A

PRACTICAL TREATISE

ON

DYEING,

AND

CALLICOE PRINTING:

EXHIBITING THE PROCESSES

IN THE

FRENCH, GERMAN, ENGLISH, AND AMERICAN PRACTICE OF FIXING COLOURS ON WOOLLEN, COTTON, SILK, AND LINEN.

BY THOMAS COOPER, ESQ.
Professor of Chemistry in Dickenson College, Carlisle, Pennsylvania

---

PHILADELPHIA:
PUBLISHED BY THOMAS DOBSON, AT THE STONE HOUSE.
NO. 41, SOUTH SECOND STREET.
William Fry, Printer
1815.

PREFACE.

THE art of Dyeing is of great importance to a country that manufactures cloth of any kind. It adds to the beauty and contributes to the economy of the material whether woollen, silk, cotton or linen: it therefore encourages the demand.

In France, under Colbert, it was the subject of many governmental regulations, having for their object the distinction between true and false dyes; that is, permanent or fugitive colours, the great or the lesser dye. Colbert meant well, but he did not know in that day the value of the advice "Let us alone to manage our own affairs." *Laissez nous faire.*

The only good books on dyeing, however, we owe to France;—Hellot for woollen, Macquer for silk, D'Apligny for cotton, and lately Berthollet and Sons, with Bouillon La Grange's edition of Homassel. These are the most valuable books of a dyer's library.

In England, Haigh's Dyer's Assistant is little more than a copy of Hellot. Bancroft, who having discovered and secured a monopoly of the bark of the American black oak, turned his attention to dyeing, has published a very valuable treatise, but not a practical one. The history and description of the drugs used, and the theory that pervades the book, is excellent. I know of no book on the subject, however, that is original, practical, and English. All the books there published on the subject, Bancroft's excepted, are either copies of Hellot, or catchpenny compilations of no value. On callicoe printing, England has furnished but one book, published about twenty-five years ago, and of no value. That manufacturing and jealous nation, conceals all the knowledge by which other nations could profit in a manufacturing point of view.

In Germany I know of nothing but Gulich's, Scheffer's and Pœrner's treatises, which are rather experimental than didactic and practical. D'Ambourney's work, though very curious, and opening a field of future utility, is also of no use to the practical dyer.

In this country two books have been published on the subject, one a thin duodecimo, by Asa Ellis of Connecticut, and another lately by Elijah Bemiss of New York State. They are both practical books, containing processes manifestly copied from experience. Asa Ellis's book contains no theory, and his receipts can for the most part be depended on. That of Elijah Bemiss, although the first part is manifestly the work of a practical dyer, yet it is marked by such a total ignorance of chemical principles, and some of the receipts are so strange, that although a man who understands the theory of dyeing may make a good use of some parts of it, the work is not of equal merit with those which have preceded it. Still it is a book worth having, the proportions are tolerably good, and suited to the present state of this country.

The sources to which I have applied, are Hellot, Macquer, Berthollet, Homassel, and occasionally to Asa Ellis.

Thirty years ago, dyeing and printing occupied much of my time experimentally and practically: my strong and decided liking for these branches of industry, has kept me alive to every improvement I could hear of since I have been in this country; and my chemical pursuits have enabled me to understand these subjects certainly better than a merely practical man. I consider therefore that I am qualified to judge of what is likely to be to the purpose among a variety of receipts, as well as can reasonably be expected. But although I have dyed every colour upon cotton with my own hands heretofore, and that not by way of experiment, but for the market, and although I have superintended with anxious care the dyeing and the colour shop of the printing department at my own establishment, this is so long ago, that much has escaped my recollection, and probably much is known to others who have continued in the practice, which is now unknown to me. Still, I send out this book, as upon the whole the best book on the subjects of dyeing and printing now extant, scanty as the information may seem.

It is very singular that in the voluminous publication, Rees's Cyclopædia, I can find nothing on dyeing generally, and only two articles relating to the subject of printing. Can this be a wilful omission in the common jealous manufacturing spirit of the country? However, in the article dyeing, the English may have cheaper, but they have not better processes than the French have published; nor in general is the English dye house as good as the French; or their cloths so well dyed.

With us, and in the infancy of our manufacture, it is all important that we should reject as much as possible fugitive, and use only permanent colours. For this purpose it is worth while to go to the expense of these colours. At present, the English manufacture cheaper, dye cheaper, and finish their goods far superior to every other nation as well as our own; but if our cloth and our colours are substantially better, if they will last longer than the English, it will compensate in a great degree both for inferior finish and higher price. My receipts therefore are not of the cheapest kind. I have uniformly rejected the fraudulent and fugitive dyes, and insisted on the fast colours.

This work I know to be incomplete, particularly in the department of callicoe printing, but where will the reader find a better? This is my apology.

I have often been asked for a treatise on dyeing, which shall contain in a small compass all the best receipts for each colour, rejecting all inferior ones: so that an unlettered and practical man, can go to work with a full reliance on the process laid down for him: and an excellent book this would certainly be.

But those who ask for it, are not aware, that in all probability no man living is competent to such a selection. Almost every dye shop has its peculiar recipes, and processes. The directions given by the most approved authors greatly differ from each other. Different processes will suit some countries better than others, and different localities in the same country. A dyer in New York or Philadelphia, will use drugs imported, for which a dyer in the back country will be induced to find a substitute. This has induced me by way of appendix to insert D'Ambourney's experiments on the colours produced by different woods, satisfied that such a set of experiments made on our own woods, would probably lead to many useful results.

The plan of the following treatise is much in this wise.

Suppose I were a dyer, and a young lad sent to me to be instructed in the art:

I should first expect of him a good knowledge of the elements of chemistry; for it is a farce to talk of a dyer who is ignorant of chemical science; every step he takes must be in the dark; he cannot move but by rote.

I should then instruct him in the materials used in the art of dyeing: Bancroft's book, to which mine is a practical supplement, will do this better than any other.

I should then carry him if I could, to the best dye houses in the neighbourhood, and show him the processes there used for each colour on the respective kinds of stuff.

Then I would bring him home and make him dye the same colours in my own dye house, explaining the reasons of difference, wherever my practice differed from my neighbours'.

I have done so in this book. I have placed the reader in the French, the German, the English dye houses: I have given him the processes of each country, where I could get at them; I have then given my remarks on these processes, and my own alterations founded on those remarks, leaving him then to exercise his own judgment. I think this is far better than confining him to a single receipt, under the notion that I was duly qualified to select the very best, and infallible in my judgment. I know that I am not so, and therefore I have not pretended to this very desirable qualification.

In fact the art of dyeing is yet in its infancy. No one but a good chemist, who is at the same time a good dyer, can form any judgment of the very many unascertained points that yet remain as desiderata in this art. I have felt this at almost every page of the work. It is in dyeing as in all other branches of knowledge, a man must know much, before he is aware how ignorant he is. The only cure for the evil, is the general introduction of chemical knowledge, which bears upon the principles of almost every art and trade that subserves the comfort or convenience of common life.

Such as the book is, I believe it will be useful in its way, and I am glad thus to contribute my mite to the treasury of practical knowledge, of which this country stands so much in need.

THOMAS COOPER

INDEX.

A.

B.

C.

N.

O.

P.

Q.

R.

S.

Y.

Z.

ON DYEING.

PRELIMINARY REMARKS.

THE subjects of the art of dyeing, or the substances to be dyed, are wool, silk, cotton, linen, leather. The staining of ivory, bone, horn or wood, or the tinging of glass or enamels, are not comprehended under dyeing. The present treatise relates to wool, silk, and cotton.

Dyeing is performed by fixing the colouring matter of certain drugs on the substances to be dyed. This is done, either immediately, as in the case of woad or indigo; or intermediately, as in the reds of madder, and cochineal, the yellows of weld, quercitron or fustic, &c. which cannot be fixed unless by the intervention of some other substance. These intermedia, are technically termed MORDANTS; a French word, implying that they seize hold, and fasten upon the cloth in the first instance. These mordants are almost exclusively, solutions of the earth of *alum*, as the sulphat, tartrat and acetat; or of *tin*, as the nitro-muriat; or of *iron* or *copper*, as the sulphat, or acetat; and lately the nitrat of bismuth has been introduced. If in a solution of any of these salts, a decoction of colouring matter be poured, the colouring matter separates the aluminous earth, the tin, the iron and the copper from its solution, in an insoluble compound. So if the earth of alum be precipitated by an alkali, and the precipitate washed, this precipitate boiled with a decoction of logwood or madder, will attach itself to the colouring matter, and if in sufficient quantity, will leave the decoction clear. It is in this way, that the dyer ought to try the quantity and brilliancy of the colouring matter contained in a sample of colouring drugs he is about to purchase. Let him take for instance one hundred grains by weight of a dye wood offered for sale; bruise it well; boil it in snow or distilled water, till the colouring matter be extracted; then add cautiously a solution of acetat of alumine, (printer's red colour,) or nitro-muriat of tin, till all the colouring matter falls down: the eye can determine the brilliancy of it, when compared with a known sample treated in the same manner, and the weight of the precipitate will give (when dry) the comparative proportion of colouring matter in a given weight of the drug, provided the same solution be used in both cases. This method may furnish a much more useful test of the value of a parcel of drugs, than any other commonly employed.

When mordants are applied to cloth of any kind intended to be dyed, it has been supposed till lately, that the saline substances were decomposed by, and their bases united chemically to the cloth; but late experiments show, that the cloth alone is not able to separate the base from the acid: thus, when wool, silk, or cotton are alumed, the whole of the alum absorbed, can be washed out by repeated washings of hot water; and by evaporation, can be collected: so that the cloth shall be as incapable of being dyed permanently, as it was before the mordant was applied. Still, cloth prepared or mordanted with alum should be rinced before it is dyed, in most, if not in all cases. Hence however, it follows practically, first, that after cloth has been impregnated with mordant, it should not be washed too frequently, or too assiduously, or in hot water, before it be dyed: the loose and crystallized particles of the mordant should be lightly washed away, but no more. Secondly, that in many cases it would be advantageous to dip the goods in the colouring matter first: thirdly, that alternate mordanting and dying, has the best chance of saturating the cloth with colour. Hence also it follows, theoretically, that the cloth is not able to decompose the saline substances used as mordants, without the assistance of colouring matter; those saline substances therefore, are only retained in the cloth mechanically, until the solution of colouring matter precipitates them on the cloth; in that state, they combine chemically with the cloth; forming a triple compound of the base, the colouring matter, and the cloth. The acetic acid and the tartaric acid, counteract the tendency of the alum to crystallize. But although mordants in the saline state are retained mechanically in the cloth, until the dying process commences, yet when acids that hold the base in solution are taken away by other chemical means, and the base is precipitated on the cloth without the intervention of colouring matter, a chemical union takes place between the cloth and the base: thus, dip cloth in a solution of iron, whether sulphat or acetat: then dip it in lime water, or in an alkaline solution; the oxyd of iron will be fixed on the cloth indelibly as to the action of air, of water, or of washing by soap; and will receive any dye that the oxyd of iron is capable of fixing. This indeed is the common ley-colour of this country, and one species of the Manchester nankeen, or fast buff; permanent as to washing, but liable to be stained by tea and other astringents. I believe the same union takes place, when the base alumine or tin is so precitated; and in a less degree, copper also; that is, a chemical union takes place between the cloth and the base, independent of the action of colouring matter, when the acid is by other means taken away. Hence as I have already stated, coloured cloth is a triple chemical compound of cloth, base of the mordant, and colouring matter. This triple union is strengthened in most cases of metallic mordants by moderate exposure to air, to complete the oxydation of the base. When mordants are used, they should be examined. Thus, alum and sulphat of copper frequently contain iron: so do the muriatic and nitric acids used in making the scarlet composition. In this case, a violet or olive tinge, verging or approaching to black, will infallibly be produced by madder, Brazil, cochineal, weld, quercitron, or even fustic; this will be more or less apparent as the iron predominates. Roman alum, and English alum, are the best I have seen. Iron can be detected by dropping into a solution of the saline substance suspected, a few drops of prussiat of potash, or of lime; which ought also to be checked by another glass, in which is to be dropped a few drops of tincture of galls. Generally speaking, the best mordant for woollens, is tartrat of alumine; for cotton, acetat of alumine; as yet this mordant is almost confined to callicoe printing, but it well deserves the dyer's attention. Copper is a mordant chiefly for yellows.

