat, but wait some hours till they see her come to work: this they do as a precaution, lest the vat should fail, and the indigo be lost; but by this method, the indigo does not so freely yield its colour, as they are obliged

obliged to work her as soon as she is fit, that she may not cool, so that the indigo, not being entirely dissolved, nor altogether incorporated, has no effect. It is therefore better to put it into the vat at the same time the liquor is cast in, and rake her well after. If the vat is heated over again without her coming to work, she must not be scummed as in the common heatings, as the indigo would be carried off thereby, whereas, when she has worked, this scum is formed of the earthy part of the indigo and woad, united with a portion of lime.

When too much lime is put into a vat, you must wait for her till such time as she has spent it, or it may be accelerated by heating it, or by putting in ingredients which destroy in part the action of the lime, such as tartar, vinegar, honey, bran, some mineral acid, or any matter that will become sour; but all these correctors wear out the dye of the indigo and woad, so that the best method is, to let it spend of its own accord. A vat is not commonly fed with lime, but on the first, second, and sometimes the third day, and it is also remarked, not to dip the violets, purples, or any other wool or stuffs which have previously a colour that may be easily damaged; the succeeding day after its being fed with lime, as it is then too active, it dulls the first colour; the fifth or sixth day the crimson may be dyed to give them a violet, and the yellows for green; following this rule, the colours will always be bright.

When a vat has been re-heated, she must come to work before she is served with lime; if this was done a little too soon, she would be cracked; the same thing would happen if some of the grounds were put into the copper. The most effectual method in this case is to let her rest before she is worked, until she comes to, which often happens in two, three, or four hours, and sometimes a day.

By using light or weak lime, the grows too hard; because this light lime remains in the liquor, and does not incorporate with the grounds. This is known by the strong smell of the liquor, and on the contrary the grounds have a sweetish smell, whereas the smell ought to be equal in both. The best way then is, to let it spend itself, by raking her often, in order to mix the lime with the grounds, until the smell of the vat is restored, and the flurry becomes blue.

A woad vat may be set without the addition of indigo, but then she yields but little colour, and only dyes a small quantity of wool or stuffs; for one pound of indigo, as has already been observed, affords as much dye as fifteen or sixteen pounds of woad. I set one of this kind to try the qualities of woad by itself, and I could not find that indigo was any way inferior to it, either for the beauty or solidity of the colour. As lime is always used, and sometimes four liquors, in the setting of a vat, this is the proper place to speak of their preparation.

#### *Preparation of Lime.*

That the lime may be properly slacked for the Dyer's use, several pieces are immersed in water, one after another, and when each has remained till it begins to crackle, they are taken out to put in others, and after this manner they are cast into an empty vessel, where the lime finishes slacking, and reduces itself to powder, considerably augmenting its bulk; it is afterwards sifted through a canvass, and kept in a dry hoghead.

Sour liquors are not only necessary in some circumstances of setting a woad vat, but also in some of the preparations given to wool and stuffs previous

vious to their being dyed; they are prepared after the following manner.

*Preparation of four Liquors.*

A copper of the size required is filled with river water, and when it boils, it is flung into a hog-head, where a sufficient quantity of bran has been put, and stirred with a stick three or four times a day. The proportion of bran and water is not very material; I have made a good liquor by putting three bushels of bran into a vessel containing two hundred and fourscore quarts. Four or five days after, this water becomes sour, and consequently fit for use in all cases, where it will not be detrimental to the preparations of wool that are independent of dying.

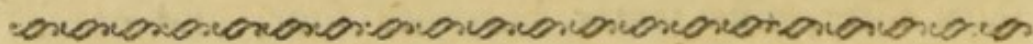
For it may happen, that wool in the fleece which has been dyed in a liquor where too great a quantity of sour water has been put, will be harder to spin, as the sediment of the bran forms a sort of starch that glues the fibres of the wool, and prevents their forming an even thread. I must here take notice of the bad custom of letting sour liquors remain in copper-vessels, as I have seen in some eminent dye-houses; for this liquor being an acid, corrodes the copper, and if it remains long enough to take in a portion of this metal, it will cause a defect both in the dye and in the quality of the stuff: in the dye, because the dissolved copper gives a greenish cast; in the quality of the stuff, because the copper dissolved preys on all animal substances. The Dyers are often ignorant of the cause of these defects.

I flatter myself to have omitted no essential point on the woad vat: if any difficulties or accidents, which I have mentioned, are not found in the practice,

tice they are not considerable, and an easy remedy will be found by those who make themselves familiar with the working part.

The readers who have no idea of this work, may think me too prolix, and find repetitions; but those who intend to make use of what I have taught in this chapter, will perhaps reproach me for not having said enough on the subject.

Those that read this chapter with attention, will not be surprized that the master-piece for apprentices to Dyers of the great dye, is, to set the woad vat and work her.



### C H A P. III.

#### *Of the* FIELD WOAD VAT.

I Have but little to say on this woad vat, different from that which has been related of the pastel or garden woad. The woad is a plant cultivated in Normandy, and prepared after the same manner the garden woad is in Languedoc. The method of cultivating it may be seen in the French "General Instructions on Dyes," of the 28th of March, 1671, from the article 259 to 288, where it treats of the culture and preparation of the pastel and woad. The woad vat is set at work after the same manner as that of pastel; all the difference is that it has less strength and yields less dye. There follows a description of the woad vat, which I carried on in small, and in a bath heat similar to that of the pastel in the foregoing chapter.

I placed in a copper a small vessel containing fifty quarts, and filled two-thirds with a liquor made of river water, one ounce of madder, and a little weld, putting in at the same time a good  
handful

handful of wheaten bran and five pounds of woad. The vat was well raked and covered; it was then five in the evening; it was again raked at seven, nine, twelve, two, and four o'clock; the woad was then working, that is, the vat was slowly coming to work, as I have already related of that of the pastel.

Pretty large air bubbles formed themselves, but in a small quantity, and had scarcely any colour. She was then served with two ounces of lime and raked. At five o'clock a pattern was put in; which was taken out at six, raking her; this pattern began to have some colour; another was put in at seven, at eight she was raked, and the pattern came out pretty bright; an ounce of indigo was then put in; at nine another pattern, at ten she was raked, and one ounce of lime was added, because she began to have a sweetish smell; at eleven a pattern, at twelve she was raked; it was thus continued till five, then three ounces of indigo were put in, at six a pattern, at seven she was raked. It would then have been proper to have served her with water, as she was at that time perfectly come to work, the pattern that was taken out being very green, and turning of a bright blue. But besides that I was fatigued, having sat up the whole night, I chose rather to put her back to the next day, to see her effect by day-light; and for that purpose, I put one ounce of lime, which kept her up till nine in the morning: from time to time patterns were put in, the last that was taken out was very beautiful; she was served with a liquor composed of water, and a small handful of bran. She was raked, and patterns put in from hour to hour; at five she was come to work; she was afterwards served with lime, and raked to preserve her till she was to be re-heated.

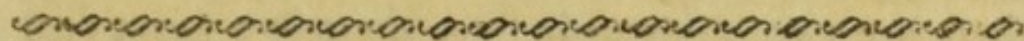
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Some time after I set another with the woad alone without indigo, that I might be able to judge of the lasting of the dye of the woad, which, upon trial, I found to be as good as the pastel or garden woad. Thus all the superiority the pastel has on the woad, is, that the latter yields less dye than the former.

The little varieties that may be observed in setting these different vats at work, prove, that there are many circumstances in these processes that are not absolutely necessary. It appears to me, that the only important point, and that to which the greatest attention is to be given, is, in the conducting the fermentation with care, and not to serve her with lime, but when judged necessary by the indications I have laid down. As to the indigo being put in at twice, or altogether, a little sooner or later, it appears very indifferent. The same may be said of the weld, which I made use of twice, and suppressed the two other times, and of pearl-ashes, which I added in a small quantity in the small pastel vat, and suppressed in the woad vat. In short, I believe, and it appears to me to a demonstration, that the greatest regard is to be had to the proper distribution of the lime, throughout the whole course of the working of the vats, either to set them at work, or to re-heat them. I must also add, that when a woad vat is set to work, she cannot be too often inspected into to know her state; for if there are some that are backward (which is attributed to the weakness of the woad) there are also others that very quickly come to work. I have seen a middling one of seventy pounds of woad, poisoned; because the woad man neglected to inspect her as often as she required, and she had been two hours fit to work before he discovered it; the grounds were entirely come up to the surface of the liquor, and the whole had  
a very

a very foul smell; it was not possible to bring her back, and they were obliged to fling her away, as she would in a short time have contracted a foetid smell. The retarding of the action of the vat may also proceed from the temperature of the air; for the vat cools a great deal sooner in winter than in summer; therefore it becomes necessary to watch it attentively, though commonly they are fourteen or fifteen hours before they come to work.

I shall endeavour to explain, in the sequel, how the colouring part of this ingredient, so necessary in dying, displays itself; but I must first of all speak of vats which are prepared from indigo.



## C H A P. IV.

### *The* INDIGO VAT.

#### *Process of making the* INDIGO *in* AMERICA.

INDIGO is the fecula of a plant named *nil* or *anil*; to make it, three vats are placed the one over the other, in form of a cascade; in the first, called the steeper, the plant is put in with its leaves, bark, and flowers\*, and filled with water; some time after, the whole ferments, the water grows intensely hot, thickens, and becomes of a blue colour, bordering on the violet; the plant, according to the opinion of some, depositing all its salts, and, according to others, all its substance. In this state, the cocks of the steeper are turned, and all the water let out stained with the colouring

\* In the village of Sargussa, near the town of Amadabat, the Indians only use the leaves of the anil; they fling away the rest of the plant. The best indigo comes from thence.

parts of the plant into the second, called the beater; because this water is beat by a mill or machine that has long sticks, to condense the substance of the indigo, and precipitate it to the bottom. By this means the water becomes clear and colourless, like common water; then the cocks are turned, that the water may run off from the surface of the blue sediment; after which, other cocks are turned that are at the bottom, that all the fecula may fall into the third vat, called the reposer; for it is there the indigo remains to dry; it is then taken out to be made into cakes, &c. See, on this subject, *Histoire des Antilles, par le Pere Labat*.

At Pondicherry, on the coast of Coromandel, there are two kinds of indigo, the one a great deal finer than the other; the best is seldom used but to lustre their silks, the inferior in dyeing. They augment in price according to their quality; there is some which cost from 15 pagodas the bar (which weighs 48 pounds) to 200 pagodas. The most beautiful is prepared nigh Agra. There is also a very good kind that comes from Masilupatan and Ayanon, where the East-India Company have a factory. At Chandernagor it is called nill when it is prepared and cut to pieces. The indigo of Java is the best of all; it is also the dearest, and consequently few Dyers use it. Good indigo ought to be so light as to float on the water; the more it sinks, the more it may be suspected of being adulterated by a mixture of earth, cinders, or pounded flates. It must be of a deep blue, bordering on the violet, brilliant, lively, and shining; it must be finer within, and appear of a shining hue. Its goodness is tried by dissolving it in a glass of water; if it be unmixed and well prepared, it will dissolve entirely; if sophisticated, the foreign matter will sink to the bottom. Another method of trying  
it

it is by burning; good indigo burns entirely away, and when adulterated, the mixture remains after the indigo is consumed.

Powdered indigo is much more subject to adulteration than that which is in cakes; for it is a difficult matter that sand, powdered slates, &c. should unite so as not to form together in different places layers of different matters; and, in this case, by breaking the lump indigo, it is easily discovered.

*Method of working the Indigo Vat.*

There are several methods of preparing the indigo vat; I tried all those I knew, and they all succeeded. I shall describe them after the most exact manner, beginning with that which is the most in use, and almost the only one known at Paris.

It is a vat which is about five feet in height, two feet diameter, and becomes narrow towards the bottom; she is surrounded with a wall that leaves a space round her, which serves to hold embers. In a vat of this size, two pounds of indigo may at least be used, and five or six for the greatest proportion. To set a vat of two pounds of indigo in such a vessel that may contain about fourscore quarts, about sixty quarts of river water are set to boil in a copper for the space of half an hour, with two pounds of pearl ashes, two ounces of madder, and a handful of bran; during this, the indigo is prepared after the following manner:

Two pounds of it are weighed out, and cast into a pail of cold water to separate the earthy parts. The water is afterwards poured off by inclination, and the indigo well ground; a little warm water is put into it, shaking it from side to side; it is poured by inclination into another vessel; what remains is still ground, and fresh water put

in to carry off the finest parts, and thus continued till all the indigo is reduced into a powder, fine enough to be raised by the water. This is all the preparation it undergoes. Then the liquor which has boiled in the copper with the grounds are poured into the high and narrow vat, as likewise the indigo; the whole is then raked with a small rake, the vat is covered, and embers placed round her. If this work was begun in the afternoon, a few embers are added at night; the same is repeated the next day morning and night. The vat is also lightly raked twice the second day; the third day, the embers are continued to be put round, to keep up the heat of the vat; she is raked twice in the day: about this time, a shining copper-coloured skin begins to appear on the surface of the liquor, and appears as if it was broken or cracked in several places. The fourth day, by continuing the fire, this skin or pelicle is more formed and closer; the flurry, which rises in raking the vat, appears, and the liquor becomes of a deep green.

When the liquor is in this state, it is a sign that it is time to fill the vat. For this purpose a fresh liquor is made, by putting into a copper about twenty quarts of water, with one pound of pearl ashes, a handful of bran, and half an ounce of madder. This is boiled a quarter of an hour, and the vat is served with it; she is then raked, and causes a great quantity of flurry to rise, and the vat comes to work the next day; this is known by the quantity of flurry with which she is covered by the skin or copper-scaly crust which swims on the liquor, which, although it appears of a blue-brown, is nevertheless green underneath.

This vat was much longer coming to its colour than the others, because the fire was too strong the second day, otherwise she would have been fit

to work two days sooner. This did no other damage but retarded her, and the day she came to work, we dipt in ferges weighing thirteen or fourteen pounds. As this caused her to lose her strength, and the liquor being diminished by the pieces of stuff that had been dyed in her, she was served in the afternoon with fresh liquor, made with one pound of pearl ashes, half an ounce of madder, and a handful of bran; the whole was boiled together in a copper for a quarter of an hour; the vat being served with it she was raked, covered, and a few embers put round. She may be preserved after this manner several days, and when she is wanted to work, she must be raked over night, and a little fire placed about her.

When there is occasion to re-heat, and add indigo to this kind of vat, two thirds of the liquor (which then is no more green, but of a blue-brown and almost black) is put into a copper; when it is ready to boil, all the scum that is formed at the top is taken off with a sieve; it is afterwards made to boil, and two handfuls of bran, a quarter of a pound of madder, and two pounds of pearl ashes are added. The fire is then removed from the copper, and a little cold water cast into it to stop the boil; after which the whole is put into the vat, with one pound of powdered indigo, diluted in a portion of the liquor as before related; after this the vat is raked, covered, and some fire put round; the next day she is fit to work.

When the indigo vat has been re-heated several times, it is necessary to empty her entirely, and to set a fresh one, or she will not give a lively dye; when she is too old and stale, the liquor is not of so fine a green as at first.

I put several other vats to work after the same method, with different quantities of indigo, from

one pound to six; always observing to augment or diminish the other ingredients in proportion, but always one pound of pearl ashes to each pound of indigo. I have since made other experiments, which proved to me that this proportion was not absolutely necessary; and I make no doubt but that several other means might be found to make the indigo come to as perfect a colour. I shall, nevertheless, proceed to some other observations on this vat.

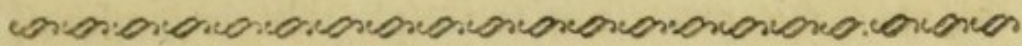
Of all those I set to work, after the manner described, one only failed me, and that by neglecting to put fire round her the second day. She never came to a proper colour; powdered arsenic was put in to no effect; red-hot bricks were also plunged in at different times; the liquor turned of a greenish hue, but never came to the proper colour; and having attempted several other means without success, or without being able to find out the cause of her not succeeding, I caused the liquor to be emptied and cast away.

All the other accidents that have happened me in conducting the indigo vat, have only lengthened the operation; so that this process may be looked upon as very easy when compared to that of the woad vat. I have also made several experiments on both, in which my chief view was to shorten the time of the common preparation; but not meeting with the desired success, I shall not relate them.

The liquor of the indigo vat is not exactly like that of the woad; its surface is of a blue-brown, covered with coppery scales, and the under part of a beautiful green. The stuff or wool dyed in this is green when taken out, and becomes blue a moment after.—We have already seen that the same happens to the stuff dyed in the woad vat; but it is remarkable,

remarkable, that the liquor of the last is not green, and yet produces on the wool the same effect as the other. It must also be observed, that if the liquor of the indigo vat be removed out of the vessel in which it was contained, and if too long exposed to the air, it loses its green and all its quality, so that, although it gives a blue colour, that colour is not lasting.

I shall examine this more particularly in the sequel, and endeavour to give the chymical theory of this change.



## C H A P V.

*The* C O L D V A T *with* U R I N E.

**A** VAT is also prepared with urine, which yields its colour cold, and is worked cold: for this purpose four pounds of indigo are powdered, which is to be digested on warm ashes twenty-four hours, in four quarts of vinegar; if it is not then well dissolved, it must be ground again with the liquor, and urine is to be added little by little, with half a pound of madder, which must be well diluted by stirring the liquor with a stick; when this preparation is made, it is poured into a vessel filled with 250 quarts of urine; it matters not whether it be fresh or stale; the whole is well stirred and raked together night and morning for eight days, or till the vat appears green at the surface when raked, or that she makes flurry as the common vat; she is then fit to work, without more trouble than previously raking her two or three hours before. This kind of vat is extremely convenient, for when once set to work, she remains good till she be entirely drawn, that is, till the in-

indigo has given all its colour; thus she may be worked at all times, whereas the common vat must be prepared the day before.

This vat may at pleasure be made more or less considerable by augmenting or diminishing the ingredients in proportion to the indigo intended to be made use of; so that to each pound of indigo add a quart of vinegar, two ounces of madder, and sixty or seventy quarts of urine. This vat comes sooner to work in summer than in winter, and may be brought sooner to work by warming some of the liquor without boiling, and returning it into the vat; this process is so simple that it is almost impossible to fail.

When the indigo is quite spent, and gives no more dye, the vat may be charged again without setting a new one. For this purpose, indigo must be dissolved in vinegar, adding madder in proportion to the indigo, pouring the whole into the vat, and raking her night, and morning, and evening as at first, she will be as good as before; however she must not be charged this way above four or five times, for the ground of the madder and indigo would dull the liquor, and in consequence render the colour less bright. I did not try this method, and therefore do not answer for the success; but here follows another with urine which gives a very lasting blue, and which I prepared.

*Hot Vat with Urine.*

A pound of indigo was steeped twenty-four hours in four quarts of clear urine, and when the urine became very blue, it was run through a fine sieve into a pail, and the indigo which could not pass, and which remained in the sieve, was put with four quarts of fresh urine; this was so continued  
till

till all the indigo had passed through the sieve with the urine; this lasted about two hours. At four in the afternoon three hogheads of urine were put into the copper, and it was made as hot as could be without boiling. The urine cast up a thick scum, which was taken up with a broom and cast out of the copper. It was thus scummed at different times, till there only remained a white and light scum; the urine, by this means sufficiently purified and ready to boil, was poured into the wooden vat, and the indigo prepared as above put in; the vat was then raked the better to mix the indigo with the urine: soon after, a liquor was put into the vat, made of two quarts of urine, a pound of roach-allum, and a pound of red-tartar. To make this liquor, the allum and tartar were first put into the mortar, and reduced to a fine powder, upon which the two quarts of urine were poured, and the whole rubbed together, till this mixture, which rose all of a sudden, ceased to ferment: it was then put into the vat, which was strongly raked; and being covered with its wooden cover, she was left in that state all night; the next morning the liquor was of a very green colour; this was a sign she was come to work, and that she might have been worked if thought proper, but nothing was dyed in her; for all that was done was only, properly speaking, the first preparation of the vat, and the indigo which had been put in was only intended to feed the urine, so that to finish the preparation the vat was let to rest for two days, always covered, that she might cool the flower; then a second pound of indigo was prepared, ground with purified urine as before. About four in the afternoon all the liquor of the vat was put into the copper, it was heated as much as possible without boiling; some thick scum formed on it which was taken off,

and

and the liquor being ready to boil was returned into the vat. At the same time the ground indigo was put in, with a liquor made as above of one pound of allum, one pound of tartar, and two quarts of urine, a fresh pound of madder was also added; then the vat was raked, well covered, and left so the whole night. The next morning she was come to work, the liquor being very hot, and of a very fine green, she was worked with wool in the fleece, of which thirty pounds were put into the vat. It was well extended and worked between the hands, that the liquor might the more easily soak into it; then it was left at rest for an hour or two, according as lighter or deeper blues are required.

All this time the vat was well covered, that it might the better retain its heat, for the hotter she is, the better she dyes, and when cold acts no more. When the wool came to the shade of the blue required, it was taken out of the vat in parcels, about the bigness of a man's head, twisted and wrung over the liquor as they were taken out, till from green, as they were coming out of the vat they became blue. This change from green to blue is made in three or four minutes. These thirty pounds being thus dyed, and the green taken off, the vat was raked, and suffered to rest for two hours, being all that time well covered; then thirty pounds more were put in, which was well extended with the hands, the vat was covered, and in four or five hours this wool was dyed at the height or shade of the first thirty pounds; it was then taken out in heaps, and the green taken off as before. This done, the vat had still some little heat, but not sufficient to dye fresh wool; for when she has not a sufficient heat, the colour she gives would neither be uniform nor lasting, so that it must be re-heated, and fresh indigo put in as before. This may be  
done

done as often as judged proper, for this vat does not spoil by age, provided, that whilst she is kept without working, a little air is let into her.

*Re-heating of the Vat with Urine.*

About four in the afternoon, the whole liquor of the vat was put into a copper, and a sufficient quantity of urine added to this liquor, to make up the deficiency that had been lost by evaporation during the preceding work. This filling commonly takes eight or nine pails of urine; the liquor was then heated and scummed as before, and when ready to boil, returned into the vat with a pound of indigo, and the liquor above described, consisting of allum and tartar, of each one pound, madder one pound, and two quarts of urine. After raking the vat well, and covering her, she was left at rest the whole night.

The next day she came to work, and sixty pounds of wool were dyed in her at twice as before. It is after this manner all the re-heatings must be done the eve before the dying, and these re-heatings may extend to infinity, as the vat once set serves a long time.

I must here observe, that the greater the quantity of indigo put in at once is, the deeper the blue: thus, instead of one pound, four, five, or six pounds may be put in together; nor is it necessary to augment the dose of allum, tartar, or madder, of which ingredients the liquor is composed: but if the vessel hold more than three hogsheads, then the dose of these must be augmented in proportion. The vat I have mentioned held three, and was too small to dye at one time a sufficient quantity of wool to make a piece of cloth, viz. fifty or sixty pounds; for this purpose it would be necessary that the vat should

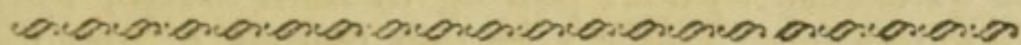
should contain at least six hogheads, and from this a double advantage would arise. 1. All the wool will be dyed in three or four hours, whereas dying it at twice, it takes eight or ten hours. 2. At the end of three hours, in which time the wool would be dyed, taken out, and the green taken off, the vat being yet very hot; after raking and letting her rest a couple of hours, the same wool might be returned into her, which would heighten the colour very much, for all wool that has been dyed, aired, and the green taken off, always takes a finer colour than new or white wool, which might remain twenty hours in the vat.

Great care must be taken to air and take off the green of the dyed parcels of wool that are taken out of the vat hastily, that the air may strike them equally, without which the blue colour will not be uniform throughout the wool.

There are manufacturers who say that cloths, whose wool has received this ground of blue with urine, cannot be perfectly scoured at the fulling mill, even at twice; others vouch the contrary, and I am of opinion the last speak the truth; yet, if the first are right, it might be suspected that the animal oil of the urine becoming resinous by drying on the wool, or by uniting with the oil with which the oil is moistened; for its other preparations more strongly resist the fuller's earth and soap, than a simple oil by expression. To remedy this, the wool ought to be well washed in a running water after it is dyed, twisted, aired, the green taken off, and cooled. Be it as it may, the woad vat will always be preferred in the great dye-houses to those kinds of indigo vats made with urine or otherwise; and for this reason, that with a good woad vat, and an ingenious woadman, much more work is despatched than with all the other blue vats.

I have

I have described the indigo vats in this treatise, not with a design to introduce them in the large manufactories, but to procure easy means to the Dyers in small, and small manufactories, to whom I wish this work may be of as much advantage as to the others. I shall therefore here describe a cold vat, which may be used with advantage by those who dye small stuffs, in whose composition thread and cotton enter. The colour is lasting, but cannot be made use of for wool.



## C H A P. VI.

*Of the COLD INDIGO VAT without URINE.*

**I**T is customary at Rouen, and in some other cities of France, to dye in a cold indigo vat, different from that described in the foregoing chapter, and more convenient, as she comes to work sooner, and has no bad smell. She is prepared after the following manner:

Dissolve three pounds of indigo powdered finely, in a glazed earthen pot, with three pints of strong soap-boiler's lees, which is a strong lee of soda and quick lime. The indigo takes about twenty-four hours dissolving, and when perfectly so, remains suspended in the liquor, thickens it, and gives it the consistence of an extract. At the same time, three pounds of sifted slacked lime must be put into another vessel, with six quarts of water, and boiled together for a quarter of an hour; when settled, the clear is poured off by inclination. Then three pounds of green copperas are to be dissolved in this clear lime-water, and the whole let to rest till the next day. Three hundred quarts of water are then put in a large deal-vessel (no other wood

wood but deal will do, for it would dull and blacken the dye, especially if it was oak.) The two solutions which were made the day before are put in, the vat is well raked, and suffered to rest. I have seen her come to colour in two hours after, but this never fails to happen the next day at farthest. She makes a great deal of flurry, and the liquor becomes of a fine green colour, but a little more on the yellow than the green of the common vat.

When this vat begins to spend herself, she is to be quickened without putting in fresh indigo, by making a small liquor with two pounds of green copperas, dissolved in a sufficient quantity of lime-water; but when the indigo has spent all its colour, she must be re-charged by putting in fresh, dissolved in such a lee as has been described.

#### *Water of Old Iron.*

Some Dyers put into this vat a little water of old iron. It is a mixture of vinegar and water, in which some old iron nails have been put to rust. They say this makes the colour more lasting, but I have experienced, that it is sufficiently so without this, and as good as all the other blues, of which I have before given the preparation.

I set several small vats; those that required to be heated were put in a bath or sand-heat, in small glass bodies; and those that are worked cold were left without doing any thing to them. These last are easy, being sufficient to diminish the quantity of liquor, and of all the other ingredients, in proportion to the vessel that is to be set, and it is almost impossible to fail.

As to that which I first described, which is set hot, as it is somewhat more difficult, and that several might be willing to try the experiment, which

in itself is curious, and neither requires expence nor apparatus to perform in small, I shall give the process of one which succeeded perfectly, and in which I had designedly put a greater quantity of indigo than usually is done in the common proportion.

I boiled two quarts of water with two scruples of madder and four ounces of pearl-ashes; after boiling a quarter of an hour, I put it into a body, which held about four quarts, and had been previously heated with warm water, and in which I had put a quarter of a handful of bran. The whole was well stirred with a deal spatula, the glass body put on a very gentle sand-heat, which only kept it warm, and pretty near the same degree of heat that is required for the common indigo vat.

The fire was kept all night, and the next day under the sand-heat, without any sensible change happening; it was only stirred twice a-day. The next day some flurry began to rise, and a copper-coloured skin formed on the surface, and the liquor was of a green-brown; it was then filled up with a liquor made of a quart of water, two ounces of pearl-ashes, and a little bran. I mixed the whole together, then let it rest. It came perfectly well to colour, and the next day I dyed several middling pieces of stuffs and wool. These small vessels may be re-heated and charged again as easily as a large one.

I think I have nothing more to say concerning the method of setting to work all these kind of blue vats; yet I am persuaded that there are several other means practised in different places, and that it is even easy to contrive new ones; however, I can affirm that all those which I have described are very sure, and that they have all been worked several times with the same success.

## C H A P. VII.

*Of the Method of DYING BLUE.*

**W**HEN the vat is once prepared and come to work, the dying of wool or stuffs is easy. Wet them well in clear warm water, wringing and dipping them in the vat, and keeping them in more or less time, according as the colour is required in shade. From time to time the stuff is aired, that is, taken out of the vat and wrung, so that the liquor may fall back into the vat, and exposed a little to the air, which takes off the green in one or two minutes; for let what vat soever be used, the stuff is always green at its coming out, and only takes the blue colour in proportion as the air acts upon it. It is also very necessary to let the green go off before it is returned into the liquor to receive a second shade, as being then better able to judge of its colour, and know if it is requisite to give what is called one or several returnings.

It is an ancient custom among Dyers to reckon thirteen shades of blue from the deepest to the lightest. Although their denominations be somewhat arbitrary, and that it is impossible exactly to fix the just passage from one to the other, I shall notwithstanding give the names. They are as follow, beginning with the lightest: milk-blue, pearl-blue, pale-blue, flat-blue, middling-blue, sky-blue, queen's-blue, turkish-blue, watchet-blue, garter-blue, mazareen-blue, deep-blue, and very deep blue.

These distinctions are not equally received by all Dyers, nor in all provinces, but the most part are known; and it is the only method that can be taken to give an idea of the same colour, whose only difference is in being more or less deep.

It

It is easy to make deep blues. I have already said, that to effect this, the wool or stuffs are to be returned several times into the vat; but it is not so in respect to light blues; for when the vat is rightly come to work, the wool can seldom be left in short time enough, but that it takes more than the shade required. It often happens when a certain quantity of wool is to be dipped, and that it cannot all be put in at the same time, that what goes in at first is deeper than the other. There are some Dyers who, to obviate this inconveniency in making very light blues, which they call milk and water, take some of the liquor of the indigo vat, and dilute it in a very great quantity of lukewarm water; but this method is a bad one, for the wool dyed in this mixture has not near so lasting a colour as that dyed in the vat; as the altering ingredients which are put into the vat with the indigo, serves as much to dispose the pores of the subject which is dipped in, as to the opening of the colouring fecula which is to dye it, their concurrence being necessary for the adhesion of the colour. The best method of making these very light blues, is to pass them either in a woad or indigo vat, out of which the colour has been worked, and begins to cool. The woad vat is still preferable to that of the indigo, as it does not dye so soon.

The blues made in vats that have been worked are duller than the others; but they may be pretty sensibly roused by passing the wool or stuffs in boiling water. This practice is even necessary to the perfection of all blue shades; by this the colour is not only made brighter, but also rendered more secure, by taking off all that is not well incorporated with the wool; it also prevents its spotting the hands or linen, which commonly happens, and

the Dyers, to gain time, neglect this precaution. After the wool is taken out of the warm water, it is necessary to wash it again in the river, or at least in a sufficient quantity of water for the carrying off all the superfluous loose dye.

The best method to render the blue dye brighter, is by filling them with a thin liquor of melted soap, and afterwards cleansing them from the soap by warm water, and, if convenient, by rinsing them in an old cochineal liquor. This method is to be taken with deep blues; but if the same was taken with very light blues, they would lose their bright-blue lustre and incline to grey.

I hope to have removed all difficulties on the preparation of blue, and in the method of dying it. Some Dyers, for the sake of gain, spare the woad and indigo, and use for blue, orchel or logwood, and brazil; this ought to be expressly forbid, though this adulterated blue is often brighter than a lasting and legitimate blue. I shall take notice of this in the chapters treating on the lesser dye.

I shall now explain the theory of the invisible change of the blue dye. This colour, which I shall here only consider in relation to its use in the dying of stuffs of what kind soever, has hitherto been extracted only from the vegetable world, and it does not appear that we can hope to use in this art the blues the painters employ: such are the Prussian blue, which holds of the animal and mineral kind\*; the azure, which is a vitrified mineral substance; the ultramarine, which is prepared from a hard stone; the earths that have a blue colour, &c. These matters cannot, without losing their colour in whole or in part, be reduced

\* 1748, Mons. Macquer, of the Royal Academy of Sciences, found the means of using the Prussian blue to dye silk and cloth, in a blue whose brightness surpassed all the blues hitherto known.  
into

into atoms sufficiently minute, so as to be suspended in the saline liquid, which must penetrate the fibres of the animal and vegetable substances of which stuffs are manufactured; for under this name linen and cotton cloths must be comprehended, as well as those wove of silk and wool.

Hitherto we know but of two plants that yield blue after their preparation: the one is the isatis or glaustum, which is called pastel in Languedoc, and woad in Normandy. Their preparation consists in a fermentation continued even to the putrefaction of all the parts of the plant, the root excepted; and consequently in the unfolding of all their principles into a new combination, and fresh order of these same principles, from whence follows an union of infinite fine particles, which, applied to any subject whatever, reflects the light on them very different from what it would be, if these same particles were still joined to those which the fermentation has separated.

The other plant is the anil, which is cultivated in the East and West-Indies, out of which they prepare that fecula that is sent to Europe under the name of indigo. In the preparation of this plant the Indians and Americans, more industrious than ourselves, have found out the art of separating only the colouring parts of the plant from the uselefs ones; and the French and Spanish colonies have imitated them, and thereby made a considerable increase of commerce.

That the indigo, such as is imported from America, should deposit on the wool or stuffs the colouring parts required by the Dyer, it is infused several ways, the processes of which we have already given. They may be reduced to three; the cold indigo vat may serve for thread and cotton; those that are made use of hot, are fit for stuffs of any kind whatever.

In the cold vat, the indigo is mixed with pearl-ashes, copperas or green vitriol, lime, madder, and bran. The hot vats are either prepared with water or urine; if with water, pearl-ashes and a little madder must be added; if with urine, allum and tartar must be joined to the indigo. Both of these vats, principally intended for wool, require a moderate degree of heat, but at the same time strong enough for the wool to take a lasting dye, I mean such as will withstand the destroying action of the air and sun, the proof of dyes.

I have prepared, as I said before, these three vats in small, in cylindrical glass vessels, exposed to the light, in order to see what passed before the infusion came to a colour, that is, whether it was green beneath the flurry at the surface, which is a sign of internal fermentation. I have said that the green colour of the liquor is a condition absolutely essential, and without which, the colour the stuff would take would not be a good dye, and would almost entirely disappear on the least proofs.

I shall now give a description of the cold indigo vat in small, for the changes are much better seen in her, and for this reason, that what happens in the two others is not very essentially different. It is proper to take notice, that what I shall call *part*, in this Observation of Experiments, is a measure of the weight of four drachms, of all matter either liquid or solid, and that it will be this quantity that must be supposed, each time that I use that word in the detail of these experiments.

I put three hundred parts of water into a vessel, containing five hundred and twelve, or eight quarts, in which I dissolved six parts of copperas, which gave the liquor a yellow dye. Six parts of pot-ashes were also dissolved by themselves in thirty-six parts of water. The solution made, I digested in  
it

it six parts, or three ounces, of indigo of St. Domingo well ground; it was left over a very gentle fire three hours. The indigo swelled, and taking up a larger space, rose from the bottom of this alkaline liquor, with which it formed a kind of thick syrup, which was blue. This was a proof that the indigo was only divided, but not dissolved; for had its solution been perfect, that thick liquor would have been green instead of blue; for all liquor that has been tinged blue by a vegetable of any kind, grows green on the admixion of an alkaline salt, either concrete or in a liquid form, whether it be a fixed or volatile.

From hence the reason is discovered why indigo does not dye a stuff of a lasting blue when its liquor is not green; for its solution not being complete, the alkali cannot act upon these first elementary particles; as for example, it acts on the tincture of violets, which is a perfect solution of the colouring parts of those flowers, which it turns green in an instant, and on the first contact.