Indigo, woad, carthamus, yellow berries, turmeric, zedoary, annatto, and some few other drugs, require no saline mordant. The *common* mordant or saline substances in the preparation liquor, for woollens, when a very full colour is intended, is four ounces of alum and two of tartar to each pound weight of woollen. The alum should be first dissolved, then the tartar *ground fine*, by small quantities at a time; for an effervescence takes place, which may throw the liquor out of the boiler. The cloth should in general be boiled in the mordant, or preparation liquor, for about two hours, and be well stirred.

Although this be the general proportion of mordant for aluming woollens, yet this proportion may vary according to the depth of colour required: and for some colours, as a weld yellow for instance, half the quantity will answer. So, much less tartar is required for gold colours, bright yellows, and some others, for which the dose of mordant is three ounces alum, and an ounce of tartar per pound.

Water that has been employed for one alum-bath is better for another preparation liquor than fresh water; so that a second preparation, or solution of the mordant, produces brighter colours than the first: for the cloth has taken away with it all foulness and heterogeneous matter, and the solution is clearer.

Delicate colours, such as a brimstone yellow, and carnation, are best dyed out of a preparation liquor that has been twice used.

For crimson and false scarlet with Brazil wood, the mordant or preparation is, twenty-two pounds of alum, and eight or ten of tartar for the first hundred pounds of cloth; twenty pounds of alum, and eight pounds of tartar for the next hundred pounds, continuing with the same water; eighteen pounds of alum, and six pounds of tartar for the third hundred and each succeeding one; for the water will retain much of the mordant. For these colours, the boiling should continue three hours. Woollens boiled in the preparation for fine colours, should be left for some days in an underground room, or cellar, upon clean planks, but not of oak wood. But weld colours, whether yellow or green, should be dyed the day after their preparation. Brazil crimsons and scarlets, may stay a fortnight. Flocks of wool that had been prepared with the mordant, were as good at the end of a year as the first day, for alum is a preservative.

The WATER used in a dye-house, ought to be tested in the same way. Also, if the water meant to be employed, be foul or hard, and not fit for washing, or curdles soap, it is not fit for dyeing light colours. For it may be considered as containing saline substances, which will act as mordants where they are not wanted. This defect may be remedied by throwing a handful of starch and a little alum in the copper and boiling and scumming it before using it; or in some degree, by boiling bran in it: but no bright colour can be obtained from foul or hard water. All COLOURING DRUGS, should be purchased as fresh as possible; they should be kept in a dry place; and not much exposed to the air. They should be used rasped rather than chipped; where the powdery or rasped state is objectionable in the copper boiler, they can be inclosed in a close basket or in a bag, and occasionally pressed: it is great waste to use them in large chips, or in chips of any kind. When a sample is offered, it should be tried as to its richness in the way above mentioned; that is, make a solution of a sample, and precipitate it with acetat of alumine. Acetat of alumine is made thus: dissolve one part, as a pound or an ounce of alum free from iron, in as much water as will dissolve it, that is, about eight parts water to three of alum; when dissolved, add one part and a quarter, as a pound and a quarter or an ounce and a quarter, of the salt called acetat or sugar of lead; stir them well together; let the sediment subside, which is sulphat of lead; pour off, or filter the supernatant liquor; for the purpose of this experiment, it may be diluted with three waters. Instead of this you may use the scarlet composition, nitro-muriat of tin, or even a solution of alum; I prefer the acetat.

Colours on woollen, are expected to stand exposure to air and light; if by these tests they are fugitive, in so much they are inferior, and (technically) false dyes; such for instance are logwood blacks and blues. In cotton goods, beside standing these tests, the colours are commonly required to stand also the test of washing with soap; though not so frequently in dyed cottons as in printed cottons.

It is a general rule, admitting however of some few exceptions, that colours obtained from barks and roots, are more permanent than those from woods; and these latter, more so than those from leaves. This rule appears to me not to apply to those leaves, which like sumach, and perhaps weld or wold, contain astringent matter; by astringent matter, meaning tannin and gallic acid. Indeed, these two substances combined as nature usually combines them, are powerful mordants, and have of late years been introduced with great success to give depth and permanency to colours; as in the Turkey-red dye. The extent to which astringent substances can be thus applied, is not yet fully known.

In extracting the colours of many colouring drugs, as yellows and reds, it seems to me, that a full boiling heat ought generally to be avoided: 180° or 190° of Fahrenheit is generally more favourable to brilliancy of colour, than 212°. Hence I should approve of the method employed in the English dye-houses, on the recommendation of count Rumford, of boiling by steam; which unless the copper be very closely covered, which is seldom the case in a dye-house, does not raise the water to a full boiling heat. Some colours however require a continued boiling, and a concentration of the coloured liquor, in which case, the fire-flues ought not to reach high up the boiler.

When a dye vat has performed its office on cloths requiring full and rich colours, it may often serve for *followers*, (that is cloths of inferior quality) which may be winced in it, till the colour be exhausted; as is done in the indigo vat, and the scarlet baths. In like manner the remains of drabs and olives are used up for common blacks.

Of CLOTHS TO BE DYED, wool retains colouring matter more perfectly than cotton, and cotton than linen. Hence of late, attempts have been made to animalize cotton cloth, by impregnating it with animal oils, with animal salts and mucilage, or with animal gelatine (glue). The process of the callicoe printers, who from time immemorial have fixed their mordant by running the piece, after being printed with acetat of alumine, through sheep's dung or cow dung, and the very complicated but effectual and instructive process for dyeing Turkey-red, have suggested this practice; which I believe succeeds on cotton wherever it is applied. In this case, it seems to me that there is a quadruple chemical compound, viz. the cotton, the base of the mordant, the animal matter, and the vegetable colouring matter. In the Adrianople Turkey-red, I am persuaded it is at least a quintuple compound by the addition of the astringent matter furnished by the galling. At all events the Turkey-red process may well suggest the great importance of galls and blood, or other soluble animal matter, in dyeing cotton. The softness to the touch, and the velvet feel for which fine cloth is admired, depends mainly upon previous scouring.

It is essential to a DYE-HOUSE, that it be placed where there is plenty of good water to supply it, and plenty of fall to carry off the spent dye-stuff. The floor of the dye-house should be of *hard* brick closely set, with drains and channels to carry off waste liquor. If not of brick, it should be of stone, or of hard cement, or leached ashes; so as to admit of being accurately washed. The light should be good and in plenty, without letting in too much sunshine: it should come from above; that is, the bottom of the windows should be 12 or 18 inches above the rim of the coppers: the shade of colour is thus most advantageously discerned. There should be conveniences for carrying off steam. The coppers, except one for logwood which may be of iron, should be of brass or copper, and no iron nails be used about them. They should have covers to be used occasionally. The scarlet dye-house should be separate, and the vessels in it should be of tin, or tinned copper. It would be better also, if the black and blue dyes were at a distance from the other colours: want of extreme cleanliness, is a want that occasions great waste and expense, which ultimately falls on the dyer. Over the coppers, should be poles fixed in the walls for the skeins and hanks to hang on, that the dye-liquor dripping from them, may fall back into the copper.

Ladles, wooden shovels, barrels, ladders and barrows, nets and crosses, for wool, winces and reels for piece work, shovels for lime, &c. will be provided of course. The ladders, barrows and winces, should be kept as much as possible to the use of one kind of colour, and scrupulously clean. It is common and convenient, to have a certain quantity of alum dissolved in a given quantity of water in a barrel, to be measured out by the ladle: and so of sulphat of iron, and iron-liquor (acetat of iron): where care is taken not to splash about, this saves much trouble.

In a dye-house, no step should be taken but by weight or measure. All guess-work surely brings waste. Every cotton dye-house, should have a hogshead or two, containing old iron, such as hoops, nails, fragments of all kinds, which should be perpetually supplied with vinegar brewed from cyder, or from coarse meal. The iron liquor, or iron dissolved in vinegar, is absolutely essential to a good black upon cotton, and is not fit to use under six months, and is the better for having been made six years. This iron liquor may be made by means of the pyroligneous acid, as it now is almost universally in England; but, I think the common method of brewing vinegar, is best adapted for the present state of this country. The pyroligneous acid, and tar acid, are in fact vinegar.

Where there is room and convenience, all the parts of the establishment should occupy their own quarter: the scarlet dye-house, the blue dye-house, the black dye-house, should not be intermingled with the apparatus used for other colours. Scarlet, and blue, should be alone. The black may be contiguous to the drabs, olives, bottle greens: or to the chocolates, but should not be next to the pinks or yellows.

All the *dye-woods* should be kept in tight barrels, well guarded from damp and the steam of the dye-house. The drug-house should be fitted up with shelves conveniently, and the floor swept occasionally; it should also be well furnished with weights and scales, steel-yards, stone-ware jugs and pans; cleanliness and neatness are very frugal parts of every place and every process belonging to a dyeing establishment.

This habit of cleanliness should be carried also as far as the *tenters* on which the cloths are hung: they should be frequently examined, wiped always, and washed when necessary. The tenter hooks should be of copper, brass or some similar composition. Iron is only admissible to black cloths. The tenters should be under a shed.

The DRYING-HOUSE is best heated by means of iron stoves with drums and pipes. It is generally made too hot, which hurts the lustre of the colours. I think the heat is often injurious when it exceeds from 120° to 1 0° of Fahrenheit.

STOVE-ROOMS for drying goods, should not be heated by means of a current of hot air thrown into them, as rooms are warmed in large manufactories. There is danger of a current of dust also. If there be current enough gradually to carry away the steam driven off in drying, it is sufficient.

I suggest no improvements in the construction of boilers, or the mode of heating them, being persuaded that in the present state of the art in this country, the beaten path is the most safe and the most profitable. By and by, as manufacture improves, new inventions may be tried; as yet, and while we are hardly out of leading strings, it is too early.

Of the DRUGS used in dyeing. The general remarks I have to make on these drugs, will as properly come in here as elsewhere.

The colouring drugs, employed in dyeing *black*, are galls, sumach, alder bark, walnut-peel, logwood. In printing callicoes, madder, weld, and quercitron are also employed for this purpose, but not generally in dyeing.

Galls. Aleppo galls. Sometimes they are picked, and the choicest sold as blue galls. They are properly astringents, and contain gallic acid and tannin, both of which seem necessary to a full black colour. Indeed the gallic acid chemically separated, seems inadequate to the purpose. This is a dear article, and the other drugs above mentioned are used as substitutes for cheapness chiefly, though not entirely so. But the following experiment of Berthollet seems to prove that the price must be very high, not to preserve to galls their title to preference. A solution was made of green vitriol, or sulphat of iron. Decoctions were made of a quantity equal to 1152 parts of each of the following drugs, which were exhausted of their colouring matter, viz. Aleppo galls, oak bark, sumach, and logwood. The decoction of 1152 parts of galls, decomposed and threw down a precipitate from sulphat of iron, amounting to 267 parts of iron; the precipitate weighed 528 parts. The same quantity of decoction of oak bark, precipitated but 18 parts of iron, and the precipitate weighed 22 parts. The same result took place, when the heart of oak was used; the precipitate from the sap was still less. The same quantity of decoction of sumach, threw down 162 parts of iron. The same quantity of decoction of logwood, threw down 156 parts of iron. These numbers therefore, give an approximation to the relative value of the drugs. Myrobolans are an excellent substitute for galls. Catechu, or Terra Japonica, is defective in gallic acid, though rich in tannin.

Sumach. Rhus coriaria. It grows in Syria, Spain, Portugal, Montpelier; and plentifully in Pennsylvania, where want of population, or want of industry, prevents its being gathered. It gives of itself a brownish yellow or fawn colour. It is used in grays, olives, drabs, &c. Pennsylvania sumach (rhus glabrum) is now (December 1814) worth sixty dollars the ton weight.

Alder bark: vulgarly called oler, or owler bark. I believe this is not much used as yet in America; but in England, particularly at Manchester, its use as an astringent dye, is very extensive: it is about the same value with sumach as a dye-drug. In France, they use also the outward peel of ripe walnuts; *Brou de Noix*, and that very generally. It gives without any mordant, an agreeable, and permanent brownish colour to woollen, which is the more valuable, as the cloth is softer to the touch after it; not being made harsh by a mordant, which always has this effect more or less. It well deserves to be introduced here. Indeed I consider it as indispensable. So does the *bear-berry*, arbutus non ursi, which is the common substitute in Sweden for sumach; and grows in Pennsylvania: see Dr. Muhlenberg's catalogue, page 44. The walnut-peel and bearberry both contribute to a black with iron, and save galls, in browns particularly; but we can do without the bear-berry, though a dye-house would be ill furnished without walnut-peel.

The drugs that give a *red* or reddish dye, are madder, madder roots, Brazil, Brazilletto, Nicaragua, peach, cam, bar wood, kermes, lac, cochineal, archil. I think the santal or red saunders may be dispensed with.

Madder. The common madder in use, is the crop (grappe) Dutch or Zealand madder, prepared and ground in Zealand, previous to exportation. The fresher the plant so prepared, the better. It grows in any part of Pennsylvania just as well as in the Netherlands, provided the ground be good. At the settlement of Harmony, about twenty miles from Pittsburgh, they put in annually eight or ten acres of madder for their own consumption; they use a great deal, but none except what they raise upon their own lands. The only precaution in purchasing crop madder, is, that it should look of a bright yellowish red-brown, and smell fresh and sweetish. It would be one of the most profitable crops a farmer could put in, in this country; and it is neither difficult to raise or to cure.

Madder roots. These are small long roots of madder, usually imported in that state from Smyrna, grown at Lizari, and universally used in the Levant for the Turkey or Adrianople red. In Manchester, every attempt to dye this very fine colour with crop madder has failed; it will produce a good colour, but not that rich full bright red, which characterizes this dye, and which has not yet been produced but by means of Smyrna madder roots. A cargo imported into this country, and distributed for planting, would be a national present. They succeed now in England. About three years ago, I procured some roots from Europe, and distributed them here, but they have been neglected.

Brazil. This is a wood exported from Surinam, growing in the neighbourhood of Fernambouca. Doubtless the richest in colour of all the dye-woods; but like the dye of almost all woods, it is fugitive. A small quantity gives a liveliness and a bloom to madder reds, that improves them greatly. It is an excellent substitute for cochineal in cheap scarlets and crimsons. We get little of it now; but neither dyer or printer can well dispense with it.

Brazilletto. This is an inferior kind of Brazil wood, and substituted for it.

Nicaragua, Peach, Cam, and Bar Woods. These also are now imported, and used as very inferior and cheap substitutes for Brazil and Brazilletto. It would be well worth while to make a set of comparative experiments, as to the quantity and brightness of colouring matter they contain, for the purpose of ascertaining their relative value. The nitro-muriat of tin should be the precipitant for these woods. The colour being equal, their relative values will be accurately expressed by the quantity of tin which the decoction from a given weight of wood will throw down combined with colouring matter. Indeed no dyer ought to purchase these woods, without subjecting a sample to this test. It is great extravagance to use these woods unrasped.

Kermes. This is an insect (coccus ilicis, Linn.) formerly used for dyeing what were called "colours in grain," the kermes having the appearance of a red grain. It is now superseded by the richer dye of the cochineal which is not half so permanent, though brighter. It appears to me, that kermes would be worth importing at the present price of cochineal. Their relative values might be tried in the way I propose, so far as relates to the quantity of colouring matter contained.

Stick lac: seed lac: shell lac. The red colouring matter of the resin lacca, (choosing the stick lac) is very frequently used as a dyeing material on the continent of Europe; but in England, I believe lac is only used for sealing-wax, and black Japan varnish.

Cochineal. This is an insect whose fluids are coloured red, by feeding upon the red juices of the opuntia or prickly pear. Mr. Andrew Ellicot informs me, that the prickly pear grows in most luxuriant abundance, on all the small islands opposite the American coast from Carolina to the Mississippi. If so, it may become in time an article of cultivation worth attention, to people the opuntia with the cochineal insect, and collect them there.

Archil. Orseille, roccella of the French. A moss or lichen, which when prepared with urine, is used for inferior reds and purples, particularly in dyeing silk. It is the plant of which the turnsole is made. The usual chemical test of neutralization. I do not know whether we use it much here, but I do not see how the silk dyer can conveniently dispense with it.

There is only one drug used for dyeing a true *pink* colour, to wit, *carthamus* or safflower. An imitation of pink, or rather a rose colour, can be produced by madder, with a little Brazil; but I know of no substance that gives a true pink except safflower. The mode of preparing it for the purpose, will be detailed when I come to the colour pink.

Mahogany sawdust or shavings, are very useful for dyeing a nankeen colour, on cotton.

The drugs used for the purpose of dyeing *yellow*, are weld or wold, quercitron, old fustic, young fustic, yellow berries, turmeric, zedoary, saffron, golden rod, barberry root.

Weld or wold, (not woad, which is a different substance). Reseda luteola. This is a plant grown in great quantities in France, and in Yorkshire and Kent in England, and might be grown to great advantage in any part of Pennsylvania. It is the only drug used by the London dyers, and callicoe printers, for their finest and fastest yellow upon chintz patterns. Altogether, there is no yellow drug to be compared with it in permanency and brilliancy. The colour requires blue vitriol or sulphat of copper to be added to the aluminous mordant. It might be grown in Pennsylvania as easily as rye.

Querceton bark, or rather quercitron, quercus citrina, lemon-coloured oak; the inner bark of the black oak, quercus nigra. It is a good, a permanent, and a cheap dye; not quite so bright, and not quite so permanent however as weld. But for common calicoes and chintzes, and for patterns that are quickly wanted in the market, it is preferred to weld or wold, because the stain given to the white part of the piece, is sooner discharged on the bleach-green. Dr. Bancroft's book was principally intended to promote the sale and the use of this drug, which he has a patent for importing into England; and doubtless, it has proved a valuable acquisition to the dyer and printer. The modes of using it to the best advantage have been detailed by Dr. Bancroft, whose publication contains much experiment worthy of attention.

Old Fustic. This is the bois jaune, the yellow wood that comes to us in logs, and therefore distinguished by the English dyers, as old fustic. It is used much for drabs, olives, &c., and the callicoe printers use it for their common yellows. It will not bear above one or two washings. The colour is rendered more permanent when used in dyeing, as it generally is, with sumach.

Young Fustic. Fustet of the French; Venice sumach. Of no *peculiar* value; it furnishes a reddish-orange colour, while old fustic gives only a golden yellow.

Yellow Berries. Grains d'Avignon. These require no mordant, but they do not produce a fast colour. The silk dyers use them. And these berries furnish the only chemical yellow used by the callicoe printers of Manchester. For this purpose, a strong decoction is made, and mixed in the proportion of a gallon, with half a pint of nitrat of iron, which retains its buff colour, when the yellow of the berries fades.

Turmeric. This drug also is not improved in colour or fastness by the common mordants. I believe it is only used by the silk dyers. It is very fugitive.

Zedoary. The same remarks apply to this root.

Saffron. The French saffron is the best. It is full of colour, but too dear for common use, and not permanent. It is the common family yellow dye.

Golden rod. Solidago. A very common plant on all the rich bottom land of Pennsylvania and the Genesee country, in its natural state. It gives a tolerable good and fast yellow, and might answer in point of cheapness for common work. So also might the hickory tree, and the common arsmart, (pusicaria urens, polygonum pusicaria;) but unless in cases of scarcity, a dyer does better with three or four known drugs easily procured though imported, that he is in the habit of managing, than with a numerous catalogue of materia tinctoria. This will apply also to the *sarrette*, seratula tinctoria, used in France, but little known in England; and to the *yellow broom*, genista. Lately also, the *Lombardy poplar*, which the experiments of M. Dambournay have brought into vogue, with good reason.

Barberry root. Berberis. This is a rich and bright colour, and exclusively used by the red morocco dyers, to mix with their cochineal red. I cannot tell the exact reason of preference. In Pennsylvania they import the Barberry root from Boston: I do not see why we cannot raise it at home. It ought to be in every garden. The fruit makes an excellent tart, and a beautiful pickle.

The Birch tree furnishes a very useful colour for woollens, and is much used by the French dyers.

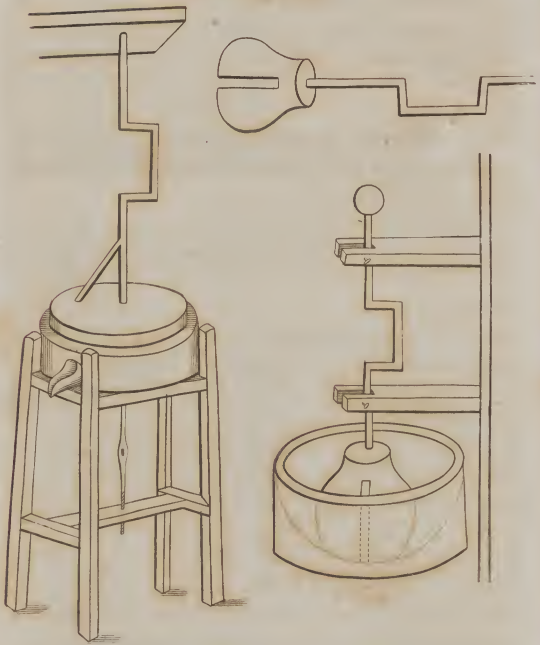
Soot is also used by the French dyers for black-browns: they consider it indispensable for tapestry work.

The drugs used for a *blue* colour, are indigo, pastel, woad.

Indigo is furnished by Guatimala, by South Carolina, by the East Indies.

Face page

Mills for Grinding Indigo.



Guatimala Indigo, is the lightest and the best; it is called Flora indigo, and flotant or floating indigo from its swimming on water: but it is too dear.

The indigo manufacture of South Carolina, is almost abandoned.

The principal source of our supply is the East Indies, where the price is greatly enhanced. I remember East India indigo at half a dollar a pound in Manchester. The indigo must be ground for half a day in a mortar with a twelve or eighteen pound cannon ball. Or, as the indigo dyers in the back country grind it, by working a small millstone inside a stone trough with a spout to it. The millstone being turned round by the crank-handle of an iron bar, one end of which is let into a beam in the ceiling, and the other into the centre of the millstone. The man turns it round by laying hold of the crank. It works inside a stone trough about three inches deep, and the trough is set by means of a screw underneath, that raises it nearer to, or depresses it from the millstone. The trough has a spout in it. The end in the beam, works in a pivot. A hole can be cut any where in the stone to feed it with indigo and a stopper adapted to it. There is a machine something of the same kind invented and used by Mr. Charles Taylor, afterward Dr. Taylor, of Manchester; viz. an iron ball with a slit in it, worked by a crank-handle in a mortar. The slit increases the friction. (See the figures in the plate.) The indigo should be worked first dry: then in a paste. It is advantageous for fine colours, to wash it well in hot water after it is ground, to extract a great deal of dirty matter combined with it. There is not much above one half the weight of the indigo of real colouring matter. However, this differs so greatly in proportion to the quantity, that no rule can be laid down concerning it. When the indigo is patiently and accurately ground, it should be mixed with water in a pan not too shallow but rather so; and then the indigo being left to settle for two or three minutes that the unground particles if any, may fall to the bottom, the pan should be turned round backward and forward, in a vessel of water in a half circle, till the finer parts of the indigo in the pan are gently thrown out, so that if there be any lumps, they may be ground over again. It is essential that the indigo be in an impalpable powder, first to save it—to make it go farther; and secondly, to secure evenness in the dyeing of the pieces. This drug is so dear, that these directions ought to be strictly adhered to. If they are well followed, and the indigo carefully, and laboriously ground into a perfectly fine powder, six pounds and a quarter of the best East India indigo, may be made to dye one hundred pounds weight of cloth, a full deep blue.

Pastel. Woad. These are much used, both on the continent of Europe and in England, to save indigo. The woad is distinguished into the field woad and the garden woad or pastel; but they amount to the same thing. The plant, isatis, glastum, is much cultivated in Holland and in Languedoc in France; and made up in bundles or bales of about a hundred and fifty pounds weight. It resembles little clods of dry earth of a mud colour, with fibres interwoven in them. It is suffered to undergo a kind of putrefaction, and then made into masses to dry. Berthollet details the process, which will be worth consulting when we grow it at home, as we ought to do. It appears to furnish a fecula of the nature of indigo, and equally fast; and indeed it is used for the purpose of saving indigo; I am in doubt whether much is gained by it altogether here; and considering the value of labour, perhaps we do not lose much by confining our blues to the indigo vat. But if it were not of use in Europe, it would not be so universally employed. I have heard but of one parcel hitherto imported into this country (1814). The mode of using it will be detailed under the blue dye.