I poured this thick blue liquor into the solution of vitriol, and after well shaking the mixture, I added six parts of lime that had been slacked in the air; it was cold weather when this experiment was made; the thermometer was at two degrees under the freezing point, which was the cause that this was near four days coming to a colour, and the fermentation, which must naturally ensue in all vitriolic liquor, where an alkaline salt has been put in, such as pot-ashes, and an alkaline earth, was carried on with so much slowness that very little scum appeared on the surface of the liquor. In a hot season, and by making use of lime newly calcined; these kind of vats are sometimes fit to dye in four hours.

Each

Each time I stirred the mixture with a spatula, I observed that the iron of the vitriol or copperas was the first that precipitated to the bottom of the vessel, and that the alkaline salt had precipitated it, to join itself to the acid. Thus in this process of the cold indigo vat, a tartar of vitriol after the manner of Tachenius is formed; whereas by the common method of preparing this neutral salt, the acid of vitriol is poured on a true alkaline salt, such as salt of tartar or pot-ashes. This again is a circumstance that leads insensibly to the theory of the good dye. I desire the reader to take notice of this, as it will occur in the sequel of this observation, as well as in other chapters.

The earthy parts of the lime precipitate next after the iron; they are easily distinguished by the whiteness, which are yet difficult to distinguish when the colouring parts of the indigo are sufficiently loosened. In short, under this white earth the fecula of the indigo deposits itself, and by degrees rarifies in such a manner, that this substance, which the first day was only the eighth of an inch above the precipitated lime, rose insensibly within half an inch of the surface of the liquor, and the third day grew so opaque and muddy that nothing further could be distinguished.

This rarefaction of the indigo, slow in winter, quick in summer, and which may be accelerated in winter by heating the liquor to fifteen or sixteen degrees, is a proof that a real fermentation happens in the mixture, which opens the little lumps of indigo, and divides them into particles of an extreme fineness; then their surfaces being multiplied almost *ad infinitum*, they are so much the more equally distributed in the liquor, which deposits them equally on the subject dipped in to take the dye.

If fermentation comes on hastily, or in a few hours, whether on account of the heat of the air, or by the help of a small fire, a great quantity of flurry appears; it is blue, and its reflection they have also named coppery, because the colours of the rainbow appear in it, and the red and yellow here predominate; however this phænomenon is not peculiar to indigo, since the same reflection is perceived in all mixtures that are in actual fermentation, and particularly in those which contain fat particles blended with salts, urine, soot, and several other bodies put into fermentation, shew on their surface the same variegated colours.

The flurry of the indigo vat appears blue, because exposed to the external air; but if a small portion of the liquor which is under it be taken up with a spoon, it appears more or less green in proportion as it is filled with colouring particles. In the course of this observation, I shall shew the reason of this difference, or, at least, a probable explication of this change of blue, which, as I have said before, is absolutely necessary for succeeding in the process described.

When the vat is in this state, it has already been said that cotton, thread, cloths wove from them, &c. may be dyed in her, and the colours which they take are of the good dye; that is, this cotton and thread will maintain them, even after remaining a suitable time in a solution of white soap, actually boiling. This is the proof given them preferable to any other, because the linen and cotton cloths must be washed with soap when dirty.

Though the indigo liquor which is in this state can make a lasting dye without the addition of any other ingredient; the Dyers who use this cold vat add, as in the other hot vats, a decoction of madder and bran in common water run through a sieve;  
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this is what they call *bever*. They put madder to insure, as they say, the colour of the indigo, because this root affords a colour so adhesive that it stands all proofs; they put the bran to soften the water, which they imagine generally to contain some portion of an acid salt, which, according to their opinion, must be deadened.

This was the opinion of the French Dyers against indigo in the days of Monsier Colbert; and as this Minister could not spare time to see the experiments performed in his presence, on the foundation of this report, he forbid indigo to be used alone. But since the Government has been convinced, by new experiments made by the late Mr. Dufay, that the stability of the blue dye of this ingredient was such as could be desired; the new regulation of 1737, licenses the Dyers to use it alone or mixed with woad; so that if they continue to use the madder, it is rather because this root giving a pretty deep red, and this red mixing with the blue of the indigo, gives it a tint which approaches the violet, and also a fine hue.

As to the bran, its use is not to deaden the pretended acid salts, but to disperse throughout a quantity of fizy matter; for the small portion of flour which remains in it, dividing itself into the liquor, must diminish in some measure its fluidity, and consequently prevent the colouring particles which are suspended in it, being precipitated too quick, in a liquor which had not acquired a certain degree of thickness.

Notwithstanding this distributed throughout the liquor, as well from the bran as the madder, which also affords something glutinous, the colouring particles will subside if the liquor remains some days without being stirred; then the top of the liquor gives but a feeble tint to the body dipped in, and if  
a strong

a strong one is wanted, the mixture must be raked, and left to rest an hour or two, that the iron in the copperas, and the gross parts of the lime may fall to the bottom, which otherwise would mix with the true colouring particles, and prejudice their dye, by depositing on the body to be dyed a substance that would have but little adhesion, which in drying would become friable, and of which each minute part would occupy a space, where the true colouring particle could neither introduce nor deposit itself by an immediate contact on the subject.

Not to deviate from the method followed by the Dyers, I boiled one part of grape-madder and one of bran, in 174 parts of water: this proportion of water is not necessary, more or less may be put, but I wanted to fill my vessel, which contained 512 parts. I passed this liquor through a cloth and squeezed it, putting this liquor, still hot, and which was of a blood-red, into the indigo liquor, observing the necessary precautions to prevent the breaking of the glass vessel. The whole was well stirred, and two hours after the liquor was green, and consequently fit for dying. It dyed cotton of a lasting blue, somewhat brighter than it was before the addition of the red of madder.

I shall now endeavour to find out the particular cause of the solidity of this colour; perhaps it may be the general cause of the tenacity of all the rest; for it appears already, from the experiments above related, that this tenacity depends on the choice of salts, which are added to the decoctions of the colouring ingredients, when these same ingredients contain none in themselves. If from the consequences which shall result from the choice of these salts, of their nature, and of their properties, it be admitted (and it cannot be fairly denied) that they afford more or less tenuity in the homogeneous  
colouring

colouring parts of the dying ingredients, the whole theory of this art will be discovered, without having recourse to uncertain or contested causes.

One may easily conceive that the salts added to the indigo vats not only open the natural pores of the subject to be dyed, but also unfold the colouring atoms of the indigo.

In the other preparations of dyes (to be mentioned hereafter) the woollen stuffs are boiled in a solution of salts, which the Dyers call preparation. In this preparation tartar and allum are generally used. In some hours the stuff is taken out, slightly squeezed, and kept damp for some days in a cool place, that the saline liquor which remains in it may still act, and prepare it for the reception of the dye of these ingredients, in the decoction of which it is plunged to boil again. Without this preparation, experience shews that the colours will not be lasting, at least for the greatest part; for it must be owned that there are some ingredients which yield lasting colours, though the stuff has not previously undergone this preparation, because the ingredient contains in itself these salts.

It is therefore necessary, that the natural pores of the fibres of the wool should be enlarged and cleansed by the help of those salts, which are always somewhat corroding, and perhaps they open new pores for the reception of the colouring atoms contained in the ingredients. The boiling of this liquor drives in the atoms by repeated strokes. The pores already enlarged by these salts, are further dilated by the heat of the boiling water; they are afterwards contracted by the external cold when the dyed matter is taken out of the copper, when it is exposed to the external air, or when it is plunged into cold water. Thus the colouring atom is taken in, and detained in the pores or fissures of  
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the dyed body, by the springiness of its fibres, which have contracted and restored themselves to their first state, and have reassumed their primary stiffness upon being exposed to the cold.

If, besides this spring of the sides of the pore, it be supposed that these sides have been plaistered inwardly with a layer of the saline liquor, it will appear plainly that this is another means employed by art to detain the colouring atom; for this atom, having entered into the pore, while the saline cement of the sides was yet in a state of solution, and consequently fluid; and this cement being afterwards congealed by the external cold, the atom is thereby detained; by the spring which has been mentioned, and by this saline cement, which by chrysalization is become hard, forms a kind of mastic which is not easily removed.

If the coloured atom (which is as small as the little eminence that appears at the entrance of the pore, and without which the subject would not appear dyed) be sufficiently protuberant to be exposed to more powerful shocks than the resistance of the sides of the cement that retains it, then the dye resulting from all these atoms sufficiently retained, will be extremely lasting, and in the rank of the good dye, provided the saline coat can neither be carried off by cold water, such as rain, nor calcined or reduced to powder by the rays of the sun; for every lasting colour, or colour belonging to the good dye, must withstand these two proofs. No other can reasonably be expected in stuffs designed for apparel or furniture.

I know but of two salts in chymistry, which, being once chrysalized, can be moistened with cold water without dissolving; and there are few besides these that can remain several days exposed to the sun, without being reduced to a flour or  
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white

white powder. These are tartar, either as taken from the wine vessels, or purified, and tartar of vitriol. The tartar of vitriol may be made by mixing a salt already alkalized, (or that may become such when the acid is drove out with a salt whose acid is vitriolic as copperas and allum); this is easily effected if it be weaker than the acid of vitriol, and such is the acid of all essential salts extracted from vegetables.

In the process of the blue vat, which I tried in small, to discover the cause of its effects, copperas and pot-ash (which is a prepared alkali) are mixed together; as soon as these solutions are united, the alkali precipitates the iron of the copperas in form of powder almost black; the vitriolic acid of the copperas, divested of its metallic basis by its union with the alkali, forms a neutral salt, called *tartar of vitriol*, as when made with the salt of tartar and the vitriolic acid already separated from its basis; for all alkalis, from whatever vegetables they are extracted, are perfectly alike, provided they have been equally calcined.

More difficulties will occur with regard to the water for the preparation of other colours, such as reds and yellows. It may be denied that a tartar of vitriol can result from the mixture of allum and crude tartar boiled together; yet the theory is the same, and I do not know that it can be otherwise conceived. The allum is a salt, consisting of the vitriolic acid united with an earth; by adding an alkali, the earth is immediately precipitated, and the tartar soon forms; but instead of this alkaline salt, allum is boiled with the crude tartar, which is the essential salt of wine, that is, a salt composed of the vinous acid (which is more volatile than the vitriolic) and of oil, both concentrated in a small portion of earth.

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This salt, as is known to chymists, becomes alkali by divesting it of its acid. Thus when the allum and crude tartar are boiled together, besides the impression which the fibres of the stuff to be dyed receive from the first of these salts, which is somewhat corrosive, the tartar is also purified, and by the addition of the earth, which is separated from the allum, (and which has near the same effect upon the tartar, as the earth of *Merviels*, which is used at Montpellier in manufacturing cream of tartar) it becomes clear and transparent. It may very probably happen, that the vitriolic acid of the allum, driving out a part of the vegetable acid of the tartar, a tartar of vitriol may be formed as hard and transparent as the chrystal of tartar. Admitting one or other of these suppositions, consequently there is in the open pores of the wool a saline cement which chrystalizes as soon as the stuff which comes out of the dye is exposed to the cold air, which cannot be calcined by heat, nor is soluble in cold water. I could not avoid making this digression.

This theory is common to the indigo vat, where urine is used instead of water; allum and crude tartar in the place of vitriol and pot-ashes. This urine vat gives a lasting dye only when used hot, and then the wool must remain in an hour or two to take the dye equally. As soon as the vat is cold, she strikes no more dye; the reason of this would be difficult to discover in an opaque metal vat, but in a glass vessel it is easily seen.

I let this little glass proof vat cool, and all the green colour, which was suspended in it while hot, precipitated little by little to the bottom; for then the tartar chrystalizing itself, and reuniting in heavier masses than its mocus were during the heat of the liquor, and its solution, it sunk to the

bottom of the vessel, and carried with it the colouring particles.

When I restored this liquor to its former degree of heat, after shaking it, and letting it settle a while, I dipped a piece of cloth, which I took out one hour after, with as lasting a dye as the first; so that when this vat is used and fit to work, the tartar is to be kept in a state of solution, which cannot be done but by a pretty strong heat. The alkali of the urine greens it, the allum prepares the fibres of the wool, and the chrystal of tartar secures the dye by cementing the colouring atoms deposited in the pores.

There still remains a difficulty with respect to the indigo vat, in which, neither vitriol, allum, or tartar are used, but only pearl-ashes in equal quantity with the indigo, and which is pretty briskly heated to dye the wool and stuffs. But before I enter into the cause of the solidity of its dye, which is equal to that of the other blue vats where the other salts already mentioned enter, I must examine into the nature of pearl-ashes, which are the lees of wine dried and calcined: it is therefore an alkaline salt, of the nature of salt of tartar but less pure, as proceeding from the heaviest parts of the dregs of wine, and consequently the most earthy; besides, the alkali of the pearl-ashes is never as homogeneous as the alkaline salt of tartar well calcined, and there are scarcely any pearl-ashes not purified, from which a considerable quantity of tartar of vitriol may not be obtained: it is even probable by an experiment which I have related, that it might at length be entirely converted into this neutral salt; the same may be said of pot-ashes, and of all other alkaline salts, whose basis are not that of the marine salt.

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The want of this homogenous quality, is the cause that pearl-ashes never fall entirely into deliquium in the air; therefore since experience shews that there is a tartar of vitriol already formed in the pearl-ashes, it is evident that this indigo vat, which does not give a good dye until the liquor has been so briskly heated as not to suffer the hand without scalding, will dissolve the small portion of tartar of vitriol that is contained in it, and consequently this salt will introduce itself into the pores of the wool to cleanse and cement them, and will coagulate therein on the wool being taken out of the liquor, and exposed to the air to cool.

I must now give the reason why the indigo vat is green under the first surface of the liquor; why this liquor must be green that the blue dye may be lasting, and why the stuff that is taken green out of the liquor becomes blue as soon as it is aired. All these conditions being of necessity common to all indigo vats either cold or hot, the same explanation will serve for them all.

1. The flurry which rises on the surface of the indigo liquor when it is fit to dye, is blue, and the under part of this scum is green; these two circumstances prove the perfect solution of the indigo, and that the alkaline salt is united to its colouring atoms since it greens them, for without they would remain blue.

2. These circumstances prove that there is also in the indigo a volatile urinous alkali, which the fixt alkali of the pot-ash, or the alkaline earth of the lime displays, and which evaporates very shortly after the exposition of this scum to the air. The existence of this urinous volatile appears plainly by the smell of the vat during the fermentation; when stirred, or when heated, the smell is sharp, and resembles that of stinking meat roasted.

3. In the preparation of the anil, in order to separate the fecula, a fermentation is continued to putrefaction. All rotten plants are urinous. This volatile urinous quality is produced by the intimate union of salts with the vegetable oil, or is owing to a prodigious quantity of insects falling on all sides of fermenting planks, and attracted by the smell exhaling from them, where they live, multiply, and die in them, and consequently deposit a number of dead bodies; therefore to this vegetable substance an animal one is united, whose salt is always an urinous volatile. This same urinous quality exists also in the woad, which is prepared after the same manner, viz. by fermentation and putrefaction, and which will be further explained in the abridged narrative of its preparation.

4. And lastly, if indigo or woad be distilled in a retort, either alone or (which is much better) with some fixed saline or earthly alkali added to it, a liquor will be obtained, which, by all chymical essays, produces the same effects as volatile spirits of urine.

Why does not this volatile urinous quality in the indigo cause it to appear green, since it must be equally distributed through all its parts? And why does indigo, being dissolved in plain boiling water, tinge it blue and not green? It is because this volatile urinous salt is not concreted; that it requires another body more active than boiling water to drive it out of the particles surrounding it; and the solution of indigo is never perfected by water alone; whatever degree of heat is given, it is only diluted, and not dissolved in it. Indeed this decoction of indigo blues the stuffs that are dipped, but the blue is not equally laid on, and boiling water almost instantly discharges it. I shall endeavour to answer this by an example drawn from another subject.

Salt ammoniac, from which chymists extract the most penetrating volatile spirit, has not that quick urinous smell by dissolving and boiling it in water; either lime, or a fixed alkaline salt, must be added to disengage the urinous volatile parts. In like manner, the indigo requires fixed saline, or earthly alkalis, to be exactly decomposed, that its volatile urinous salt may be discovered, and that its colouring atoms may be reduced probably to their elementary minuteness.

I now come to the second quality required. The liquor of the indigo vat must be green, that the dye may be lasting; for the indigo would not be exactly dissolved, if the alkali did not act upon it. Its solution not being as perfect as it ought to be, its dye would be neither equal nor lasting; but as soon as the alkaline salts act upon it, they must green it; for an alkali, mixed with the blue juice or tincture of any plant or flower, immediately turns it green, when equally distributed on all its colouring parts. But if by evaporation these same parts, coloured, or colouring, have re-united themselves into hard and compact masses, the alkali will not change their colour till it has penetrated, divided, and reduced them to their primary fineness. This is the case with indigo, whose fecula is the dry inspissated juice of the anil.

With respect to the last circumstance, which is that the stuff must be green on coming out of the liquor, and become blue as soon as it is aired, without which, the blue would not be of a good dye, the following reasons may be given: it is taken out green because the liquor is green; if it was not, the alkaline salt put into the vat would not be equally distributed, or the indigo would not be exactly dissolved. If the alkali was not equally distributed, the liquor contained in the vat would not  
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be equally saline: the bottom of this liquor would contain all the salt; the upper would be insipid. In this case, the stuff dipped in would neither be prepared to receive the dye, nor to retain it; but when it is taken out green at the end of a quarter of an hour's dipping, it is a proof that the liquor was equally saline, and equally loaded with colouring atoms; it is also a sign, that the alkaline salts have insinuated themselves into the pores of the fibres of the stuff and enlarged them, as has been observed, and perhaps have formed new ones. Now there can be no doubt that an alkaline salt may have this effect on a woollen stuff, when it is evident that a very sharp alkaline ley burns and dissolves almost in an instant a flock of wool or a feather.

A process in dying called, by the French, *fonte de bourre*, that is, the melting or dissolving of flock or hair, is still a further example. The hair, which is used and boiled in a solution of pearl-ashes in urine, is so perfectly dissolved as not to leave the least fibre remaining. Therefore if a lixivium, extremely sharp, entirely destroys the wool, a ley which shall have but a quantity of alkaline salt sufficient to act on the wool without destroying it, will prepare the pores to receive and preserve the colouring atoms of the indigo.

The stuff is aired after being taken green out of the vat, and after wringing it becomes blue. What is done by airing? it is cooled; if it is the urinous volatile detached from the indigo which gave it this green colour, it evaporates, and the blue appears again; if it is the fixed alkaline that causes this green, not only the greatest part is carried off by the strong expression of the stuff, but what remains can have no more action on the colouring part, because the small atom of tartar of vitriol, which

which contains a coloured atom still less than itself, is chrystalized the instant of its exposition to the cold air, and contracting this same colouring atom by the help of the spring at the sides of the pore, it entirely presses out the remainder of the alkali, which does not chrystalize as a neutral salt.

The blue is roused, that is, it becomes brighter and finer by soaking the dyed stuff in warm water, for then the colouring particles, which had only a superficial adherence to the fibres of the wool, are carried off. Soap is used as a proof of the lasting of the blue dye, and it must stand it, for the soap, which is only used in a small quantity in proportion to the water, and whose action on the dyed pattern is fixed to five minutes, is an alkali, mitigated by the oil, which cannot act upon a neutral salt. If it discharges the pattern of any part of its colour, it is because its parts were but superficially adhering; besides, the little saline chrystal which is set in the pore, whose use is to cement the colouring atom, cannot be dissolved in so short a time, so as to come out of the pore with the atom it retains.

This treatise lays down the essay of a method of dying different from any hitherto offered. I appeal to philosophers, who would think little of a simple narrative of processes, if I did not at the same time give their theory. I shall follow this method in the other experiments on reds, the yellows, or other simple colours, as it is absolutely necessary to have a knowledge of them before entering on the compound, as these are generally but colours laid on one after the other, and seldom mixed together in the same liquor or decoction.

Thus having once the knowledge of what procures the tenacity of a simple colour, it will be more easily known, if the second colour can take place in the spaces the first have left empty without displacing the first.

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This is the idea which I have formed to myself of the arrangement of different colours laid on the same stuff, for it appears to me a matter of great difficulty to conceive that the colouring atoms can place themselves the one on the other, and thus form kinds of pyramids, each still preserving their colour, so that from a mixture of the whole a compound colour shall result, and which, notwithstanding, shall appear uniform, and as it were homogeneous. To adopt this system, we must suppose a transparency in these atoms, which it would be difficult to demonstrate; and further, that a yellow atom must place itself immediate on a blue one, already set in the pore of the fibre of a stuff, and that it must remain there strongly bound, so that they must touch each other with extreme smooth surfaces, and so with every new colour laid on.

It is not easy to conceive all this, and it appears more probable, that the first colour has only taken up the pores that it found open by the first preparation of the fibres of the stuff; that on the side of these pores there remains more still to be filled, or at least spaces not occupied, where new pores may be opened to lodge the new atoms of a second colour, by the means of a second preparation of water, composed of corroding salts, which being the same as those of the first preparing liquor, will not destroy the first saline crystals, introduced into the first pores.

What has been already said with regard to the indigo vat, may also serve to explain the action of the woad vat on wool and stuffs; it is only supposing in the woad, that salts do naturally exist, pretty near of affinity to those that are added to the indigo vat. It appears by the description given of these vats, that the woad vat is by much the most difficult

difficult to conduct. I am convinced that these difficulties might be removed, if an attempt was made to prepare the isatis as the anil is in the West-Indies. I shall therefore compare their different preparations. I have taken the following narrative from the memoirs of Mr. Astruc's *Histoire Naturelle du Languedoc. Paris, Cavelier 1737*, in 4to, p. 330 and 331.

“ According to the opinion of Dyers, woad  
 “ only gives feeble and languishing colours;  
 “ whereas those of the indigo are lively and bright.  
 “ This opinion I grant is conformable to reason:  
 “ the indigo is a fine subtle powder; consequent-  
 “ ly capable to penetrate the stuffs easily, and  
 “ give them a shining colour. The woad, on the  
 “ contrary, is only a gross plant, loaded with  
 “ many earthy parts, which slacken the action and  
 “ motion of the finer parts, and prevent them  
 “ from acting effectually.

“ I know but one way to remove this incon-  
 “ veniency, that is, to prepare the woad after the  
 “ same manner the indigo is prepared; by this  
 “ means, the colours obtained from the woad  
 “ would acquire the lively and bright qualities of  
 “ those procured from the indigo, without dimi-  
 “ nishing in the least the excellency of the colours  
 “ produced by the woad.

“ I have already made in small \* experiments on  
 “ what I propose, and those experiments have suc-  
 “ ceeded, not only in the preparation of the powder  
 “ of woad, but also in the use of this powder for  
 “ dying.”

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\* As this ingenious man has succeeded in small experiments, it is probable he would also in the large ones; and then this plant, easily cultivated in England, would well recompence the pains of the husbandman.

It is incumbent on those who have the public good at heart, to cause trials at large to be made, and if they have the success that can reasonably be expected, it will be proper to encourage those who cultivate woad, to follow this new method of preparing it, and offer premiums to enable them to sustain the expences this new practice will engage them in, until the advantage they will reap from it may be sufficient to determine them to follow it.

I shall now propose the means to succeed in Mr. Astruc's experiments, and these means naturally result from considering the method used in Languedoc for the preparation of woad, and the ingenious method by which they separate the fecula of the anil in America. I have already given the preparation of this last; those who desire a fuller description may consult *l'Histoire des Antilles du P. du Tertre & du P. Labat*. The following preparation of the pastel, or garden woad, is thus described by Mr. Astruc.

*The manufacturing of Pastel, or Garden Woad in France.*

Peasants of Abbigevois distinguish two kinds of woad seed; the one violet colour, the other yellow: they prefer the former, because the woad that shoots from it bears leaves that are smooth and polished, whereas those that spring from the yellow are hairy; this fills them with earth and dust, which makes the woad prepared from them of a worse quality. This woad is called *pastelbourg*, or *bourdaigne*.

The woad at first shoots five or six leaves out of the ground, which stand upright whilst green; they are a foot long, and six inches broad; they begin to ripen in June; they are known to be ripe by their  
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their falling down and growing yellow; they are then gathered, and the ground cleared from weeds, which is carefully repeated each crop.

If there has been rain, a second crop is obtained in July; rain or dry weather advances or retards it eight days. The third crop is at the latter end of August; a fourth the latter end of September; and the fifth and last about the tenth of November. This last crop is the most considerable, the interval being longer. The plant at this crop is cut at the root from whence the leaves spring. This woad is not good, and the last crop is forbid by the regulations. The woad is not to be gathered in foggy or rainy weather, but in serene weather, when the sun has been out some time.

At each crop the leaves are brought to the mill to be ground, and reduced to a fine paste; this is to be done speedily, for the leaves when left in a heap ferment, and soon rot with an intolerable stench. These mills are like the oil or bark-mills, that is, a millstone turns round a perpendicular pivot, in a circular groove or trough, pretty deep, in which the woad is ground.

The leaves thus mashed and reduced to a paste, are kept up in the galleries of the mill, or in the open air. After pressing the paste well with the hands and feet, it is beat down and made smooth with a shovel. This is called the woad piled.

An outward crust forms, which becomes blackish; when it cracks, great care must be taken to close it again. Little worms will generate in these crevices and spoil it. The pile is opened in a fortnight, well worked between the hands, and the crust well mixed with the inside; sometimes this crust requires to be beat with a mallet to knead it with the rest.

This paste is then made into small loaves or round balls, which, according to the regulations,

must weigh a pound and a quarter. These balls are well pressed in the making, and are then given to another, who kneads them again in a wooden dish, lengthens them at both ends, making them oval and smooth. Lastly, they are given to a third, who finishes them in a lesser bowl-dish, by pressing and perfectly uniting them.

The pastel or woad thus prepared is called *Pastel en Cocaigne*; whence arises the proverb, *Pais de Cocaigne*; which signifies a rich country, because this country \* where the woad grows, enriched itself formerly by the commerce of this drug.

These balls † are spread on hurdles, and exposed to the sun in fine weather; in bad weather they are put at the top of the mill. The woad that has been exposed some hours to the sun, becomes black on the outside, whereas that which has been kept within doors is generally yellowish, particularly if the weather has been rainy. The merchants prefer the former; this makes little difference as to its use; it is in general always yellowish, as the peasants mostly work it in rainy weather, when they cannot attend their rural employments.

In summer, these balls are commonly dry in fifteen or twenty days, whereas in autumn those of the last crop are long in drying.

The good balls when broke are of a violet colour within, and have an agreeable smell; whereas those that are of an earthy colour and a bad smell, are not good: this proceeds from the gathering of the woad during the rain, when the leaves were filled with earth. Their goodness is also

\* *L'Abigeois & Lauragois.*

† There is a place in India, the name I do not recollect, where the anil is prepared after the manner of the woad, and the indigo comes from it in lumps, containing all the useless parts of the plant.—It is very difficult to prepare a blue vat with it.

also known by their weight, being light when they have taken too much air, or rotten by not having been sufficiently prest.

*Powder of Woad.*

Of these balls well prepared, the powder of woad is to be made; for this purpose a hundred thousand at least are required. A distant barn or a warehouse must be procured, larger or smaller according to the quantity intended to be made. It must be paved with bricks and lined with the same, to the height of four or five feet; the walls would be better to be of stone to that height, yet often the walls are only coated with earth; this coat breaking off and mixing with the woad is a great prejudice to it. In this place the balls are reduced to a gross powder with large wooden mallets. This powder is heaped up to the height of four feet, reserving a space to go round, and is moistened with water; that which is slimy\* is best, provided it be clear; the woad thus moistened, ferments, heats, and emits a very thick stinking vapour.

It is stirred every day for twelve days, flinging it by shovels full from one side to the other, and moistening it every day during that time; after which no more water is flung on, but only stirred every second day; then every third, fourth, and fifth; it is then heaped up in the middle of the place, and looked at from time to time to air it in

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case

\* I can see no reason why slimy water, and yet to be clear, is preferred. It appears to me that clear river water would be more secure; with this they would avoid the inconveniencies that must attend a standing water, always filled with filth; or of a muddy water, which contains useless earth, and which must make the dye uneven.

case it should heat. This is the pastel or garden woad powder fit for sale to the Dyers.

Mr. Astruc, to prove that the sale of woad formerly enriched the higher Lauguedoc, quotes the following passage from a book entitled *Le Marchand*.

“ Formerly they transported from Toulouze to Bourdeaux, by the river Garonne, each year a hundred thousand bales of woad, which on the spot are worth at least fifteen livres a bale, which amounts to 1,500,000 livres; from whence proceeded the abundance of money and riches of that country.” Castel in his *Memoirs de l’Histoire du Languedoc*, in 1633, p. 49.

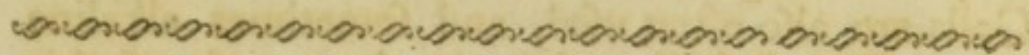
The comparing of these two methods of preparing the woad and indigo may be sufficient to a person of understanding, who might be appointed to try, by experiments, the possibility of extracting a fecula from the isatis of Languedoc like that of the anil. It is neither the Dyer or Manufacturer that ought be applied to for that purpose; both would condemn the project as a novelty, and it would require many experiments, which in general they are not accustomed to.

I could wish this experiment was tried in great, so that at least fifty pounds of this fecula might be got, that several vats might be set in case the first should fail. Whoever does try it, should be very careful to describe all the circumstances of the process. Perhaps it might not succeed at the first crop of the leaves of the woad, because the heat in June is not sufficient, but probably he might meet with success in August.

If this succeeds, there are without doubt several other plants of the same quality as the isatis, and which yield a like fecula.

It is also probable that the dark green of several plants is composed of yellow and blue parts; if by fermentation

fermentation the yellow could be destroyed, the blue would remain. This is not a chymical idea, and it is easy to prove that some use might be derived from such an experiment.



## C H A P. VIII.

## Of R E D.

**R**ED, as has been said, is one of the primary or mother colours of the Dyers. In the great dye there are four principal reds, which are the basis of the rest. These are,

1. Scarlet of grain. 2. The scarlet, now in use, or flame-coloured scarlet, formerly called Dutch scarlet. 3. The crimson red. And, 4. The madder red.

There are also the bastard scarlet and the bastard crimson; but as these are only mixtures of the principal reds, they ought not to be considered as particular colours.

The red, or *nacaret of bourre*\*, was formerly permitted in the great dye.

All these different reds have their particular shades from the deepest to the lightest, but they form separate classes, as the shades of the one never fall into those of the other.

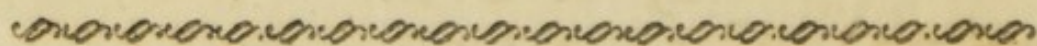
The reds are worked in a different manner from the blues, the wool or stuffs not being immediately dipped in the dye, but previously receiving a preparation which gives them no colour, but prepares them to receive that of the colouring ingredient.

F 3

This

\* This colour is given with weld and goat's hair boiled in pot-ashes, and is a bright orange red.

This is called the water of preparation it is commonly made with acids, such as four waters, allum and tartar, aqua fortis, aqua regalis, &c. These preparing ingredients are used in different quantities, according to the colour and shade required. Galls are also often used, and sometimes alkaline salts. This I shall explain in the course of this treatise, when I come to the method of working each of these colours.



## C H A P IX.

## Of SCARLET of GRAIN.

**T**HIS colour is called scarlet of grain, because it is made with the kermes, which was long thought to be grain of the tree on which it is found. It was formerly called French scarlet, imagining it to be first found out in France, and is now known by the name of Venetian scarlet, being much in use there, and more made than in any other place. The fashion passed from thence into France and other countries. It has indeed less lustre, and is browner than the scarlet now in fashion; but it has the advantage of keeping its brightness longer, and does not spot by mud or acid liquors.

The kermes is a gall insect, which is bred, lives, and multiplies upon the *ilex acculeato cocci glandifera*, C. B. P. Some comes from Narbonne, but greater quantities from Alicant and Valentia, and the peasants of Languedoc yearly bring it to Montpellier and Narbonne. The merchants, who buy them to send abroad, spread them on cloths, and sprinkle them with vinegar, in order to kill the little insects that are within, which yield a red powder,

powder, which is separated from the shell after drying, and is then passed through a sieve; this is done particularly in Spain.

They then make it up in bales, and in the middle of each a quantity of this powder is inclosed in a leather bag, in proportion to the whole bale. Thus each Dyer has his due proportion of this powder. These bales are generally sent to Marfeilles, from whence they are exported to the Levant, Algiers, and Tunis, where it is greatly made use of in dying.

The red draperies of the figures in the ancient tapestry of Brussels, and other manufactories of Flanders, are dyed with this ingredient; and some that have been wrought upwards of two hundred years, have scarcely lost any thing of the brightness of the colour. I shall now proceed to give the method of making this scarlet of grain, which is now seldom used but for wools designed for tapestry.

*Preparation of the Wool for Scarlet of Grain.*

Twenty pounds of wool and half a bushel of bran are put into a copper, with a sufficient quantity of water, and suffered to boil half an hour, stirring it every now and then; it is then taken out to drain.

It is necessary to observe, that whenever spun wool is to be dyed, a stick is passed through each hank (which commonly weighs one pound) and they remain on the stick during the course of the work to prevent their entangling. This stick also enables the Dyer to return the hanks with more ease, by plunging each part successively in the liquor, by which they take an equal dye; by raising the hank with the stick, and drawing it half way  
out

out of the copper, seizing the other end of the hank with the other hand, it is plunged towards the bottom. If the wool be too hot, this may be done with two sticks, and the oftener this is repeated, the more even will be the dye; the ends of the sticks are then placed on two poles to drain. These poles are fixed in the wall above the copper.

*Liquor for the Kermes.*

While this prepared 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 (on the sticks) which are to remain in for two hours, stirring them continually one after the other after the method already laid down.

I must in this place observe, that the liquor in which the allum is put, when on the point of boiling sometimes rises so suddenly that it comes over the copper, if not prevented by adding cold water. If, when it is rising, the spun wool is instantly put in, it stops it, and produces the same effects as cold water.

The liquor does not rise so suddenly when there is a large quantity of tartar, as in the process; but when the allum is used alone, sometimes above half the liquor comes over the copper when it begins to boil, if not prevented by the method described.

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. This is to  
make

make it penetrate the better, and helps to augment the action of the salts, for as a part of the liquor always flies off, it is evident that the remaining, being fuller of saline particles, becomes more active, provided there remained a sufficient quantity of humidity; for the salts being chrystalized and dry, would have no more action.

I have dwelled much longer on this preparing liquor, and the method of making it, than I shall in the sequel, as there are a great number of colours for which it is prepared pretty near in the same proportion, so that when this happens, I shall slightly describe it, mentioning only the changes that are to be made in the quantity of allum, tartar, four water, or other ingredients.

After the spun wool has been covered five or six days, it is fitted to receive the dye. A fresh liquor is then prepared according to the quantity of wool to be dyed, and when it begins to be lukewarm, take 12 ounces 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 to 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 the bag, and kept in a cool place) is put in. If it had been boiled a long time before and grown dry, it must be lightly passed through lukewarm water, and well squeezed before it is dyed.

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 black scum, which the kermes cast up, by which the wool that is afterwards dipped acquires a finer colour. This handful of wool being taken out, the prepared is to be put in. The hanks are passed

on sticks as in the preparation, 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 the 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.

When different shades are wanted, a less quantity of kermes is used, so that for twenty pounds of prepared wool seven or eight are sufficient.

The quantity of wool that is to have the lightest shade is first to be dipped, and to remain no longer in than the time sufficient to turn it and make it take the dye equally. Then the next deepest shade intended is dipped, and left to remain some time longer; after this manner the work is continued to the last, which is left as long as requisite to acquire the necessary shade.

The reason of working the lightest shades first, is, that if the yarn is left too long in, no damage is done, as that hank may serve for a deeper shade; whereas, if they begin by a deeper, there would be no remedy if a failure happened in some of the lighter shades. The same caution is to be taken in all colours whose shades are to be different.