Annatto. Spanish Annatto, Rocou. A reddish or brownish-red paste, brought from South America and prepared from the seeds of the bixa orellana. It is used for orange colours, and salmon colours upon silks; but very little in the woollen or cotton dye. The solvent is an equal weight of pot or pearl ash, boiled with it in water. This is Scot's patent nankin dye. The colour is fugitive, being destroyed both by the air, and by washing. When nankin-coloured breeches or pantaloons are washed, a little of this, mixed with the last rincing, gives a kind of nankin tinge to the faded cotton. It is used also to colour cheese.

The dyer will also want drugs for *mordants* and *tests.* Oil of vitriol; aqua fortis; spirit of salt; common salt; sal ammoniac; tin; bismuth; alum; green vitriol; green copperas or sulphat of iron; acetat of iron; blue vitriol or sulphat of copper; verdigris; yellow orpiment; argol; pot and pearl ash; lime; prussiat of potash; tincture of galls.

Oil of vitriol, concentrated, or strong sulphuric acid. This will be wanted to dissolve indigo for Saxon blue, used chiefly for silks. It ought to be limpid as water. If it be not so, it (the oil of vitriol) must be boiled in a glass or leaden vessel till it becomes limpid: this may be done in a retort in a sand bath over a fire: or it may be boiled in small quantities in a glass capsule, or in a Florence flask; adding a very small quantity of pure nitre. It ought to weigh twenty-nine and a half ounces to the wine pint. The indigo ought to be well ground, and well washed in boiling water till it comes off clear, and then dried, before it is put to dissolve in the oil of vitriol. If the oil of vitriol be not very strong, it will not dissolve the indigo.

Aqua fortis, or strong nitric acid: colourless. This will be wanted to make the scarlet composition, and the bismuth solution. It ought to be freed from sulphuric acid by nitrat of barytes, and from muriatic acid by nitrat of silver. I shall dilate upon this when I come to the scarlet dye.

Spirit of salt, or muriatic acid. This should be cleared from the contamination of volatile sulphureous acid, by means of muriat of barytes. If the dyer be not, as he ought to be, chemist enough to do this for himself, he should employ a chemist to do it for him.

Common salt requires no observation; nor is it often wanted, although the French use it with bismuth dissolved in aqua fortis.

Sal ammoniac. All the precaution about this drug, necessary to be observed is, to ascertain whether it contains accidentally any iron. If it does, it will sadden the scarlet colour. It must be tried for this purpose with prussiat of potash or of lime, and with tincture of galls. The dirt should be scraped off the lumps.

Tin. The remarks I have to make on the solution of tin, I shall reserve for the section on the scarlet dye.

Bismuth. The solution of this semi-metal, lately introduced in France, for the bright clarets, violets, &c. I shall give when I come to those colours.

Alum. The Roman and the English alum, are generally free from iron. Whatever alum is purchased, must be tested to ascertain its purity in this respect. If it be found to contain iron, and no good alum can be procured, dissolve your alum in boiling water, and expose it for a week or fortnight in shallow vessels to the air. The iron will gradually become oxyded, and separate in the form of rust. Filter the solution, evaporate the water, and recrystallize it. Some recommend passing oxymuriat gas through the solution, or boiling it with a small quantity of nitric acid: but the method I propose is more simple and as effectual, with patience.

Green Vitriol. Sulphat of iron. Green copperas. This is used to strike a black colour with astringent vegetables, and also to de-oxydize or de-oxygenate indigo, and thereby render it soluble in alkali, and in lime. It should be purchased of a light green colour, in large crystals, free from rust on the outside as much as possible, and should be kept close, and not exposed to the air. The air oxyds the iron, which falls down from the solution in a rusty state, and the solution becomes acid. A solution of green vitriol, should be kept with a piece of iron in it, to remedy this. It is true the rust of iron will strike a deeper black than the fresh made green vitriol, but it is the latter only that can be applied evenly and regularly as a mordant; and exposing the cloth to air, makes the black perfect. Moreover in the blue dye, iron already oxyded, is of no use in abstracting oxygen from the indigo. These remarks should be attended to.

Nitrat of Iron. An admirable mordant where the cloth will bear the expense.

Acetat of Iron. No good black can be struck on callicoe by means of any other mordant, than acetat or pyrolignat of iron, which are the same thing. A hogshead containing any old rusty fragments of iron should be filled with vinegar, which may be brewed for the purpose, either from cider or from meal of any kind. It should be frequently stirred, and in about six months it will be tolerably good. I do not know that the value of this combination of acid with iron, has been tried in the woollen or silk dye, but I suspect it would be worth while.

Blue Vitriol, or sulphat of copper. Blue copperas. If this be rusty on the outside, it is contaminated with iron. Dissolve it in boiling water, expose it in shallow pans to the air: filter it, and recrystallize it, if it be wanted free from iron. It is so wanted, when it is used as a partial mordant to weld yellows; but it is not of much consequence when merely used for a false blue dye with logwood: or with logwood in finishing the blacks of woollen cloth or of hats.

Verdigrease: verdigris. I think this is better for being kept slightly moistened with vinegar. This drug is now so dear, that a precipitate of sulphat of copper (blue vitriol) by means of potash may be substituted for it. Verdigris might be manufactured to great profit in Pennsylvania, by means of the fox grape. It is preferable to blue vitriol.

Yellow Orpiment. For the indigo vat. Generally confined to callicoe printers.

Bismuth in nitric acid has of late years been introduced among the French dyers as a mordant, but not generally.

Argol, or tartar, red and white. This is essential to the dyeing of the greater part of the colours fixed on woollens by means of mordants. The addition of argol to alum, tin, iron, and bismuth, serves to brighten the colour and render it more permanent on woollen, but not on cotton; which seems to take a better colour with the acetats, where the price will permit them to be used. Dyers have a notion that red argol is better for some colours than white, and vice versâ; but I do not think there is any good reason of preference. I am not well satisfied on the theory of tartar as necessary to the dyeing of woollen; but I think it prevents the alum from crystallizing, and weakens the affinity of the sulphuric acid.

Pot and Pearl Ash. Pearl ash is too often adulterated with common salt. If a sample of it will not deliquesce or absorb moisture, on exposure to air, it is not good.

Lime. This should be purchased fresh, slacked immediately, and packed down into tight casks, closed tightly also on top from the air. If not slacked first, the steam and moisture in a dye-house will be apt to slack it, and even set fire to the casks in some cases.

Prussiat of Lime, and of Potash; and Tincture of Galls. These should be kept as tests of the presence of iron. Prussiat of potash is made thus: take a clear strong solution of potash: add to it while boiling in a Florence flask, powder of Prussian blue, while it continues to deprive the Prussian blue of its colour, and converts it into a rusty brown: when on the addition of a little more Prussian blue it ceases to have this effect, then filter it and bottle it for use. If the alkali was very strong, it may be diluted with an equal quantity of distilled or snow water. A single drop, will convert iron into Prussian blue again. Prussiat of lime, which is in some cases preferable, is made in like manner.

For tincture of galls; take an ounce of powdered galls, and digest them in a moderate warmth in a quart of fourth proof spirit, or whiskey, for a couple of days. Then filter it. A drop will produce an inky tinge when any iron is present. There will also be wanted,

A thermometer in a tin case, such as the brewers make use of; this will be very useful.

A *dyer's establishment* then, will consist of

A drug house, with shelves, steelyards, weights and scales, pans, &c.

A common dye-house, with holes or flues to let out the steam: furnished with the necessary vats, coppers, casks and boilers. The fires on the outside.

A scarlet dye-house, if he dyes scarlet.

A fulling mill for cleansing the pieces when dyed.

A field contiguous to the house, for drying goods in the open air, under a shed.

A stove-house, with iron stoves, drums and pipes.

A finishing room and packing room.

A store and compting-house.

Coppers, vats, winces, ladders, barrows, shovels, and other utensils.

A separate set of vats for the blue dye of cotton goods.

In the whole establishment, much of the profit will depend upon an accurate and incessant attention to cleanliness; and next to that, a constant employment in every process, of weight and measure; and the keeping memoranda wherever any new process is attempted. Nothing should be left, if it can be prevented, to guessing or conjecturing, or to hazard.

THE DYEING OF WOOLLEN.

ALL colours are better dyed in the wool, than in the piece. It is evidently more difficult to make the dye penetrate perfectly through the twist of piece goods, than through the loose fibres of the wool. In this country, where weavers are in such demand, that they sometimes refuse to weave dyed wool, piece goods are dyed, but never so well. By and by, as manufactures extend, this will be altered; as it ought to be.

Before wool can be well dyed, it must be cleansed from its natural grease, which seems much more abundant in the wool of merino sheep, than in any other. No cloth can receive so bright a colour, nor can it have the same soft velvety character to the touch and to the eye-sight, if it be dyed without scouring, as if it be scoured. The brightness of the colour is also improved by sulphuring, but I do not think it is thus improved to the touch or feeling. I think no dye can so thoroughly penetrate unscoured as scoured wool.

To cleanse or scour wool. That is, raw wool. In a clean boiler of any kind that will hold twenty measures of whatever kind, put three measures of stale urine, and twelve measures of water: bring the liquor to a moderate heat, never to reach 130° of Fahrenheit;

about 120 is the proper temperature. Put the wool to be scoured in a net loosely; about four pounds to each pailful of urine. Work it about for twenty minutes, then take it out and wash it well.

Or treat wool in the same way with one pound of soft soap to about twenty-five pounds of wool, for coarse, or fine hard soap for fine goods. The colour will be better for using white soap. Take care the heat is kept under 130°, and that the wool is not kept in more than twenty minutes. Good soap is too dear to be used for this purpose unless for fine goods.

Or to a hundred pounds of raw wool, take a bushel of bran and a pound of potash. When you use potash the heat should not exceed 120° of Fahrenheit.

If a net be not used, the wool can be taken out and laid on ladders across the copper.

The washing and beetling must be continued while any, the least dirty tinge appears in the water. Wool will sometimes lose nearly a fourth of its weight by this indispensable operation.

Boiling sets the grease, and injures the wool.

As oil is often used in spinning wool, the proportions must be greater in this case of urine or soap. A little potash may also be added, where oil has been used to the yarn; but cautiously, for potash acts on wool. If potash be used alone to cleanse oiled yarn, use one pound potash to fifty pounds yarn, at the heat of 120° at the highest.

The wool of diseased sheep can never be well scoured. If in the usual mode of scouring the wool continues dirty, a disease may be suspected.

If the wool be intended for any fine and bright colours, it will be the better for being either sulphured, or exposed for a day to the action of the sulphureous acid.

Woollen is *sulphured*, by being hung up on very clean pegs or laths in a close room, but with a window in it, and exposed to the fumes of burning brimstone on earthen dishes beneath, for ten or twelve hours; then washed well. This is generally repeated. See the sulphuring of silk.

Or it may be improved in colour, by immersing it for twelve hours in oil of vitriol made quite black by throwing into it cork, flour, rosin, or sugar, and then diluting the acid till it be about the strength of common vinegar; wash the cloth afterward thoroughly. These acid processes are not often used, but for fine goods and lively colours, in England; and in this country may be dispensed with, for all common colours. Sulphuring is best, and cheapest. The impregnation of water with sulphureous acid gas, is too troublesome. All goods to be dyed, require to be soaked in water previously, and then pressed, that they may imbibe the colour evenly. This ought also to be done previous to aluming. It should be done in water brought to a scalding heat. But when cloths are well scoured, this preliminary soaking is not absolutely necessary for aluming, although it is for dyeing.

Homassel's directions for sulphuring are as follow. The room should be close: for the sulphureous vapour, will spoil all the colours in the vicinity. The window should open on the outside, and also the door, for it is frequently necessary to stretch or to turn the goods. The perches which serve for silk as well as woollen should be kept very clean. Examine the sulphur, that there be no accidental dirt or mixture capable of producing smoke. Burn it in an earthen dish or an old mortar of any kind but iron. Before you burn it within side the room, set fire to it out of doors, that you may be sure it will not smoke. Leave the goods exposed to this vapour twelve hours, and then dry them. This is the common process.

But it is sufficient simply to detail this process, to discover how imperfect it is. The sulphureous acid here, does no more than attach itself to the surface, and does not penetrate the interior of the silk, so that the outside only is hereby partially bleached. By employing the modern discoveries of the properties of this sulphureous acid, we can establish a practice founded on surer principles.

The sulphureous acid, resulting from the imperfect combustion of sulphur, differs from the sulphuric acid, in containing less oxygen than this last, and is indeed a middle substance between sulphur and sulphuric acid. This gas unites very easily with water, and in this combination it may be employed to bleach woollen and silk.

To prepare it with economy, put chopt straw into a matrass closed with a stopper, or a cork, through which you may insert a glass tube, of which one end goes into water at the bottom of a tubulated receiver. In the tubulure of this receiver insert a tube through a cork, and let the end of the tube enter the water about the eighth of an inch. To another tubulure in this receiver, adapt a bent tube that goes into a second receiver or bottle, and so on if you please to a third: in short use the apparatus known to every chemist under the name of Wolf's apparatus: (greatly improved in point of safety and efficiency by Mr. W. Hembell of Philadelphia. *T. C.*) Pour strong oil of vitriol on this cut straw: lute all the junctures: the oil of vitriol is decomposed; a part of its oxygen is abstracted by the straw and forms water with the hydrogen, and carbonic acid with the carbon of the straw, while the sulphureous acid comes over, and unites with the water.

(The apparatus employed for bleaching the silk and cotton with the sulphureous acid thus obtained, may be any vessel wherein the goods can be worked by a wince or soaked in the liquor. This can be contrived although the box be covered to keep in the gas more perfectly, by means of apertures in the cover. Thus, the silk or woollen, rolled on rollers at one end, may be made to pass through the liquor the whole length of the box, by means of a division in the middle not reaching quite to the bottom. The woollen cloth for instance is drawn by one end under this division, and the end so passing under, immersed in the liquor, is rolled on a wooden roller at the other end, and so backward and forward: or the whole of the goods may be permitted to soak in this sulphureous acid till they are sufficiently bleached.

Generally for a fine white, they give two sulphurings; then wash at the river, and finish with Spanish white.

Blueing is done by means of one part of Prussian blue in four hundred parts of water; wincing the goods in this rapidly. The goods are then entered into a *warm* bath of soap and water to give the requisite softness.

There are some plants that may be used for this purpose, as the saponaica, the garden lichnis and some others. But I fancy soap is the best material. *T. C.*)

Of Dyeing Blue on Woollens, and Cottons. First with pastel, or with woad. These two plants are nearly the same; the garden pastel, is the pastel; the field pastel is the woad. They differ as to their dyeing properties, merely in the first affording more colour. These plants have not been used so extensively since the introduction of indigo, but they are still in common use every where in Europe. The dyer may do well without them, and they are troublesome to manage, owing in a great degree to the variations in the quality of the drug; but the colour they do afford, is good and solid; and in Europe is obtained at a cheaper rate than the blue from indigo alone. They do not afford a full deep blue.

The pastel or woad vats, are set in the ground, and project upward above the floor, no higher than is necessary for the dyers to work them conveniently. They are nine or ten feet deep, and from five to six feet diameter; made of staves six inches broad and two inches thick, bound with iron hoops about three feet asunder. The bottom instead of being made of wood, may be made with cement, such as lime, pounded bricks and leached ashes. The drugs of which the vat is composed, are stirred up by means of a long rake, or rather a semicircular piece of wood with a handle to it, used to plunge in the liquor, and *force* the surface down toward the bottom.

The cloth is worked by means of hooks fastened to the end of a staff. An iron hoop covered with a net whose meshes are about an inch square, is let down into the vat to prevent the cloth from mixing with the grounds or sediment at the bottom.

Sometimes they make use of brandy puncheons, or well cleansed oil puncheons, as vats for this purpose; but they should be iron hooped, and the hoops painted.

The boiler or cauldron should be placed near to the vat.

The process for setting a woad vat is as follows.

For a vat of nine feet deep by five feet and three quarters over, take about four hundred weight of woad, break it into small pieces, and throw it into the vat. Boil in the contiguous boiler, thirty-three pounds of weld with a sufficient quantity of water for the vat; add as much madder, and about a bushel or a little more of bran; continue the boiling for half an hour; add a few buckets of water; let the liquor settle, and take out the weld;* turn the liquor into the vat, stirring the vat all the time; stir the liqour well afterwards in the vat, also, for a quarter of an hour, to mix together all the contents; then cover up the vat close for six hours; open it at the end of that time; stir up the contents for half an hour; do so every three hours

* The liquor need not be very clear: if some of the bran and madder should go into the vat I see no harm it can do. *T. C.*

for three or four times. When blue veins begin to appear in the liquor, add between eight and nine pounds of good *fresh burnt* lime; lime that has remained exposed to the air for some time is good for little: if you can get no other, use the more of it; but spent lime is worse than useless. The vat now puts on a new character; its colour is much deepened, and the vapour from it is more penetrating.

When indigo is used with the woad vat, this is the point of time when it is to be put in, being first carefully, patiently, finely ground into a very smooth paste; the quantity depends on the shade of blue you require; you may use from five to five and twenty pounds weight.

So soon as on plunging in the semicircular rake, you perceive a fine blue froth on top of the liquor, let the contents be well stirred up twice in six hours, and one or two pounds more of lime may be added: take care to leave the surface exposed to the air, no longer than is necessary to stir it: indeed it would be an improvement to have an opening in the cover that might just admit the rake, and a lid to shut down upon the opening. During all this time, the warmth is to be preserved in the liquor by covering it close as much as possible.

The vat is in proper order for dyeing, when the sediment, and the body of the liquor are of a fine brownish green colour—when the froth at the top exposed to the air, is of a fine blue—when a pattern immersed for a couple of hours in the liquor, comes out a grass green colour, and gradually turns blue on exposure to air.

Sometimes a vat will not furnish a good colour because it is too cold: sometimes, because it has been overcharged with lime: sometimes because it runs into a state of putrefaction.

In the first case, all that is necessary, is to heat part of the liquor, and return it hot into the vat, stirring up the contents for twenty minutes with the rake, and then covering it up, to preserve this renewed warmth.

In the second case, reheat in the boiler part of the liquor; then add about a couple of pecks of bran, and a few pounds (four or five) of madder; stir these in the liquor, but do not rake up the sediment; and let it remain covered. If the fault is trifling, the addition of the bran and madder will answer without raking it. Leave it to rest, for a day or two, or even more. Some add crude tartar to a vat so circumstanced, with a view to neutralize the lime; but I believe the practice is not sanctioned by common usage.

If the contents of the vat putrefy, which may be known by the disappearing of the blue veins, and of the blue froth—by the rusty colour of the liquor—by the sediment spontaneously beginning to rise—and by the fetid smell of the vat, lime must be added, and the grounds raked up: in two hours more, a little more lime may be added, and the sediment stirred again; and so on, cautiously, till the evil be remedied.

Hence the skill in treating the woad-vat, depends on the proper addition of lime to prevent the too hasty fermentation of the vegetable substances employed to disoxygenate the indigo, which would destroy the colouring matter; and to dissolve a part of the colouring matter so disoxygenated. The lime is gradually precipitated in the form of pulverized limestone by the addition of carbonic acid proceeding from the gradual fermentation of the madder, the bran, and the decoction of weld. Hence the necessity of now and then adding a small quantity of fresh lime, to renew the necessary solvent.

When goods are to be dyed, the vat should be stirred, and left to settle for about two hours before the goods are entered. The dyer then lets down his cross, his net or his trellis, to prevent the sediment and cloth coming in contact. The wool, whether unspun or in the yarn or in the piece, should be pressed out of warm water before it is entered into the vat.

It is not easy to dye an even colour in a full rich vat: it is better done for bright colours, by making use of vats that have been in part worked, and are beginning to cool, finishing in a fresh vat.

When goods have been dyed blue, they should be carefully washed to get rid of all colour that adheres mechanically only: and indeed they would be improved by being fulled with a small quantity of white soap, which has no effect upon the blue colour, but cleans the cloth from any superfluous sediment.

I have made no distinction between the pastel and the woad vat, because the process is the same in both vats.

The woad vat is used, to give a blue ground to black.

In setting the vat, the old liquor of a spent madder copper may be used to save madder, which like the weld is of no use as a colouring, but only as a fermenting ingredient. In this point of view, the weld (especially in this country) might be saved, by increasing the proportions of madder and bran: I do not think quercitron bark would be a proper substitute, because it is more astringent, and not so fermentable as weld, but I think weld might be superseded by common hay.

Five pounds of indigo of the best kind, contain near as much colouring matter as two hundred pounds of woad, as is said.

The vat should never have lime added to it just before it is reheated. In Holland, to save the trouble of reheating the vat repeatedly, they have metal vats, six feet deep, four feet and a half at the bottom, and five feet and a half at the top; the bottom part for two and a half feet upward, is made of lead, the upper part for three and a half feet is made of copper: the vat is surrounded with a brick wall six inches thick, and the intermediate space is filled with warm embers or wood ashes, high enough to keep up a continued moderate heat. When cold, the embers can be removed, by taking out a brick or two at the bottom. In my opinion it can be cheaply warmed by means of a supply of steam even from a common kettle that would hold a couple or three gallons. If the vat be of wood the steam could be thrown in; if of metal, it could fill an interstice on the outside.

All the lime used, should be previously slacked.

There is no advantage in letting the bran liquor grow sour, either in the vat or out of it.

These instructions are all that are principally necessary when it is intended to dye blue with woad, either with or without indigo.

The Woad or Pastel Vat according to Homassel.—To set this vat, it is useful to employ either putrid water, or an old vat of madder, to accelerate the fermentation of the woad; but if you have not these, proceed thus:

The day before you set your vat, grind twelve or fifteen pounds of woad, and having put it in a basket, pour hot water upon it to moisten it. Let it thus remain till it comes down to the warmth of leaven. Then take four ounces of yeast, and mix it with warm water, add it to the pastel or woad and stir it in; cover it so that it may retain its heat. In a short time the fermentation begins, and the woad becomes of a fine green colour; this serves as a ferment or leaven for the vat. After this, common water will answer the purpose, which when boiled for a short time is emptied into the vat, but the woad must not be put in while boiling, otherwise it will set, and be injured. Break the lumps of three or four balls of pastel (they are about one hundred and fifty pounds each) and put them in the vat; and when the heat is sufficiently moderated not to burn the leaven or ferment prepared the day before, and which by this time ought to be of a fine green colour, and in a state of lively fermentation, put this in also; stir the vat and cover it; but you must put your ear close to it from time to time, to observe the gentle noise of the fermentation within, which should not be permitted to go on too hastily; this may be prevented by throwing in a small wine glass full of slacked lime each time you stir the vat, for this absorbs part of the carbonic acid gas which is extricated; this should be done occasionally till the moment when the blue tinge appears; at which time, and while the fermentation is yet lively, add to the vat ten pounds of well ground and sifted indigo, and stir the vat well, then let it rest covered, during four hours. After this, try the vat with small specimens of woollen, till you see them come out a full green and turn blue in the air. While you are trying these sample-pieces, take care that the fermentation does not proceed too wildly, before all the indigo is dissolved; if this should threaten, stop it now and then with a small handful of lime. The fermentation ought to be nearly confined to the bottom; if the liquor be ill coloured, and the working of the vat throws gross particles up to the top, it is a sign it works too strongly, and is to be corrected (but cautiously) with *small* quantities of lime; for if so much be thrown in as to stop the fermentation, you will get no colour. Should this happen, you must refresh it with some woad, set to ferment with yeast—or with tartar and bran—or with madder—but the shortest way is to throw in about thirty pounds of woad well prepared and green, and to reheat part of the liquor, and guard against such an accident in future. For this reason, in all blue dye-houses, there is a guederon, or woad-man, whose only business it is, to take care of the vats, to stir them every six hours, and as it is wanted, to put in the requisite quantity of lime. Few of these men know the reason why lime is put into the vat; they say it makes the vat work kindly; for when the fermentation is too hasty, the vat becomes greasy, and the goods are spotted; too much lime on the contrary, stops all fermentation and kills the vat. When the specimens or sample-pieces which have been an hour in the liquor, exhibit the colour required, boil some river water and fill up the vat. This will not weaken the liquor; on the contrary the admixture of boiling water, will enliven the fermentation, and increase the depth of colour. When full, stir it, and let it rest covered for four hours, when it will be fit to work; but before you stir it this time, add a little lime, lest the warmth during four hours, and the agitation of the liquor during the working of the vat, should excite the fermentation too strongly.