There are seldom more shades than one from the colour now spoken of; but as the working part is the same for all colours, what has been said on this subject will serve for the rest.

The yarn thus dyed, before bringing it to the river, may be passed through lukewarm water, in which a small quantity of soap has been perfectly dissolved; this gives a brightness to the colour, but at the same time saddens it a little, that is, gives it a little cast of the crimson. As I shall often  
make

make use of the terms *rouzing* and *saddening*, especially in the acids, it is necessary to explain their meaning.

*Saddening*, is giving a crimson or violet cast to red; soap and alkaline salts, such as ley of ashes, pot-ashes, lime, sadden reds; thus they serve to bring them to the shade required when too bright, and that they are too much rouzed.

*Rouzing*, is doing quite the reverse; it is giving a fire to the red, by making it border on the yellow or orange. This is performed on wool by the means of acids, as red or white tartar, cream of tartar, vinegar, lemon juice, and aqua fortis. These acids are added more or less, according to the depth of the orange colour required. For example, if the scarlet of grain was wanted to be more bright, and to approach somewhat nearer to common scarlet, a little of the scarlet composition, which shall be spoken of, must be poured into the liquor after the kermes is put in, and the brown colour of that liquor would immediately be brightened by the acid, and become of a brighter red; the wool dipped in would be more liable to be spotted by mud and acid liquors: the reason will appear in the next chapter.

I have made various experiments on this colour, in order to make it fitter and brighter than what it generally is, but I never could extract a red that was to be compared to that of cochineal.

Of all the liquors which I made for the preparation of the wool, that which was made with the preparations just mentioned succeeded best. By changing the natural dye of the kermes, by different kinds of ingredients of metallic solutions, &c. various colours are made, which I shall immediately speak of.

I shall

I shall say but little about dying stuffs with this red, as the proportion cannot be prescribed for each yard of stuff, on account of their breadth and thickness, or the quantity of wool entering their composition; practice alone will teach the necessary quantity for each sort of stuff; however, not to work in the dark, or to try experiments at random, the surest way will be to weigh the stuffs, and to diminish about one fourth part of the colouring ingredients laid down for spun wool, as stuffs take up less colour inwardly, their texture being more compact, prevents its penetration, whereas yarn or wool in the fleece receives it equally within and without.

The allum and tartar for the liquor of preparation for the stuffs must be diminished in the same proportion, and they are not to remain in the preparing liquor as long as the wool. It may be dyed the next day after boiling.

If wool in the fleece is dyed with the red of the kermes, either to incorporate it with cloths of a mixed colour, or to make full cloths, it will have a much finer effect than if the wool had been dyed in the red of madder. I shall mention this in describing the compound colours in which the kermes is used, or ought at least to be used in preference to madder, which does not give so fine a red, but, being cheaper, is commonly substituted for it.

Half-grain scarlet, or bastard scarlet, is that which is made of equal parts of kermes and madder. This mixture affords a very holding colour, not bright but inclining to a blood red. It is prepared and worked in the same manner as that made of kermes alone. This dye is much cheaper, and the Dyers commonly make it less perfect by diminishing the kermes and augmenting the madder.

By

By the proofs that have been made of scarlet of grain, or kermes, whether by exposing it to the sun, or by different proofs, it is certain there is not a more holding or a better colour; yet the kermes is no where in use but at Venice. The mode of this colour has been entirely out since the making of flame-coloured scarlets. This scarlet of grain is now called a colour of bullock's blood; nevertheless, it has great advantages over the other, for it neither blackens nor spots, and grease may be taken out without prejudice to its colour; but it is out of fashion, and that is sufficient. This has entirely put a stop to the consumption of kermes in France. Scarce a Dyer knows it, and when Monsieur Colbert wanted a certain quantity for the experiments above related, he was obliged to send for it to Languedoc, the merchants of Paris keeping only a sufficiency for medicinal purposes.

When a Dyer is obliged to dye a piece of cloth, known yet under the name of scarlet of grain, as he has neither the knowledge of the kermes, nor the custom of using it, he makes it of a cochineal, as I shall relate in the following chapter; it comes dearer, and is less holding than that made of the kermes. The same is done in regard to spun wool designed for tapestries, and as this shade is pretty difficult to hit with cochineal, they commonly mix brazil wood, which hitherto has been a false ingredient, permitted only in the lesser dye. For this reason all these kind of reds fade in a very short time, and though they are much brighter than required, coming out of the hands of the workman, they lose all their brightness before the expiration of a year; they whiten or become exceeding grey; it is therefore to be wished that the use of kermes was again established. It is also certain, that if some Dyer set about using it, there are several co-

lours that might be extracted from it with more ease and less expence than the common method; for these colours would be better and more holding, and he would thereby acquire a greater reputation. I have made above fifty experiments with the kermes, from which some use in practice may arise; I shall only relate such as have produced the most singular colours.

By mixing the kermes with cream of tartar, without allum, and as much of the composition as would be used for the making a scarlet with cochineal, you have in one liquor an exceeding bright cinnamon, for nothing but the acid entering in the mixture, the red parts of the kermes become so minute that they almost escape the sight. But if this cinnamon colour be passed through a liquor of Roman allum, part of this red appears again; whether it be by the addition of the allum that drives out a part of the acid of the composition, or the earth of the allum precipitated by the attraction of the kermes, which has the effect of galls, I know not; but this red thus restored is not fine.

With cream of tartar (the composition for scarlet) and allum, in greater quantity than tartar, the kermes gives a lilach colour, which varies according as the proportion of ingredients are changed.

If in the place of allum and tartar, ready prepared tartar of vitriol is substituted, which is a very hard salt, resulting from the mixture of the vitriolic acid and a fixed alkali, such as the oil of tartar, pot-ashes, &c. and if, I say, after boiling the kermes in a solution of a small quantity of this salt, the stuff be dipped in and boiled one hour, it acquires a tolerable handsome agath grey, and in which very little red is seen, for the acid of the composition having too much divided the red of the kermes, and the tartar of vitriol, not containing the earth of the  
allum,

allum, it could not re-unite these red atoms, dispersed by precipitation. These agath greys are of the good dye, for, as I have observed in the chapter treating of indigo, the tartar of vitriol is a hard salt, which is not calcined by the sun, and is indissoluble in rain water.

Glauber salts mixed with the kermes entirely destroy its red, and give an earthy grey that does not stand the proof, for this salt neither resists cold water nor the rays of the sun, which reduce it into powder. Vitriol or green copperas, and blue vitriol separated substituted for allum, but joined to the chrysal of tartar, equally destroy or veil the red of the kermes, which in these two experiments produce the same effect as if galls or sumach had been made use of; for it precipitates the iron of the green vitriol, and dyes the cloth of a grey brown, and the copper of the blue vitriol dyes it of an olive.

Instead of blue vitriol, I used a solution of copper \* in aqua fortis, which also produced an olive colour; a convincing proof that the kermes has the precipitating quality of the galls, since it precipitates the copper of the vitriol as a decoction of gall-nut would.

There is great probability that what renders the red of the kermes as holding as that of madder, is from the insects feeding on an astringent shrub, which, notwithstanding the changes made by the digestion of the juices of the plant, still retains the astringent quality of the vegetable, and consequently the virtue, and so gives a greater spring to the pores of the wool to contract themselves quicker and with greater strength, when it comes out of the boiling water, and is exposed to the cold air; for I have

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observed

\* Verdigrise.

observed that all barks, roots, woods, fruits, and other matters that have some astringency, yield colours of the good dye.

*Violets without Blue.*

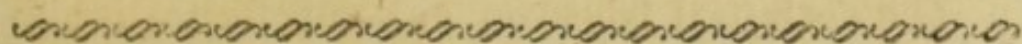
The white vitriol of gossar, whose basis is the zinck, being joined with the chrystal of tartar, changes the red of the kermes into a violet. Thus with one colouring ingredient, and simple changes, violets are made without a blue ground; for this compound colour, hitherto only obtained by putting a blue on a red, or a red on a blue, is made as well with cochineal, or even with madder, as shall be shewn treating of these two ingredients. White vitriol being extracted from a mine, containing lead, arsenic, and several other matters, whose recrement melted afterwards with sand and alkaline salts, vitrifies into a blue mass, called *safre*. I suspected the white vitriol might contain a portion of this blue, which, with the red of the kermes, might have changed to a violet, and consequently that the mine of the bismuth, which really contains this blue matter, and the bismuth itself, would produce the same effect as white vitriol; neither was I mistaken in my conjecture; for having put some of the extract of the mine of bismuth in the liquor of kermes, and some of the solution of the bismuth itself, upon another decoction of the same ingredient, they both dyed cloth of a violet colour. I shall not here give the process of extracting the mine of bismuth, for it is a difficult operation for a Dyer. However, if the reader is desirous to know what I mean by the extraction of the mine of bismuth, he will find the process in the Royal Academy of Sciences for the year 1737, where there is a memoir on sympathetic inks. As to the solution  
of

of bismuth, which produces almost the same effect, it is made after the following manner:

Take four parts of spirits of nitre, and four parts of very clear water, which mix together, and dissolve therein one part of bismuth, or tin glass, broken in small pieces, put the last little by little into the liquor, lest they should occasion too violent a fermentation. Acids put in too great abundance in the liquor of the kermes, whether it be spirits of vitriol, aqua fortis, vinegar, lemon juice, even four water, so greatly divide the red colouring particles, that the cloth receives but a cinnamon colour, bordering on the aurora, if there is too much acid, and a little redder if there is less.

Fixed alkaline salts, mixed with four water and cream of tartar, in the place of allum, do not destroy the red of the kermes as acids do, but saddens and mudds it if too much be put in, so that the cloth receives only a faded lilach colour.

Other experiments, still more diversified than those here related, presented an infinite variety of colours, but nothing more beautiful than what may be done with cheaper drugs than the kermes; I shall therefore pass them over.



## C H A P X.

### *Of* FLAME-COLOURED SCARLET.

**F**LAME-coloured scarlet, that is, bright-coloured scarlet, known formerly under the name of Dutch scarlet, (the discovery of which Kunkel attributes to Kuster, a German chymist) is the finest and brightest colour of the dye. It is also the most costly, and one of the hardest to bring to perfection. It is not easy to determine the point of perfection,

for, independent of different tastes concerning the choice of colours, there are also general fancies, which make certain colours more in fashion at one time than another; when this happens, fashionable colours become perfect ones. Formerly scarlets were chosen full, deep, and of a degree of brightness which the sight easily bore. At this time they must be on the orange, full of fire, and of a brightness which dazzles the eye. I shall not decide which of these two fashions deserve the preference, but shall give the method of making them both, and all the shades which hold a medium between these extremes.

Cochineal, which yields this beautiful colour, and is also called mescick, or tescalle, is an insect that is gathered in great quantities in Mexico. The natives and Spaniards, who have but small establishments there, cultivate them, that is, carefully gather them from the plant on which they feed before the rainy season. They kill and dry those designed for sale, and preserve the rest to multiply when the bad season is over. This insect feeds and breeds upon a kind of prickly opuntia, which they call topal. It may be preserved in a dry place for ages without spoiling.

The cochineal sylvestre, or campeffiane, is also brought from Vera-Cruz. The indians of Old and New Mexico gather this kind in the woods; it feeds, grows, and generates there on the wild uncultivated opuntias; it is there exposed in the rainy season to all the humidity of the air, and dies naturally. This cochineal is always smaller than the fine or cultivated; the colour is more holding and better, but has not the same brightness, neither is it profitable to use it, since it requires four parts, and sometimes more, to do what may be done with one of fine.

Sometimes

Sometimes they have damaged cochineal at Cadiz; this is fine cochineal that has been wetted with salt water, occasioned by some shipwreck or leakage. These accidents considerably diminish the price, the sea salt faddening the dye. This kind serves only to make purples, and even those are not the best. However, a person in 1735 found the secret to turn this to almost as much advantage for scarlet as the finest cochineal. The discovery of this secret is easy, but let him that possesses it enjoy it, I shall not deprive him of the advantage he might have in it.

Every Dyer has a particular receipt for dying scarlet, and each is fully persuaded that his own is preferable to all others; yet the success depends on the choice of the cochineal, of the water used in the dye, and on the manner of preparing the solution of tin, which the Dyers call composition for scarlet.

As it is this composition which gives the bright flame colour to the cochineal dye, and which without this acid liquor would naturally be of a crimson colour, I shall describe the preparation that succeeded best with me.

*Composition for Scarlet.*

Take eight ounces of spirit of nitre (which is always purer than the common aqua fortis mostly used by the Dyers) and \* be certain that it contains

\* Dissolve in a small quantity of spirit of nitre as much silver as it will take; put a few drops of this into some of the spirit of nitre that is to be proved; if this spirit remains transparent, it is pure; but if a white cloud be perceived, which will afterwards form a sediment, it is a sign that there is a commixture of vitriol or spirit of salt. In order therefore to render the spirit of nitre absolutely pure, drop the solution of silver gradually into it, so long

tains no vitriolic acid; weaken this nitrous acid by putting into it eight ounces of filtered river water; dissolve in it, little by little, half an ounce of very white salt ammoniac, to make it an aqua regia, because spirits of nitre alone will not dissolve block-tin. Lastly, add two drachms of salt-petre; this might be omitted, but I observed that it was of use in making the dye smooth and equal. In this aqua regia thus weakened, dissolve one ounce of the best block-tin, which is first granulated or made small while melted by casting it from a height into a vessel of cold water. These small grains of tin are put into the dissolvent one by one, letting the first dissolve before putting in others; this prevents the loss of the red vapours, which would rise in great abundance, and be lost if the dissolution of the metal was made too hastily; it is necessary to preserve these vapours, and, as Kunkel observed, they greatly contribute towards the brightness of the colour, either because these vapours are acids that evaporate and are lost, or contain a sulphur peculiar to saltpetre, which gives a brightness to the colour. This method is indeed much longer than that used by the Dyers, who immediately pour the aqua fortis upon the tin reduced to small pieces, and wait till a strong fermentation ensues, and a great quantity evaporates before they weaken it with common water. When the tin is thus dissolved, this scarlet composition is made, and the liquor is of the beautiful colour of dissolved gold, without any dirt or black sediment,

as

as it shall produce the least turbidness, time being given for the spirit to become clear betwixt each addition. The spirit of nitre being then poured off from the sediment will be perfectly pure; and if this sediment, which is the silver precipitated, be evaporated to dryness, and then infused in a crucible with a small quantity of any fixed alkaline salt, it will be reduced to its proper metalline state.

as I used very pure tin without allay, and such as runs from the first melting of the furnaces of Cornwall. This solution of tin is very transparent when newly made, and becomes milky and opaque during the great heat of summer; the greatest part of the Dyers are of opinion, that it is then changed and good for nothing; yet mine, notwithstanding this defect, made as bright scarlet as if it had remained clear; besides, in cold weather, what I made recovered its first transparency. It must be kept in a glass bottle with a stopper, to prevent the evaporation of the volatile parts.

As the Dyers do not attend to this, their composition often becomes useless at the end of twelve or fifteen days. I have laid down the best method, and if they seek perfection, they will abandon their old practice, which is imperfect.

The Dyers in France first put into a stone vessel, with a large opening, two pounds of salt ammoniac, two ounces of refined saltpetre, and two pounds of tin reduced to grains by water, or, which is still preferable, the filings of tin; for when it has been melted and granulated, there is always a small portion converted into a calx which does not dissolve. They weigh four pounds of water in a separate vessel, of which they pour about two ounces upon the mixture in the stone vessel; they then add to it a pound and a half of common aqua fortis, which produces a violent fermentation. When the ebullition ceases, they put in the same quantity of aqua fortis, and an instant after they add one pound more. They then put in the remainder of the four pounds of water they had set aside; the vessel is then close covered, and the composition let to stand till the next day.

The salt petre and salt ammoniac are sometimes dissolved in the aqua fortis before the tin is put in; they

they practice both methods indiscriminately, though it is certain that this last method is best. Others mix the water and aqua fortis together, and pour this mixture on the tin and salt ammoniac. In short, every Dyer follows his own method.

*Water for the Preparation of Scarlet.*

The day after preparing the composition, the water for the preparation of scarlet is made, which differs from that made in the preceding chapter.

Clear the water well. For each pound of spun wool, put twenty quarts of very clear river water (hard spring water will not do) into a small copper. When the water is a little more than lukewarm, two ounces of cream of tartar finely powdered, and one drachm and a half of powdered and sifted cochineal is added. The fire is then made a little stronger, and when the liquor is ready to boil, two ounces of the composition are put in. This acid instantly changes the colour of the liquor, which, from a crimson, becomes of the colour of blood.

As soon as this liquor begins to boil, the wool is dipped in, which must have been previously wetted in warm water and wrung. The wool is continually worked in this liquor, and left to boil an hour and a half; it is then taken out, slightly wrung, and washed in fresh water. The wool coming out of the liquor is of a lively flesh colour, or even some shades deeper, according to the goodness of the cochineal, and the strength of the composition. The colour of the liquor is then entirely passed into the wool, remaining almost as clear as common water.

This is called the water of preparation for scarlet, and the first preparation it goes through before it is dyed; a preparation absolutely necessary, without

without which the dye of the cochineal would not be so good.

*Reddening.*

To finish it, a fresh liquor is prepared with clear water, the goodness of the water being of the greatest importance towards the perfection of the scarlet. An ounce and a half of starch is put in\*, and when the liquor is a little more than lukewarm, six drachms and a half of cochineal finely powdered and sifted is thrown in. A little before the liquor boils, two ounces of the composition is poured in, and the liquor changes its colour as in the former. It must boil, and then the wool is put into the copper, and continually stirred as in the former. It is likewise boiled an hour and a half; it is then taken out, wrung, and washed. The scarlet is then in its perfection.

One ounce of cochineal is sufficient for a pound of wool, provided it be worked with attention, and after the manner laid down, and that no dye remains in the liquor. For coarse cloth less would do, or half as much for worsted. However, if it was required to be deeper of cochineal, a drachm or two might be added, but not more, for it would then lose its lustre and brightness.

Though I have mentioned the quantity of the composition, both in the water of the preparation and the dye, yet this proportion is not to be taken as a fixed rule.

The aqua fortis, used by the Dyers, is seldom of an equal strength; if, therefore, it be always mixed with an equal quantity of water, the composition would not produce the same effect; but there is a method of ascertaining the degree of  
acidity

\* Starch softens it.

acidity of aqua fortis. For example, to use that only, two ounces of which would dissolve one ounce of silver. This would produce a composition that would be always equal, but the quality of the cochineal will then produce new varieties, and the trifling difference that this commonly causes in the shade of scarlet is of no great signification, as more or less may be used to bring it precisely to the colour desired. If the composition be weak, and the aforesaid quantity not put in, the scarlet will be a little deeper and fuller in colour. On the contrary, if a little more is added, it will be more on the orange, and have what is called more fire; to rectify which, add a little of the composition, stirring it well in the copper, having first taken-out the wool, for if it was to touch any part before it was thoroughly mixed, it would blot it. If, on the contrary, the scarlet has too much fire, that is, too much on the orange, or too much rouzed, it must be passed through clear warm water; when finished, this saddens it a little, that is, diminishes its bright orange; if there still remained too much, a little Roman allum must be mixed with the hot water.

For spun wool that is to have all the various shades of scarlet, about half the cochineal, and half the composition for full scarlet is sufficient. The cream of tartar must also be diminished proportionably in the water of preparation. The wool must be divided into as many hanks or skains as there are to be shades, and when the liquor is prepared, the skains that are to be lightest are first to be dipped, and to remain in but a very short space of time; then those that are to be a little deeper, which must remain in somewhat longer, and thus proceeding to the deepest; the wool is then to be washed, and the liquor prepared to finish them. In this liquor, each of these shades are to be boiled

one after the other, beginning always with the lightest, and if any are perceived not to be of the proper shade, they must be passed again through the liquor. The eye of a Dyer will readily judge of the shades, and a little practice will bring this to perfection.

The Dyers are divided in opinion of what metal the boiler should be made. In Languedoc they use those made of the finest block-tin, and several Dyers in Paris follow the same method. Yet that great Dyer, M. de Julienne, whose scarlets are in high repute, uses brass. The same is used in the great manufactory at St. Dennis. M. de Julienne, to keep the stuffs from touching the boiler, makes use of a large rope-net with close meshes. At St. Dennis, instead of a rope-net, they have large baskets, made of willow stripped of the bark, and not too close worked.

As so much had been said concerning the metal of the boiler, I tried the experiment. I took two ells of white sedan cloth, which I dyed in two separate boilers of equal size; one was of brass, fitted with a rope-net, the other of block-tin. The cochineal, the composition, and other ingredients, were weighed with the utmost accuracy, and boiled precisely the same time. In short, I took all possible care that the process should be the same in both, that if any difference arose it might only be attributed to the different metals of the boiler. After the first liquor, the two pieces of cloth were absolutely alike, only that which had been boiled in the tin vessel appeared a little more streaked and uneven, which, in all likelihood, proceeded from these two ells of cloth being less scoured at the mill than the two others; the two pieces were finished each in the separate boilers, and both turned out very fine; but that which had been made in the tin

boiler had a little more fire than the other, and the last was a little more faddened. It would have been an easy matter to have brought them both to the same shade, but that was not my intention.

From this experiment, I conclude, that when a brass boiler is used, it requires a little more of the composition than the tin one; but this addition of the composition makes the cloth feel rough; to avoid this defect, the Dyers who use brass vessels put in a little turmeric, a drug of the dye, but which gives to scarlet that shade which is now in fashion; I mean that flame-colour, which the eye is scarce able to bear.

This adulteration is easily discovered by cutting a piece of the cloth; if there is no turmeric, the web will be of a fine white, but yellow if there is. When the web is dyed the same as the surface, it is said that colour is webbed, and the contrary, when the middle of the weaving remains white. The lawful scarlet is never dyed in the web: the adulterated, where the turmeric or fustic has been made use of, is more liable to change its colour in the air than the other. But as the brightest scarlets are now in fashion, and must have a yellow cast, it is better to tolerate the use of turmeric, than to use too great a quantity of the composition to bring the scarlet to this shade; for in this last case, the cloth would be damaged by it, would be sooner spotted by dirt from the quality of the acid, and would be more easily torn, because acids stiffen the fibres of the wool, and render them brittle.

I must also take notice, that if a copper vessel is used it cannot be kept too clean. I have failed several times with my patterns of scarlet, by not having the copper scoured.

I cannot help condemning the common practice of some Dyers, even the most eminent, who pre-  
pare

pare their liquor over-night, and keep it hot till next morning, when they dip in their stuffs; this they do not to lose time, but it is certain that the liquor corrodes the copper in that space, and by introducing particles of copper in the cloth, prejudices the beauty of the scarlet. They may say they only put in their composition just at the time when the cloth is ready to be dipt in the copper; but the cream of tartar, or the white tartar, which they put in over-night, is an acid salt sufficient to corrode the copper of the vessel, and form a verdigrise, although it dilutes itself as it forms, still has not a less effect.

It would therefore be better to make use of tin boilers, a boiler of this metal must contribute to the beauty of scarlet; but these boilers of a sufficient size cost much, and may be melted by the negligence of the workmen, and there is a difficulty in casting them of so great a size without sand-flaws, which must be filled. Now if these sand-holes are filled with solder, there must of necessity be places in the boiler that contain lead; this lead in time being corroded by the acid of the composition, will tarnish the scarlet. But if such a boiler could be cast without any sand-holes, it is certain such a one would be preferable to all others, as it contracts no rust, and if the acid of the liquor detaches some parts, they cannot be hurtful.

Having laid down the manner of dying spun wool in scarlet, and its various shades, which are so necessary for tapestry and other work, it is proper to give an idea of the dying of several pieces of stuff at one time. I shall relate this operation as it is practised in Languedoc. I made the trial on some ells of stuff, which succeeded very well, but this scarlet was not so fine as the flame-coloured.

There are two reasons why the wool is not dyed before it is spun (for fine colours) first in the course of the manufacturing, that is, either in the spinning, carding, or weaving, it would be almost impossible in a large workshop, where there are many workmen, but that some particles of white wool, or some other colour would mix, which would spoil that of the stuff by blotting it ever so little; for that reason, the reds, the blues, the yellows, the greens, and all other colours that are to be perfectly uniform, are never dyed before they are manufactured.

The second reason, which is peculiar to scarlet, or rather to cochineal, is, that it will not stand the milling, and as the greatest part of high stuffs must be milled after they are taken from the loom, the cochineal would lose part of its colour, or at least would be greatly saddened by the soap, which produces this effect by the alkaline salt which destroys the brightness given to the red by the acid. These are the reasons that the cloths and stuffs are not dyed in scarlet, light red, crimson, violet, purple, and other light colours, but after being entirely milled and dressed.

To dye, for example, five pieces of cloth at one time of five quarters breadth, and containing fifteen or sixteen ells each, the following proportions are to be observed. Put into a stone or glazed earthen pot twelve pounds of aqua fortis, and twenty pounds of water, to which add a pound and a half of tin, made in grains by running it in water, or filed. The dissolution is made quicker or slower, according to the greater or lesser acidity of the aqua fortis. The whole is left to rest twelve hours at least, during which time a kind of black mud settles at the bottom of the vessel; what swims over this sediment is poured off by inclination; this liquor is  
clear

clear and yellow, and is the composition which is to be kept by itself.

This process differs from the first in the quantity of water mixt with the aqua fortis, and in the small quantity of tin, little of which must remain in the liquor, since aqua fortis alone cannot dissolve it, but only corrodes it, and reduces it to a calx, as there is neither salt petre nor salt ammoniac which would form an aqua regia. However, the effect of this composition differs from the first only to the eyes accustomed to judge of that colour.

This composition made without salt ammoniac, and which has been of long use amongst a great number of manufacturers at Carcassone, who certainly imagined that its effect was owing to the sulphur of the tin, can only keep thirty-six hours in winter without spoiling, and twenty-four hours in summer; at the expiration of which it grows muddy, and a cloud precipitates to the bottom of the vessel, which changes to a white sediment. This is the small quantity of tin, which was suspended in the acid, but an acid not prepared for that metal; the composition which ought to be yellow becomes at that time as clear as water, and if used in that state would not succeed; it would have the same effect as that which would become milky.

The late M. Baron pretended to have been the first discoverer at Carcassone of the necessity of adding salt ammoniac to hinder the tin from precipitating. If so, there was no one in that town that knew that tin cannot be really dissolved but by aqua regia.

Having prepared the composition as I have described it after M. de Fondriers, about sixty cubical feet of water are put into a large copper for the five pieces of cloth before mentioned, and when the water grows warm, a bag with bran is

put in, sometimes also four waters are used: the one and the other serve to correct the water, that is, to absorb the earthy and alkaline matters which may be in it, and which, as I have already said, saddens the dye of the cochineal, for the effect of the water ought to be well known, and experience will teach whether such expedients should be used, or whether the water, being very pure and denuded of salts and earthy particles, can be used without such helps.

Be that as it will, as soon as the water begins to be little more than lukewarm, ten pounds of powdered cream of tartar is flung in, that is, two pounds for each piece of cloth. The liquor is then raked strongly, and when it grows a little hotter, half a pound of powdered cochineal is cast in, which is well mixt with sticks; immediately after, twenty-seven pounds of the composition very clear is poured in, which is also well stirred, and as soon as the liquor begins to boil, the cloths are put in, which are made to boil strongly for two hours, stirring them continually by the help of the wynch; they are then taken out upon the scray, and well handled three or four times from end to end, by passing the lists between the hands to air and cool them. They are afterwards washed.

After the cloth has been washed, the copper is emptied and a fresh liquor prepared, to which, if necessary, a bag with bran or some four water is added; but if the water is of a good quality, these are to be omitted; when the liquor is ready to boil, eight pounds and a quarter of powdered and sifted cochineal is put in, which is to be mixed as equally as possible throughout the liquor, and having left off stirring, it is to be observed when the cochineal rises on the surface of the water, and forms a crust of the colour of the lees of the wine; the instant  
this

this crust opens of itself in several places, eighteen or twenty pounds of the composition is to be added. A vessel with cold water must be at hand to cast on the liquor in case it should rise, as it sometimes does, after the composition is put in.

As soon as the composition is in the copper, and equally distributed throughout the whole, the cloth is cast in, and the wynch strongly turned two or three times, that all the pieces may equally take the dye of the cochineal. Afterwards it is turned slowly to let the water boil, which it must do very fast for one hour, always turning the wynch, and sinking the cloth in the liquor with sticks, when by boiling it rises too much on the surface. The cloth is then taken out, and the lists passed between the hands to air and cool it; it is then washed, after which it is to be dyed and dressed.

In each piece of the Languedoc scarlet cloth there is used, as has been shewn, one pound and three quarters of cochineal in the dye and preparation; this quantity is sufficient to give the cloth a very beautiful colour. If more cochineal was added, and a deeper orange-colour required, the quantity of the composition must be augmented.

When a great quantity of stuffs are to be dyed in scarlet, a considerable profit arises by doing them together, for the same liquor serves for the second dip which was used for the first. For example: when the five first pieces are finished, there always remains in the liquor a certain quantity of cochineal, which in seven pounds may amount to twelve ounces; so that if this liquor be used to dye other stuffs, the cloths dipped in it will have the same shade of rose colour as if they had been dyed in a fresh liquor with twelve ounces of cochineal; yet this quantity may vary pretty much, according to the quality or choice  
of

of the cochineal, or according to the fineness it has been reduced to when powdered. I shall say no more of this before I finish this chapter; but whatever colour may remain in the liquor, it deserves some attention on account of the high price of this drug. The same liquor is then made use of for other five pieces, and less cochineal and composition are put in proportion to what may be judged to remain; fire and time are also saved by this, and rose-colour and flesh-colour may also be produced from it; but if the Dyers have not leisure to make these different liquors in twenty-four hours, the colour of the liquor corrupts, grows turbid, and loses the rose-colour entirely. To prevent this corruption some put in Roman allum, but the scarlets which are prepared after that manner are all faded.

When cloths of different qualities, or any other stuffs are to be dyed, the surest method is to weigh them, and for each hundred weight of cloth add about six pounds of chrystal or cream of tartar, eighteen pounds of composition in the water of preparation, as much for the reddening, and six pounds and a quarter of cochineal. Thus in proportion for one pound of stuff use one ounce of cream of tartar, six ounces of composition, and one ounce of cochineal; some eminent Dyers at Paris put two-thirds of the composition and a fourth of the cochineal in the water of preparation, and the other third of the composition with three-fourths of the cochineal in reddening.

It is not customary to put cream of tartar in the reddening, yet I am certain, by experience, that it does not hurt, provided the quantity does not exceed half the weight of the cochineal, and it appeared to me to make a more lasting colour. Some Dyers have made scarlet with three dippings; namely,

namely, a first and second water for preparation, and then the reddening; but still the same quantity of drugs is always used.

I observed, in the foregoing chapter, that the little use made of kermes for the brown or Venetian scarlets, obliges most Dyers to make them with cochineal; for this purpose a water of preparation is made as usual; and for the reddening, eight pounds of allum are added for each hundred weight of stuff; this allum is dissolved by itself in a kettle, with a sufficient quantity of water, then poured into the liquor before the cochineal is put in. The remainder is performed exactly as in the common scarlet; this is the Venetian scarlet, but it has not near the same solidity as if made with the kermes.

There are no alkaline salts which do not sadden scarlet; of this number are the salt of tartar, potash, pearl-ashes calcined, and nitre fixed by fire; therefore allum is more generally used; and if these alkaline salts be boiled with the stuffs, they would considerably damage them, for they dissolve all animal substances. If the allum be calcined, it is still the more secure.

The redder the scarlet is, the more it has been saddened; from thence it appears that these colours lose in the liquor that browns them a part of their ground; however one cannot brown in the good dye but with salts. The late M. Baron observes, in a memoir he gave some time ago to the Royal Academy of Sciences, that all the salts he had made use of for browning, making the colour smooth, and preserving its brightness and deepness, he had succeeded best with salt of urine, but, as he observes, it is too troublesome to make this salt in any quantity.

I said,

I said, in the beginning of this chapter, that the choice of the water for dying of scarlet was very material, as the greatest part of common water saddens it, for they mostly contain a chalky, calcareous earth, and sometimes a sulphureous or vitriolic acid; these are commonly called hard waters, that is, they will not dissolve soap or boil vegetables well. By finding a method of absorbing or precipitating these hurtful matters, all waters may be equally good for this kind of dye: thus, if alkaline matters are to be removed, a little sour water produces this effect; for if five or six buckets of these sour waters are mixed with sixty or seventy of the hard water before it comes to boil, these alkaline earths rise in a scum, which is easily taken off the liquor.

All that I have hitherto said in this chapter is for the instruction of Dyers; I shall now make an attempt to satisfy the philosopher how these different effects are produced.

Cochineal, infused or boiled by itself in pure water, gives a crimson colour bordering on the purple; this is its natural colour; put it into a glass, and drop on it spirits of nitre; this colour will become yellow, and if you still add more, you will scarcely perceive that there was originally any red in the liquor; thus the acid destroys the red by dissolving it and dividing its parts so minutely that they escape the sight. If in this experiment a vitriolic, instead of a nitrous acid be used, the first changes of the colour will be purple, then purpled lilach, after that a light lilach, then flesh-colour, and lastly, colourless. This bluish substance, which mixes with the red to form a purple, may proceed from that small portion of iron, from which oil of vitriol is rarely exempt. In the liquor of preparation for scarlet, no other salt but cream of tartar

is used, no allum is added as in the common preparing water for other colours, because it would sadden the dye by its vitriolic acid; yet a calx or lime is required, which, with the red parts of the cochineal, may form a kind of lake like that the painters use, which may set in the pores of the wool by the help of the chrystal of tartar.

This white calx is found in the solution of very pure tin, and if the experiment of the dye is made in any small glazed earthen vessel, immediately on the cochineal's communicating its tincture to the water, and then adding the composition drop by drop, each drop may be perceived with a glass or lens, to form a small circle, in which a brisk fermentation is carried on; the calx of the tin will be seen to separate, and instantaneously to take the bright dye, which the cloth will receive in the sequel of the operation.

A further proof that this white calx of tin is necessary in this operation, is, that if cochineal was used with aqua fortis, or spirits of nitre alone, a very ugly crimson would be obtained; if a solution of any other metal was made use of in spirits of nitre, as of iron or mercury, from the first would be had a deep cinder-grey, and from the second, a chestnut-colour with green streaks, without being able to trace in the one or other any remains of the red of the cochineal. Therefore, by what I have laid down, it may be reasonable to suppose, that the white calx of the tin, having been dyed by the colouring parts of the cochineal, rouzed by the acid of the dissolvent of this metal, has formed this kind of earthy lake, whose atoms have introduced themselves into the pores of the wool, which were opened by the boiling water, that they are there plaistered by the chrystal of tartar, and these pores, suddenly contracting by the immediate cold the cloth was  
exposed

exposed to by airing, that these colouring particles are found sufficiently set in to be of the good dye, and that the air will take off the primitive brightness, in proportion to the various matters with which it is impregnated. In the country, for example, and particularly if the situation be high, a scarlet cloth preserves its brightness much longer than in great cities, where the urinous and alkaline vapours are more abundant. For the same reason, the country mud, which in roads is generally but an earth diluted by rain water, does not stain scarlet as the mud of towns where there are urinous matters, and often a great deal of dissolved iron, as in the streets of great cities, for it is well known that any alkaline matter destroys the effect which an acid has produced on any colour whatsoever. And for the like reason, if a piece of scarlet is boiled in a ley of pot-ash, this colour becomes purple, and by a continuation of boiling it is entirely taken out; thus from this fixed alkali, and the chrystal of tartar, a soluble tartar is made, which the water dissolves and easily detaches from the pores of the wool: all the mastic of the colouring parts is then destroyed, and they enter into the leys of the salts.

I have tried several experiments on the dye of cochineal, to discover what might be produced from the union of its red with other different matters, which generally are not esteemed colouring; but I shall only relate here such as had the most singular effects.

*Experiments on Cochineal Liquor.*

Zinc dissolved in spirit of nitre changes the red of cochineal to a slatey violet-colour.

The salt of lead, used instead of cream of tartar, makes a lilach somewhat faded; a proof that some  
portion

portion of lead is joined to the colour of the cochineal.

Vitriolated tartar made with pot-ash and vitriol destroys its red, and there only remains an agath grey.

Disimuth dissolved in spirit of nitre, weakened by an equal part of common water, and poured on the liquor of cochineal, gives the cloth a dove-grey, very beautiful and very bright.

A solution of copper in spirit of nitre not weakened, gives to the cochineal a dirty crimson.

Cupullated silver, a cinnamon colour, a little on the brown.

Arsenic added to the liquor of cochineal, gives a brighter cinnamon than the preceding.

Gold dissolved in aqua-regia gave a streaked chesnut, which made the cloth appear as if it had been manufactured with wool of different colours.

Mercury dissolved with spirit of nitre, produces pretty near the same effect.

Glauber's salts alone destroys the red, like the vitriolated tartar, and produces like that an agath grey, but not of the good dye; because this salt easily dissolves even in cold water, and besides it calcines in the air.

The fixed salt of urine gives a cinder-grey colour, where not the least tincture of red is perceived, and like the foregoing is not of a good dye, for it is a salt that cannot form a solid cement in the pores of the wool, as it is soluble by the moisture of the air.

*Violet without Blue.*

Lastly, the extract of busmuth changes the cochineal red to a purple, almost violet, as beautiful as if this red had been put on a cloth that had been previously dyed of a sky-blue.

From these experiments it is evident, that the salts and metallic solutions yield particles which unite themselves with the particles of the colouring ingredients used in dying, and which salts and particles contribute greatly to the tenacity of colours.

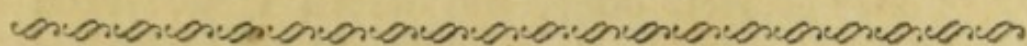
Before I finish this chapter on scarlet, I must add some observations which perhaps the reader may be glad to know.

Neither the mud of the streets nor several acrid matters can stain scarlet, if the spotted part is immediately washed with plain clean water and a clean cloth; but if the mud has had time to dry, then the spot appears of a violet black; this cannot be taken off but by a vegetable acid, such as vinegar, lemon juice, or a warm solution of white tartar slightly loaded with salts; but if these acids are not made use of with precaution and skill in taking off the black spot, a yellow one will succeed; because, as has been said before, the acids rouze and even destroy the red of the cochineal.

But there are some for which the colour must be discharged, and the stuff dyed again. There are other salts besides alkalis which will discharge the colour of scarlet; for if a piece of scarlet cloth be put into the water of preparation for that colour, it will lose a great part of its colour, insomuch, that if it was sewed with two or three pieces of white cloth, it would be difficult after one hour's boiling to distinguish which was the scarlet from the others; but if it was boiled afresh in a liquor of cochineal or in the reddening, it would regain its first colour.

Scarlets always lose some part of their brightness in the dressing, for the dressing lays the hair, and forces the fibres to be almost parallel to the web. In this case the cloth has numerically less surface, and consequently less rays of light are reflected from it. Besides the extremity of the hair

is always most penetrated with the dye which causes the brightness, and when it is laid on the cloth, the greatest part of these points appear no more.



## C H A P. XI.

*Of* C R I M S O N.

**C**RIMSON, as I have already observed, is the natural colour of the cochineal, or rather, that which it gives to wool boiled with allum and tartar, which is the usual water of preparation for all colours. This is the method which is commonly practised for spun wool; it is almost the same for cloths, as will be seen hereafter.

For each pound of wool, two ounces and a half of allum, and an ounce and a half of white tartar, are put into the copper. When the whole boils, the wool is put in, well stirred, and left to boil for two hours; it is afterwards taken out, slightly wrung, put into a bag, and left thus with its water, as for the scarlet in grain, and for all other colours.

For the dye a fresh liquor is made, in which three-fourths of an ounce of cochineal is added for each pound of wool. When the liquor is little more than luke-warm, the cochineal is put in, and when it begins to boil, the wool is cast in, which is to be well stirred with sticks; it is to remain thus for an hour; when taken out, wrung and washed.

If degrees of shades are required, (whose names are merely arbitrary) proceed, as has been already related for the scarlet, using but half the cochineal at first, and beginning with the lightest.

The beauty of crimson consists in its bordering as much as possible on the grisdelin, a colour between a grey and a violet. I made several trials to bring crimson to a higher perfection than most Dyers have hitherto done, and indeed I succeeded so as to make it as fine as the false crimson, which is always brighter than the fine.

This is the principle on which I worked. As all alkalis sadden cochineal, I tried soap, barilla, pot-ash, pearl-ashes; all these salts brought the crimson to the shade I wanted, but at the same time, they tarnished and diminished its brightness. I then bethought myself to make use of volatile alkalis, and I found that the volatile spirit of salt ammoniac produced a very good effect; but this spirit instantly evaporated, and a pretty considerable quantity was used in the liquor, which greatly augmented the price of the dye.

I then had recourse to another expedient which succeeded better, the expence of which is trifling. This was to make the volatile alkali of the salt ammoniac enter into the liquor, at the very instant that it comes out of its basis; and to effect this, after my crimson was made after the usual manner, I passed through a fresh liquor, in which I had dissolved a little of the salt ammoniac. As soon as the liquor was a little more than luke-warm, I flung in as much pot-ash as I had before of salt ammoniac, and my wool immediately took a very brilliant colour.

This method even spares the cochineal; for this new liquor makes it rise, and then less may be used than in the common process; but the greatest part of Dyers, even the most eminent, sadden their crimsons with archil, a drug of the false dye.

Very beautiful crimsons are also made by boiling the wool as for the common scarlet, and then boiling

ing it in a second liquor, with two ounces of allum and one ounce of tartar, for each pound of wool, leaving it one hour in the liquor. A fresh liquor is then prepared, in which six drachms of cochineal is put for every pound of wool. After it has remained an hour in this liquor, it is taken out, and passed immediately through a liquor of barilla and salt ammoniac. By this method, gradations of very beautiful crimson shades are made by diminishing the quantity of the cochineal. It is to be observed, that in this process there are but six drachms of cochineal to dye each pound of wool, because in the first liquor a drachm and a half of cochineal is used for each pound. It is also necessary to remark, that, to sadden these crimsons, the liquor of the alkaline salt and salt ammoniac be not made too hot, because the separation of the volatile spirit of this last salt would be too quick, and the crystal of tartar of the first liquor would lose its proper effect by being changed, as I have already said, into a soluble tartar.

The same operation may be done by using one part of the cochineal sylvestre instead of the fine cochineal, and the colour is not less beautiful, for commonly four parts of sylvestre have not more effect in dying than one part of fine cochineal. The sylvestre may be also used in dying scarlet, but with great precaution; it should only be used in bastard scarlets and half crimsons. I shall speak of this when I treat of these colours in particular.

When a scarlet is spotted or spoiled in the operation by some unforeseen accident, or even when the dye has failed, the common remedy is to make it a crimson, and for that purpose, it is dipt in a liquor where about two pounds of allum are added for each hundred weight of wool. It is immediately

diately plunged in this liquor, and left there until it has acquired the shade of the crimson desired.

*Languedoc Crimson.*

I shall now shew the method they follow in Languedoc to make a very beautiful sort of crimson, or the cloths exported to the Levant, but which is not so much faddened as that which I have just spoken of, and which resembles much more the Venetian scarlet. For five pieces of cloth the liquor is prepared as usual, putting bran if necessary. When it is more than luke-warm, ten pounds of sea salt are put, instead of crystal of tartar, and when it is ready to boil, twenty-seven pounds of the scarlet composition, made after the manner of carcaffine already described, are poured in, and without adding cochineal the cloth is passed through this liquor for two hours, keeping it always turning with the wynch, and continually boiling. It is afterwards taken out, aired and washed; then a fresh liquor is made, with eight pounds and three quarters of cochineal powdered and sifted, and when it is ready to boil, twenty-one pounds of composition are added; the cloth is boiled for three quarters of an hour with the common precautions, after which it is taken out, aired and washed: It is of a very fine crimson, but very little faddened; if it is required to be more faddened, a greater quantity of allum is put into the first liquor of preparation, and in the second less of the composition, the sea salt is also added to this second liquor; a little practice in this method will soon teach the Dyer to make all the shades that can properly be derived from crimson.

Whenever cochineal has been used, there is found at the bottom of the reddening liquor a quantity

quantity of very brown sediment, which is flung away with the liquor as uselefs. I examined it and found, that the liquor for the reddening of scarlet contained a precipitated calx of tin: I united this metal with a great deal of trouble; the remaining parts of this sediment are the dross of the white tartar, or of the cream of tartar, united with the gross parts of the bodies of the cochineal, which is, as has already been said, a small insect. I washed these little animal parts in cold water, and, by shaking this water, I collected, with a small sieve, what the agitation caused to rise on the surface.

After this manner I separated these light parts from the earthy and metallic; I dried them separately, then levigated them with equal weight of fresh crystal of tartar; I boiled a portion with a little allum, and put in a pattern of white cloth, which boiled for three quarters of an hour, at the end of which it was dyed of a very beautiful crimson.

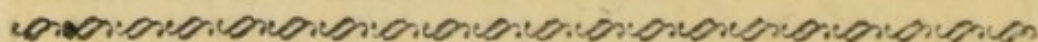
This experiment having convinced me, that by powdering and sifting the cochineal as is commonly practised, all the profit that might be extracted from this dear drug is not obtained, I thought proper to communicate this discovery to the Dyers, that they might avail themselves of it by the method following.

Take one ounce of cochineal powdered and sifted as usual; mix with it a quarter of its weight of very white cream of tartar very crystalline and very airy; put the whole on a hard levigating stone, and levigate this mixture till it is reduced to an impalpable powder; make use of this cochineal thus prepared in the liquor, and in the reddening, subtracting from the cream of tartar which is to be used in the liquor, the small quantity before  
used

used with the cochineal. What is put to the red-  
dening, although mixed with a fourth of the same  
salt, does not prejudice its colour, it even appeared  
to me that it was more solid. Those that will fol-  
low this method will find that there is about a  
fourth more profit to be obtained by it.

*The Natural Crimson in Grain.*

In proportion for every pound of cloth or other  
things, take two ounces of tartar pure, and two  
ounces of allum; boil them with the goods an  
hour and a half; then rince the goods very well  
from the boiling. The kettle must be filled again  
with clear water and a few handfuls of bran put in,  
in order to take out the filth of the water, as well  
as to soften it. Scum the scurf off when it begins  
to boil, and put in an ounce of well-powdered  
grain, with one dram of red arsenic and one spoon-  
ful of burnt wine lees; this gives a pretty lustre;  
then wash and rince it well, and you have a most  
beautiful colour.



C H A P. XII.

SCARLET of GUM-LACQUE.

**T**HE red part of the gum-lacque may be also  
used for the dying of scarlet, and if this scar-  
let has not all the brightness of that made of fine  
cochineal alone, it has the advantage of being more  
lasting.

The gum-lacque, which is in branches or small  
sticks and full of animal parts, is the fittest for dy-  
ing.

ing. It must be red within, and its external parts of a blackish brown; it appears, by a particular examination made of it by M. Geoffroy some years since, that it is a sort of a hive, somewhat like that of bees, wasps, &c.

Some Dyers make use of it powdered and tied in a linen bag; but this is a bad method, for there always passes through the cloth some resinous portion of the gum, which melts in the boiling water of the copper, and sticks to the cloth, where it becomes so adherent when cold, that it must be scraped off with a knife.

Others reduce it to powder, boil it in water, and after it has given all its colour, let it cool, and the resinous parts fall to the bottom. The water is poured out, and evaporated by the air, where it often becomes stinking, and when it has acquired the consistence of thick honey, it is put up into vessels for use. Under this form it is pretty difficult justly to determine the quantity that is used; this induced me to seek the means of obtaining this tincture separated from its resinous gum, without being obliged to evaporate so great a quantity of water to have it dry, and to reduce it to powder.

I tried it with weak lime water, with a decoction of the heart of agaric, with a decoction of comfrey-root, recommended in an ancient book of physic; in all these the water leaves a part of the dye, and it still passes too full of colour, and it ought to be evaporated to get all the dye; this evaporation I wanted to avoid, therefore I made use of mucilaginous or slimy roots, which of themselves gave no colour, but whose mucilage might retain the colouring parts, so that they might remain with it on the filtre.

The great comfrey-root has, as yet, the best answered by intention: I use it dry and in a gross powder,

powder, putting half a dram to each quart of water, which is boiled a quarter of an hour, passing it through a hair sieve. It immediately extracts from it a beautiful crimson tincture; put the vessel to digest in a moderate heat for twelve hours, shaking it seven or eight times to mix it with the gum that remains at the bottom, then pour off the water that is loaded with colour in a vessel sufficiently large, that three-fourths may remain empty, and fill it with cold water: then pour a very small quantity of strong solution of Roman allum on the tincture; the mucilaginous or slimy dye precipitates itself, and if the water which swims on the top appears still coloured, add some drops of the solution of allum to finish the precipitation, and this repeat till the water becomes as clear as common water.

When the crimson mucilage or slime is all sunk to the bottom of the vessel, draw off the clear water, and filter the remainder; after which, dry it in the sun.

If the first mucilaginous water has not extracted all the colour of the gum-lacque, (which is known by the remaining of a weak straw colour) repeat the operation until you separate all the dye the gum-lacque can furnish; and as it is reduced to powder when dry, the quantity to be used in the dye is more exactly ascertained than by evaporating it to the consistence of an extract.

Good gum-lacque, picked from its sticks, yields, dried and powdered, but little more dye than one-fifth of its weight. Thus at the price it bears at present, there is not so great an advantage as many may imagine in using it in the place of cochineal; but to make the scarlet colour more lasting than it commonly is, it may be used in the first liquor or preparation, and cochineal for reddening.

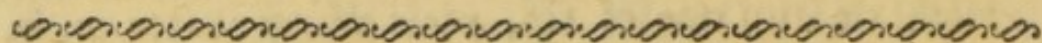
If

If scarlet is made of gum-lacque, extracted according to the method here taught, and reduced to powder, a caution is to be taken in dissolving it, which is useles when cochineal is used; that is, if it was put into the liquor ready to boil, the Dyer would lose three quarters of an hour, before it would be dissolved entirely; therefore for dispatch, put the dose of this dry tincture into a large earthen vessel, or into one of tin, pour warm water on it, and when it is well moistened, add the necessary dose of the composition for scarlet, stirring the mixture well with a glass pestle. This powder, which was of a dirty deep purple, as it dissolves takes fire-coloured red extremely bright; pour the dissolution into the liquor, in which was previously put the crystal of tartar, and as soon as this liquor begins to boil, dip the cloth in, keeping it continually turning. The remaining part of the operation is the same as that of scarlet with cochineal: the extract of gum-lacque, prepared according to my method, yields about one-ninth more of dye than cochineal, at least than that which I made use of for this comparison.

If instead of the crystal of tartar and the composition some fixt alkaline salt or lime water is substituted, the bright red of the gum-lacque is changed into the colour of lees of wine, so that this dye does not fadden so easily as that of cochineal.

If instead of these alteratives, salt ammoniac is used by itself, cinnamon or clear chesnut colours are obtained, and that according as there is more or less of this salt. I have made twenty other experiments on this drug, which I shall not relate here, because they produced none but common colours, and which may be easier had from ingredients of a lower price. My experiments were  
with

with a view of improving the red of the lacque, and the method I have here laid down to extract its colouring parts answers extremely well; the more ingredients that are discovered for scarlet, the less will be the cost; for, although these experiments made on cochineal, lacque, and other drugs, may appear useless to some Dyers, they will not be so to others who study to improve this art\*.



## C H A P. XIII.

*Of the COCCUS POLONICUS, a colouring Insect.*

THE *coccus polonicus* is a little round insect, somewhat less than a coriander seed; it is found sticking to the roots of the *polygonum cociferum incanum flore majore perenni* of Ray, and which M. Tournefort has named *alchymilli graminco folis majore flore*. According to M. Breyn, it abounds in the palatinate of Kiovia, bordering the Ukrania, towards the towns of Ludnow, Piatka, Stobdyzeze, and other sandy places of Ukrania and Podolia, of Volhinia, of the grand duchy of Lithuania, and even in Prussia, towards Thorn.

Those that gather them say, that immediately after the summer solstice the coccus is ripe, and full of its purple juice. They hold in their hand a small hollow shade, made in the shape of a shepherd's crook, which has a short handle. With one hand they hold the plant, raising it out of the ground with the other, armed with this instrument; they then shake off these little insects, and place the plant in the same hole in order to preserve it.

Having

\* The colouring parts of the gum-lacque may be extracted by common river water, by making it a little more than luke-warm, and inclosing the powdered lacque in a coarse woollen bag.

Having separated the coccus from the earth, which they do by a riddle made for that purpose, their chief care is, that it should not change into a small worm; for this purpose they sprinkle it with vinegar, and sometimes with very cold water; they then bring them to a warm place, or else expose them to the sun to dry; without this, these insects would destroy themselves, and if they were dried too precipitately, they would lose their beautiful colour. Sometimes they separate these small insects from their vesicles or bladders with the ends of their fingers by a gentle pressure, which they form into small round cakes. The Dyers pay dearer for this dye when in lump than when it is in grain.

Bernard de Bernitz, from whose book I have taken this, adds, that the great marechal Konitspoliki, and some other Polish noblemen, who had lands in the Ukrania, set this gathering of the coccus to the Jews at a considerable profit, and caused it to be gathered by their vassals; that the Turks and Arminians, who bought this drug of the Jews, used it for the dying of wool, silk, the manes and tails of their horses; that the Turkish women made use of it to paint their fingers' ends of a beautiful carnation colour; and that formerly the Dutch used to buy the coccus at a high price, and mixed it with an equal quantity of cochineal; that with the dye of this insect and chalk, a lacque for the painters might be made as fine as the Florence lacque; and that a beautiful red was prepared from it for the toilet of the ladies in France and Spain.

## C H A P. IV.

*Of the RED of M A D D E R.*

**T**HE root of madder is the only part of this plant which is used in dying. Of all the reds this is the most lasting, when it is put on a cloth or stuff that is thoroughly scoured, then prepared with the salts with which it is to be boiled two or three hours, without which, this red, so tenacious after the preparation of the subject, would scarcely resist more the proofs of the reds than any other ingredients of the false dye. This is a proof that the pores of the fibres of the wool ought not only to be well scoured from the yolk or unctuous transpiration of the animal, which may have remained, notwithstanding the scouring of the wool after the common manner with water and urine; but it is also necessary, that these same pores be plaistered inwardly with some of those salts which are called hard, because they do not calcine in the air, and cannot be dissolved by rain-water, or by the moisture of the air, in rainy weather. Such is, as has been said before, the white crude tartar, the red and the crystal of tartar, of which, according to common custom, about a fourth is put into the preparing liquor, with two-thirds or three-fourths of allum.

The best madder roots come generally from Zealand, where this plant is cultivated in the islands of Tergoés, Zerzée, Sommerdyke, and Thoolen. That from the first of these islands is esteemed the best; the soil is clay, fat, and somewhat salt. The lands that are deemed the best for the cultivation of this plant are new lands, that only served for pasture, which are always fresher and moister than others. The Zealanders are beholden to the refugees

fugees of Flanders for the cultivation and great commerce of this root.

It is known in trade and dying under the names of grape-madder, bunch-madder, &c. It is however the same root; all the difference in regard to its quality is, that the one kind contains pith and root, and the other has the small fibres from its principal root adhering to it.

Both are prepared by the same work, which I shall not relate the particulars of here, as it would only serve to lengthen this treatise to no purpose.

They choose the finest roots for the first sort, drying them with care, grinding them and separating the rind at the mill, and preserving the middle of the root ground in hogheads, where it remains for two or three years; for after this time, it is better for dying than it would have been coming from the mill; for if madder was not kept close after this manner, the air would spoil it, and the colour would be less bright. It is at first yellow, but it reddens and grows brown by age; the best is of a saffron colour, in hard lumps, of a strong smell, and yet not disagreeable. It is also cultivated about Lisle in Flanders, and several other places of the kingdom, where it was found to grow spontaneously.

The madders which are made use of in the Levant and in India, for the dying of cottons, are somewhat different from the kinds used in Europe, it is named *chat* on the coast of Coromandel. This plant thus called grows abundantly in the woods on the coast of Malabar, and this chat is the wild sort. The cultivated comes from Vafur and Tucorin, and the most esteemed of all is the chat of Persia, named *dumas*.

They also gather on the coast of Coromandel the root of another plant called *ray de chaye*, or

root of colour, and which was thought to be a kind of *rubia tinctorum*, but is the root of a kind of *gallium flore albo*, as it appeared by observations sent from India in 1748. It is a long slender root, which dyes cotton of a tolerable handsome red, when it has received all the preparations previous to the dye.

At Kurder, in the neighbourhood of Smyrna, and in the countries of Akissar and of Yordas, they cultivate another kind of madder, which is called in the country *chioc-boya ekme hazala*. This of all the madders is the best for the red dye, by the proofs that have been made of it, and far more esteemed in the Levant than the finest Zealand madder the Dutch bring there. This madder so much valued is called by the modern Greeks *lizari*, and by the Arabs *foiiy*\*.

There is another kind of madder in Canada called *tyssa-voyana*. It is a very small root, which produces pretty near the same effect as our European madder.

The water of preparation for madder red is pretty near the same as for kermes, that is composed of allum and tartar. The Dyers do not agree as to the proportions; but the best appears to be four ounces of allum and one of red tartar to each pound of spun wool, and about one-twelfth part of four water, and let the wool boil in it for two hours. If it is spun wool, leave it for seven or eight days, that it may be well moistened by the dissolution of these salts; and if it is cloth, finish it the fourth day.

To dye wool with madder, prepare a fresh liquor, and when the water is come to a heat to bear the

\* These kinds of madders give brighter reds than the best grape madder of Zealand, for they are dried in the air and not in a stove. The madder of Languedoc, even that of Poitou, succeeds as well as that of *lizari*, when it is dried without fire.

the hand, put in half a pound of the finest grape madder for each pound of wool; let it be well raked and mixed in the copper before the wool goes in, keep the wool in an hour, during which time it must not boil \*. Shades from madder are obtained after the manner laid down for other colours, but these shades are little used, except in a mixture of several colours.

When several pieces of cloth are to be dyed at once in madder red, the operation is the same, only augmenting the ingredients in proportion; and let it be remarked that in small operations the quantity of ingredients must be somewhat greater than in great, not only in madder red, but in all other colours.

These reds are never so beautiful as those of the kermes, and much less so than those of the lacque or cochineal, but they cost less, and are made use of for common stuffs whose low prices would not allow a dearer dye. Most of the reds for the army are of madder, saddened with archil or brazil (though these drugs be of the safe dye) to make them finer, and more on the velvet, which perfection could not be procured to them even with cochineal, without considerably augmenting the price.

I have already said that madder put on stuffs not being prepared to receive it by the allum and tartar-water, did in fact give its red colour, but that which it dyed was blotted and not lasting, it is therefore the salts that secure the dye; this is common to all other colours red or yellow, which cannot be made without a preparing liquor. Now the question is, whether these act by taking off the remains of the oily and fat transpiration of the sheep,

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or

\* If madder is boiled its red becomes obscure, and of a brick  
colour.

or whether that of the two salts, particularly that which even cannot be carried by luke-warm water, remains to catch, seize and cement the colouring atom opened or dilated by the heat of water to receive it, and contracted by the cold to retain it.

To determine which, use any alkaline salts, such as pot-ash, the clarified lays of oak-ashes, or any other pure lixivial salt instead of allum and tartar, put in a due proportion so as not to dissolve the wool, and afterwards dip the stuff in madder liquor. This stuff will come out coloured, but will not last, even boiling water will carry off three-fourths of the colour. Now it cannot be said that a fixed alkaline salt is unfit to extract from the pores of the wool the yolk or fat of the sheep, since lixivial salts are used with success in several cases, to take the grease out of stuffs of what kind soever they be, which water alone could not take off. It is also well known, that with fats foreign to the stuff, and an alkaline salt, a kind of soap is formed which water easily carries off.

Again, take a piece of stuff dyed in madder red, according to the usual method, boil it some time in a solution of fixt alkaline salts, a small quantity will also destroy the colour, for the fixt alkali, attacking the small atoms of the crystal of tartar or crude tartar, which lines the pores of the wool, forms a soluble tartar, which water dissolves very easily, and consequently the pores being opened in the hot water of the experiment, the colouring atom came out with the saline atom that sheathed it.

This stuff being washed in water, the remaining red colour is diluted, and a colour half brown and half dirty remains. If, instead of an alkaline salt, soap is substituted (which is an alkaline salt, mitigated by oil) and another piece of cloth dyed also in madder, be boiled for a few minutes, the  
red

red will become finer, because the alkali which is in the soap being sheathed with oil, it could not attack the vegetable acid, and the boiling only carried off the colouring parts ill stuck together, and their numbers diminishing, what remains must appear deeper or clearer.

I must also add, for further proof of the actual existence of salts in the pores of a stuff prepared with allum and tartar, before dying it with madder, that more or less tartar gives an infinite variety of shades with this root only; for if the quantity of allum be diminished, and that of the tartar augmented, a cinnamon will be had, and even if nothing but tartar alone be put into the liquor, the red is lost, and a deep cinnamon or a brown-root colour is obtained, though of a very good dye; for the crude tartar, which is an acid salt, has so much dissolved the part which should have produced the red colour, that there only remained a very small quantity, with the ligneous fibres of the root, which, like all other common roots, does then yield but a brown colour, more or less deep according to the quantity used. I have already proved that the acid which brightens the red, dissolves them if too much is used, and divides them into particles so extremely minute that they are not perceptible.

If in the place of tartar, any salt which is easily dissolved be put with the allum in the liquor, to prepare the stuff for the madder dye, such as salt petre, the greater part of madder red becomes useless, it disappears, or does not stick on, and nothing is got but a very bright cinnamon, which will not sufficiently stand the proof, because the two salts used in the preparing liquor are not of the hardness of the tartar.

Volatile

Volatile urinous alkalis which are obtained from certain plants, such as the perilla, the archil of the Canaries, and other mosses or lichens, destroy also the madder red, but at the same time communicate another to it, for on experiment, madder prepared after the manner of archil with fermented urine and quick lime, produced only nut colours, but which nevertheless are lasting; because there entered into the liquor only the little portion of urinous volatile that moistened the madder which the boiling was sufficient to evaporate, and besides, the cloth was sufficiently furnished with the salts of the liquor made as usual, to retain the colouring parts of the dye.

When a pure red, that for cochineal an example, is laid upon a cloth first dyed in blue, and afterwards prepared with the liquor of tartar, and alum to receive and retain this red, a purple or violet is produced according to the quantity of blue or red. The red of madder has not this effect, for it is not a pure red like that of the cochineal, and as I said above, it is altered by the brown ligneous fibres of its root, and makes on the blue a chestnut colour, more or less deep according to the preceding intensity of the blue first laid on. If this chestnut colour is wanted to have a purple cast, a little cochineal must be added.

In order to avoid this brown of the root, the Dyers who make the best reds of madder take great heed to use the liquor of madder a little more than luke-warm; the madder tarnishes considerably by the heat of the water, extracting the particles which dye brown, and unite themselves with the red.

This inconveniency might be remedied, if at the time that the madder root is fresh a means could be found to separate from the rest of this root the red circle which is underneath its brown pelicle,  
and

and which surrounds the middle pith; but this work would augment its price, and even then it would not afford so good a red as cochineal. However, it might be attempted to dye cottons red, whose price might bear the expences of this preparation.

Madder being of all ingredients the cheapest of any that dye red and of the good dye, it is mixt with others to diminish the price. It is with madder and kermes that the bastard scarlets of grain are dyed, otherwise called half-grain scarlets, and with madder and cochineal the half-common scarlets, and the half-crimsons are made.

To make the half-grain scarlet, the water of preparation, and all the rest of the operation is to be performed after the same manner as scarlet made of the grain of kermes, or the common Venetian, only the second liquor is composed of half kermes and half grape madder.

For the half-scarlet and flame colour, the composition and preparation is as usual, nothing but pure cochineal being put in, but in the reddening, half cochineal and half madder is used: here also the sylvestre may be made use of, for after having made the preparation with cochineal for reddening, use half a pound of cochineal, a pound and a half of sylvestre, and one pound of madder instead of cochineal alone.

That the wool and stuffs may be dyed as equally as possible, it is necessary that the two kinds of cochineal be well rubbed or sifted, as also the madder, with which they must be well incorporated before they are put into the liquor. This must be observed in all colours where several ingredients are mixt together. This half scarlet is finished like the common scarlet, and it may be saddened after  
the

the same manner, either with boiling water or allum.

The half-crimson is made like the common crimson, only using half madder and half cochineal, the cochineal sylvestre may be used here also, observing only to retrench half of the common cochineal, and to replace it with three times as much of the sylvestre. If a greater quantity of the sylvestre was used, and more of the other taken off, the colour would not be so fine. Various shades may be produced by augmenting or lessening the madder or cochineal.

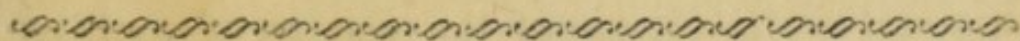
*Purple with Madder without Blue.*

I shall finish this chapter with an experiment which afforded a pretty fine purple without cochineal, or without the cloth being first dyed blue. I boiled a piece of cloth weighing half an ounce, with ten grains of Roman allum, and six grains of crystal of tartar; half an hour after, I took it out, wrung it, and let it cool; then added to the same liquor twenty-four grains of grape madder; after it had furnished its dye to this liquor, still impregnated with salts, I dropt in twenty-four drops of a solution of bismuth, made with equal parts of water and spirit of nitre, and then dipt my cloth again. Half an hour after, I took it out, wrung and washed it; it was almost as fine a crimson as if it had been done with cochineal, it had even a sufficient ground to have remained in that state.

I dipt it again in the same liquor, and boiled it for a quarter of an hour; it came out a pretty bright purple; this purple, tried by the proof of allum, rouzes and embellishes itself, and by the proof of soap it remained of a much finer red than the common reds of madder.

If the cloth be kept for several days moistened in its liquor of tartar and allum, and afterwards dyed in fresh madder liquor, plain and without salts, according to the common method, till it has taken a bright cinnamon colour, and to this liquor be added the same solution of bismuth, a chesnut colour, and no purple will be obtained. This shews what exactness is required in describing the processes of dying, for want of which, all books hitherto published on this art have been useles, as they neglected to point out the necessary circumstances for the success of the desired colour.

In this second experiment, the cloth did at first take too much salts, they remained too long in it, and there was none in the liquor of the dye; for want of allum the purple did not appear, because the white earth of this salt could not precipitate itself with the dissolved parts of the bismuth, which, as has been said in the chapter of the kermes, carry with them the blue parts of the smalt, which is always found in the mine of bismuth, and a portion of which very probably unites itself to this half metal during the melting. This mutual precipitation is performed in operation of dying, by the help of the astringent parts of the ligneous fibres of the madder root.



## C H A P. XV.

## Of Y E L L O W.

**H**itherto ten sorts of drugs have been named for dying yellow, but by the proofs that have been made it is certain there are but five that are sufficiently lasting to be used in the good dye. Several more might be added to these five, as yellows

lows are easily obtained. I shall therefore first speak of these five, which are the weld or wold, savory, green wood, the yellow wood and the fenugreek, because these only are of the good dye. The three first are very common plants in Europe, the yellow wood comes from the Indies, and fenugreek is found every where. Weld is most commonly used, as it gives the brightest dye. The savory and the green wood are best for wools that are to be made greens, because their natural colour borders a little on the green; the two others give shades of yellow somewhat different.

The yellows most known in the art of dying are the straw yellow, the pale yellow, and the lemon yellow. The orange yellows commonly made are not simple colours, therefore I shall not speak of them here.

For dying yellow, the common preparing water with tartar and allum is used for wool or stuffs, in the proportion of four ounces of allum for each pound of wool, or twenty-five pounds for the hundred, and one ounce of tartar, and the method of boiling is the same as before. For welding, after the wool or stuff is boiled, put five or six pounds of weld in a fresh liquor for each pound of stuff; let the weld be inclosed in a linen bag, that it may not mix with the stuff, and that the bag may not rise to the top of the copper, it must be kept down with a heavy cross of wood. Others boil the weld till it has furnished all its dye, and sinks itself to the bottom of the copper, at which time they place on it a cross or iron circle fitted with a net of cords. Others take it out with a rake when it is sufficiently boiled: sometimes yellow wood and other ingredients are mixed with the weld, according to the shade required, by altering the quantities and the proportions of the salts

in

in the preparation, and the time of boiling. I know by experience, that these shades may be obtained *ad infinitum*. This proof I have had in the essays I made with the flower of the virga, a very great acquisition in the art of dying, if this plant was improved, which may be easily done, since it shoots a great many stems, and whose small ones may be easily transplanted, and produce quantities in the course of one year.

Light shades of yellow are obtained in the same manner as all others spoken of, only the preparing liquor for these light yellows must be weaker. I recommend twelve pounds and a half of allum for each hundred pounds of wool, and the tartar in proportion; but these light shades do not resist the proofs as deeper shades do, made with the full proportion of tartar.

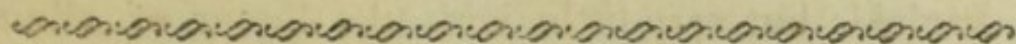
Some Dyers endeavouring to help this, leave the wool and stuffs for a longer time in the dye, because they take it slower in proportion to the weakness of the liquor; but if they put at the same time in the colouring liquor, wools whose preparation shall have been different, they shall take at the same time different shades. These liquors more or less strong are called half-preparing liquors, or quarter-preparing liquors, and they make great use of them in light shades of wool dyed in the fleece, that is, before being spun, and which are intended for the manufacturing of cloths and other mixed stuffs; because the more allum there is in the liquor of the wool, the more it is harsh and difficult to spin, and it must spin thicker, and consequently the stuff is coarser. This observation is not of great consequence for spun wool which is intended for tapestry or for stuffs. I only mention it to shew that the quantity of ingredients may be sometimes varied without danger.

The yellow wood is used in chips, or in coarse shavings; by this means it is more divided, and yields its dye the better, and a less quantity will do; which way soever it is used, it is put into a bag, that it may not mix with the wool or stuffs. The same precaution is necessary for the savory and green wood, when they are mixed with the weld to change its shade.

I refer to the lesser dye the five other ingredients hitherto known which dye yellow, and shall only observe here in regard to the good dye, that the root of the dock, the bark of the ash-tree, particularly that which is raised after the first sap, the leaves of almond, peach and pear-trees; in short, all leaves, barks, and roots, which by chewing shew some little astringency, give yellows of the good dye more or less fine, according to the time they are boiled, and in proportion to the tartar and allum used in the liquor: a proper quantity of allum brings these yellows to the beautiful yellow of the weld. If the tartar is in greater quantity, these yellows will border on the orange; and lastly, if these ingredients are too much boiled, let them be roots, barks, or leaves, the yellow obscures itself, and takes brown shades.

Altho' some Dyers use turmeric in the good dye, which gives an orange yellow, this practice is to be condemned, for it is a colour that soon passes in the air, unless it be secured by sea-salt, which some Dyers do, who take care to keep this imposition to themselves. Those who make use of it in common scarlets, to spare cochineal, and to give to their stuff a red bordering on the orange, are blameable, for the scarlets that have been dyed after this manner lose in a short time that bright orange, as I have already said, they brown considerably in the air. Yet these falsifications are obliged

obliged to be in some measure tolerated; for at this time that bright orange being in fashion, it would be impossible to give it to scarlet, without putting a larger dose of composition, whose acids would greatly hurt the cloth. The fustic wood is now preferred in scarlet.