The eye and the ear, must not alone be trusted to by the workmen, for the purpose of ascertaining whether the vat is in order; the sense of smelling too will greatly assist; for the odour is much the same as in the pencil blue, and may be recognized by dissolving an ounce of indigo by means of liver of sulphur, but the pastel vat ought not to smell quite so strong, although similar; but it should be like a mixture of volatile alkali and pencil blue. The woad-man will be guided by this odour, as to when the vat is fit for work; and by it he will be guided also in putting in his lime. If the vat should blacken, lessen the quantity of lime. If on stirring it, you see fine blue veins shoot through the yellow liquor, you may work it boldly. With some practice the directions here given are enough to make a good workman.

When you dye, let down your net to the middle of the vat; work your cloth by means of hooks, with the greatest attention to prevent its taking air while you are dyeing it. When dyed, hang it on hooks that can be fixed as they are wanted, and one end being connected with a wince, by turning this, the cloth may be wrung to free it from superfluous liquor, and then opened to be blued by the air. If the colour be not deep enough, give it another dipping. The vat stirred twice a-day, may be worked for three days. The cooler the liquor, the lighter the blue. No dye-house for blue colours, should have less than three vats in different states, that a piece begun to be dyed in one, may be finished in another.

But if there be only one woad vat it may be occasionally reheated, by boiling a part of the clear liquor in a boiler, and returning it into the vat; then stir the vat and let it rest for six hours; then add some lime and stir it again; it must be stirred every six hours, but not used for dyeing till twenty-four hours after it has been heated afresh.

The blue of the pastel or woad vat, is very solid, but not so bright as the blue of the indigo vat.

Of dyeing Blue on Woollen with Indigo alone. Indigo is made soluble in lime or alkali, by disoxygenation alone. Three kinds of substances are employed by dyers to disoxygenate indigo: first, fermentable substances, such as bran and madder. Secondly, fresh green vitriol, or sulphat of iron. Thirdly, orpiment, red or yellow; that is, sulphuret of arsenic. Other substances will produce the same effect, such as sugar, liver of sulphur, &c., but experience has given its sanction to these.

Of the Bran and Madder Vat. This is the vat commonly used by the blue dyers of Pennsylvania, and does not differ in its mode of operation from the woad vat. It is also the common vat for the wool-dye, employed in Europe. The vats are conical, from two to four feet in diameter at the top, from five to six feet deep, and from one foot to eighteen inches at the bottom. A vat four feet at top, two feet at bottom, and six feet deep, will hold about three hundred and fifteen wine gallons: a vat two feet diameter at the top, one foot at the bottom and five feet deep, will hold a little above sixty-six wine gallons. The proportions of the materials are the same whatever be the size of the vat. In general the bottom of the vat should not exceed eighteen inches. The lower part of the vat may be copper, the upper part wood. A vat may be proportioned in size, about fifty gallons to a pound of indigo. In America, the back country dyers use a vat of this description, in which they can conveniently work about two pounds of indigo at a time. A small fire-place at the lower part of the copper but above the sediment, in which fire is put, enables the dyer to keep up a moderate heat in the vat; the flame strikes against the lower part of the copper, and circulating round it, passes up a flue into the chimney. A moderate fire is sufficient for the purpose of keeping the vat at the necessary heat.

Two pounds of indigo are very carefully and patiently ground into an impalpable paste, which ought to be washed through a fine sieve; very small particles unground, will stain the goods unevenly. Fine and patient grinding are essential; I have said this more than once before, and I shall repeat it as opportunity offers, that it may be taken for granted as a condition absolutely necessary. In mean time from five to six quarts of sifted bran, and one pound of madder, are to be put into the vat half filled with boiling water. It would be better to boil them separately for two or three hours. Then, two pounds of potash, previously broken and dissolved in hot water, are added: it is better to dissolve the potash separately, for it takes some time to dissolve; and lumps of it may remain too long undissolved in the vat. Lime is not used in this vat, but the strength of the potash itself would be greatly increased by the addition of a pound of lime to the liquor in which the potash is previously dissolved; as the practice is with the soap boilers, and with the callicoe printers, who always make use of pure or caustic potash made so with lime, as the solvent of their indigo for pencil blue.

Now stir up the liquor containing the madder, bran and potash. When this is done, introduce the indigo into the vat either through a sieve, or by washing off from the indigo paste, gradually, all the finer parts of the indigo, giving a little time for the sediment to settle; this sediment must be ground again and again, till it remains suspended in the water in a fine powder: in this state it must be introduced into the vat. During all this time, the vat must be kept closely covered, unless so long as is absolutely necessary to introduce the ingredients. When the indigo is put in, fill up the vat with hot water, so as to make the whole body of the liquor, below a scald. The vat should be filled within four inches of the top. Cover it carefully from the air, and let it rest for about ten hours. Hence it is convenient to have your vat set about ten o'clock at night, and open it the first thing the next morning. The heat should be confined within 135° of Fahrenheit's thermometer, which it ought not to exceed. It is of consequence to work by a thermometer.

In the morning, open the vat and plunge your rake several times with force from the top to the bottom of the vat. Cover the vat closely again, and feed the fire so as to keep up a warmth in the liquor, such as you can just bear your hand in for a short time and no more, or rather about 135° of Fahrenheit. In two hours, again uncover the vat, and plunge in the rake half a dozen times. If bubbles appear—if a thick blue froth rises to the top and puts on presently a dark green colour, and the coppery hue, the vat is ready for dipping the goods. Try the state of the vat every two hours until it puts on these appearances, but take care to keep it covered in the intermediate time. Should the froth appear of a pale blue instead of a coppery green colour, sprinkle into it a quarter of a pound of madder. Should the liquor be of a pale colour with a whitish scum, it must be reheated by boiling a part of it, and a small quantity of all the ingredients with about half a pound of fresh slacked lime should be put in.

Frequent opening of the vat, has two mischievous effects: first, it tends to cool the liquor at the surface; and secondly, it brings back the dissolved and green indigo into an undissolved and blue state, by allowing it to reabsorb oxygen from the atmosphere. A good workman will give a full blue to one hundred pounds weight of woollen, by means of about six pounds of the finest indigo, such as that of Guatimala.

I have said, that the vat should be covered: but to keep in the warmth and exclude the air, it is of great use to cover the wooden top with blankets.

A vat of this description being in order, and your cloth intended to be dyed, well scoured from the grease (otherwise it is in vain to expect an even dye, or that the cloth should be soft to the feel) let it be dipped in hot water and evenly pressed, so as to be evenly moist throughout.

The vat being full to within three or four inches of the top, and the body of the liquor of a full warmth, there will be (if in order for dyeing) two or three gallons of copper-blue froth or head, on the top of it; and the body of the liquor will be green. Take off the froth, and put it by in some vessel that will hold it. Then let down the net gently to the top of the sediment, taking care not to disturb it; and then fix your stick or cross about an inch and a half below the surface of the dye liquor, for the purpose of hauling the cloth over it. Haul the cloth (previously moistened in hot water and evenly pressed) into the vat, beginning at one end, keeping it open, till the whole is hauled into the vat; persevere in hauling it backward and forward for at least twenty minutes, keeping it all this time in the dye, and covered with it. After this process, begin at one end of the cloth, wring it up, and take it on the folding board, and fold it over till it becomes of an even blue colour, the air giving to it the blue tinge, instead of the green. When the whole cloth has thus acquired an even blue colour by exposure to air, and not till then, dip it again, hauling it over the cross and under the liquor. Take it in folds on the folding board as before; carry it away; take out the net and cross; return the froth into the vat; plunge in the rake half a dozen times; cover the vat close; keep up by means of a moderate fire, a warmth somewhat below a scald, such as you can conveniently bear your hand in; or 135° of Fahrenheit's scale: let all remain for an hour or two; then open the vat; put in the net carefully, and the cross; enter the cloth again, and proceed as before, until the colour required be nearly obtained.

The cloth should now be milled a second time. If before it be again entered for the last time, four or five pounds of well powdered woad, be mixed with the ingredients in the vat, the colour will be improved. The woad should be put in at once, after the cloth is taken out; but though convenient as an ingredient, woad is not necessary.

In hot weather, the vat need not be heated more than once in three or four weeks: maggots will now and then appear on the surface, which must be taken off. When the dye becomes glutinous by use, it must be boiled (that is the clear part of it, freed from the sediment,) and scummed; return the liquor upon the sediment, adding a small quantity of lime, which settles the grounds. Manganese is sometimes put into a vat to make it give out all its colour, but I think it useless. Two or three small bundles of hay, or some stale urine, are often of great use to make a vat come to, when it does not work well. Indeed I am strongly of opinion that common hay may be made to supply the place of madder. The sediment should be perfectly settled before the net is let down.

After full colours are dyed, the vat will serve very well for light colours; indeed these last cannot be dyed so well in a fresh vat, as in one that has been already used.

The method of setting an Indigo vat, by M. Homassel.—For a boiler of from thirty-six to fifty buckets of water, employ four pounds of indigo of a fine copper colour, two pounds of madder, eight pounds of pearl ash (*cendres gravelèes*, calcined wine lees) or of potash, and half a French bushel of good bran.

Fill the boiler three-fourths full of river water; put in four pounds of the alkali, a pound and a half of madder, and a quarter of a bushel of bran. (Note: that the English bushel contains 2150 cubic inches, but the French *boisseau* contains but 640 French and 681$\frac{4}{10}$ English cubic inches according to Romè de L'Isle, so that the quantity prescribed for four pounds of indigo, is little more than one-sixth of an English bushel.) Boil these together for *at least* four hours; this is absolutely necessary. When the liquor has boiled during that time, let it rest for twenty minutes, and and strain it clear from the sediment.

While the bath or liquor is boiling, prepare the indigo, which it is absolutely essential should be bruised into a paste fine enough to pass through a fine sieve, which it must be made to do. The sediment that will not pass through, must be ground over again. Put in the indigo, and take care that the boiler be not more than two-thirds full; nor should the heat be now permitted to exceed 45 degrees of Reaumur's thermometer or 133 of Fahrenheit, to which degree it should be kept up; a few degrees below this, will prevent its working well, and a few degrees above, will scald it too much.

In twelve or fifteen hours, the liquor will be green, when you must put in one pound of alkali; stir it well, and let it rest twelve hours, always keeping up the same degree of heat. You may then put in the rest of the alkali, bran and madder, and let the liquor boil for five minutes, but no more, otherwise it will become greasy (gras): to conquer this if it should happen, will require a four hours boiling, otherwise unnecessary. Let the liquor now rest, until it be cool enough to empty into the vat: empty it therein, and stir it well; let it rest four hours, when it will have a fine green colour and a pleasant smell.

When the wool is dyed, the liquor must be cooled to the degree in which the hand can be immersed without inconvenience; that is, rather under than above 138 degrees of Fahrenheit. Should the vat after working become black, the indigo collects and is not diffused; if it become (gras) greasy, it leaves white spots on the cloth. In the latter case, put half a boisseau (about a gallon and a half) of bran in two or three bags, and throw them into the vat; when they have absorbed all the grease they will rise to the top of the vat, when they may be taken out and a refreshing of madder and alkali added, according to the quantity of indigo calculated to remain in the vat. Stir the liquor in the vat; let it rest four hours at the heat of 133° Fahrenheit. Stir it well again, and let it again rest four hours. If the vat be black, add a little alkali, and bring up the heat to 133° Fahrenheit, for twelve or fifteen hours, till it begins to come to, and then add a little madder and bran.

Woollen yarn to be dyed must be strung separately, pound by pound, and wetted evenly at two or three dippings: the water should not be boiling if the wool be greasy; otherwise it will detach the grease, which will unite with the alkali in the vat, and make the vat black. The wool should not be dyed in parcels of more than ten pounds at a time in a vat of this size. A circular net, weighted to make it descend to within one-third of the bottom, will prevent the wool from disturbing the sediment. When the wool is to be dyed, pass a rod or stick through the strings of ten pounds of the wool, and plunge it into the vat, so as no part be exposed to the air; it must be worked by separate parcels in the vat (but never exposed to the air) during twenty minutes, when it may be taken out, wrung over the vat, and opened to be aired: then take a second parcel of ten pounds, and proceed as with the last: then recommence with the first parcel of ten pounds, and keep it in the liquor till the required colour is obtained.