## C H A P. XVI.

*Of* B R O W N.

**B**ROWN is the fourth of the primary colours. It is placed in this rank, because it enters in the composition of a great number of colours. The working it is different from others, for commonly no preparation is given to wool to be dyed brown, and, like the blue, it is only dipped in hot water.

The rinds and roots of walnut, the rind of the alder, fantal, fumach, roudoul or fovic, foot, &c. are used in this dye.

The rind of the walnut is the green part that covers the nut; they are gathered when the nuts are entirely ripe, then filled into great casks and moistened with water; they are thus preserved until the ensuing year, and longer if required.

The fantal or faunders is a hard wood brought from the Indies; it is commonly used ground to a very fine powder, it is preserved for some time in this state in bags, to excite (as imagined) a slight fermentation, which they pretend makes it the better for use, but I could find no difference.

This wood is most commonly ground with a third part of cariatour wood, which softens it according to those who sell it. It is greatly inferior to walnut rinds, for it hurts the wool by hardening

it considerably if used in large quantities, therefore it is better not to use it for fine wools and stuffs, or at least to draw but the lightest shades, for then its effect will be of less consequence. It is generally mixed with galls, alder, bark, and sumach; it is only by this means that it gives its colour when used alone, and unmixed with the cariatour wood. It yields but very little with the liquor of allum and tartar unless it be rasped. Notwithstanding this defect, it is tolerated in the good dye, on account of the solidity of its colour, which naturally is a yellow-red-brown: it browns and grows deep in the air, it lightens with soap, but loses less by the proof of allum, and still less by that of tartar.

Of all the ingredients used for the 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. If it is spun wool, and that the shades required are to be matched with great exactness, a small quantity of rind is to be put in first, and the lightest are first made; more rind is then put in, and then the deepest are made: but to work with stuffs, the deepest are generally made first, and as the colour of the liquor diminishes, the lightest are dipped; they are aired as usual to cool them, dried, and dressed.

Next to the walnut rind is the root; it gives a great number of shades and pretty near the same; thus they may be substituted the one for the other, according

according to the facility of obtaining them, but there is a difference in the manner of using the root. A copper is filled three quarters full of river water; the quantity of root that is thought convenient is cut into small pieces, and added in proportion to the quantity of wool to be dyed and the shade required.

When the liquor is hot so as not to bear the hand, the stuffs are put in and turned, until they have the desired shade, carefully observing to air them from time to time, and to pass them between the hands by the lists, to make the small pieces of roots that stick fall off to prevent their blotting; but this may be remedied by inclosing the cut root in a bag, as has been said of the yellow root. The stuffs that are to be of lighter shades are then to be dipped, and to be thus continued until the root gives no more dye. If it is spun wool, the lightest are to be made first to match them the better, as I have already said in speaking of other colours; but above all, care must be taken not to boil the liquor at first, for then this root would give all its colour to the first piece of stuff, and there would not remain sufficient for the rest.

The method of dying wool with roots is not very easy, for if great care is not taken to bring the dye to a proper degree of heat, and to stir the wool and stuffs so that they may be equally soaked in the copper, they run the hazard of being made too deep or of being blotted, which cannot be remedied but by giving them a chesnut, prune, or coffee colour, as I shall shew when I treat of the colours and shades arising from the mixture of black and brown.

To avoid this inconvenience, the stuffs must be continually turned round the wynch, and dipped piece after piece, and great care must be taken not to boil the roots too much, but always to leave

some dying substance in them. When the wool or stuffs are dyed after this method, they are aired, washed, and dried.

The method of treating the alder bark differs not from that of the walnut root before described, except that there is less danger in boiling it at the beginning, as it gives less ground of colour to the stuff. It is commonly used for thread, and for colours that are to be saddened with green copperas; it has however a good effect on wool for colours that are not very deep, and it perfectly resists the action of the air and sun.

The sumach is pretty near the same; it is used after the same manner as the green shells or inward coats of walnuts; it still gives less ground of colour, and borders somewhat on the green; it is often substituted for galls in colours that are to be saddened, and it answers perfectly well, but must be used in larger quantities.

These different matters are often mixed together, and as they are equally good, and produce nearly the same effect, they readily afford a variety of shades; and yet there is nothing but practice can teach this variety of brown shades, for they entirely depend on the eye of the Dyer.

To use these ingredients mixt, and ground saunders together, put four pounds of this last into a copper, half a pound of powdered galls, twelve pounds of elder bark, and ten pound<sup>s</sup> of sumach; this quantity will dye twenty-five or twenty-seven ells of cloth; the whole is boiled, and having slackened the boil by means of a little cold water, the cloth is put in, turned, and well stirred for two hours; after which it is taken out, aired and washed; other stuffs that are to be of a lighter shade are then put in, and thus continued as long as the liquor affords any colour.

The quantity of these ingredients is augmented or diminished in proportion to the height of the shade, and the stuffs or wool are boiled more or less accordingly. I have already observed that by this means only the colour can be extracted from the saunders.

I have here treated of the saunders and the manner of using it, although it should have been classed with the lesser dyes, as this woad ought only to be used for stuffs of low prices, because of the defects before spoken of; yet as it is worked almost after the same manner as the other ingredients for dying brown, and in several places is even tolerated in the good dye, as it resists the sun and air as well as the others, I thought it would not be improper here to give the method of working it; for the same reason I shall now describe the method of dying with foot, though permitted only in the lesser dye, having less solidity than the rest, besides hardening the wool, and giving a disagreeable smell to the stuffs.

The foot\* is commonly put into the copper the same time as the water, and the whole is well boiled together; the stuff is then dipt in, which is to boil more or less according to the shade required; after which it is taken out and aired, and those put in which are to be lighter; they are then to be well washed and dried, but it is better to boil the foot in the water for two hours than let it settle, and empty the liquor into another copper, without mixing the foot; the wool and stuffs are put into this liquor, and are less hardened and dried than when they have been mixt with the foot itself, but the colour is not solid, and it is better not to make use of it for dying stuffs that bear a price, and  
more

\* Wood foot.

more so as all its shades may be had by the foregoing ingredients, which are better, more lasting, and also soften the wool.

The Dyers of the lesser dye usually employ the rinds of the nut and the root of the walnut-tree for their brown colours; the working of these two ingredients being common to Dyers of the greater and lesser dye; but there are places where it is difficult to obtain them, and then the saunders and even foot are obliged to be used in their stead.

What I have hitherto said to account for the solidity of the colours of the good dye, may seem not to agree with brown colours spoken of in this chapter, since these are firmly applied on the wool without any preparation to receive them by the liquor of allum and tartar, and consequently without first introducing into the pores of the fibres a salt capable of hardening itself in the cold, and to cement the atoms that colour the brown; but if on a chymical analysis the green shell of walnuts, the root of the walnut-tree, the rind of alder, should be proved to contain, besides their astringent properties, a vitriolated tartar, which is a salt that does not calcine in the sun, and that is only dissolved by boiling water; this I say will convince that these ingredients are sufficient of themselves to produce on the stuffs, without any foreign help, the same effect as the other drugs, whose colours are not set in with solidity, but by the help of a salt capable of cementing the colouring atoms.

The foot does not give so lasting a brown, because it only contains a volatile and an earthy salt easily dissolved, and in fact the foot being only composed of the lightest and most volatile parts of combustible bodies, which have served as food for the fire, it could not raise tartar of vitriol along with

with it, which is a salt that does not rise by heat, and which is also seldom found in the wood which we commonly burn in our chimnies.

As I am not willing to omit any thing within the limits of my knowledge, on the article of woollen dying, I shall give two or three hints on the acid of vitriol.

If you would have a beautiful claret on wool, stuffs, or cloth, boil in a copper of a good size, redwood or saunders in proportion to the shade you want, and two pounds of logwood, for forty pounds of wool previously scoured. When the ingredients have boiled half an hour, put a pint of oil of vitriol into a pail of cold water, and add it to the liquor, when the wool must be put in, and gently boiled for two or three hours. It is then to be taken up on a scray, that is, set across the copper to drain, and five or six pails of water poured over it. The copper must be then run down and filled as before with fair water, and when it is hot, ten pounds of copperas and four ounces of pearl-ashes must be added, and the wool returned and well worked with a long pole to make it even.

The ashes (which are a fixed alkali) act upon the logwood, and give it a fine lustre at the same time. It weakens the acid of the vitriol, and makes way for the copperas to do its part, which would otherwise be kept at a distance; the vitriol does not obstruct the cloth in the fulling-mill, for the vitriol, which some suppose to be a great enemy in the mill, is divested of its acid by the strong alkali contained in the chamberley in scouring, and the colour remains perfectly vivid. If for forty pounds of wool, &c. ten pounds of nut-galls were bruised and boiled with the above ingredients, the acid therein contained would produce as brilliant a colour, and, if possible, more holding than the former;

former; but if galls are used, the same liquor will do the same business when the copperas is added without ashes as a fresh water would when vitriol is used. If forty pounds of cloth, stuff, or worsted were boiled in a sufficient quantity of redwood or saunders, and one pint of prepared aqua-fortis be added to the liquor after the goods have boiled an hour and a half, and then turned well for half an hour, the colour will be vivid and fine; the copper must be well cooled when the spirits are put in.

When cloth or stuffs are dyed claret with oil of vitriol, great care must be taken to turn them continually over the wynch, and particularly in taking out observe the instant the last end comes up to take off into a large tub of cold water, that all parts may cool alike, or the colour will be very uneven, as the vitriol when hot will not bear the air.

Oil of vitriol is so useful a thing in dying, that any colour, save woaded blue or green, may, by the help of its acid, be brought to a fine claret, black not excepted.

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C H A P. XVII.

*Of* B L A C K.

**B**LACK is the fifth of the primary colours. To dye the best and most lively shade, a vessel sufficiently large must be filled with soft water, and for every hundred weight of cloth, thirty pounds of logwood in chips must be put in, with half a pail of elder bark and six pounds of sumach; boil these ingredients together half an hour, when the cloth may be entered (the copper being first cooled by  
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the addition of cold water) and boiled an hour and a half, being instantly turned on the wynch to prevent an unevenness of dye. This operation being ended, which is called a preparation or stuffing the blacks, I shall proceed to the finishing.

A small tub is to be placed at the side of the copper, out of which it must be filled with hot liquor, in which put ten or fourteen pounds of copperas to dissolve; the cloth is then kept turning, whilst a man with a piggin is lading the copperas water into the copper; the cloth is turned here at a boiling heat one hour, then taken out and cooled well in all parts alike; when thoroughly cold, return it into the copper, with two handfuls of copperas, and boil it gently as before for two hours, then cool it again.

Whilst the second cooling is carrying on, six pounds of logwood, ten pounds of bark, and two pounds of argil, with ten pounds of soda or common ashes, and three pounds of copperas, must be added to the liquor; these ingredients must be made to boil one hour, when the goods must be turned and worked one hour. Keep the wynch continually turning, always observing that the small portion of air which the goods receive by turning on the wynch, contributes much to the beauty of the colour. Some Dyers instead of ashes use chamberley, but this is a bad custom. If they would become good black Dyers, they must abandon their old practice, and by mixing their natural genius with reason and good sense, they will soon find by experience, that the acid of the argil acts only on the vitriolic acid of the copperas, and prevents a brown or rusty hue that will unavoidably proceed from the logwood; the alkaline power of the ashes at the same time forces it to assume its natural violet colour; that if too great a quantity of logwood is not  
used,

used, (which would certainly prejudice the colour) and this rule carefully observed, the black would resemble a raven's feather; they must be well washed at the fulling-mill.

I shall not entertain the reader with a tedious recital of the manner of treating those goods whose superior quality renders it needful that they should previously be dyed blue. It is sufficient to know, that they must have a less proportion of ingredients, though the operation is the same as that of the common black.

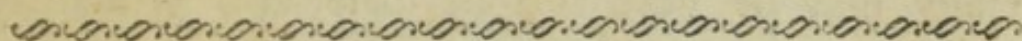
When fine cloth is to be dyed black, great care must be taken not to let it hang on the wynch one minute; it must be thrown off that instant the last comes up; otherwise its own weight when wet and hot would fill it with wrinkles that would never remove. The same caution must be taken when the cloth is on the floor, to draw it between two men over a long stick by the lifts, each taking hold of one end with their left hand, to be continued till cold before it be returned.

*Remarks on the Black Dye.*

The most essential thing to be remarked, is, that it prejudices and weakens the goods; for this reason those that are dyed black are soonest worn out; they are however in all other respects equal to those that are dyed other colours. This defect is chiefly to be attributed to the vitriolic acid of the copperas, which is only imperfectly saturated by the iron; as iron united to any other acid, and even to vegetable acids, is capable of producing black with astringent vegetables. There is great cause to think that by substituting other combinations of this metal for the copperas, this inconvenience might be remedied.

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These are certainly good and useful essays to attempt. It is not without cause that the blacks are directed to be aired between the dippings, as it infinitely contributes to the beauty of the dye; for it is certain that this dye is different from most others which lose of their colour in drying; this, on the contrary acquires a great deal; it is universally known, that good writing-ink does not appear any thing near so black when fresh and recently used, as when dry, and that even it grows more black during a certain space of time. The same happens to the black dye. The cloth is in some measure of a grey-blackish colour immediately after the first dip; it only acquires the beautiful black on being exposed to the air; this is not the only example of the influence of the air on colours; the blue-vat exhibits something like it.



## C H A P. XVIII.

*Of the MIXTURE of BLUE and RED.*

**I**N speaking of the red I observed that there were four different kinds in the good dye. We shall now explain the effect of these different reds placed on a stuff that has been previously dyed blue. If a blue stuff is boiled in allum and tartar (after the manner and proportion taught in the article of red, and which is afterwards to be dyed with kermes) the following colours will result, viz. The king's colour, the prince's colour, the pansy, the violet, the purple, and several other like colours; but the kermes is seldom used for these colours, on account of its high price, and the quantity which would be required, but more so,  
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because cochineal yields a finer colour for this purpose, and with greater ease. I have already observed that kermes is seldom used, though there are several compound colours in which it produces a very good effect, as will be more particularly described.

When the kermes is used to lay a red on blue, it is indifferent what ground of blue is first given, or whether it be given before or after the stuff is dyed red, because the colour of the kermes is too solid to be changed by the lime of the woad vat, (unless the vat be overloaded) or by the pearl-ashes in the indigo. Thus if the woad vat is not too old, it may be begun by either of these two colours at pleasure, or by that which is most convenient to match the shade. Although I named but a small number of colours, a great many may be drawn from these two principal ones, according as the one or the other may be more predominant.

The mixture of blue with fire-colour scarlet is never used in any of their shades. To convince myself by experience, I took a piece of cloth dyed in scarlet, and dipt it in the blue vat, and I dyed a second piece according to the method of dying scarlet, having previously dyed it blue. The one and the other succeeded very badly, and made a kind of dull spotted violet, so it appeared that the two colours did not unite, but that they were laid each on different parts of the wool. This no doubt is caused by the acids which enter the composition of the scarlet. But without entering here upon the physical reason of this operation, which might occasion too long a dissertation, and tedious repetition of what I have already said, the fact appears sufficient here: it proves that no beautiful colour  
can

can be had from the mixture of blue and scarlet; it must be crimson.

From the mixture of blue and crimson, the columbine, the purple, the amaranth, the pansy, and the violet are formed; these colours have also a great number of shades which depend upon the shades of the other colour, from whence they are derived.

I have said so much on the primary colours, that no difficulty can remain in the execution of the compound colours.

Stuffs or spun wool are first made of one colour, and then dyed of the other, precisely as if it was white; but it must be observed in this case, that the stuff be first dyed blue before it is made into crimson, for the reason before given, that the alkali of the one or other vat greatly obscures the brightness of the red of the cochineal.

To make violets, purples, and other like shades, what I have already said on crimson is to be followed, because these colours will have neither brightness nor lustre, but by following the precautions necessary for making fine crimsons.

From blue, and the red of madder, proceeds also the king's colour, the prince's colour, (but infinitely less beautiful than when the kermes is made use of; for the red of the madder is always obscured by the brown of its ligneous parts) the minime, the tan colour, the amaranth, the dry rose, always less bright than when the kermes is made use of. Nevertheless, it is sometimes mixed with madder, as I have already said, to make half-grained scarlets, and the colours which proceed from it are always finer than when madder alone is used on a stuff dyed blue; madder is also mixed with cochineal, as in the half crimsons, and a great number of very fine shades are drawn from them,

which cannot have particular names, but which border on those I have just mentioned. Some of these may be made as fine as if dearer ingredients were made use of. It is the business and profit of the Dyer not to use the dearest, when the same effects may be produced by the cheapest ingredients. It is impossible for me to give any instructions on this article, since use alone can teach it. The old liquor of madder and cochineal is often used, whose colours have not been entirely extracted, which makes a considerable saving, and the colour is not less good. I can say nothing positive on this, since the effect which will result from it depends on what colour may remain in the liquor, and on the shade intended.

C H A P. XIX.

*Of the MIXTURE of BLUE and YELLOW.*

**F**ROM the mixture of blue and yellow but one colour is produced, which is green; but there are a variety of shades; the principal ones 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, the cabbage green, and I shall add, the duck-wing green, and the celadon green without 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 in allum and tartar, as is usually done to make a white stuff yellow, and then with weld, savory, or greening wood. All these ingredients are equally good as

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to solidity, but as their yellows differ a little, so do the greens that arise from their mixture. The weld and the savory are the two plants that afford the finest greens.

To make the green shades which border on the yellow, the stuff must be of a very light blue, and boiled with the common quantity of tartar and alum, to receive the yellow; for without these salts it would not be lasting, (but for a parrot or cabbage green the blue must be very deep) and as it is only to have a light yellow, the stuffs must have but a half preparation; I have already mentioned this; sometimes even a quarter of the water for the common preparation is sufficient.

When the workmen make these colours, they often use the salts without weighing them, and guess at the quantity which they think necessary for the shade intended; a long practice may in some measure make them pretty exact, but it would be still better if they did not trust to it.

I know by repeated experiments that these green-blue shades are as well made by giving the stuff the common preparation. The yellow which is afterwards applied to it is the more lasting, but on this occasion less weld is to be put into the liquor of the dye, or any other colouring matter, and the stuff must remain less time in the liquor, notwithstanding two reasons induced the contrary; the first and most interesting to the Dyer is, that they would consume a greater quantity of drugs than is necessary; and the second, that the less alum used in the preparation, the more the softness and the quality of the wool is preserved, and the less the first dye of blue is damaged; for the alum always greys the blues a little. Thus it is better to leave the Dyer to his custom of regulating the strength of

his preparation to the necessary pitch to give these colours.

I have said that to dye green it was necessary that the wool should be previously blue; because I think that the two colours laid on in this order hold better, and that the colour would not be so good if otherwise done. Of this I assure myself by making the greens, of which I have spoken, with the five colouring matters already known, which make a yellow of the good dye; I have tried a yellow of the same materials, the contrary, having dipped five yellow pieces in the woad vat, and have had as fine greens as the first. I exposed both to the summer's sun, and they have resisted sufficiently to be esteemed of the good dye; but those which had received the blue before the yellow lost the least, so that in particular circumstances the Dyer must be allowed to begin first with yellow. But greens which have the blue colour last, will fully the linen more than the others; for if the blue has been first dyed, all that could be taken off was done by the allum liquor, which happens on the contrary when the blue was put on last; the only remedy for this is, to scour the green well after it comes out of the copper.

Cloth dyed king's blue, and greened with the flower of the *virga aurea canadensis*, makes a very fine green, provided it has been boiled in a liquor with three times the weight of allum to one of white tartar; the green is not inferior to that made of weld.

I have also greened blues with ash-bark powdered; they are of a very good dye, but not of a fine colour, and only fit for liveries. The leaves of almond, peach and pear-trees, &c. give yellows, which serve to make green shades, that are rather difficult to hit on at first.

A stuff

A stuff dyed in the king's blue, well scoured, then boiled with four parts of allum and one of tartar, takes a fine deep green of the shade of a duck's wing; but it must be boiled for two hours in a liquor, with a sufficient quantity of the root of sharp-pointed dock grossly bruised.

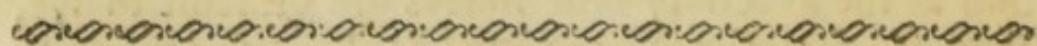
This root, which grows in every hedge and field, is a good acquisition to the art of dying; for with it, and without any other addition but the preparing liquor for the stuffs, it produces an infinity of shades, from the straw colour to a pretty fine olive; only putting more or less to the liquor, and boiling it from half an hour to three hours. These shades stand all manner of proof. I strongly recommend the cultivation of this dock in damp places, for its use in dying.

The celadon green (a particular colour) is much admired by the inhabitants of the Mediterranean, and may in strict business be made in the good dye, by giving a blue ground to the stuff. But this shade of blue must be so weak that it is only a milk and water colour, which is very difficult to give smooth and equal. When this shade has been happily hit, it is easier to give the yellow dye that suits it, with the *virga aurea* than with the weld. The *virga aurea* is not known to the Dyers of Languedoc, who make most these kind of colours; and as the necessary blue shades are difficult to dye, they are sometimes permitted to dye celadons with verdigrise, although this colour be in the rank of the lesser dye.

The Dutch make this colour perfectly, and render it more lasting than it commonly is with the verdigrise. Here follows their method.

Two coppers are set a little distance the one from the other. In the first is put for two pieces of cloth of forty-five or fifty ells long, eight or  
ten

ten pounds of white soap cut small and perfectly melted. When the liquor is ready to boil, the cloths are dipt in, and boil for half an hour. Another liquor is prepared in the next copper, and when it is scalding hot a cloth bag is put in containing eight or ten pounds of cyprus or blue vitriol, and ten or twelve pounds of lime, both powdered and well mixt; this mixture must be as equal as possible. The bag is moved about in the hot water, but not boiling, till all the blue vitriol is dissolved in the liquor; then a wynch is put up, surrounded by a clean linen cloth, and well fastened on; one end of the two cloths is put on the wynch, which is turned swiftly, that the cloths may quickly pass through the soap liquor to that of the vitriol; then the wynch is worked more gently, that the cloth may have time to charge itself with the parts of copper, which the lime has scattered in the liquor, by separating and precipitating them from the vitriol which contained them. The cloths are left in this liquor, which must not boil until they have taken the shade of the celadon that was wanted; then they are taken out and well aired: they must be entirely cold before they are washed, and must touch no wood before they are, for the wood spots them; for this reason the wynch and the horse are surrounded with cloth.

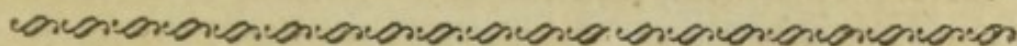


## C H A P. XX.

*Of the* MIXTURE *of* BLUE *and* BROWN.

**L**ITTLE use is made of the shade which arises from the mixture of blue and brown: these are greenish greys, or a kind of olives, which are only fit to match shades for tapestries; these colours

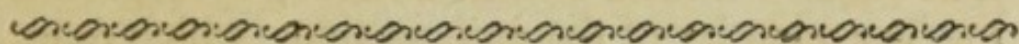
colours are easily made when wanted, and it is equal to begin by the blue or the brown colour to the spun wool; but care must be taken that it be well scoured, as is done for the blue and the compound colours which are finished by dipping them in the vat. Any substance that dyes brown may be equally made use of for these colours, and some give the shade required better than others.



## C H A P. XXI.

*Of the MIXTURE of BLUE and BLACK.*

**N**O particular shades arises from this mixture, except by the mixture of blue and grey (which are shades of the black). In this case the blue must not be very deep, and is afterwards worked the same as the black, excepting that the colour not being so dark less copperas enters in; but I repeat again that this colour ought only to be esteemed a shade of the black. Thus it may be said that no shades are made from blue and black used by themselves, and very few from blue and brown.



## C H A P. XXII.

*Of the MIXTURE of RED and YELLOW.*

**F**ROM scarlet of grain or kermes and the yellow are formed the aurora, the marigold, and the orange. The wool is first boiled in allum and tartar, and dyed in one of these colours, and then dipped in the second, or by mixing in the same li-  
quor

quor the kermes, the weld, the savory, &c. and so dying it at once. Yet it is easier to attain the exact shades by dying it at twice; for this reason, the wool or the stuff may be alternately passed in the one or other liquor, till it be precisely of the desired colour.

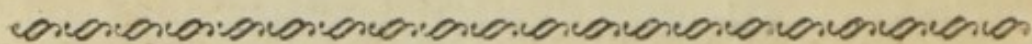
The lobster and pomegranate colours are done exactly as scarlet is, that is, boiled with cream of tartar, cochineal, and the composition, after which they are taken out, aired, and washed. For the finishing, a fresh liquor is prepared as for the scarlet, but without cochineal; in its stead, a little yellow wood ground is substituted; this depends on the colour the stuff is intended to be of. The more it borders on the orange, the more yellow wood is added, diminishing the quantity of the cochineal.

I endeavoured to make this colour after three different methods, and succeeded in all; the first is that which I have described; the second is by putting fustic instead of yellow wood, and this saves a great deal of cochineal, and the shade of the fustic is a great deal more on the orange than the yellow wood, but these ingredients are not lasting, and ought not to be used but in the lesser dye. The method is with cochineal alone, by augmenting the quantity of the composition, which rouses the cochineal, and turns it to orange as much as is desired; but this is attended with very great inconvenience. 1<sup>st</sup>, The colour becomes very expensive, because it requires more cochineal than common scarlet, as the great quantity of the composition, which is an acid, makes it lose part of its ground. 2<sup>d</sup>, For the same reason the colour always looks starved, it appears as if the cochineal had been spared, the composition having dissolved part of it. 3<sup>d</sup>, This large quantity of composition hardens

hardens the wool, and makes it more liable to be spotted by dirt and sharp liquor, and consequently this method is the worst. I mentioned that the inconveniency of the second was using the fustic, which is a wood forbid in the good dye; consequently the first ought to have the preference, if it gave the lobster colour as bright as the second. But this colour made by the yellow wood has not all the solidity that might be desired, as I have tried by exposing it to the sun; this at first appears extraordinary, since the ingredients used have all the solidity possible. But the reason why they are not so good in the present case is, that the cochineal used in the scarlet composition and the cream of tartar are too solid; thus the lobster colour loses nothing in the air. But the case is otherwise with the yellow wood though it be very lasting on the wool boiled in allum and tartar, especially when a little allum is added to the liquor of its dye; it is not the same as when the wool or stuff has received the water for the scarlet-preparation in which no allum can enter, and consequently when these sort of colours are exposed to the air, they sadden in a short time, that is, they lose part of their orange colour, produced by the mixture of the yellow with the red, and the effect of the air upon this colour is the same, though it appears different from that on all others, &c. that it commonly turns them pale; yet this one darkens and browns them by taking away part of its bright orange. For it is demonstrated by several chymical experiments, that there is a vitriolic acid in the air like unto that which may be extracted from allum. Now if a stuff dyed lobster colour was to be passed through a light solution of allum, the acid of the salt would immediately sadden it, and the red of the cochineal would eclipse the orange dye; the same thing must then

then happen when such a colour is exposed to the air, which is impregnated with the same acid.

Very few shades are made from the crimson and yellow, because of the price of the first, and that pretty near the same shades are made with madder and kermes, yellow and half scarlet of grain, as well as from the yellow and half crimson. It is with these different mixtures, that marigold, orange, gold yellow and other like shades are made, which are simply produced by the mixture of the yellow and red, and sometimes by yellow alone.

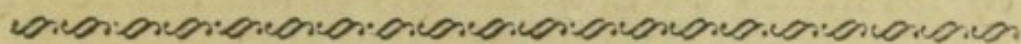


### C H A P. XXIII.

#### *Of the MIXTURE of RED and BROWN.*

**T**HE reds of the kermes and cochineal are not used in this mixture, for madder has as good an effect on those which cannot become bright, because of the dark obscure colour of the brown, but after they are maddered, they are dipt in the old liquors of cochineal or kermes; yet a liquor of these ingredients is seldom purposely prepared, being too dear for such common colours which are as easily made with madder. The stuff is to be boiled with a quantity of allum and tartar, proportioned to the red shade of madder intended; it is then passed through a liquor of this root, and afterwards dipped and worked in a liquor of walnut roots or walnut rinds; the following colours will be produced, viz. cinnamon, tobacco, chefnut, musk, bear's hair, and numberless others, by varying the ground of the madder from the brownest to the lightest, and keeping them longer or shorter in the liquor of the root. The process may begin with any one of these colours, but the red is commonly

monly dyed first, as the liquor proper for the madder might hurt the brown, therefore they are not to be mixt as the red and yellow are sometimes.



## C H A P. XXIV.

*Of the MIXTURE of YELLOW and BROWN.*

**F**ROM this mixture are produced the shades of feulemort and bear's hair.

Soot is commonly used in these colours instead of the rinds of walnuts, or the root of the walnut tree, as it makes them finer, but care must be taken that the wool or stuff be well scoured after it is dyed, to take off the bad smell of the liquor, for only the clear liquor of the soot is to be used, as has already been said. The walnut rinds are preferable to the soot, unless obliged to match a pattern of feulemort with the greatest exactness, and which may sometimes be done with the walnut.

These are the only two browns resulting from these shades, the sumach and the alder bark not giving sufficient ground.

Wool must be boiled in allum and tartar to dye it yellow before it is made brown; but if it should not have a sufficient ground of yellow, it might be passed afresh through the yellow dye, notwithstanding it has been browned, though in fact this method of seeking exactly the shade does not make so lasting a colour as when the yellow was at first sufficiently dyed, for when the yellow is dyed first, the brown is a great deal brighter.

## C H A P. XXV.

*Of the MIXTURE of BROWN and BLACK.*

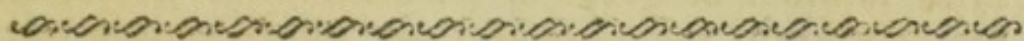
**F**ROM this mixture a great number of colours may be extracted, as coffee, chesnut, prune, musk, thorn, and several like shades, whose numbers are almost infinite, and of great use. The method of working them is this:

After the wool or stuffs have been made brown as already described, and that several shades have previously been given; as for example, a stronger brown for the coffee, chesnut, &c. galls, sumach, and alder bark are put into a copper in proportion to the quantities of stuffs to be dyed; the whole is boiled for one hour, after which green copperas is to be added. The stuffs that are to be lightest, as the thorn, are first dipped in this liquor, then taken out, and others that are to be browner are put in, observing to add copperas to the liquor each time, and as occasion may require, which is known by its not browning the stuff quickly, thus continuing until all the stuffs are browned: the liquor must not boil, nor be of a greater degree of heat than the hand can bear.

When the galls and other ingredients are boiled, cold water is added to refresh the liquor before the stuff is put in: this is a precaution that is absolutely necessary, as I have often said. The stuffs are first to be dipped in luke-warm water before they are put into the copper, lest since they were browned they should have dried; and they must be aired when they have remained some time in the browning, by passing them between the hands by the lifts, without which they would perhaps spoil, blot, and be unequally dyed, and the brown, for want of  
airing,

airing, would not be lasting, as there would not be a successive congelation of the saline parts of the vitriol.

I have now shewn all the necessary colours or shades which may be produced by the mixture of the primitive colours taken two by two, and have given a minute description both of their effects and the method of producing them. There being but few colours which may not be greatly varied, it depends on the judgment of the Dyer to choose the easiest, provided the colour be equally fine.



## C H A P. XXVI.

*Of the MIXTURE of the PRIMITIVE COLOURS, taken three by three.*

**F**ROM blue, red, and yellow, the red olives and greenish greys are made, and some other like shades of little use only for spun wool designed for tapestry. It would be a repetition to give the method of using these colours, having sufficiently explained it in the preceding pages.

In the mixture, where blue is a shade, it is usual to begin with it; the stuff is afterwards boiled to give it the other colours, in which it is dipped alternately one after the other; notwithstanding they are sometimes mixed together, and are as good, provided they are colours which require the same preparation; for example, the madder-red and the yellow. As to the cochineal and kermes, they are seldom used in these common colours, but only light colours which have a bloom or vinous hue, and which must be bright and brilliant, and then they are only used in the last liquor,

that is, the stuff is only dipped in when it has received the other colours, unless they are to be greyed a little, which is lastly done by passing them through the browning. It is impossible to give any precise rules for this work, and the least practice of these rules will teach more than I could say in many volumes.

Olives are made from blue, red, and brown, from the deepest to the lightest, and by giving a little shade of red, the slated greys, the lavender greys, and such like.

From the blue, the red, and the black, an infinite number of greys of all shades are made, as the sage grey, the pigeon grey, the slate grey, the lead grey, the king's and prince's colour, browner than usual, and a variety of other colours almost innumerable.

From blue, yellow, and brown, are made the greens, goose dung, and olives of all kinds.

From blue, brown, and black are produced the brown olives and the green greys.

From the red, yellow, and brown proceed the orange, gold colour, marigold, feulemort, old carnations, burnt cinnamon, and tobacco of all kinds.

From the red, yellow, and black, pretty near the same as the last, and the deep feulemort; as also the ox hair and brown nut, and others of the like kind.

I give this list of colours only as a table to shew in general what ingredients are made use of to make these sorts of colours, which also partake of several others.

Four or five of these colours may be mixed together; however this is rarely done: a minute detail on this subject would be useless, because all that may be done is oftentimes superfluous. I shall now only relate the manner in which I have seen  
about

about forty different shades of carnations made in spun wool; this example will shew what may be done in all other cases. There were none of those bright shades of scarlet in these which are made as in the chapter on that colour.

*Variety of Carnation Colours.*

All these flesh or carnations were old carnations, or shades of it, so that they were all obliged to be taken from the mixture of the red of kermes, yellow, brown, and black.

An unequal preparation was first given to the wool, reserving for the lighter shades those whose preparing liquors had been weakest. When they had remained as usual four or five days in the liquor, the lighter shades were dyed; these colours were disposed in four different vessels, which were always kept sufficiently hot without boiling. A skain of wool was immediately dipped in the liquor of the kermes for a minute, it was taken out, wrung, and passed through a liquor of weld, and an instant after through a brown one, and it became of the colour required by the Dyer; he immediately dipped another, which remained a little longer in each liquor: he went on after this manner, and when, after being strongly wrung, and seemed to want a little red or any other colour, he dipped it in the liquor which it appeared to want. By this method he brought all his colours to the desired shade, and passed through the brown those that were required to be deeper. I was fully persuaded by this method of working, that only patience and practice were wanting to make all the colours which can be conceived.

Too much caution cannot be given in this kind of work, to begin always with the lightest shades;

for it often happens that they are kept too long in some of these liquors, and then that skain must be made into a darker shade. But when once the lighter shades are matched, and in a right degradation, the rest are easily made.

What I have been speaking of, relates only to wool intended for tapestry, when it is necessary that the shades be carried on with the greatest degree of precision, without which it would be impossible to imitate the flesh colours of the painter.

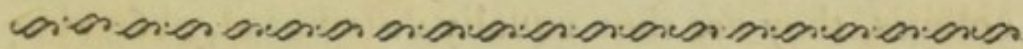
With regard to stuffs, it seldom or never happens that they are made in these gradations of shades, or that so many colours are mixed together; two or three are generally sufficient, since it has been shewn what a variety of colours arose from their combination, that even names cannot be found for them.

I think I have omitted nothing regarding the dying of wool or woollen stuffs in the great and good dye, and I make no doubt but that by exactly following what I have laid down, each colour and all the shades may be executed to the greatest perfection, as well in fleece wool, spun wool, as on stuffs manufactured in white.

I think it yet necessary to add something in regard to mixed stuffs, that is, whose wool is mixed before the manufacturing of the stuff, and to teach the method by which this mixture of dyed wool is performed, to be afterwards carded and spun to form a colour resulting from those different wools.