After having coloured twenty pounds of wool, the vat may be slightly refreshed and stirred, and left to settle for four hours; but this refreshment need not be put in, unless you observe the vat rather spent, and the green colour turning blackish: too much refreshing with madder and bran, will make the vat turn (gras) greasy.

A vat thus set, will dye thirty pounds of wool, a royal or king's blue, for each pound of indigo; and also thirty other pounds a lighter blue, and even give a light blue ground to other parcels intended for greens and browns. This vat ought to be worked out, till it is spent and clear, that there may be no need of the trouble and expense of reheating; and the quantity of indigo should be previously calculated to answer the quantity of blues and greens you contemplate to dye in it.

It is essential to remember, that when wool previously dyed yellow with weld, is entered into such a vat, it must be well washed and beaten, to extract perfectly all the alum mordant that may remain in the cloth or wool. This vat is superior in colour, when the indigo is good, to the pastel or woad vat: but when *cloth* is to be dyed in it, instead of wool, the dyers proceed thus:

For a vat of a hundred buckets of water, they employ but four pounds of indigo, which is treated as above. In another small boiler, holding ten or a dozen buckets of water, they set another vat, wherein they employ from ten to twelve pounds of indigo in perfect solution, that is, using the proportions of madder and bran necessary with the alkali to dissolve the indigo. By taking a bucket full or two out of this small vat, and pouring it into the large one, the latter is conveniently refreshed, and kept up of any desired strength. Before the cloth is dyed, it is exposed on the grass to bleach, and then fulled, and the large vat is kept rather weak than strong. The bleaching and milling contributes much to brilliancy of colour.

The silk dyers use a vat shaped like a sugar-loaf. The small end of the cone is kept sunk a foot under ground, and the fire which strikes against the vat, always strikes above the sediment, which by this means is never burnt. For these vats, they use in mounting the vat, no more than half a pound of pearl or potash to the pound of indigo, which they boil for about five minutes; then they put in another half pound of indigo, four ounces of madder, and a quarter of a boisseau (170 cubic inches, of which 231 make the wine gallon) of bran. They have difficulty with this vat, which often blackens, but they are of opinion that the alkali injures the silk. But as they enter but one small bundle or hank at a time, the loss is trifling if the colour should not be good. The silk dyers vat, seldom holds more than twelve or fifteen buckets, and some of them use so much as ten pounds of indigo to a vat. Yet if the silk intended for blue, green or violet, be not dry in ten minutes, the colour disappears, notwithstanding such a superabundance of indigo, or else it becomes spotted.

(I insert the above directions of M. Homassel, because the directions as to the degrees of heat are worth attending to, and his book is manifestly the result of practice. But I cannot think that a pound of indigo requires two pounds of the best potash to dissolve it. The cendres gravelèes of the French are a kind of pearl ash, not so strong as potash. I am well persuaded, that a pound and a quarter of good potash dissolved with an equal quantity of lime to abstract the carbonic acid, is *fully sufficient* for a pound of indigo; nor can I conceive any reason why any carbonic acid should be permitted to remain in the alkali, which is rendered weak and inefficient in exact proportion to its presence. Indeed, potash supplied with as much carbonic acid as it can take up, crystallizes, and remains crystallized even when exposed to the open air; it is nearly tasteless, and unfit for the purpose of an alkali, being in fact a neutral salt. If the potash be as it ought to be, previously dissolved in water, before it be put into the vat, it is not of much consequence if there should be an over proportion of lime. Good potash may not require of lime more than half its weight, pearl ash usually contains more carbonic acid and requires an equal weight.—*T. C.*)

The old liquor of a spent vat may be used to set a new one.

This vat will dye woollen, cotton, linen, or silk: but a full deep blue cannot well be given to silk by indigo alone; it will require a ground of archil first, for silk. Nor does so much alkali as this vat usually takes, agree with silk.

The vat wherein the indigo is disoxygenated by means of fresh made green vitriol, or sulphat of iron, is chiefly used for the cotton dye, but as it may be used for wool too, I will describe it here, so that whatever relates to the indigo dye, may be collected and consulted together.

Every dyer has notions of his own, about the size of his vats, and the proportions of his ingredients; it is no wonder therefore if the processes I give, should not be exactly the same in all respects as those followed by twenty other good dyers, who in non-essential particulars may each differ from the other. I will copy from my notes, two processes used by the cotton dyers of Manchester, varying but slightly from each other; and then give the methods used in France. All of them may be relied on as the descriptions of actual practice, notwithstanding their varying so much from each other in the proportion of ingredients, and the times of immersion.

Indigo vat, with lime, for Cotton dyeing.—This may be constructed of stone or wood; the best material is pine wood lined with sheet lead. To enable you to dye two pieces of callicoe, of twenty-eight and a half yards long, at a time, the dimensions of the vat should be four feet, by six feet, and seven feet deep. The vat should be on a level with the floor, or within a few inches of it, so that two boys may be able to lift the frame on which the callicoes are stretched, by taking hold one at each end. There should be a series of these vats (six or eight) where much of this work is to be done, that there may be sufficient intervals of time for the vats to be refreshed.

As blue dyeing on callicoe does not admit of wincing, the pieces, two at a time, must be stretched tightly on hooks on a frame, so that there may be a space of at least two inches between the folds, to prevent the opposite sides of the cloth from sticking together, which would hinder the dye from striking evenly. I think, notwithstanding iron stain is of less consequence in blue than in lighter colours, the hooks should be copper, and set two inches apart. The frames may be of pine, proportioned to the size of the vats, and regulated in height by the width of the goods. The upper rails, which must also be furnished with copper hooks, may be made to slide in a groove cut in the upright or corner posts, so as to admit of being adjusted to the width of the cloth. The piece is hooked in folds from side to side, and stretched tightly, so that the folds cannot touch each other. The number of dips, each of five minutes duration, depend upon the required colour.

The vats may be set either with *orpiment* or with *copperas* to de-oxyd or disoxygenate the indigo, but copperas (green copperas, sulphat of iron) is commonly used for the blue vat; the use of orpiment being almost confined to the pencil-blue of the callicoe printers. The Guatimala flotant indigo is usually preferred; next to that, the East India indigo. The indigo of South Carolina, is so inferior as to be out of use. The proportions of ingredients in common use for these vats are, from two to five pounds of indigo for each hundred gallons of water. Vats of the dimensions above indicated will hold about a thousand gallons, and forty pounds of indigo will suffice to produce an intense blue at four or five immersions. To one part of the best indigo, use two parts by weight of green copperas, (green vitriol) and two and a half parts of *well burnt*, *recently burnt*, slacked and sifted lime. The copperas also should be fresh; not covered with an ochry yellow rust; it should be well crystallized; if it be already oxygenated by the oxygen of the atmosphere, it will not so well serve to disoxygenize the indigo. I again repeat the absolute necessity of having the indigo very finely ground throughout. Put in the indigo first, then the copperas finely bruised, introduced in a basket suspended in the vat, or else previously dissolved in water, which I think is the best way; the lime should not be added till the copperas be dissolved. Let the whole be then raked up for about twenty minutes. If the rake worked through a hole in the cover, it would be better. The vat should then be covered with a cover in two pieces, to exclude as much as possible the atmospheric air, which would gradually furnish fresh oxygen to the oxyd of iron, and to the indigo, and also carbonic acid to the lime. In two hours, rake it up again for ten minutes, and again cover it. In a short time it will exhibit signs of the indigo being dissolved, becoming of a dark green colour, with veins of blue. Rake the vat two or three times a-day during two days; when it appears of a yellowish green after being raked up, the solution is complete; let it subside for eight or ten hours, and then dye your goods. I consider this as an approved process for the callicoe blue vat.

Another process for the Indigo Dye on Cotton. There are various methods practised by the callicoe printers and dyers to take the oxygen from indigo. The following is used by the dyers of cotton goods, whose pieces are generally from 24 to 28 yards long, and from six-quarters to nine-eighths wide. Having two vats each six feet deep, three and a half feet wide, and six feet long, with a light frame to go easily out and in, and two slides on the two sides, to move up and down, with copper hooks on the slides, and on each side of the frame, on which they can be fastened by the two selvages at the top and bottom of the piece. The slides are for the purpose of stretching the pieces, and are moveable, that they may be placed according to the width of the goods. Take eight pounds of good indigo *well ground*, boil each pound in one gallon of water with two pounds of potash for two hours, and then put it in one of the vats previously charged with water. Add four pounds of well burnt, fresh lime, slacked and sifted immediately, for each pound of indigo; that is, two pounds of lime to one pound of potash; stir up the vat well, then add two pounds of well crystallized clean copperas for each pound of indigo. Stir it well again; let it settle (closely covered) for twenty-four hours, at which time or near it, the vat will be fit to work. Add or diminish your indigo, and the proportions of the other ingredients, according to the shade of blue your pieces require. As the vat becomes weaker add lime and copperas in the above proportions till you have exhausted all your indigo. (In this vat, I do not approve of so much potash. *T. C.*) The other vat, which is filled with pure water, is intended to dip the pieces stretched on the frame, in and out, on taking them out of the dye-vat, by which means the colour is rendered regular and even, and free from stains: for the liquor of the dye-vat when it first receives the air, fixes on the piece; and in taking the piece out of the vat, runs from the top selvage to the bottom one, and acquires oxygen from the air: thus the bottom selvage, without this precaution, would be of a deeper colour than the top one; which irregularity of colour is prevented by the water vat, as the piece is plunged immediately into it, on its being taken out of the indigo vat; it washes off the colouring matter that would lie in loose particles, while at the same time the water gives out some oxygen from the atmospheric air, which all water contains in small quantity: this oxygen is sufficient to fix the indigo that has entered the interior part of the cloth. For dark blues, the water vat may be dispensed with, as the marks formed by the running of the colour are not observed; but for light blues it is indispensable.

The more perfectly the indigo is de-oxyded the better; this is known by the uniform green colour of the liquor in the vat. The cloth should remain in the liquor one hour, so as to insure a complete penetration of the dye: for the oftener it is dipped and receives the air, and is dipped again, the more of it lies on the surface uncombined, and by friction and wearing falls off. There have been some dark blues that would bear as much colour to be rubbed and beaten off, as might dye a good light blue.

In general, after the blues are taken out of the water vats, they are run through a cold liquor composed of water and sulphuric acid, about the strength of common vinegar. This neutralizes the lime and alkali that may adhere to the cloth, and also turns the green tinge to a blue, inasmuch as the sulphuric acid oxygenates (that is, gives oxygen to) the indigo. To get rid of this sour liquor they must be rinced in cold, and then in hot water. If a little alum be dissolved in this hot water, the colour is supposed to be improved in fixity.

Before I make my remarks on these two processes employed in England, I shall give those employed in France, from the late work of Berthollet and Son, vol. 2, page 82, of the French edition of 1804, from which I translate it.

Blue Indigo Vat for Cotton, according to M. Le Pileur D'Apligny.—To dye linen and cotton blue. Fix a vat or cask that will hold about five hundred litres (one thousand and thirty-two wine gallons). For such a vat three or four kilogrammes of indigo are employed (from 105,8 to 141,1 avoirdupois ounces, that is in round numbers, from six pounds and a half to nine pounds avoirdupois). This indigo is well and carefully ground into an impalpable powder (a condition always to be insisted on) and then boiled with a ley or lixivium drawn clear from a quantity of potash double in weight to the indigo, and a quantity of lime of an equal weight with the indigo. This must be well stirred during the boiling, which may be in an iron pot well cleaned, in order that the whole of the indigo may be fully penetrated and intimately mixed with the clear liquor of the potash and lime; it must be well stirred and prevented from sticking to the sides and bottom of the pot.

While the indigo is boiling, slack with hot water sprinkled on it, a quantity of lime equal in weight to the indigo: add to it twenty litres (5,16 wine gallons) of boiling water: dissolve also of green vitriol or copperas bruised, a quantity equal to double the weight of the indigo. When dissolved, pour it into the vat already half filled with water; then pour in the indigo and the alkaline lixivium, then the lime and the water in which it is dissolved or mixed. Stir all up once or twice, then fill the vat to within three fingers breadth of the top; stir it again well together; cover it close; stir it up twice or thrice a day, till the vat is in order for dyeing, which in summer will be about forty-eight hours, in winter something more.