It may be objected that this article rather relates to the manufacturing of stuffs than their dyes; but to this I answer, that sometimes colours are made by mixing wool of different shades, whose colours would not easily be imitated by dying the stuff of a compound colour; some of these  
different

different shades are composed of ingredients which would require a different preparation; whereas by dying every part of the wool separately, the mixture is made without any difficulty; it cannot therefore be improper here to give the manner of mixing together wool of different colours, and I shall also give the manner of making mixtures for an essay or proof in small, (which is always necessary) to choose that which produces the most agreeable effect.



## C H A P. XXVII.

*Of the Manner of mixing* WOOL *of different*  
COLOURS *for* CLOTHS *or* MIXED CO-  
LOURS.

[*Colours mixed in the Loom.*]

ONE example of the method of mixing (after the most exact manner possible) wool of different colours, will be sufficient, and it will be easily applied in all other cases required. Suppose a mixed cloth of a coffee colour to be made, the following is the method of the manufacturers of Languedoc, and pretty near the same is practised in all other manufactories.

Three hundred and fifty pounds of wool are first dyed coffee colour, which is called the ground wool, that is, that which prevails in the stuffs; after which are taken five pounds of wool dyed in madder-red or kermes, and two pounds dyed in king's blue; these last are called the wool of mixture. This wool is distributed to different persons placed in a ring in a large room. The factor, or he that has the care of the mixture,  
stands

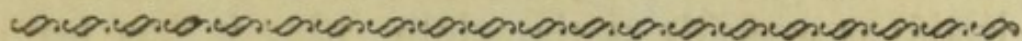
stands with a stick in his hand in the centre of this circle, the men being at six feet distance from him; eight or ten are generally employed at this work, and all the wool is given to them. In the present case, for example, six will be employed in bearing the prevailing wool or coffee colour, one the blue, and another the red; but they must be so situated that there may be three together who have the coffee coloured wool, then he that has the red, then three with the coffee colour, and lastly he that has the blue. When there is a greater number of colours, they are thus equally distributed, observing to divide them, as much as possible, the one from the other.

The men thus disposed walk slowly round the factor, keeping an equal distance, and each step they take they cast at the feet of the factor a small lock of the wool they carry, with this difference, that those that have the red or the blue, having but a small quantity to distribute, fling but little each time, whereas the others must fling much more. The factor stirs the wool with his stick whilst the men are flinging it, and that the mixture should be perfect, they must all have distributed their wool at one and the same time. The factor then mixes it again, and gives it to the carders.

The carding makes a perfect mixture, so that no particular colour is to be distinguished, and it appears of one uniform colour; it is afterwards spun, the cloth manufactured, and brought to the mill. The importance of this mixture being exactly made is easily conceived, for if these colours were unequally distributed, the cloth would appear full of blots.

As in the composition of these mixtures it is not possible to judge exactly of the effect which may be produced by the combination of all these colours

colours in different proportions, I shall give a method of making a proof in small, that a colour formed after this manner by a known proportional mixture, it may be executed in great, and be certain that the colour of the stuff will be equal to that of the pattern.



## C H A P. XXVIII.

*Of the Method of preparing the PATTERN  
FELTS, or Mixture for an ESSAY.*

**T**HIS little work is very simple and very useful, as it will shew in an hour what a mixt cloth will be after it is manufactured, and even when it is entirely dressed. For this purpose, wool of different colours are taken, and after having weighed each exactly, the mixture is made with the fingers in the proportion which is judged sufficient, but the whole in a very small quantity; so that the mixture being made, it may not exceed the bigness of the fist. This wool is then moistened with a little oil, and carded several times with small cards, till all these colours are well incorporated together and perfectly well mixt. This wool, which is extremely open and of the square form of the card, is folded four times, and gently pressed between the hands. It is then plunged into a strong soap water, and putting it again between the hands, it is strongly pressed at different times, striking sometimes one hand on the other. It is then gently rubbed betwixt the two hands, which hardens the wool by contracting it all manner of ways, and making it occupy less space. It is then dipped again in the soap water, and continued to be felted, until it has acquired some consistence, and that it becomes  
like

like felt, and pretty near the same consistence as the common cloth. This felt is then a true copy of what the cloth will be after its manufacturing; for when it has been well felted, that is, that the wool has been equally and carefully extended under the hand coming from the card, it is as equal and as smooth as the cloth itself can be. To finish it also as perfectly as the cloth, after it has been washed to take off the soap, it is dried and put between two papers, and prest with an iron somewhat hot: by this means it acquires a lustre which makes it appear like a cloth which has been entirely dressed.

If the colour of the felt is approved of, the mixture in great is made for the cloth, by following the same proportions exactly, and it will certainly be like the pattern, for not only the wool of different colours are as entirely mixt and closed one to the other in the felt as in the cloth, but the soap which has been made use of to felt it, has produced the same effect as that which happens to the cloth in the fulling mill, for there are several colours, and particularly those that have been browned, that is, in whose compositions there are shades of black and grey, which lose in the mill part of their browning, so that it must always be dyed of a deeper colour than intended to be after finishing: this defect of solidity in the browning does not hinder it from standing very well the action of the air, but it is easily spotted by acid liquors, as has been before said. The colours that have been saddened in the woad or indigo vat are not liable to this, they scarce lose any thing in the mill. The felt produces the same effect, and it is certain that the stuff will not lose more in great at the mill than the felt did with soap: consequently this preliminary operation of the felt may be looked upon as a sure  
guide

guide for the choice and assortment of wool in mixt cloths.

These patterns are made still better with black soap, but it gives them a disagreeable smell, which is not easily taken off by repeated washings.

The felts, when made, may be dyed for stuffs, in which it is required that one colour should cover the other, for then, after the stuff should have been mixt with the same colours as the felt, it might be dipt in the same dye through which that had been passed, and by this means it would be of the same colour as the felt; but this is not to be done to the stuff till it comes from the mill, has been sheered, and nothing remains but to dress it. This method will be of great use when it is a mixt cloth in which cochineal has been used, for it saddens too much and spoils at the mill; so that when it is used in mixt stuffs, a fresh liquor must be made, in which the cloth must be dipt, when it requires no more dressing than that which is given to cloth dyed white after it is come out of the dye.

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C H A P. XXIX.

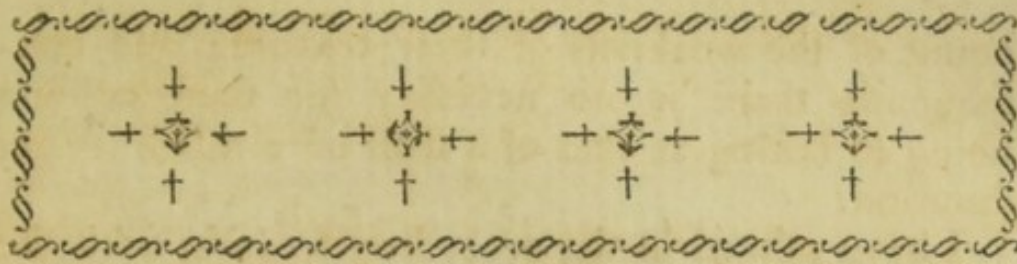
P O L I S H R E D.

**B**EFORE I enter upon the colours of the lesser dye, I shall give the process of a very excellent colour, called Polish red.

If you would dye forty pounds of wool this bright and holding colour, boil ten pounds of nut galls, in a copper sufficiently large, an hour and a half: then cool the liquor with cold water about ten degrees under a boiling heat, because the madder should not boil, and add best madder in proportion to the shade required, from fourteen to  
twenty

twenty pounds. Work these ingredients with the wool for two hours with long poles, that it may dye in all parts alike. Rince it well, and you have the true Polish red. If you would have a dark colour, use a little ashes. Observe to have the wool well scoured. This process will hold good in cloth and other things.

T H E



T H E  
D Y E R ' s   A S S I S T A N T .

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P A R T   I I .

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C H A P .   I .

*Of the DYING of WOOL by the LESSER DYE.*

**I** Observed in the beginning of this treatise, that the dying of wool, or woollen stuffs manufactured from it, were distinguished by the great and lesser dye. The French regulations have fixed what the quality of the wool and stuffs are to be, which are to be dyed by the great or lesser dye. This distinction has been founded on this principle, that stuffs of a certain value, and which generally constitute the upper part of cloathing, should receive a more solid and lasting colour than stuffs of a low price, which would be dearer and become less saleable, were they obliged to be dyed by the good dye, as the good dye is a great deal more expensive than the lesser, and that stuffs of low price, which are permitted to be dyed by the lesser dye, are generally used to make linings, so that they are little exposed to the action of the air, and if they are put to other uses they are soon worn out, on account

O count

count of the weakness of their texture; and consequently there is no necessity for their colours being so lasting as that of a stuff of a much longer duration.

I have related in the preceding treatise, with the greatest exactness and precision in my power, the method of executing by the good dye all imaginable colours; I shall do the same in that which concerns the lesser dye, and shall lay down the method of making the same colours with other ingredients than I have hitherto spoken of, and which, though they have not the solidity of the first, often have the advantage of yielding more lively colours; besides which, the greater part give a smoother colour, and are worked with greater facility than the ingredients of the good dye.

These are the advantages of these substances which are called false ingredients, and though it is to be wished that their use was not so general, it must be agreed that they have their utility for stuffs less exposed to the air, or whose colour does not stand in need of a long duration. I might also add, that the colours are most commonly sorted with greater ease, and with more expedition, in the lesser dye than can be done in the great.

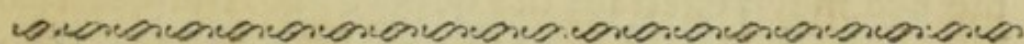
I shall not follow the same order for this kind of dye as I did for the good, since in this no primary colours are known. Few serve as a ground for others: the greatest part do not arise from a combination of two or several simple colours. In short, there are colours, such as the blue, &c. which are seldom or never made in the lesser dye.

This is the order which I propose to follow, and shall first set forth the names of all the ingredients which particularly belong to the lesser dye, and then give the method of using each of these ingredients, and the extraction of all the colours they can yield.

It

It will be found that several of these ingredients produce similar colours, so that it would have been impossible to have treated of them separately, without tiring the reader with tedious and troublesome repetitions.

The ingredients are flock or goat's hair madder, archil, logwood, brazil, fustic, roncou, grains of *Avignon*, turmeric, or *terra merrita*. I shall not here speak of the sanders or foot, though these ingredients particularly belong to the lesser dye; I have already given the manner of using these last.



## C H A P. II.

*Of the DYING of FLOCK or GOAT's HAIR.*

**T**HERE are two preparations very different one from the other in the dying of flock: the first is with madder, and belongs to the great and good dye; the second is to dissolve it and make use of it; this belongs to the lesser dye. The dying with flock was formerly permitted in the good dye, but was rather on account of its being extracted from madder, than by any experiment that had been made concerning its durability. I tried it with great attention, and found it beyond any doubt that there is no colour that resists the air less. It is certainly for this reason that it was restrained to the lesser dye in the new regulation of France in 1737. Yet, as by the same regulation, it is not permitted to the Dyers of the lesser dye to use madder, nor even to keep it in their houses; it has been enacted, that only the Dyers of the great dye should be suffered to madder flock, and those of the lesser dye to dissolve and use it.

This maddering of flock ought to have found a place in the foregoing treatise, but that I chose rather to class together all operations that have any necessary connection, than to stick too scrupulously to that distinction of the great and lesser dye, which is the particular object of the civil government of that art, and which upon some occasions might have made me fall into some obscurities, or run into continual repetitions; besides, the government of dying is not the art considered in itself.

To madder the flock or goat's hair, four pounds of either of them is cut and well separated, that the dye may penetrate the better. It is boiled two hours in a sufficient quantity of four water; then it is drained for an hour, and put into a middling copper, half filled with water, with four pounds of roach allum, two pounds of red tartar, and one pound of madder. The whole is boiled for six hours, putting in hot water as the liquor wastes; it is left all night and next day in this liquor: the third day it is taken out and drained in a basket. Some Dyers let it remain eight days, but it often happens that by this delay in a copper vessel it is tarnished by the liquors corroding a part of the copper; a middling copper is then filled to the two-thirds with half four water and half common water, and when the liquor is ready to boil, eight pounds of madder, well cut and crushed between the hands, is added. When the madder is well mixed in the liquor, four pounds of flock or hair is put in and boiled for six hours; it is then well washed, and the next day it is maddered a second time after the same manner, only putting in four pounds of madder instead of eight, which were before used. After this second maddering, it is well washed and dried; it is then almost black and fit for use.

It appears by this operation, that four pounds of flock or hair is loaded with thirteen pounds of the dye of madder, yet there still remains some dye in the liquor, which is then called an old madding, and which is preserved for use on certain occasions, as in tobacco, cinnamon colour, and several others.

When the flock is thus maddered by the Dyer of the great dye he sells it to Dyers of the lesser, who have then the liberty to dissolve and use it: this is the common method, which has many difficulties, and is known but to few Dyers. Madder is hereby made fine.

About half an hour after seven in the morning, six pails full of clear water are put into a middling copper, and when the water is lukewarm, five pounds of pearl-ashes are put in: the whole is boiled till eleven, and the liquor is then considerably diminished, so as to be held in a lesser copper, into which it is emptied, observing first to let the dregs of the pearl-ashes subside, that none but the clear may be used.

A pail full of this liquor is afterwards put into the middling copper, having first scoured it well, and a little fire made under it; the four pounds of maddered flock are scattered in it by degrees, and at the same time a little of the lukewarm and saline liquor of the small copper is added to keep down the boiling, which rises from time to time to the top of the copper, in which the operation is performing.

When all the flock and the liquor of the little copper are put into the middling one, a pail full of clear water is put on the dregs of the pearl-ashes remaining in the little copper. This water serves to fill the middling one as the liquor in it evaporates. All this flock melts, or is dissolved by the action of the pearl-ashes, and after the first half

hour, not the least hair is to be perceived. The liquor is then of a very deep red. The whole is then boiled without any addition, till three in the afternoon, that the whole dissolution of the flocks may be the more exactly performed. Then a stick is placed upon the copper, and upon this stick is placed a pail of fermented urine, in which pail a small hole has been previously made towards its lower part, and a little straw put into it, that the urine may very slowly run into the copper; whilst it is running, the liquor is made to boil strongly, and this urine makes good what may be lost by evaporation. This operation continues five hours, during which time three pails full of urine are discharged into the copper, being made to run faster when the boil is stronger, than when moderate. It is here to be observed, that, on account of the small quantity of flock in the experiment which I lay down here, five pounds only of pearl-ashes are ordered; for when thirty pounds of flock are dissolved at one time, which is the common custom of the French Dyers, they put twelve ounces of pearl-ashes to each pound of flock.

During the whole time of this operation, a strong volatile smell of urine is emitted, and there swims on the surface of the liquor a brown scum, but much more so after the addition of the urine. The liquor is known to be sufficiently done when this rises no more, and that the boil rises but gently, that is what happened to the operation now related, at eight in the evening. The fire is then raked out, the copper covered, and thus left to the next day. Patterns had been taken at different times of the colours of the liquor from three to eight in the evening, by dipping in small pieces of paper: the first were very brown, and they became continually lighter, and united themselves more and more, in  
proportion

proportion as the volatile part of the urine acted on the colouring parts of the liquor.

Nothing now remained but to dye the wool in the liquor thus prepared, and which is called melting of flock; this is the easiest work belonging to the Dyer. A quarter of an hour before the dying is begun, a little piece of very clean roach allum is put in, and the copper is well raked to melt it. As this liquor which was in the middling copper had been covered the whole night, and the fire had not been put out, the liquor was still so hot as not to suffer the hand. The clearest was taken out and brought into a small copper, with a sufficient quantity of lukewarm water, some wool dyed yellow with weld was dipped in; it immediately became of a fine orange, bordering on the flame colour, that is of the colour called *nacaret*, and known to the Dyers by the name of *nacaret of flock*, because it is commonly made with melted flock.

Twenty hanks of white wool were dipped one after the other in the same liquor, beginning by those that were to have the deepest ground, and leaving them longer or shorter in the liquor according to the shade required. An assortment was made after this manner from the *nacaret*, or bright orange red, to the cherry colour. It ought to be observed, that in proportion as the liquor was consumed, fresh was taken from the middle-sized copper, great care being taken not to stir the sediment at the bottom; a little fire was also kept under the small copper, to keep the liquor always in the same degree of heat. The wool is thus dipped until the whole liquor is used, and all the colour drawn out. But the lighter colours could not be dyed in it; for when the colour of the liquor is once weakened, as it ought to be for these colours, it is generally loaded with filth, which would take off the brightness required in these shades.

The

The following is the method of making shades lighter than the cherry colour. A copper is filled with clear water, and five or six hanks of wool dyed of the deepest dye from the flock, that is, from the shade that immediately follows the nacarat, are put in. As soon as the water boils, it takes out all the colour the wool had, and it is in this fresh liquor that the other wool that is to be dyed is dipped, from the cherry colour to the palest flesh colour, observing always to begin by the deepest shades.

Most of the Dyers who do not know how to melt the flock, or who will not give themselves that trouble, buy some pounds of this scarlet of flock, which they use after this manner, to make all the lighter shades, which, as has been said, is done with much ease. This operation shews what little dependance can be put on the solidity of a colour that passes so quickly in boiling water. And in fact, it is one of the worst colours there is in dying, and on that account the new regulation has taken it from the great dye, and permits it in the lesser for the reasons above mentioned.

Thus a very bad colour may be had from an ingredient which, of all those that are used in dying, is perhaps the best and the most durable; yet when this hair, dyed with all the necessary precautions to insure the colour as much as possible, comes to be dissolved or melted in a liquor of pearl-ashes, its colour, by acquiring a new lustre, loses all its solidity, and can only be ranked in the number of the falsest dyes.

It may appear that the little solidity of this colour proceeded from the wool having no preparation, and retaining no salt before its being dipped in the dissolved flock; but I found that this was not the cause; for I dipped in this liquor wool  
boiled

boiled as usual, and other wool differently prepared, without finding that the colour of the latter had acquired any more solidity; the lustre was less, that is, it came out more faddened than the wool that had been dyed in it without any preparation.

Though I have said that wool receives no preparation before its being dyed in a dissolution of flock, it is nevertheless necessary to sulphur those that are to make clear shades, for that gives them a great brightness and lustre, as the dissolved flock is applied on a ground a great deal whiter than it would be without the vapour of the sulphur, which cleanses it of all its filth. The same thing is done for the light blues, and for some other colours; but this operation is seldom made use of but for wool intended for samples or tapestry.

#### *Sulphuring of Wool.*

The Dyers do not do this, because of the stink of the sulphur, or rather to avoid the trouble. Nevertheless, to give an idea of it, the white wool is suspended on hoops or perches in a close room, and under this wool chaffing-dishes are placed with lighted coals, on which powdered sulphur is cast. The room door is afterwards shut, that the smoke may be the longer retained and act on the wool, which is to remain till it is entirely whitened; it is then called sulphured wool; and this is the preparation it must receive to give a brightness to the rose, cherry, and flesh colours, which are made from the dissolution of flocks.

#### *The Theory of the Dissolution of Flock.*

The reason why from an ingredient, such as the root of madder, perishable colours are produced  
from

from dissolved flock, is not difficult to assign. In the first operation of maddering the flock, the red of the madder was fixed in the hair by the preparation of allum and tartar as much as possible, but as it is overloaded with this colour, it is easy to conceive that the superfluous colouring atoms being only applied on those which already filled the pores of this hair, these alone are really retained in the pores, and are cemented by the salts. The hair thus reddened by the madder so as to become almost black, would lose a great deal of the intensity of its colour, if it was boiled in any liquor, was it even common water; but to this water, pearl-ashes are added in equal weight with the flock already dyed, which is to be melted in it; consequently there is a very strong lixivium of fixed alkaline salts made. I have already said in another place, in the foregoing treatise, that very strong alkaline leys destroy the natural texture of almost all animal substances, as also gums and rezins; in short, that an alkaline salt is their dissolvent. In the present operation, the lixivium of the pearl-ashes is very concentrated, and very acrid, and consequently in a state to melt the hair, which is an animal substance, which it does very quickly, and with a strong fermentation, which shews itself by the strong and violent elevation of the liquor; consequently it destroys the natural texture of each of these hairs, and the sides of the pores being at the same time broken and reduced to very minute parts, these sides have neither consistence nor spring to retain the salts, and the colouring particles that were sticking to them. Therefore the animal particles of the hair, the colouring parts of the madder, the saline parts of the liquor, and the alkali of the pearl-ashes, are all confounded together, and form a new mixture, which cannot afford a lasting dye,

dye, because from these saline parts mixed together there cannot be formed a sufficient quantity of salts capable of chrystalization, and producing moleculas, which can resist cold water and the rays of the sun. In short, it could not form a tartar of vitriol, because the alkaline salt is in too great a proportion.

To rouse the deep and overloaded dye of the madder first applied on the flock, and after confounded by the melting of this hair in the mixture already spoken of, putrified urine is added in a considerable quantity; this is a further obstacle to chrystalization; consequently wool not prepared by other salts, and dipped in a liquor thus composed, can only be covered by a superficial colour, which finds no prepared pores, or any thing saline in those pores, which may cement the colouring atoms; therefore such a dye must quit its subject on the least effort of what nature soever it be.

But wool prepared by the liquor of tartar and allum, does not take a more lasting colour, in the liquor of the melted flock, than wool not prepared by these salts; for a liquor which abounds with fixt alkaline salts attacks the tartar left of the preceding preparation in the pores of the wool. This tartar changes its nature, and from being hard to dissolve, as it was before, it becomes a soluble tartar, that is, a salt that dissolves very easily in the coldest water.

It may perhaps be objected, that particles of allum remain in the pores of the prepared wool, that from these particles of allum, as well as from a portion of the same salt which is put into the liquor, reddened by the melting of the flock, the alkali of the pearl-ashes must form a tartar of vitriol, which, according to my principles, ought to secure the dye.

To this I answer, that the urine hinders the combination of these two salts, which is necessary for the formation of the tartar of vitriol; if even this hindrance did not exist, the quantity of this salt, which I have named *hard* in another place, could not be sufficient to cement the colour in the pores of the wool, or put them in a state to retain the colouring atoms. Further, the sharpness of the alkaline salts in this liquor, which is capable of intirely dissolving the hair boiled in it, would equally be able to dissolve the wool, were it boiled as the flock was. But yet, though a degree of heat is not given to the liquor, which would be necessary for this total destruction, it is easily conceived, that if the sum of the destroying action is not the same, at least a part exists, which is still sufficient to corrode the sides of the pores of the wool, to enlarge them greatly, and to render them unfit to retain the colouring atoms; to this may be added, that the hair is melted in the liquor, and consequently mixt with the colouring parts of the madder in a great quantity; that these are heterogeneous parts, which prevent the immediate contact of these same colouring parts, and that from all these obstacles taken together, the colour must be rendered less durable and less holding than any of the lesser dye. This, experience sufficiently proves, for if a skain of red wool, dyed in this manner, be put into boiling water, the colour will be taken off intirely.

## C H A P. III.

*Of the Manner of using ARCHIL.*

**A**RCHIL is a soft paste, of a deep red, which being simply diluted in hot water affords a number of different shades; there are two kinds, the most common, which is not so fine or so good, is generally made in Auvergne, of a lichen or sort of moss, very common on the rocks of that province: it is known under the name of Archil of Auvergne, or Land Archil. The other is a great deal finer and better; it is called the Archil of Herb, or of the Canaries, or Cape Verd Archil; it is prepared in France, England, Holland, and other places.

The workmen who prepare this herb archil, make a secret of the preparation, but the particulars may be found well related in a treatise of M. *Pierre Antoine Micheli*, which bears for title, *Nova Plantarum Genera*, therefore I shall not here give the method of preparing it.

When a Dyer wants to assure himself that the archil will produce a beautiful effect, he must extend a piece of this paste on the back of his hand and let it dry, afterwards washing his hand with cold water. If this spot remains with only a little of its colour discharged, he may judge the archil to be good, and be assured it will succeed.

I shall now give the method of using the prepared archil, but I shall only treat of that of the Canaries, and just mention the difference between it and that of Auvergne. A copper is filled with clear water, and when it begins to be luke-warm, the proper quantity of archil is put in and well stirred: the liquor is afterwards heated almost to boiling, and the wool or stuffs are dipt without any  

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preparation,

preparation, only keeping those longer in that are to be deeper.

When the archil yields no more colour at this degree of heat, the liquor is made to boil to extract the remainder; but if it is archil of Auvergne, the colours drawn after this manner will be sadder than the first, on account of the boiling of the liquor. The Canary archil, on the contrary, will lose nothing of its brightness, if even the liquor boiled from the beginning. This last, though dearer, yields much more dye, so that there is more profit in making use of it, besides its superiority over the other in beauty and goodness of colour. The natural colour which is drawn both from the one and the other archil, is a fine *gris-de-lin*, bordering on the violet. The violet, the pansy, the amaranth, and several like colours are obtained from it, by giving the stuff a ground of blue more or less deep before it is passed through the archil.

It must here be observed, that to have the clear shades of these colours as bright as they ought to be, the wool ought to be sulphured, as was said in the foregoing chapter, either before it is dipped in the archil for the *gris-de-lin*, or before it is dyed blue for the violet and other like colours.

This way of using archil is the simplest, but the colours that proceed from it are not lasting. It may be imagined that the colours would be better by giving a preparation to the wool previous to its being dyed, as is practised in the great dye, when madder, cochineal, weld, &c. are used; but experience shews the contrary, and I have used the archil on wool boiled in allum and tartar, which did not resist the air more than that which had received no preparation.

There is, notwithstanding, a method of using the Canary archil, and giving it almost as much  
duration

duration as the most part of the ingredients of the good dye; but then its natural colour of *gris-de-lin* is taken off, and it acquires a red or scarlet, or rather a colour known under the name of bastard scarlet. The colours of the kermes or Venetian scarlet, and several other shades that border on the red and the orange, may also be drawn from it. These colours are extracted from the archil by the means of acids, and all those that are thus made may be looked upon as much more lasting than the others, though, strictly speaking, they are not of the good dye.

There are two methods of extracting these red colours from the archil. The first is by incorporating some acid in the composition itself that is made use of to reduce this plant to a paste (such as is known to the Dyers under the name of archil). I have been assured that it may be made violet and even blue, which probably is done by the mixture of some alkalis, but I must confess I could not succeed in it, although I made above twenty trials for that purpose. I shall now proceed to the second method of extracting from archil a beautiful and pretty lasting red, and which I executed four times with success.

#### *Bastard Scarlet by Archil.*

Prepared archil from the Canaries is diluted as usual in warm water, and a small quantity of the common composition for scarlet is added, which is, as has been shewn in the preceding treatise, a solution of tin in *aqua-regia*, weakened with water; this acid clears the liquor immediately and gives it a scarlet colour. The wool or stuff is then to be dipped in this liquor, and left till it has received the shade required. If the colour should not have

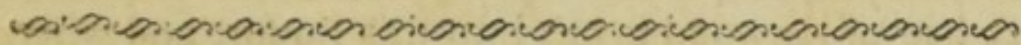
brightness enough, a little more of the composition must be put in, and pretty near the same method must be followed as in the dying of common scarlet: I tried to make it in two liquors as the scarlet, that is, to boil the stuff with the composition, and a small quantity of archil, and afterwards to finish it with a greater quantity of both, and I succeeded equally; but the operation is longer after this manner, and I have sometimes made as fine a colour in one liquor. Thus the Dyer may take his choice of either of these methods.

I cannot exactly fix the quantity of ingredients in this operation. First, As it depends on the shade that is to be given to the stuff. Second, As it is a new process in dying, I have not had sufficient experiments to know with exactness the quantity of archil and composition which ought to be used: the success also depends on the greater or lesser acidity of the composition. In short, this method of dying with archil is so easy, that by making two or three trials in small, more knowledge will be acquired from it than I could teach in a large volume: I must only add, that the more the colour drawn from this ingredient approaches the scarlet, the more lasting it is. I have made a great number of shades from the same archil, and which consequently only differed by the greater or less quantity of the composition, and I always found that the more the archil went from the natural colour, the more lasting it became, so that when I brought it to the shade known by the name of bastard scarlet, it withstood the action of the air and essay proof almost as well as that which is commonly made with cochineal or madder.

If too much composition be put in the liquor, the wool will become of an orange colour, and disagreeable.

disagreeable. The same thing also happens with cochineal, so that this is not an inconvenience peculiar to this dye; besides it is easily avoided by proceeding gradually in the addition of the composition, and by putting a small quantity at first.

I have tried the different acids in this scarlet composition, but none succeeded well; vinegar did not give a sufficient redness to the liquor, and the stuff dyed in it only took a colour of lees of wine, which even was not more lasting in the air than that of the archil in its natural state, and other acids saddened the colour. In short, it appears that (as in scarlet with cochineal) a metallic base extremely white must be united to the red of the archil, and this basis is the calx of tin. I have repeated the same operation with the archil of Auvergne, but the colours were not near so fine or so good.



#### C H A P. IV.

##### *Of* LOGWOOD *or* CAMPEACHY.

**T**HE campeachy wood, known under the name of logwood, is of great use in the lesser dye, and it were to be wished that it was not used in the good dye, for the colour which that wood produces loses its brightness in a short time, and even disappears in some places on being exposed to the air; the low price of this drug in some measure tolerates its use; but the principal reason of using it is, that by the means of different preparations and salts it affords a great number of colours and shades, which are not easily made by the ingredients of the good dye alone. Yet it is possible, as I have said before, to make all these colours without the help

of logwood; therefore it was proper to forbid the use of this ingredient in the good dye.

Logwood is necessary to soften and velvet the blacks; it is this velvet hue that gives that excellency to the Sedan blacks. I shall now add some little matter concerning the other colours in which this wood is used, and I shall observe, that when any wood whatsoever is used in dying, it must be cut into small shavings or chips, and put into a bag, that it may not stick to the wool or stuffs; for the rough chips will not only tear the goods, but blot them in those places to which they stick.

Logwood is used with galls and copperas for all the shades of grey which border on the slate or lavender, the pigeon grey, the lead grey, and such like. To make these, a copper is filled with clear water, and a proper quantity of galls is added; this must be proportioned to the quantity of stuffs to be dyed, and to the depth of the shade required. A bag of logwood is put into this liquor, and when the whole has boiled and cooled, the stuff is dipped in it, adding by little and little some copperas previously dissolved in water. I cannot fix any exact proportion of ingredients, as the Dyers of the lesser dye are not accustomed to weigh them; they work by the eye, and their business being to match low-priced stuffs for linings of cloths for which they have the patterns, they first make them lighter than is wanted, and sadden them by adding copperas till they are come to the shade required. If they find there is not logwood sufficient, they add more; they do the same when they have several stuffs to pass through the same liquor, when they find the wood they have given has yielded all its dye. This work is not difficult, and only requires practice to judge pretty nearly the quantity of ingredients to be used, and to judge by the stuff, while wet, whether,  
when

when dry, it would have the intended colour, which is done by strongly wringing the end, and blowing on it strongly; by this means, the greatest part of the humidity, which has by twisting been brought to the surface of the stuff, is driven off; then for an instant the colour is seen pretty nearly such as it will be when dry; but this must be done by a quick eye, for in a moment after the adjacent moisture is communicated to this dry place, and then you may be deceived.

A pretty fine violet is also made with logwood, by first boiling the wool as usual with allum and tartar, and afterwards passing it through a liquor of logwood in which a little allum is dissolved. But it is made much finer by bluing and alluming the stuff first, then dipping it in a liquor of Brazil mixt with a little logwood; this violet, though of the lesser dye, is much better than the former, because the blue ground always sustains the colour, and makes it more holding.

The logwood also affords a blue colour, but it lasts so ill that this wood is seldom used for dying blue. Yet if from curiosity you wish to make a trial, you need only prepare a liquor with logwood, and mix a little cyprus or blue vitriol in it, and dip the stuffs in this without any other preparation, and you have a fine blue.

By the same means, green may be made in the same liquor. For this purpose, logwood, French berries or grains of Avignon and verdigrise are put into a copper; this mixture gives the liquor a beautiful green colour; the wool may be then dipt to the height desired, and may be of any desired shade, by putting in more or less of the logwood and Avignon grains. But this colour is not better than the blue, and both ought to be excluded the art of dying: I have given the process, merely that  
I might

I might omit nothing which came to my knowledge concerning the art.

The use to which logwood is most commonly applied in the lesser dye is for plumb, prune colours, purples and their shades.

This wood joined with galls, readily gives all its colours to wool that has had a ground of blue; it is faddened with a little green copperas, which browns them, and by this means some shades may be easily obtained which are much more difficult to hit in the great dye, as the different degrees of faddening are much more difficult to match in a blue vat, than by the help of the iron of the copperas. But these colours fade away very soon in the air, and in a few days a great difference is seen between the parts that were exposed to the air and those that were covered.

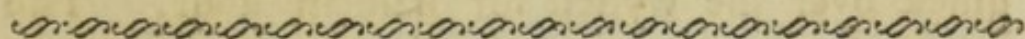
Having experienced, as I said in the preceding chapter, that the scarlet composition changed the colour of the archil, and made it more lasting, I tried what effect it might produce on the logwood; but what appeared singular to me was, that whatsoever quantity of composition I put into this liquor, it never lost its violet colour. Being desirous to put this to a further trial, I dyed a piece of cloth with logwood, and put into the liquor a quantity of composition, pretty nearly equal to that which I would have put for an equal dose of archil: the cloth took a pretty good violet colour. This cloth was put in the weather for twelve summer days, and the colour proved no better than if no composition had been used. By adding a small quantity of chrystals of tartar to another liquor composed as the former, I had a more lasting colour, but considerably different.

*The*

*The Raven Grey.*

The raven grey on worsted or stuffs is performed in the following manner.

In a copper sufficiently large for sixty pound weight, dissolve eight ounces of allum, and work the worsted on sticks very quick for the space of half an hour at a boiling heat; then take it up, and add to the same liquor three or four pounds of copperas, and work it at a boiling heat for half an hour longer; while this is performing, the worsted must be washed, and one pail full of logwood chips must be boiled in another copper about twenty minutes; the worsted must then be turned very quick in the logwood decoction about half an hour, when it must be taken out, and returned about ten or fifteen minutes in the decoction of allum and copperas, as at first. This last operation is absolutely necessary, as it contributes much to the beauty and lustre of the colour, by discharging the gross particles of the logwood, and leaves a beautiful raven grey. This process will hold good for thin goods and coarse cloth, but a less proportion of logwood will do.



## C H A P. V.

*Of SAXON BLUE and GREEN.*

**I** Place here among the lesser dyes that called Saxon blue and green, which has been for some time greatly in fashion, being finer and brighter than any blue or green hitherto known either in the greater or lesser dye, but it bears no proof, and  
in

in twelve days exposition to the sun, it loses a great part of its colour.

*Blue on Cloth, Stuff, or Yarn.*

Put into a glazed earthen pot four pounds of good oil of vitriol, with twelve ounces of choice indigo very finely ground and sifted; stir this chymical mixture very hastily and frequently in order to excite a fermentation, and break the lumps with a stick whose bark has been stript off. It is customary with some Dyers to put into this composition a little antimony or salt petre, tartar, chalk, allum, or 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 twenty-four 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 chymic mixed well with water in a piggin is put in according to the shade required, having first put in a handful of powdered tartar; the cloth, &c. is to be well wet, and worked very quick over the wynch for half an hour. The liquor must not be made hotter than that for madder red. Observe, the hot acid of the vitriol would cause the blue to incline to green if too much heat was given. The cloth, stuff, or yarn must be turned in this liquor very quick for half an hour, and having been previously very well scoured, the colour will be brilliant and fine; it is best after washing to dry this colour in the shade.

*Chymic*

*Chymic for Green.*

Eight ounces of indigo is sufficient for four pounds of oil for green, because this mixture works green (and would even dye a pea-green if used very hot) and therefore would not do for blue. The indigo is better suspended in this mixture than in the former, and is supposed to go further in green. The goods being well scoured are to be allumed; for every twenty pound weight, two pounds of allum is to be put into a copper with fair water, and the goods boiled gently an hour and a half; whilst this is performing, another copper is got ready, in which fustick chips are put to boil; if there are any to dye pea-green it is best to dye them first, not as practised in some dye-houses, for this great reason, that when several parcels of goods have been through the same liquor, there remains a scurf which the acid extracts, and that is sure to stick to the next parcel that goes in; and if pea-green was the last, the colour would be dulled thereby. The greens (pea-green excepted) are to be turned about ten minutes in the allum liquor after they are dyed, in order to clear them of the stuff, and render the colour brighter. The allum liquor is not to be hotter than that the hand may be borne in. Observe, if the allum was put in (as is customary in some dye-houses) with the fustick, it would retard its working so well; for allum, being an acid, would discharge if used with, as well as prepare for fustick.

The reader will perhaps think me too tedious in this process, and say (because he is not used to this method) it is a superfluous work; but be assured that the time lost in the process will be saved in the fustick, if attention is paid.

## C H A P. VI.

*Of BRAZIL WOOD.*

**U**NDER the general name of Brazil wood is comprehended that of Fernambouc, St. Martha, Japan, and some others which I shall not here distinguish, since they are all used after the same manner for dying. Some give greater variety of colours than others, or finer; but this often proceeds from the parts of the wood being more or less exposed to the air, or that some parts of it may be rotted. The soundest or highest in colour are to be chosen for dying.

All those woods give a tolerable good colour, either used alone, mixt with logwood, or with other colouring ingredients. It has been shewn that, in the false or bastard violet, a little Brazil was added to the logwood; but in the vinous greys, or those which have a cast of the red, a great deal more is used. Sometimes only, a small quantity of galls is put with the Brazil, and it is saddened with copperas; often also logwood, archil, or some other ingredient, is added, according to the shade, from whence it is not possible to give any fixt rule for this kind of work, on account of the infinite variety of shades which are obtained from these different mixtures.

The natural colour of the Brazil, and for which it is most used, is the false scarlet, which appears fine and bright, but far inferior to the brightness of the cochineal or gum lacque.

To extract the colour from this wood, the hardest water, such as will not dissolve soap, must be made use of, for river water has not nearly so good an effect; it must be cut into chips and  
boiled

boiled for three hours; the water is then taken out and put into a large vessel, and fresh well water put on the wood and boiled again for three hours; this water is added to the first.

This liquor, which is called juice of Brazil, must be old and fermented, and rope like an oily wine before it is fit for use. To extract a bright red from it, the stuff must be filled with the salts of the common liquor of preparation, but the allum must predominate, for the tartar alone, and also four water, greatly spoils the beauty of this colour: in short, acids are hurtful to it, and dissolve its red colouring part. Four ounces of allum for each pound of stuff is to be added to the liquor, and only two ounces of tartar, or even less. The wool is to be boiled in it for three hours; it is then taken out and gently wrung, and thus kept moist for eight days at least, that by the salts being retained it may be sufficiently prepared to receive the dye. To dye with this, one or two pails full of the old juice of Brazil is put into a convenient copper, and well scummed. Dip the stuff which has remained eight or ten days moistened in the preparing liquor, and it must be well worked in it without making the liquor boil too strongly, until it be smoothly and equally dyed. Care must be taken to wring a corner of this stuff now and then, as I have already said, to judge of its colour, for, whilst wet, it appears at least three shades deeper than when dry. By this method, which is somewhat tedious, very bright reds are made, perfectly imitating certain colours the English sell under the name of Campeachy scarlets, which, by the proof of dyes, are not found to be better than this, only that they seem to have been lightly maddered.

This red, of which I have given the process, and which is no where else described, withstands

the weather three or four months in the winter, without losing any of its shade; on the contrary, it faddens, and seems to acquire a ground, but it does not stand the proof of tartar.

Some Dyers of the great dye use Brazil to heighten the red of madder, either to save this root, or make its red more bright than usual. This is done by dipping in a Brazil liquor a stuff, begun with the madder, but this kind of fraudulent dye is expressly forbid by the French regulations, as well as any mixture of the great dye with the lesser, because it can only serve to cheat, and to pass for a fine madder red, a colour which in a few days loses all its brightness along with the shade, which has been drawn from the Brazil, prepared in the common manner.

The first colour extracted from this wood is not of a good dye, probably because it is an indigested sap, and whose colouring particles have not been sufficiently attenuated to be retained and sufficiently fixt in the pores of the wool dyed in it. When these first gross parts of the colour have been carried off, those that remain in small quantity are finer, and mixing themselves to the yellow parts, which are furnished by the pure woody parts, the red resulting from it is more lasting.

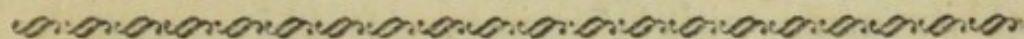
By the means of acids, of what kind soever, all the red colour of this wood is carried off or disappears; then the stuff that is dyed by it takes a hind colour, more or less deep in proportion to the time it is kept in the liquor, and this colour is of a very good dye.

It is said that the Dyers of Amboise have a method of binding the Brazil colour in this manner; after their stuffs lightly maddered have been passed through a liquor of weld, and consequently boiled twice in allum and tartar, they put arsenic  
and

and pearl-shes in the juice of Brazil, and it is asserted that this colour then resists the proofs; I tried this process, but it did not succeed.

When a very bright red is required from the Brazil, I know by experience that it is possible to insure the colour drawn from it after such a manner that, having exposed it thirty days to the rays of the summer's sun, it will not change; but these kind of colours are coffee and chesnut purples.

To make these, I keep the stuff moistened in its liquor in a cellar for fifteen days; this liquor is prepared as for the reds, of which I have heretofore spoken; I fill a copper to two-thirds with well water, and the remaining third up with Brazil juice, to which I add about one ounce of Aleppo galls in very fine powder to every pound of stuff, and then boil it one or two hours, as I want the shade to be in deepness: the stuff is aired from time to time, and when it has taken the colour desired, it is well cooled before it is washed. This stuff being brushed, the nap layed, and cold-pressed, comes out very fine and very smooth.



## C H A P. VII.

### *Of* F U S T I C.

**T**HE fustic gives an orange colour that is not lasting; it is commonly used in the lesser dye, like the roots or husks of walnuts, without boiling the stuff, so that it is easily managed. It is often mixt with walnut husks and weld, to make tobacco and cinnamon colours, and other like shades. But this wood is a very bad ingredient, for its colour being exposed to the air for a very

short time loses all its brightness and the greatest part of its yellow shade.

If a stuff dyed with fustic is dipt in the woad vat, a disagreeable olive ensues, which does not resist the air, but soon loses its colour.

I have already said that fustic was made use of in Languedoc for making of lobster colours for foreign markets, as it greatly saves cochineal. For this purpose they mix weld, fustic, and cochineal, with a little cream of tartar, in the same liquor, and the stuff boiled in this liquor comes out of a lobster colour, and accordingly, to the quantity of these different ingredients, it becomes more or less red, tending to the orange. Although the method of mixing together ingredients of the good with those of the lesser dye ought to be condemned, yet in this case, and for this colour only, which is in considerable demand in the Mediterranean, it appears that the fustic may be tolerated; for having attempted to make the same colour, with only the ingredients of the good dye, I did not get a more lasting colour.

The change which the air produces in the lobster colour made with fustic is very sensible, but it is not so disagreeable as the changes incident to several other colours; for all the shade goes off and weakens at once, so that it is rather a diminution than a change of colour; whereas the lobster colour made with the yellow wood becomes of a cherry colour.

C H A P.

## C H A P. VIII.

*Of R O U C O U.*

**T**HE roucou or racourt is a kind of dry paste brought from America; this ingredient gives an orange colour pretty near the same as the fustic, and the dye is not more lasting. However it is not by the proof allum that the quality of the roucou is to be judged, for this does not in the least alter its colour; on the contrary, it becomes finer and brighter, but the air carries it off, and effaces it in a short time; soap has the same effect, and it is by this it must be tried according to the instructions on these kind of proofs. The place of this ingredient is easily supplied in the good dye by weld and madder mixt together, but roucou is made use of in the lesser dye after the following manner.

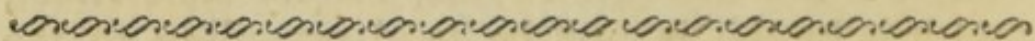
Pearl-ashes are dissolved in a copper with a sufficient quantity of water; it is well boiled for one hour that the ashes may be totally dissolved; then as many pounds of roucou as there are of ashes, are added; the liquor is well raked and suffered to boil for a quarter of an hour; the wool or stuffs that are to be dyed are then dipt without any preparation, except dipping them in luke-warm water, that the colour may spread itself equally.

They are left in this liquor, working them continually until they are come to the desired shade, after which they are washed and dried.

The roucou is often mixt with other ingredients of the lesser dye, but I cannot give any instructions on these mixtures, as they depend on the shades you wish to make, and are in themselves attended with no difficulty.

I have boiled the stuff in allum and tartar before I dyed it with roucou, but though the colour was more lasting, it was not sufficiently so to be deemed of the good dye. On the whole, the roucou is a very bad ingredient for dying of wool, and is not made much use of, for it is dear, and other ingredients, that are cheaper and hold better, are used in its stead.

Wool dyed with roucou, and afterwards dipt in the indigo or woad vat, takes a reddish olive, which in a very short time becomes almost blue in the air, the colour given by the roucou disappearing.



## C H A P. IX.

### *Of the* GRAINS *of* AVIGNON.

**T**HE grains of Avignon are but little used in dying, they give a pretty good yellow, but not lasting, no more than the green, produced by dipping in the same liquor a stuff that has a ground of blue. To work it, the stuff must be boiled in allum and tartar as for weld. Then a fresh liquor is made with these grains, and the stuff is dipt, and must lie in it longer or shorter, according to the shade that is wanted. There is no difficulty in working of it, so I need only observe that it ought never to be used but when all other ingredients for dying yellow are wanting; this must seldom happen, as they are neither scarce nor dear.

C H A P.

## C H A P. X.

## Of TURMERIC.

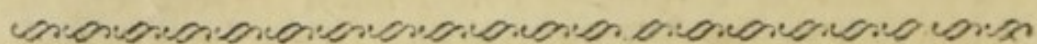
**T**HE turmeric is a root that is brought from the East-Indies; that which comes from Patna is most valued. The Indian Dyers call it *baleli*; it is also called *concome* in the regulations of M. Colbert. It is reduced to a very fine powder, and used pretty near the same way as the grain of Avignon, but in much less quantity, on account of its yielding a great deal of dye. It is somewhat better than the other yellow ingredients spoken of in the preceding chapter, but, as it is dear, it is a sufficient reason for seldom or never using it in the lesser dye.

It is sometimes used in the great dye to gild the yellows made with weld, and to brighten and orange the scarlets; but this practice is to be condemned; for the air carries off all the colour of the turmeric in a short time, so that the gilded yellows return to their first state, and the scarlets brown considerably; when this happens to these sort of colours, it may be looked on as certain that they have been falsified with this ingredient, which is not lasting.

I omit speaking of saffron, which may also be made use of to dye yellow, but which I believe is not used; first, on account of its being dear; and secondly, because its yellow is still worse than those of the two preceding ingredients.

This is all that remains for me to say on the ingredients of the lesser dye, they are only to be used for common and low-priced stuffs. It is not that I think it impossible to extract lasting colours from them, but then those colours will not strictly  
be

be the same which these ingredients yield naturally, or by the ordinary methods, as that gum and astringent which is wanting in them must be added, and then they are no more of the same quality; consequently the rays of light will be differently reflected, and the colour will be different.



## C H A P. XI.

*Of SILVER GREY.*

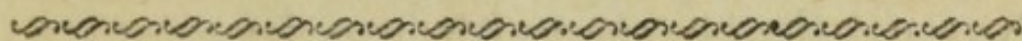
**F**OR pearl colour or silver grey, to dye forty pounds of woollen cloth or worsted, boil in a small copper four pounds of logwood chips for half an hour, add to it six ounces of pearl-ashes, and mix them well together; while this is performing, (having the worsted well scoured and parcelled in hanks on the dye-sticks) heat a great copper with clean water, and put one peck of wheat bran in a bag into the copper; let it remain with often stirring about an hour; when the water begins to boil, put in three ounces of allum, which will throw the filth of the water to the top, when it must be taken off with the bowl; wash the worsted in this liquor about forty minutes, when it must be taken up, and three or four pails of the logwood liquor added to the allum water. The goods must then be worked very quick for forty minutes, when you may add more logwood liquor if you see occasion. Great care must be taken after washing to dry this colour in the shade, or it will perhaps change.

Some dye this colour in one liquor and boil the logwood in a bag. This process is less tedious, but I prefer the former. It will be well for the Dyer to take notice, that if too great a quantity of  
allum

allum or ashes are used herein, the colour will be imperfect; for the allum, if used in a right proportion, gives that bloom to the goods which is necessary for a pearl; if too much, the contrary would happen. The ashes also, if used in too great quantity, would make the colour too red; this may seem a contradiction, because the ashes are an alkali, but practice will teach the truth.

*Another excellent Silver Dye.*

For twenty pounds weight of cloth or worsted, eight ounces of allum and twelve pounds of fenu-greek must boil with the goods half an hour; then take it up, and add one pound of pearl-ashes and eight ounces of Brazil wood; boil them gently with the goods half an hour; rinse it and you have a beautiful colour.



I N S T R U C T I O N S

ON THE PROOF OF

DYED WOOL *and* WOOLLEN STUFFS.

**A**S it has been found that the methods prescribed for the proof of dyes, by the thirty-seventh article of the French regulations for the Dyers in the good dye, of cloth, serges, and other woollen stuffs made in 1669, and by article 220 of the general instructions for the dying of wool of all colours, and for the culture of drugs and ingredients therein used made in 1671, were insufficient for an exact judgment of the goodness or falsity of several colours, that they might sometimes lead into error, and leave room for disputes, different experiments have been made by the French king's order

order on wool designed for the manufacture of tapestry, to ascertain the degree of goodness of each colour, and the most convincing proofs of each.

For this purpose, fine wool was dyed in different colours both in the great and lesser dye, and exposed to the air and sun during a proper time; the good colours kept themselves perfectly, and the false ones were carried off more or less according to their bad quality; and as a colour is only to be accounted good inasmuch as it resists the action of the air and sun, this proof served as a rule to decide the goodness of different colours.

After this, several proofs were made on the same wool whose patterns had been exposed to the air and sun, and it was immediately found that the same trials could not be indifferently used in proving of all colours; for it often happened that one colour, known to be good by exposition to the air, was considerably changed by the essay proof, and that a false colour stood the same proof.

These experiments exploded lemon juice, vinegar, sour waters, and strong waters, as it was impossible to ascertain the degree of acidity of these liquors; and it appeared that the surest method is to use ingredients with common water, whose effects are always equal.

In following this plan, it has been judged necessary to divide into three classes all the colours in which wool is dyed, either in the great or lesser dye, and to fix the ingredients that are to be made use of in the essay proofs of the colours, comprehended in each of these three classes.

The colours comprehended in the first class are to undergo the proof of Roman allum, those of the second with white soap, and those of the third with red tartar.

But

But it is not sufficient to be assured of the goodness of a colour by using in the proof ingredients whose effect may always be equal; it is also necessary, that not only the duration of this trial be exactly determined, but even the quantity of water fixed; for the proportion of water considerably augments or diminishes the activity of the ingredients which are put into it. The method of proceeding in these different proofs shall be set forth in the following articles:

## ARTICLE I.

*The Proof of Roman Allum must be made as follows:*

One pound of water and half an ounce of allum are to be put in an earthen vessel or pan. The vessel is to be placed on the fire, and when the water boils strongly, the wool is put in and left to boil for five minutes, after which it is to be taken out and washed in cold water; the weight of the pattern of wool must be a drachm or thereabouts.

## II.

When several patterns are to undergo the proof together, the quantity of water and allum is to be doubled, or even trippled, which will no ways change the strength or effect of the proof, if you observe the same proportion of water and allum, so that for each pound of water there may be one ounce of allum.

## III.

To render the effect of the proof more certain, care must be taken not to try together wool of different colours.

## IV.

## IV.

*The Proof with White Soap is to be made after the following Manner:*

To one pound of water add two drachms of white soap, and place the vessel on the fire; stir it with a stick that the soap may be thoroughly dissolved; when it is so, and the water boils strongly, the woollen pattern is put in, which is to boil for five minutes.

## V.

When several patterns are to undergo this proof, the same method is to be observed as in the second article, that is, to put to each pound of water two drachms of soap.

## VI.

The proof with red tartar must be exactly the same, with the same proportions as the proof with allum, taking care that the tartar is finely powdered and well dissolved in the water before the pattern is put in.

## VII.

The following colours are to be proved with Roman allum, viz. crimson of all shades, Venetian scarlet, flame colour or common scarlet, cherry colour and other shades of scarlet, violets and *gris-de-lin* of all shades, purples, lobster, pomegranate, slate greys, lavender greys, violet greys, vinous greys, and all other like shades.

## VIII.

If, contrary to the orders of the regulations on dying, any ingredients of the false dye have been  
made

made use of for fine wool dyed in crimson, the cheat will be easily found out by the proof of allum, for it changes the fine crimson a little on the violet, that is, makes it border a little on the *gris-de-lin*, but it destroys the highest shades of the bastard crimson; thus this proof is a sure method to distinguish false crimson from fine.

## IX.

Scarlet of kermes or grain, commonly called Venetian scarlet, is no ways prejudiced by this proof; it raises the fire-colour scarlet to a purple, and gives a violet colour to the lighter shades, so that they border on the *gris-de-lin*, but it carries off the greatest part of the false Brazil scarlet, and brings it to an onion-peel colour; it has yet a more sensible effect on the lighter shades of this false colour.

The same proof carries off almost entirely the scarlet of flock and its shade.

## X.

Though the violet is not a simple colour, but formed of blue and red shades, it is nevertheless of so much consequence as to merit a particular enquiry.

The same proof with Roman allum has scarcely any effect on the fine violet, whereas it considerably alters the false; but it must be observed, that it does not always equally carry off a great part of the shade of the false violet, because this colour has sometimes a ground of woad or indigo; now this ground being of the good dye, is not carried off by the proof, but the redness goes off, and the brown shades become almost blue, and the pale ones of the colour of lees of wine.

## XI.

With regard to half fine violets, forbidden by the present regulations, they must be ranked in the class of false violets, and do not stand the proof.

## XII.

The fine *gris-de-lin* may be known from the false by the same method, the difference is but trifling; the *gris-de-lin* of the good dye loses a little less than that of the false.

## XIII.

Fine purples intirely resist the proof with allum, whereas the false intirely lose the greatest part of their colour.

## XIV.

Lobster colours and pomegranate strike on the purple after the proof, if they have been made with cochineal, whereas they will pale greatly if fustic has been used; the use of which is prohibited.

## XV.

Blues of the good dye will lose nothing in the proof, whether of woad or indigo; but those of the lesser dye will lose the greatest part of their colour.

## XVI.

The slate greys, lavender greys, violet greys, and vinous greys, lose almost all their colour if they are of the false dye; whereas they perfectly maintain it, if of the good.

## XVII.

## XVII.

The proofs of the following colours are to be made with white soap; yellow, jonquille or lemon colour, orange, and all the shades of yellow; all green shades from the yellow green or light green, to the cabbage or parrot green, the reds of madder, cinnamon, tobacco, and such like.

## XVIII.

This proof perfectly shews if the yellows and other shades derived from it are of a good or false dye; for it carries off the greatest part of their colour if they have been made with grains of Avignon, roucou, turmeric, fustic, or saffron, whose use is prohibited for fine dyes, but it no ways impairs the yellows made with savory, Dyers wood, yellow wood, weld, or fenugreek.

## XIX.

The same proof will also shew the goodness of greens, as those of the false dye lose most of their colour, or become blue if they have a ground of woad or indigo; whereas those of the good dye lose almost nothing of their shade, but remain green.

## XX.

The reds of pure madder lose nothing by the soap proof, on the contrary become finer, but if Brazil wood has been used, they lose their colour in proportion to the quantity of it in the composition of the dye.

## XXI.

Cinnamon, snuff colours, and others of this cast, are scarcely altered by this proof, if of the

good dye, but they lose considerably if roucou, fustic, or dissolved flock has been made use of.

## XXII.

The proof of allum would be of no use, and might even lead us into errors with regard to several colours belonging to this second class, for it no ways alters the fustic nor the roucou, which nevertheless do not withstand the action of the air; on the other hand, it carries off a great part of the savory and of the Dyers wood, which are very good yellows and greens.

## XXIII.

All the brown or root colours should undergo the proof with red tartar. The Dyers call by this name all colours that are not derived from the five primary colours; they are made with rinds and roots of walnut, alder-bark, sumach or roudoul, fantal and foot; each of these ingredients gives a great variety of shades, which are all comprehended under the general name of brown or root colour.

## XXIV.

The above-named ingredients in the preceding article are good, except the fantal and foot, which are not quite so good, and make the wool stiff when too great a quantity is used, so that all this proof can shew on these kind of colours, is, whether too much fantal or foot has been put into them; in this case they lose considerably by the proof with tartar; but if made with other ingredients, with only a moderate quantity of fantal or foot, they stand a great deal better.

## XXV.

## XXV.

Black is the only colour which cannot be comprehended in any of the three classes above-mentioned, and a much more active proof must be made use of. To know if the wool has had a deep ground of blue, conformable to the regulations, the proof is to be made in the following manner: take a pint or pound of water, one ounce of tartar, and the same quantity of Roman allum well powdered; boil it, and then put in the pattern; let it boil strongly for a quarter of an hour, and afterwards wash it in cold water; you will then easily know if it has had the proper blue ground, for if so, the wool will remain of a dark blue almost black; if not, it will turn very grey.

## XXVI.

It is common to brown certain colours with galls and copperas; this operation is called browning, which is to be permitted in the good dye; but as this may cause a particular effect in proving of these colours, it is to be observed that although the proof liquor appears loaded with dye as the browning is carried off, the wool must be reputed of a good dye if it still preserves its ground; if on the contrary it loses it, it is then deemed to be of the false dye.

## XXVII.

Although the browning, which is made of galls and copperas, if of the good dye, yet, as it hardens the wool, it is better to make use of the indigo or woad vat in preference.

## XXVIII.

Common greys made with galls and copperas are not to undergo any of these proofs, because these colours are of the good dye, and are not otherways made; but it is to be observed, that they are first to be passed thro' the liquor of galls, and afterwards thro' a second liquor, containing the copperas, which must be much cooler than the first, for by this method they are made finer and more lasting.

THE



THE  
DYER'S ASSISTANT.

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PART III.

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ADDITIONAL ARTICLES.

CHAP. I.

*Of* FLOWERS.

**A**MONG the infinite variety of colours which glow in the flowers of plants, there are very few which have any durability, or whose fugitive beauty can be arrested by art, so as to be applied to any valuable purposes. The only permanent ones are the yellow. The red, the blue, and all the intermediate shades of purples, crimsons, violets, &c. are extremely perishable. Many of these flowers lose their colour on being barely dried; especially if they are dried slowly, as has been usually directed, in a shady and not warm place. The colours of all of them perish, on keeping, even in the closest vessels. The more hastily they are dried, and the more perfectly they are secured from  
from

from the air, the longer they retain their beauty. The colouring matter, extracted and applied on certain bodies, is still more perishable: oftentimes it is changed or destroyed in the hands of the operator.

### *Of Blue Flowers.*

The colour of many blue flowers is extracted by infusion in water, but there are some from which water gains only a reddish or a purplish hue. Of those that have been tried, there is not one which gives any blue tincture to spirituous liquors: some give no colour at all, and some a reddish one. The juice prest out from the fresh flowers is for the most part blue.

The blue juices and infusions are changed red by all acids; the marine acid seems to strike the most florid red. The flowers themselves, macerated in acid liquors, impart also a deep red tincture. Alkalis, both fixt and volatile, and lime water, change them to a green. Those infusions or juices, which have nothing of the native colour of the flower, suffer the same changes from the addition of acid and alkaline liquors; even when the flowers have been kept till their colour is lost, infusions made from them acquire still a red colour from the one, and a green from the other, though in a less degree than when the flowers were fresh.

The red colour produced by acids is scarcely more durable than the original blue; applied upon other bodies, and exposed to the air, it gradually degenerates into a faint purplish, and at length disappears, leaving hardly any stain behind. The green produced by alkalis changes to a yellow, which does not fade so soon. The green by lime water is more permanent and more beautiful.

Green

Green lakes, prepared from these flowers by lime water, have been used as pigments by the painter.

The flowers of cyanus have been greatly recommended, as affording elegant and durable blue pigments; but I have never been able to extract from them any blue colour at all. They retain their colour indeed, when hastily dried, longer than some other blue flowers, but they communicate nothing of it to any kind of menstruum. Infusions of them in watery, spirituous, and oily liquors, are all more or less of a reddish cast, without any tendency to blue. Allum, which is said to heighten and preserve their blue colour, changes it like that of other blue flowers, to a purplish red; acids to a deep red; alkalis and lime water to a green.

Solution of tin, added to the watery infusion, turns it to a fine crimson; on standing, a beautiful red fecula subsides, but it loses all its colour by the time it is dry. The watery infusion, inspissated to the consistence of an extract made with rectified spirit, is of a purplish colour. The colour of both extracts, spread thin and exposed to the air, quickly fades.

The flowers employed in these experiments were those of the common blue bottle of the corn-fields; *cyanus segetum* C. B. *centaurea calycibus ferratis; foliolis linearibus integerrimis; infimis dentatis* linn. *spec.*

#### *Red Flowers.*

Red flowers readily communicate their own red colour to watery menstrua; among those that have been tried there is not one exception. Those of a full red colour, give to rectified spirit also a deep red tincture, brighter, though somewhat paler than the watery infusion; but the lighter red flowers,  
and

and those that have a tendency to purplish, impart very little colour to spirit, and seem to partake more of the nature of the blue flowers than of the pure red.

Infusions of red flowers are supposed to be heightened by acids, and turned green by alkalis, like those of the blue; but this is far from being universal. Among those I have examined, the rose colours and purplish reds were all changed nearly in the same manner as the blues, but the full deep reds were not. The deep infusion of red poppies is turned by alkalis, not to a green but to a dusky purple.

#### *Yellow Flowers.*

The colours of yellow flowers, whether pale or deep, are in general durable. Many of them are as much so perhaps as any of the native colours of vegetables. The colour is extracted both by water and by spirit; the watery infusions are the deepest. Neither acids nor alkalis alter the species of colour, though both of them vary its shades; acids rendering it paler, and alkalis deeper: allum likewise considerably heightens it, though not so much as alkalis.

Wool or silk, impregnated with a solution of allum and tartar, receives, on being boiled with the watery infusion, or decoction, a durable yellow dye, more or less deep according as the liquor is more or less saturated with the colouring matter.

An infusion of the flowers made in alkaline ley, precipitated by allum, gives a durable yellow lake. Some of these flowers, particularly those of the chrysanthemum, or corn-marigold, appear (from the *Ars Tinctora Fundamental*, published by Stahl) to be made use of by the German Dyers.

In

In some of the deep reddish yellow, or orange-coloured flowers, the yellow matter seems to be of the same kind with that of the pure yellow flowers, but the red to be of a different kind from the pure red ones: watery menstrua take up only the yellow and leave the red, which may afterwards be extracted by rectified spirit of wine, or by water actuated with fixed alkaline salt. Such particularly are the saffron-coloured flowers of carthamus. These, after the yellow matter has been extracted by water, are said to give a red tincture to ley; from which, on standing at rest for some time, a deep bright red fecula subsides, called, from one of the names of the plant which produces it, safflower, and from the countries whence it is commonly brought to us, Spanish red, and China lake; this pigment impregnates spirits of wine with a beautiful red tincture, but communicates no colour to water.

I have endeavoured to separate by the same treatment, the red matter of some of the other reddish yellow flowers, as those of the garden marigold, but without success. Plain water extracted a yellow colour, and alkaline ley extracted afterwards only a paler yellow; though the digestions were continued till the flowers had lost their colour, the tinctures were no other than yellow, and not so deep as those obtained from the pure yellow flowers.

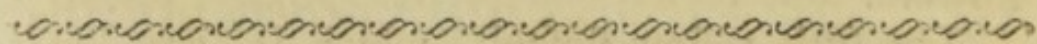
The little yellow flosculi, which in some kinds of flowers are collected into a compact round disc, as in the daisy and corn-marigold, agree so far as they have been examined with the expanded yellow petala. Their colour is affected in the same manner by acids, by alkalis, and by allum, and equally extracted by water and by spirit.

But

But the yellow farina or fine dust lodged on the tips of the stamina of flowers, appears to be of a different kind. It gives a fine bright yellow to spirit, and a duller yellow to water; the undissolved part proving, in both cases, of a pale yellowish white. Both the watery and spirituous tinctures were brightened by alkaline liquors, turned red by acids, and again a deep yellow on adding more of the alkali. I know no other vegetable yellow that is changed red by acids.

### *White Flowers.*

White flowers are by no means destitute of colouring matter. Alkaline lixivium extract from some of them a green tincture, and change their colourless expressed juices to the same colour. But I have not observed that they are turned red by acids. The flowers of the common wild convolvulus or bind-weed, which in all their parts are white, give a deep yellow or orange tincture to plain water, which, like the tinctures of flowers which are naturally of that colour, is rendered paler by acids, heightened a little by allum, and more considerably by alkaline salts. The vapours of the volatile vitriolic acid, or of burning sulphur, which whiten or destroy the colour of the coloured flowers, make no change in the white.



## C H A P. II.

### *Of FRUITS.*

**T**HE red juices of fruits, as red currants, mulberries, elder berries, and Morello and black cherries, &c. gently inspissated to dryness, dissolve

dissolve again almost totally in water, and appear nearly of the same red colour as at first. Rectified spirit extracts the tinging particles, leaving a considerable portion of mucilaginous matter undissolved: and hence the spirituous tincture proves of a brighter colour than the watery. The red solutions and the juices themselves are sometimes made dull, and sometimes more florid, by acids, and generally turned purplish by alkalis.

The colours of these juices are for the most part perishable. They resist indeed the power of fermentation, and continue almost unchanged after the liquor has been converted into wine. But when the juice is spread thinly on other bodies, exsiccated, and exposed to the air, the colour quickly alters and decays: the bright lively reds change the soonest. The dark, dull red stain from the juice of the black-cherry, is of considerable durability. The fruit of the American opuntia, or prickly pear, the plant upon which the cochineal insect is produced, is perhaps an exception: this bright red fruit, according to *Labat*, gives a beautiful red dye. Some experiments, however, made upon the juice of that fruit, as brought into England, did not seem to promise any great advantage from it; but the particulars I cannot now recollect.

The ripe berries of buckthorn stain paper of a green colour. From these is prepared the substance called sap-green, a pigment sufficiently durable, readily soluble in water, but not miscible with oil. The berries dried whilst green, and macerated in allum-water, are said to yield a yellow pigment; and when they have grown over-ripe, so as to fall off spontaneously, a purple one. Woollen cloth, prepared with allum and tartar, receives, on being boiled with the berries, a perishable yellow dye. The French berries, or grained Avignon of the

French Dyers, one of the most false, that is, the most perishable of the yellow dyes, is the berry of a species of buckthorn smaller than that which grows wild among us.

It is said that the berry of the *Heliotropium tricoccum*, which grows wild about *Montpelier*, stains paper of a green colour, and that this green turns presently to a blue: that the common blue paper receives its colour from this juice: and that the red rags, called *turnsol*, employed for colouring wines and other liquors, are tinged by the same juice, turned red by acids. According to M. *Niffolle* of the French academy of sciences (as quoted by Savary in his *Dictionnaire de Commerce*) the colouring juice is obtained, not from the berries, but from the tops of the plant, gathered in August, ground in mills, and then committed to the press. The juice is exposed to the sun about an hour, the rags dipped in it, dried in the sun, moistened by the vapour which arises during the slacking of quick-lime with urine, then dried again in the sun, and dipped again in the juice. The Dutch and others are said to prepare *turnsol* rags, and *turnsol* in the mass, from different ingredients, among which archil is a principal one.

In some plants, peony for instance, the seeds at a certain point of maturity are covered with a fine shining red membrane: the pellicles of the seeds of a certain American tree afford the red masses brought into Europe under the names of *annotto*, *orlean*, and *roucou*. The red seeds, cleared from the pods, are steeped in water for seven or eight days or longer, till the liquor begins to ferment; then strongly stirred, and stamped with wooden paddles and beaters, to promote the separation of the red skins: this process is repeated several times till the seeds are left white. The liquor passed through

through close cane sieves is pretty thick, of a deep red colour, and a very ill smell. In boiling it throws up its colouring matter to the surface in form of scum, which is afterwards boiled down by itself to a due consistence, and made up, while soft, into balls.

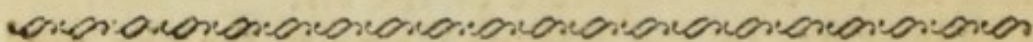
The annotto commonly met with among us, is moderately hard and dry, of a brown colour on the outside, and a dull red within. It is with difficulty acted on by water, and tinges the liquor only of a pale brownish yellow colour. In rectified spirit of wine it readily dissolves, and communicates a high orange or yellowish red. Hence it is used as an ingredient in varnishes, for giving more or less of an orange cast to the simple yellows. Alkaline salts render it perfectly soluble in boiling water, without altering its colour. Wool or silk boiled in the solution, acquire a deep but not a very durable orange dye. Its colour is not changed by allum or by acids any more than by alkalis; but when imbibed in cloth, it is discharged by soap, and destroyed by exposure to the air.

Mr. Pott, in the Berlin Memoirs for the year 1752, mentions a very extraordinary property of this concrete. "With the vitriolic acid, it produces a blue colour, of extreme beauty, but with this capital defect, that all salts and liquors, even common water, destroy it." The specimen of annotto which I examined, was not sensibly acted on by spirit of vitriol. It received no change in its own colour, and communicated none to the liquor. Nor did any visible change ensue upon dropping the acid into tinctures of annotto made in water or in spirit.

Labat informs us, that the Indians prepare an annotto greatly superior to that which is brought to us, of a bright shining red colour, almost equal

to carmine; that for this purpose, instead of steeping and fermenting the seeds in water, they rub them with the hands previously dipt in oil, till the pellicles come off, and are reduced into a clear paste, which is scraped off from the hands with a knife, and laid on a clean leaf in the shade to dry. *De Lacet*, in his notes on *Marcgrave's Natural History of Brazil*, mentions also two kinds of annotto, one of a permanent crimson colour, (*coccineus*) used as a fucus; and another which gives a colour inclining more to that of saffron. This last, which is our annotto, he supposes to be a mixture of the first sort with certain resinous matters, and with the juice of the root of the tree.

*Ximenes* relates, that annotto with urine stains linen of such a permanent colour that it can never be washed out. Perhaps the first sort is meant. Our annotto, boiled in urine, imparted to linen a deep yellowish red: the stained linen, hung out in the air in summer, in seven or eight days lost all its colour and became white again.



### C H A P. III.

#### Of L E A V E S.

**T**HE green colour of the leaves of plants is extracted by rectified spirit of wine and by oils. The spirituous tinctures are generally of a fine deep green, even when the leaves themselves are dull coloured, or yellowish, or hoary. The colour however seldom abides long even in the liquor; much less when the tinging matter is separated in a solid form, and exposed with a large surface to the air. The editor of the *Wirtemberg Pharmacopœia* observes, that the leaves of *acanthus*,  
brankursine

brankursine or bears-breech, give a more durable green tincture to spirit than those of any other herb. Alkalis heighten the colour both of the tinctures and green juices. Acids weaken, destroy, or change it to a brownish. Lime water improves both the colour and the durability. By means of lime, not inelegant green lakes are procurable from the leaves of acanthus, lilly of the valley, and several other plants.

There are very few herbs which communicate any share of their green colour to water; perhaps none that give a green of any considerable deepness. It is said, however, that the leaves of some plants give a green dye to woollen, without the addition of any other colouring matter; particularly those of the wild chervil or cow-weed (*Myrrhis sylvestris seminibus lævibus*, C. B.) the common ragwort, and devil's bit. The process with this last, as described by *Linnaeus* (in the *Svenska Acad. Handle. ärs*, 1742) is pretty remarkable. The peasants, he informs us, in some of the Swedish provinces, stratify the fresh leaves with woollen yarn, and boil them about as long as it is customary to boil fish.

The whole is suffered to stand in the vessel for a night. The wool, taken out in the morning, does not appear to have received any colour. The pot is again made hot, and the yarn hung over it upon a stick, covered with an inverted dish to confine the steam, for this steam is supposed to be essential to the colour. The yarn is afterwards wrung, the leaves taken out of the boiling liquor, a little fresh water added to the decoction, and the wool frequently dipt therein, till it appears sufficiently coloured.

The leaves of many kinds of herbs and trees give a yellow dye to wool or woollen cloth that has

been previously boiled with a solution of allum and tartar; weld in particular affords a fine yellow, and is commonly made use of for this purpose by the Dyers, and cultivated in large quantities in some parts of England. There is no colour for which we have such plenty of materials as for yellow. Mr. Hellot observes in his *Art de Teindre*, that all leaves, barks, and roots which on being chewed discover a slight astringency, as the leaves of the almond, peach and pear-trees, ash-bark, (especially that taken off after the first rising of the sap in spring) the roots of wild patience, &c. yield durable yellows more or less beautiful according to the length of time that the boiling is continued, and the proportions of allum and tartar in the preparatory liquor: that a large quantity of allum makes these yellows approach to the elegant yellow of weld: that if the tartar is made to prevail, it inclines them to an orange: that if the roots, barks, or leaves be too long boiled, the yellow proves tarnished, and acquires shades of brown: that for dying with weld, the best proportions of the salts are, four parts of allum and one of tartar to sixteen of the wool; and that the wool prepared with these is to be boiled again with five or six times its quantity of weld: that for light shades, it is customary to diminish the allum and omit the tartar; and that in this case the colour is more slowly imbibed, and proves less durable.

Of all the colours of the Dyer, we have the fewest materials for blue; the mineral and animal kingdoms afford none, excepting perhaps Prussian blue, which Mr. Macquer has lately attempted to introduce into this art. The vegetable yields but two, which are both produced from the leaves of plants, indigo and woad.

## C H A P. IV.

*Mr. LEWIS'S HISTORY of MADDER, and  
Manner of treating it.*

**M**ADDER (*Rubia tinctorum sativa*, C. B.) is one of the asperifolious stellated plants, or of those which have rough narrow leaves, set in form of a star at the joints of the stalks. The root, which is the only part made use of, is long and slender, of a red colour both on the outside and within, excepting a whitish pith which runs along the middle.

This plant was formerly cultivated among us in great quantity for the use of the Dyers, who for some time past have been supplied from Holland and Zealand. Its culture is now again set on foot in this kingdom, under the laudable encouragement of a public society. Madder is not like alkanet, and other exotic plants, the colour of which degenerates in our climates, for English madder is equal to the best that is brought from abroad.

Madder root gives out its colour both to water and to rectified spirit; the watery tincture is of a dark dull red, the spirituous of a deep bright one. Taken internally (for it has sometimes been used medicinally as an aperient and diuretic) it tinges the urine red. In the Philosophical Transactions, and in the Memoirs of the French Academy, there are accounts of its producing a like effect upon the bones of animals, to whom it had been given with their food. All the bones, particularly the more solid ones, were changed both externally and internally to a deep red, but neither the cartilaginous nor fleshy part suffered any alteration. Some of these bones, macerated in water for many weeks together,

together, and afterwards steeped and boiled in spirit of wine, lost nothing of their colour, nor communicated any tinge to the liquors.

The dealers in this commodity make three sorts of it; madder in the branch, madder in the bunch or in the bundle, and madder unbundled.

Madder in the branch is the entire root dried. This ground in mills to a gross powder is the unbundled madder. The bundled or bunch madder is a powder of the finer roots, freed from the outer bark and from the pith. It is said that by keeping for two or three years in close casks the colour is improved; in open vessels it decays.

Madder imparts to woollen cloth, prepared with allum and tartar, a very durable, though not a very beautiful red dye. As it is the cheapest of all the red drugs that give a durable colour, it is the principal one commonly made use of for ordinary stuffs. Sometimes its dye is heightened by the addition of Brazil wood; and sometimes it is employed in conjunction with the dearer reds, as cochineal, for demi-scarlets and demi-crimsons. Mr. Hellot informs us, that those who dye the best madder reds are particularly careful to keep the liquor of a heat considerably below boiling, increasing the fire only towards the end, so as to make it boil for a minute or two just before the cloth is taken out to confirm the dye; a boiling heat enables water to extract not only the red, but a tawny or brownish matter, which debases the red to a dull brick colour.

The proportion of madder is about half the weight of the cloth. The best proportion of salts for preparing the cloth to receive the dye seems to be five parts of allum and one of red tartar for sixteen of the stuff; which is to be boiled with these for two hours or longer, then kept moist for  
some

some days, and afterwards digested with the madder.

A variation in the proportion of the salts, varies the colour communicated by the madder, and not only the shade, but the species of colour.

If the allum be diminished, and the tartar increased, the dye proves a red cinnamon; if the allum be entirely omitted, the red is destroyed, and a very durable tawny cinnamon is produced.

On boiling the dyed cloth in weak alkaline ley, great part of the colour is destroyed, and the remainder appears of a dirty or a kind of fallow hue. Solution of soap, on the other hand, discharges a part, and leaves the remaining red more lively than before.

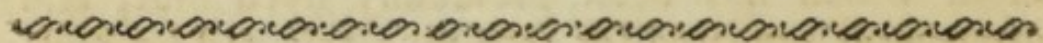
Volatile alkalis heighten the red colour of madder, but at the same time render it fugitive like themselves. Madder prepared with lime and urine, after the manner practised for archil, lost its red colour on attempting to dye with it, and communicated to the cloth only permanent nut-colours.

If a pure red, as that of cochineal, be applied on cloth which has been previously dyed blue, and afterwards prepared for receiving this red by boiling with allum and tartar, a purple or violet will be produced, according as the blue or the red prevail. The madder red has not this effect, for as its colour is not a pure red, but is tarnished by the tawny matter which its woody fibres have in common with other roots, it gives upon blue only a chesnut dye, more or less deep according to the deepness of the blue applied first.

There are, however, means of obtaining from madder a fine purple, without the addition of any other colouring drug. A piece of white woollen cloth, weighing half an ounce, was boiled for half an hour with ten grains of Roman allum and six grains

grains of crystals of tartar, and then taken out, squeezed, and suffered to cool. Twenty-four grains of bunch madder were added to the same liquor; and after the madder had given out its colour, twenty drops of a solution of bismuth (made in spirit of nitre, diluted with equal its weight of water) were dropped in. The cloth was now dipped again, and in half an hour taken out, squeezed, and washed. It appeared of a crimson colour, nearly as beautiful as if it had been dyed with cochineal. To try the effect of loading it further with the colouring matter, it was returned into the liquor and boiled for a quarter of an hour longer: it had now acquired a purple colour sufficiently vivid.

On varying this experiment by keeping the cloth moist for some days after the preparation with allum and tartar, then dipping it in a plain decoction of madder made as usual without salts, and adding, when it had gained a bright cinnamon colour, the same solution of bismuth, the dye instead of purple proved only a chesnut.



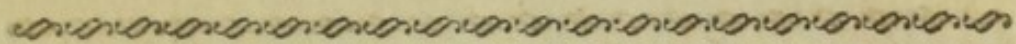
## C H A P. V.

### Of F U S T I C.

**F**USTIC is the wood of species of mulberry-tree, growing in Jamaica and Brazil, called by *Sir Hans Sloane*, *Morus Fructu Viridi. Ligno Sulphureo Tinctorio*. It is of a deep sulphur yellow colour, which it readily gives out both to water and spirit. The watery decoction dyes prepared woollen of a very durable orange yellow: the colour is imbibed by the cloth in a moderate warmth without boiling.

The

The fustet or fustel of the French is a yellow wood or root very different from our fustic. It gives a fine orange dye to woollen, but the colour is extremely perishable in the air. The plant grows wild in Italy and Provence, and is cultivated with us in gardens on account of the beauty of its flowers. It is called *Venice sumach*, *cotinus cotiaria*, *coccigria*; *cotinus matthioli*, C. B.



## C H A P. VI.

## NEPHRITIC WOOD.

**T**HIS wood is brought from the eastern countries in large pieces, covered with a dark blackish bark. The wood is hard, heavy, compact, of a fine grain, of a whitish or pale yellow colour on the outside, and a dusky reddish brown in the heart. Of the tree we have no very certain account.

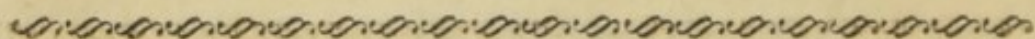
This wood, particularly the outer pale part, gives out both to water and to rectified spirit a deep tincture appearing, when placed between the eye and the light, of a golden colour; in other situations, blue. Hence it is named by *Caspar Bauhino*, *lignum peregrinum*, *aquam cœruleam reddent*.

By this mark it is easily distinguished from pieces of a different kind of wood, which are sometimes mixt with it, and which give only a yellow tincture to water.

It is remarkable, that the blue colour of the infusion of nephritic wood is destroyed by acids, the liquor after the admixture of these appearing in all situations yellow; and that the addition of alkalis, either of the fixt or volatile kind, in quantity sufficient to neutralize the acid, restores the blueness.

No other woody matter is known that gives any degree of blue tincture, and no other vegetable blue is known that is thus destructible by acids.

This wood is at present rarely met with in the shops; nor is it applied to any use, except that some have employed it medicinally, and expected from it *diuretic virtues*, whence its name *nephritic wood*.



## C H A P. VII.

Mr. FERGUSON'S *History of LOGWOOD as a Colouring DRUG.*

**L**OGWOOD or Campeachy-wood (*Lignum Brazilo-simile, cœruleo tingens, f. B.*) is the wood of a low prickly tree, which grows plentifully about Campeachy or the Bay of Honduras, and has of late been introduced into some of the warmer of the British plantations, particularly Jamaica. It is a native of low marshy places. The wood comes over in pretty large logs, cleared from the bark. It is very hard, compact, heavy, and of a red colour.

Logwood gives out its colour both to watery and spirituous menstrua, but not readily to either. It requires to be rasped and ground into fine powder, and boiled in several fresh parcels of the liquors. Rectified spirit extracts the colour more easily, and from a larger proportion of the wood than water does.

The tinctures both in water and in spirit are of a fine red, with an admixture, particularly in the watery one, of a violet or purple. Volatile alkaline salts or spirits incline the colour more to purple. The

The vegetable and nitrous acids render it pale, the vitriolic and marine acids deepen it.

The watery decoction, wrote with on paper, loses its redness in a few days and becomes wholly violet. This colour it communicates also to woollen cloth previously prepared by boiling with a solution of allum and tartar. The dye is beautiful, but very perishable. It is often used by the Dyers as an ingredient in compound colours, for procuring certain shades which are not easily hit by other materials.

With chalybeate solutions it strikes a black. Hence it is employed in conjunction with those liquors for staining wood black for picture frames, &c. and with the addition of galls for dyeing cloth and hats black. The black dyes in which this wood is an ingredient, have a particular lustre and softness, far beyond those made with vitriol and galls alone. The beauty however which it here imparts is not permanent, any more than its own natural violet dye.

On the same principle it improves also the lustre and blackness of writing-ink. Ink made with vitriol and galls does not attain to its full blackness, till after it has lain some time upon the paper. A due addition of logwood renders it of a deep black as it flows from the pen, especially when vinegar or white wine is used for the menstruum.

Decoctions and extracts made from logwood have an agreeable sweetish taste, followed by a slight astringency. They have lately been introduced into medicine, and given with success in cases where mild restringents are required. They often tinge the stools, and sometimes the urine of a red colour.

## C H A P. VIII.

*The Process of PRUSSIAN BLUE.*

**P**RUSSIAN blue is prepared by precipitating a solution of green vitriol and allum with a lixivium drawn from fixed alkaline salt that has been calcined with animal coals. Commonly about three parts of alkali and two of dried ox-blood are calcined so long as any flame appears, then thrown into boiling water, and the strained decoction poured into a hot mixture of solutions of four parts of allum and one or less of vitriol. The liquor becomes instantly thick or curdly, and looks at first of a greyish colour, which changes to a brown, and in a little time to a bluish green. The matter being well stirred together, and mixed with a quantity of hard spring water, a green precipitate subsides: spirit of salt poured upon theedulcorated powder dissolves a part, and leaves the rest blue.

Mr. Geoffrey is the first who has given any plausible theory of this process, or any rational means for improving it. He observes, that the Prussian blue is no other than the iron of the vitriol, revived by the inflammable matter of the alkaline lixivium, and perhaps brightened by an admixture of the white earth of allum; that the green colour proceeds from a part of the yellow ferrugineous calx or oker unrevived, mixing with the blue, and that the spirit of salt dissolves this oker more readily than the blue part, though it will dissolve that also by long standing, or if used in too large quantity. From these principles he was led to increase the quantity of inflammable matter, that there might be enough to receive the whole of the ferrugineous oker, and produce a blue colour at once without the use of the acid spirit. In this he perfectly

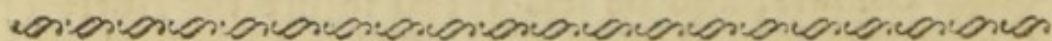
perfectly succeeded, and found at the same time that the colour might be rendered of any degree of deepness or lightness at pleasure.

If the alkali is calcined with twice its weight of dried blood, and the lixivium obtained from it, poured into a solution of one part of vitriol, to six of allum, the liquor acquires a very pale blue colour, and deposits as pale a precipitate. On adding more and more of a fresh solution of vitriol, the colour becomes deeper and deeper almost to blackness. He imagines, with great probability, that the blue pigment thus prepared will prove more durable in the air, mingle more perfectly with other colours, and be less apt to injure the lustre of such as are mixed with, or applied in its neighbourhood, than that made in the common manner; the tarnish and other inconveniences to which the common Prussian blue is subject, seeming to proceed from the acid and spirit, which cannot be totally separated by any ablution.

He takes notice also of an amusing phænomenon which happens upon mixture. When the liquors are well stirred together, and the circular motion as soon as possible stopt; some drops of solution of vitriol (depurated by long settling) let fall on different parts of the surface, divide, spread, and form curious representations of flowers, trees, shrubs, flying insects, &c. in great regularity and perfection. These continue ten or twelve minutes, and on stirring the liquor again, and dropping in some more of the solution of vitriol, are succeeded by a new picture.

Mr. Macquer has ingeniously applied the preparation of this pigment to the dying of wool and silk, and found means of fixing the blue fecula in their pores. By dipping cloth first in a diluted solution of vitriol and allum, then in the ley diluted, and afterwards in water acidulated with

spirit of vitriol, it acquires a light blue colour, which becomes deeper and deeper on repeating the dippings alternately in the same order as before; adding to the liquors each time a little more of the respective saline matters. The blue dye, he says, in beauty and lustre exceeds that of indigo and woad, as far as scarlet does the madder red, and penetrates the whole substance of fulled cloth without weakening it. The colour is durable in the air, and stands boiling with allum water, but is discharged by soap, and, without certain precautions, liable to be specky or unequal. See the Memoirs of the French Academy for the year 1749.



## C H A P. IX.

## A L K A N E T - R O O T.

**T**HE roots of alkanet in many respects very much resemble saunders wood, but differ from it remarkably in others. They impart an elegant deep red to pure spirit of wine, to oils, to wax, and to unctuous substances: I do not know of any red drug that tinges oil of so fine a colour. To water they give only a dull brownish red. The spirituous liquor, on being inspissated to the consistence of an extract, instead of preserving its fine red like that of saunders, changes to an unsightly brown.

Volatile spirits have been said to gain from this root a beautiful violet or amethyst colour; but I have not found that they extract any colour but a dull reddish brown.

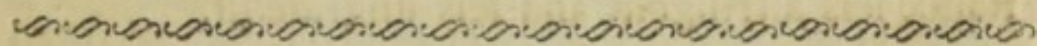
The alkanet plant is a species of bugloss, named by Tournefort, *buglossum radice rubra, sive anchusa vulgatio floribus cœruleis*. It is a native of the warmer parts of Europe, and cultivated in some of  
our

our gardens. The greatest quantities are raised in Germany and France, particularly about Montpellier, from whence we are chiefly supplied with the roots.

The alkanet root produced in England is much inferior in colour to that brought from abroad; the former being only lightly reddish, the latter of a deep purplish red. This has induced some to suspect that the foreign roots owe part of their colour to art, but a chymical examination teaches otherwise. The colouring matter is found, upon experiment, to be of the same kind in both, and to differ in several of its properties from that of all the other known red drugs; so that no artifice appears to be practicable without discovery, unless it was concentrating the colour of two roots into one, or supersaturating one root with the colour extracted from another.

The principal use of alkanet root is for colourings oils, unguents, lip-salves, plaisters, &c. Wax tinged with it, applied on warm marble, stains it of a flesh colour, which sinks deep into the stone. The spirituous tincture gives a deep red stain.

The colour of this root is confined to the cortical part, the pith being whitish; hence as the small roots have more bark in proportion to their bulk than the large ones, those also contain most colour.



## C H A P. X.

## Of A L L U M.

**N**ATURE produces no perfect allum, but affords the materials for it in sundry ores, pyritæ, stones, slates, earths, waters, and bitumens,

as pit-coal. Some late experiments by Mr. Geoffrey and Mr. Pot have shewn that the earth of allum is contained in clay, and that a true allum may be prepared by digesting clay in the vitriolic acid. Both these gentlemen imagine that only a particular part of the clay is here extracted.

Whether it existed originally in the clay, possessed of the same properties which it is found to have when extracted, or whether it has suffered a change in the operation, they have not determined. From the experiments I have made, the latter seems to be the case. Powdered tobacco-pipe-clay, being boiled in a considerable quantity of oil of vitriol, and the fire continued to dryness, the matter, examined when grown cold, discovers scarcely any taste, or only a slight acidulous one. On exposure to the air for a few days, the greatest part of it is found changed into lanuginous efflorescences in taste exactly like allum: the remainder treated with fresh oil of vitriol in the same manner, exhibits the same phænomena, and this repeatedly, till nearly the whole of the clay is converted into an astringent salt.

If the earth be separated again from the acid, (by dissolving the salt in water, and precipitating with any alkaline salt) it is now found to dissolve with ease in every acid; to form with the vitriolic allum again; with the nitrous, a compound resembling allum in taste; with the vegetable acids, a substance less astringent and less ungrateful.

## C H A P. XI.

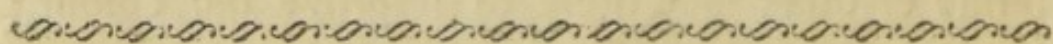
*Chymical History of SAUNDERS, and its Difference from other RED-WOODS.*

**R**ED Saunders is a hard, compact, ponderous wood, of a dark blackish red on the outside, and a light red colour within; of no particular smell or taste. It is brought from the Coromandel coast and from Golconda. Of the tree we have no certain account. Its principal use is as a colouring drug. Those whose business it is to rasp and grind it into powder, probably employ certain saline or other additions to improve the colour; whence the remarkable differences in the colour of powdered Saunders prepared in different places. That of Strasburgh is of the deepest and liveliest red. Some sorts are of a dead dark red, and some of a pale brick red; some incline to purple or violet, and some to brown.

The colour of this wood resides wholly in its resin, and hence is extracted by rectified spirit, whilst water, though it takes up a portion of mucilaginous matter, gains no tinge, or only a slight yellowish one. From two ounces of the wood were obtained by spirit of wine three drachms and a half of resinous extract, and afterwards by water, a scruple of mucilage. By applying water at first, I obtained from two ounces two drachms and six grains of a tough mucilaginous extract, which could not easily be reduced to dryness. The remainder still yielded, with spirit, two drachms of resin. The indissoluble matter weighed, in the first case, an ounce and a half and fifteen grains; in the latter, nineteen grains less. Neither the  
distilled

distilled water nor spirit had any remarkable taste or smell.

The red colour of saunders appears to be no other than a concentrated yellow, for by bare dilution it becomes yellow. A grain of the resinous extract, dissolved in an ounce of rectified spirit, tinges it red, but this solution, mixt with a quart of fresh spirit, gives only a yellow hue. Hoffman reports that this resin does not give a tincture to any kind of oil. I have tried five oils, those of amber, turpentine, almonds, anniseeds and lavender. It gave no colour to the two first, but a deep red to the last, and a paler red to the other two.



## C H A P. XII.

### Of VERDIGRISE.

**I**T may not be amiss to give the reader a chymical hint of verdigrise.

Vegetable acids dissolve copper slowly, but in considerable quantity; the solution shoots into bluish green chrystals, similar to the verdigrise, *æruugo* or *viride aris*, of the shops. This preparation is made in large quantities in France, particularly about Montpellier, by stratifying copper-plates with the husks of grapes remaining after the juice has been press'd out. These soon become acid, and corrode the copper.

Verdigrise should be chosen in cakes, not moist or unctuous, but dry, compact, and of an uniform texture, of a lively green colour throughout, as free as possible from white and black specks, and seeds or stalks of the grape. It is purified by solution in distilled vinegar, and chrystallization, and then called, improperly, distilled verdigrise or  
flowers

flowers of copper. The Dutch who prepare these chrystals in large quantities, after duly evaporating the solution, set it to shoot, not, as is customary, in a cold but in a warm place, as practised in making sugar-candy.

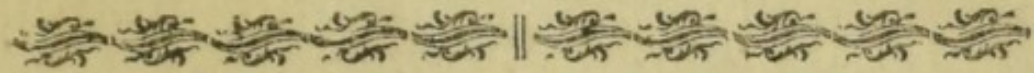
If rectified spirit of wine be added to the solution, or if volatile alkalis be added to a solution of copper and spirit of wine to this mixture, small blue chrystals will be immediately formed. These are called by some antepileptic chrystals of copper.

Highly rectified spirit of wine, digested on half an ounce or twelve scruples of powdered verdigrise, dissolved three scruples and a half; ordinary rectified spirit, four scruples; common malt spirits, four and a half, and French brandy seven and a half. Water dissolved, out of the same quantity, five scruples. Common wine vinegar dissolved all but fifteen grains, and distilled vinegar, all but ten grains. The whole quantity of verdigrise dissolved in either kind of vinegar, could not be recovered again in a chrystalline form.

From the common vinegar only two scruples and five grains chrystallized, and from the distilled vinegar three scruples. The residuum in the first case continued softish, in the latter dry. With French brandy there was no chrystallization at all; the whole that the spirit had taken up remaining uniformly mixt into the consistence of an extract.

A H I N T



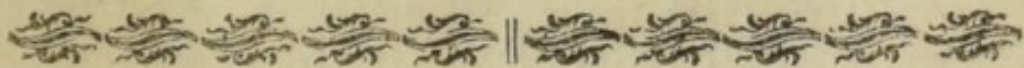


A  
H I N T  
TO THE  
D Y E R S  
AND  
CLOTH-MAKERS.

AND WELL WORTH THE NOTICE OF  
THE MERCHANT.

By JAMES HAIGH,

Late SILK and MUSLIN-DYER, LEEDS.



THE

DIYERS

AND

GLAZIERS

OF

THE

ROYAL

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## P R E F A C E.

**T**HE AUTHOR of the *DYER'S ASSISTANT* thinks it his duty, in gratitude to the professors in that noble art, to subscribe his hearty thanks for their approbation of, and encouragement given to that work, in this and every part of England. It is well known my design is not to teach strangers to dye; but to help the thinking part of the Dyers to improve; and to shew them how I spend some of my leisure hours to help them, as well as myself, to a most necessary knowledge. It is well known by that body of people, and felt too by some, that the price for dying woollen goods hath been much reduced of late. Many circumstances having determined me, long since, to acquire all possible knowledge in the practice of dying, I am therefore constrained once more to recommend a strict inquiry into the original quality of all the drugs they use, that thereby, if possible, they may discover some of the many hidden advantages that may justly be expected therefrom.

I am astonished that no artist has ever attempted to improve this most ingenious art on chymical principles. I begun the work in hopes that my master-piece would undertake to improve it, but in vain do I expect it.

*A Word to the thinking Part of Dyers.*

If you were sensible of the double advantage that might be acquired in the use of many of your vegetable drugs, which must be first grounded on chymical experiments in miniature, which will be a certain rule to the practice at large, I am certain you would not rest till you had made some improvement.

If after you have been dying with that resinous drug, saunders, when emptying the vessel you take up a handful, dry it and digest it in a phial with some pure spirits of wine, and it will afford you an excellent red, water being insufficient to dissolve the resin, and let out the prime part of the colour. Many others may be discovered if an unwearied attention was paid.

Many will censure and despise this, for no other reason than because they cannot see into it; nor will they be at any pains to learn and improve their talents. They seem rather to choose the old round, like a horse in a mill, having no spirit or courage to improve, but content with each knowing the other's method, without striving to excel, and discover more complete and less expensive ways of working, and using the drugs to the best advantage.

I know not how men can sit still when there is more to learn. Let it not be said of you, as of one of old, he lived and died and did nothing; perhaps he worked with his hands, but his head was asleep; and therefore he was an unprofitable servant, and when dead, his memory was no more. Sure it is, the invitation I have to write and publish this small pamphlet is not so much to please others, or to shew any thing I have is capable of the name  
of

of parts, but to communicate my good wishes for improvement to my brethren the Dyers, and to shew them my willingness to help to perfect one of the most useful arts in the world.

I shall leave all to itself, and to every man's just liberty to approve, or disapprove, as he pleases. And however it be, the author shall not be much troubled, for he is certain no man can have a lighter esteem for him, than he has for himself; who, however, will be best pleased, if any man shall find benefit by what he has wrote. If any should alledge a general acceptance, that, to the author, will be no prevailing argument; for the multitude, though most in number, are the worst and most partial judges. He does not plead the importunity of friends for the publication of this. If it is worthy, it needs no apology; if not, let it be despised; and I remain the same friend to trade.

J A M E S H A I G H.



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A

## HINT to the DYERS, &c.

**B**LACK being a primitive colour, and one of the most difficult to perfect, deserves a few remarks. If I ask a Dyer what ingredients compose a black, the answer will be this: Logwood, shumac, bark, and coperas; and if he knows it, he will add a little ashes and argol in the last wet. If I ask him which of these drugs contain an acid, which an alkaline, and which a neutral quality, he cannot give me an answer: so you see he knows the effect, but a stranger to the cause, and every thing else separate from fact and custom.

What a pity it is that men will not search things to the bottom, when they might be able to find out the cause of miscarriages, for which goods are frequently thrown aside to be dyed other colours, greatly to the Dyer's loss. In conversing with a sensible Dyer, I simply asked him, What part does logwood act in the black dye? the honest man as simply answered, "It helps to make it black." No other proof was wanted to know that he also followed his forefathers in the old round. But the

reader, by now, thinks it time to be informed of the business of logwood; which is (if used in a right proportion) to soften the goods, and give lustre to the colour. Logwood being possessed of a most excellent astringent quality, fixes itself in the pores of the goods, and gives them a velvet-like feel and gloss.

Some will object to this assertion, and say, but our blacks have not that velvet-like feel and gloss. True, Sir, but don't you know the reason? you dye your blacks without scouring, forgetting, or not knowing, that when the goods enter the boiling dye-liquor, they grow harsh, and the oil contained in them forms a sort of resin, which becomes as fixed as if it was pitch or tar. This is one great cause why blacks are so liable to soil and dirty linen, because the dye is in some sense held in an outside or superficial state. Think then, is it possible these goods should finish soft like velvet, or shine like a raven's feather? No, on the contrary, they spoil the press papers, and come out stiff and hard like buckram, (not velvet) and are often three-parts perished in the finishing. No greater cause can be assigned for it than that of not scouring. This is the reason of the great difference, so much spoken of, between the London blacks and those dyed at Leeds. If the Leeds Dyers would take the same pains as the Londoners do, I think they would excel, in fact, if not in name.

The finishing shops in London are not more than half so well furnished with tools as those at Leeds are; and therefore let the Leeds Dyers be equally tight and clean in their performance, and there is nothing to prevent their superiority. But the master Dyers give a very reasonable answer to the foregoing. They say, the price is too low, and

and they cannot afford to take so much pains. What a pity that the merchants do not consider this! if threepence a piece was added to the price for dying thin goods black, it would about pay for the scouring, and the goods would be finished with a brilliant lustre, and yet soft like a ruffel.

I should speak a little to the nature and business of the other drugs, which enter the composition of black, had I not done it before, (*see the article black, Dyer's Assistant, p. 146.*)

I am astonished at the ignorance of the poor cloth-makers, many of whom have applied to me frequently for instructions; one of them, on being asked what sort of ware, and how much he used to dye such a colour, shewing him a pattern, he answered, When I have a pattern given me by a merchant, I go to the salter, shew him the order, and he serves me with what is wanted. I conversed with him some time, and would have instructed him, but alas! he had left his capacity at home, and I might as well have read the newspaper to him. What a pity it is that so many hundreds of that noble branch of business work, as it were, blindfolded, and poverty bitten too, for want of instructions, which they have no spirit to seek; who, when they bring a cloth to the market, are glad to sell it for one and sixpence, or two shillings in the pound profit, when they might as easily gain five or six shillings, if they knew how to use their drugs. But I despair of doing that for them, which nature has left undone; for, without I could teach them to see with a Dyer's eye, I might talk and write for ever in vain,

But there is another class of cloth-makers, to whom I will give a useful hint, and have done.

The article sky-blue deserves our notice. This colour is often substituted, (even on fine cloth) by the

the Saxon blue, on account of its brilliancy and fine lustre; but, like a fugitive, it only stays for a season. A little experience has taught me, that if a parcel of fine wool be well scoured, then sulphured or stoved, than which nothing can make it whiter, and then dyed in a weak vat, it will have all the beauty of the Saxon blue, without its imperfections. The vat used for this purpose should be set with a small quantity of indigo, on purpose for light shades, when the shades will be always brighter than when dyed in an old vat that has been weakened by dying dark colours. But the Dyers tell you that blues bear so low a price, and indigo is so dear, that they cannot afford to set fresh vats for light shades. Here is a sufficient cause, and one very great reason of retarding the perfection of many colours. If the wool before-mentioned should be obstructed in the milling, by means of the sulphur, (of which I have not had experience) I would commend the dying of the wool after scouring only, and stove it after it is milled, which I think will answer the same purpose; and the beauty of the colour will amply pay for every superfluous work.

I would recommend to the Dyers, after washing the dark blues well at the river, to turn the cloth very quick through a warm vessel of water, in which has been dissolved a little allum, and they will see a surprising change in the lustre from that simple process.

I am not willing to omit any thing worth notice in the course of my experiments. I will, therefore, lightly touch the properties of common water. By a great number of experiments, I am thoroughly convinced, that different waters with the same ingredients strike different colours. I find

find that the purest and lightest waters strike the best light colours.

All the dye-houses at a distance from the river in London are furnished with wood cisterns which hold perhaps from one to two hundred hogheads of water, which is supplied from the water works, and is always impure, and frequently muddy; when on standing a considerable time, as is the case at some seasons of the year, it becomes putrid and emits a foetid smell; if suffered to stand longer, it purifies itself, and becomes sweet and clear, as well as considerably lighter. I have sometimes filled a vessel when the water has been all of a ferment, and stunk almost beyond bearing, which at a boiling heat was no more felt; by adding a handful of common starch and a small bit of allum, all the filth is made to rise, and is taken off with a ladle for that purpose. The superior goodness of the water obliges us to ascribe an advantage to the London Dyers of light colours; add to this their remarkable cleanliness. When a vessel is boiling they watch it carefully, and with a mop, kept for that purpose, they rub off the scum all round at the water's edge, so that the liquor is perfectly clear.

*A short Remark on the Dye of Brasil wood.*

It is impossible to wear a red, a dove colour, a crimson, purple, light or deep violet, or any other colour, the produce of Brasil wood used recently many weeks, without fading, spotting, or soiling. If these colours were dyed in grain they would indeed cost something more, but you have then a colour which will continue beautiful as long as the stuff or cloth will last; and if spotted with dirt or grease, can easily be scoured and cleaned without danger of losing or injuring the colour.

I boiled

I boiled fifty pounds of Brasil chips one hour, in a copper of the hardest spring water I could find, and carefully took off the scum, turned this liquor over into a large tub, and re-heated the copper to boil the chips a second time, when the colour was all extracted. I then put both liquors together, and let it stand six months, when it was ropy and thick like oil. Now having prepared a small piece of fine cloth in allum and four bran-water, and kept it moist five days unwashed out of the allum, I boiled one nut-gall and one quart of Brasil liquor ten minutes, then rinsed my piece of cloth, and dyed it a very beautiful marone. But the chief remark I intend to make here, is, that I hung this piece of cloth in the open air night and day during four severe winter months, and it had rather gained in beauty of colour, and was grown rather deeper. This is a sufficient proof that chymistry hath a power of securing the fine particles of those vegetables which are now called bastard drugs. Experiments (which are the best guides in natural philosophy, as well as in arts) plainly shew that a great advantage might arise in favour of the studious practitioner, who is not wearied if he miss his design after twenty or thirty trials, but still pursues his plan till he has hit it; for nothing of the kind seems to be impossible.

*A few Experimental Observations on the Dye of  
Cochineal.*

After all the common processes of dying with cochineal, there is found at the bottom of the vessel a deep brown sediment. This sediment appears to consist of the impurities of the tartar, and the grosser parts of the powdered cochineal. This being lightly washed with clear cold water, dried  
and

and ground on a marble, with one-fourth its weight of fine tartar, into an impalpable powder, and then put into water with a little allum, a piece of white cloth boiled in this liquor three quarters of an hour acquired a very beautiful crimson dye.

This experiment evinces, that, by reducing cochineal into a powder of moderate fineness as commonly practised, we do not gain all the advantage which this valuable commodity is capable of yielding.

If the cochineal, when taken from the vessel, (after the scarlets are dyed) is treated as above, the saving in the cochineal, whether for scarlet or crimson, will be about one-third. Though less tartar is usually employed in the dye-liquor, yet this quantity here directed does no harm; it appeared on trial that the colour was rather the more solid for it. All urinous and alkaline liquors or substances stain scarlet to a crimson, by destroying the effect of the acid. Hence, in pure country air, scarlet retains its lustre much longer than in cities and towns, where alkaline and urinous vapours are more abundant. The dirt of roads and sundry substances of the acrid kind, leave no stain on scarlet, if the part be washed immediately in pure water, and wrung in a clean linen cloth. If the dirt is suffered to dry, a blackish violet spot will remain, which can only be discharged by mild vegetable acids, as vinegar, citron juice, a warm dilute solution of cream of tartar, or sour bran-water; if these acids, however, be not applied with a good deal of address, whilst they take out the blackish stain they leave a yellow one, by dissolving the colouring particles of the cochineal itself.

After at least a thousand experiments, I am obliged to conclude, that the dying of wool is the most extensive branch of this art, it may be considered

sidered as its basis; but the dying of silk, thread, and cotton, deserves also our attention.

The great difference between those substances, and that of wool, is well known to the callico printers, whose grand care it is to find means of making linen receive the same dyes as wool does. The physical cause of the difference seems yet unknown; and indeed, as before observed of dyes in general, we know as yet very little. Are animal filiments tubular, and the colouring atoms received within them? are vegetable filiments solid, and the colour deposited on the surface? or, does not their different susceptibility of colour depend rather on the different intrinsic properties of the two? An answer to this would doubtless prove of great utility.

I should be happy to find some artist undertake to improve what I have in a poor way begun. I long to see the art in perfection, one half of which is yet in oblivion.

The reader may be assured, that what is here recited is purely the result of the author's own experience, (not theory) and part of the effects of many years study.

T H E E N D.