To this vat some dyers add a little madder and bran; (which are not necessary but may be of use). they use this at Yvetot.

The Process at Rouen, in Normandy, detailed by M. Quatremere D'Isjonval, who has spent much labour in the investigation of the properties of indigo, is as follows.

The vats are built of a flinty kind of stone, plaistered within side and without with a fine cement. (This may be made of fresh lime slacked and sifted, one part, fine sand sifted, five parts, Terras or Puzzuolana, one part, beat up into a paste with beaters, and then applied. *T. C.*) There are several in the same dye-house, ranged in opposite rows. The vats contain about 288 wine gallons, (four muids) and will bear nine or ten kilogrammes (about twenty-two pounds avoirdupois) of indigo. The indigo is permitted to macerate or soak during eight days in a caustic ley of potash of strength sufficient to bear an egg: (It is not said how much. *T. C.*) It is then ground in a hand mill into a fine paste. The vat being filled with water near to the top, a quantity of fresh burnt slacked lime is introduced equal in weight to the indigo; the vat is then stirred, and eighteen kilogrammes or about forty pounds of pounded green vitriol or copperas are thrown in; the vat is stirred till this is dissolved. Then the indigo is washed in, through a very fine sieve, the unground particles being ground over again. It is stirred eight times the first day, and after a repose of six and thirty hours it is ready for dyeing.

(In this receipt the quantity of lime is given, but the quantity of potash used to make the caustic lixivium in which the indigo is ground, is not given. It appears to me that if potash be used at all, it ought not to be less than pound for pound of indigo, for the lime will be fully decomposed by the copperas. *T. C.*)

The dyer ought to have several of these vats, so that some might be set at various periods of time. Moisten the cotton equally in water before you introduce it; press it so that it shall be merely but equally moist. Dip it first in the vat which is the most exhausted; then in the vat a little less exhausted; and so on, finishing with the strongest; or until you have procured the required hue. It should not remain in each vat more than five or six minutes at a time, for it will imbibe in that time, as much colour as the vat in which it is dipped will furnish.

A vat intended to be used, should be well stirred, and left to settle twenty-four hours at least if an old vat, but not quite so long if it be a new vat, before the goods are entered.

When a vat has been used three or four times, it begins to change: when it is stirred, it no longer exhibits blue veins on its surface; it turns black; and in this state requires to be refreshed. This is done by adding about two kilogrammes (about four pounds and a quarter,) of green copperas or sulphat of iron, and one kilogramme or about two pounds of lime. Let it be twice stirred or raked, and left to settle. A vat may be refreshed three or four times, by adding the quantity of ingredients which it is deficient in, employing the original proportions.

In these vats (says Berthollet) it is the potash and the lime that dissolve the indigo, which is first deprived of oxygen by means of the iron which is precipitated from the green copperas. (But in this vat of M. Quatremere D'Isjonval, it appears to me, that the sulphuric acid of the copperas is very nearly sufficient to convert all the lime employed into sulphat of lime or gypsum, which is of no use in the vat, and that the potash alone is the solvent of the indigo. *T. C.*)

M. M. Berthollets' proceed. Lime alone may be used to precipitate the iron of the sulphat of iron, and to dissolve the oxyded indigo, but the same depth of colour cannot be obtained from indigo dissolved in lime alone, as in potash, or lime combined with potash; at least the same depth of colour is not so quickly and so readily produced: but this is frequently an advantage. Some dyers strengthen the lime vat by the addition of orpiment and potash. (In England the lime vat alone, is most used by the callicoe printers. *T. C.*)

Bergman and *Haussman* have given particular descriptions of this vat, with proportions of the ingredients in some respects different. The last author (who is by trade a dyer and callicoe printer in Germany *T. C.*) observes, that the sulphat of iron (green copperas) ought not to contain any copper or blue copperas. For this ingredient is apt to re-oxyd the indigo, that is, turn it blue; which is an effect that ought never to be produced but upon the dyed cloth. (But green copperas or sulphat of iron, very seldom contains any copper. *T. C.*) He remarks also that the blue tint is improved by passing the cloth through water acidulated with the acid of sulphur. (It is not improved, but brought on sooner. *T. C.*)

We (*Berthollet and Son*) will now describe a vat of this kind, which has stood the test of experience; and note the uses to which it may be put.

The ingredients are employed in the following proportion. One part by weight of indigo, two parts of sulphat of iron, (green copperas), and two parts of fresh burnt lime. These ingredients must be treated in the manner herein before directed, and when the vat is filled, and several times raked and stirred; it is then left to rest for two days, when it will be found ready for use; perhaps somewhat sooner.

Before you dye with this vat, scum off the froth on the surface. Every night, when the men are about to leave work, this vat is refreshed, by adding to it some of the liquor out of a small vat set for the purpose, with a much less proportion of water to the other ingredients, so that the small vat contains a stronger dye stuff: the froth set by, is also returned into the dyeing vat; which is raked and left to subside, well covered, till morning. When the dye-vat becomes weak, it may also be strengthened by the addition of lime and sulphat of iron, in the original proportions.

The pieces are stretched on hooks on a frame which is let down into the vat by a pulley: the pieces in the vat are gently moved to aid their imbibing the dye equally. The whole of the piece is immersed without touching the sediment. Having given it time to become oxyded, that is, to change in the air from green to blue, it is carefully washed: while green, the dye is soluble in water; but when by oxydation it becomes blue, it is no longer so. This washing is more necessary, if there are places in the piece protected by paste-work from the dye. To dye for instance two blues and a white, the paste-work is printed on the white and also on the light blue part of the pattern. When dyed, it is well washed, and when dry, it is printed with paste-work on the white part of the pattern; so that the blue ground is twice dyed, the pale blue once dyed; and the white protected throughout these operations. When the white part is to be again dyed of any colour, the mordant is mixed with the last paste.

For reserved parts of a pattern, it is also common to make use of the known property of copper, to yield its oxygen to the indigo, and by that means prevent its fixing permanently on the places so protected. (Hence pastes usually contain blue vitriol. *T. C.*)

Bergman and *Scheffer*, also describe another vat, very convenient for linen and cotton thread and yarn, but not particular enough as to proportions. Take a strong solution of potash, add to it while hot, about three drachms troy weight of finely ground indigo for each wine quart of the liquor; when the indigo is perfectly penetrated by and moistened with the alkaline liquor, add of finely powdered orpiment six drachms troy weight; stir it well; in a very short time it becomes green with a blue froth; draw the fire and dye with it.

Berthollet then goes on to give receipts for *the common pencil blue* of the callicoe printers, of which the last above detailed is one. Although in this part of the work I have nothing to do with callicoe printing, yet every dyer will better understand his own processes, by being made acquainted with all the methods in use to give a blue dye or tinge by means of indigo. I do not therefore think it time misemployed to translate the rest of this chapter of Berthollet's work, adding my own receipts for pencil blue, which I know to be good, though almost all the colour-men at printing works vary a little in their proportions of the ingredients.

This vat (say the Messrs. Berthollet, Elemens de l'art de la Teinture, tom. 2d, page 90, edit. 1804) does not differ from the preparation used by the callicoe printers, and called *Bleu d'application*, pencil-blue, except in the proportions of orpiment and indigo, which are much greater among the last mentioned artists. For this preparation, they use according to Haussman one hundred parts water, fifteen potash, six lime, six orpiment and eight indigo. M. Oberkampf, whose processes are fixed with great consideration, uses still more indigo. In Bergman's process, indigo bears the proportion but of one part to twenty-four of water; in Scheffer's process, a still less proportion of indigo is used; in Haussman's the indigo is one-twelfth; in Oberkampf's one-ninth. The proportions of the several ingredients beside the indigo, vary also in the several recipes: so that it should appear that they admit of considerable latitude in this respect; but the best proportions have not yet been determined by direct experiment.

Hence it appears that the callicoe printers use three methods of dyeing the cloth of which the ground is intended to be blue or green; and when they are already printed in parts, with colours that the blue vat ought not to act upon, these colours are protected by a reserve of paste-work.

If the cloth is intended to have a white ground, and to exhibit patterns with one or two blues, the second method is employed. Sometimes one or two colours are joined to the blue thus raised; but in this case they must be printed after the operation of the blue vat, for there are few colours which the blue-dyer's liquor will not act upon and alter, if not discharge.

Thirdly, it is required under other circumstances, to give a blue stain to small and minute parts of a pattern already printed; in this case the blue is pencilled on the spots required, whether it be on white to give a blue, or on yellow already raised, to give a green.

Pencil blue may be printed by the block when properly thickened with gum, but the indigo is easily oxyded, and it can only succeed for small objects, and where the colour is required to be intense; and even then rarely. (It is certainly liable to the objection Berthollet mentions of being easily oxyded, but it can be printed even on blotch grounds, though not so conveniently. *T. C.*)

Bancroft says he has substituted sugar for orpiment; and others speak of grinding the indigo with oxyd of tin; but as these experiments have not received the sanction of practice, I shall not translate the remarks of M. M. Berthollets concerning them.

The Pencil Blue of the Manchester printers, is made thus:

Take eighteen parts fresh burnt lime; slack it; add to it twelve parts of potash; dissolve in boiling water, so as to draw off a strong ley; when this ley is drawn off, add other boiling water, and pour off the clear liquor; do so again; and if not exhausted, a third time; add all the clear together into one lixivium or ley, which should be of such a strength that an egg will barely sink in it; when in this state, add an equal quantity of hot water: then add to it while warm (not very hot) of finely-ground indigo eighteen parts; and orpiment ten or twelve parts; stir them well together and cover them so as to exclude the air. This must be thickened with gum arabic in powder.

Another. Take one part (as one ounce) of indigo finely ground as usual; half an ounce of orpiment, eight ounces of pearl ashes, and as much lime; draw off a clear ley from the ashes and lime; boil it to the strength and quantity of caustic ley you want; then put in the indigo; boil it one hour; take it off the fire, and let it cool; stir in the orpiment; thicken with gum arabic.

China Blue. This is a light blue, dyed by the callicoe printers in a peculiar manner. The indigo, very finely ground, is mixed with gum water of the consistence necessary for block-printing; with this mixture print on the table with a block, the blue part of the pattern. Have ready two vats of the usual dimensions for two pieces of callicoe, furnished with frames, hooks, &c.; let the water in one of the vats be saturated with green copperas, that is, put in as much copperas as it will dissolve; and the water in the other with as much lime as it will take up, or rather with a considerable surplus, for too much can do no harm. Let the piece hooked on the frame, be dipt alternately, in the one vat and the other, till the copperas having de-oxyded the indigo, the lime dissolves it and fixes it on the cloth; which after the operation is to be well washed.

The callicoe printers commonly pencil a blue on top of a yellow; in which case, orpiment must be used to disoxygenate the indigo instead of copperas, which would strike a blackish colour with the yellow.

Another China Blue. The proportions in my time, managed as above, were twelve parts indigo, twelve parts lime, ten parts green copperas, and four parts iron liquor, which is acetat of iron. This also was used as a pencil-blue.

The following are the observations of *Homassel*, on the callicoe dyer's blue vat. The callicoe dyers set their vat cold; and employ a great many articles without knowing why. To dye pieces that are protected by paste work, nothing ought to enter the vat, which will destroy the acid composition used in the paste. Hence the vat ought to be set with nothing but indigo, green copperas, lime, and a small quantity of soda, wherever the custom of the shop runs upon paste work. Potash decomposes the blue vitriol, which forms the basis of the composition, and yet many dyers set their vat with potash, or with soap boiler's ley, which they use to boil their indigo with. These callicoe vats are generally of wood lined with lead, and hold two hundred buckets of water; in such a vat, they employ thirty pounds of indigo, which is managed just as easily as a vat made of a brandy cask. The indigo is usually ground in a metal basin somewhat inclined, by means of three or four twelve pound cannon balls, which boys roll in the basin till the indigo is ground into a paste, that can be scraped off the basin without leaving any sticking to it. A boy of twelve years old can thus grind ten pounds of indigo in a day. But the grinder ought never to be implicitly trusted. No indigo should ever be used but such as has passed through a fine sieve. Even minute grains unground, are mere loss. Also, diligent search should be used, lest the vat should leak, for it is the most valuable part of the contents that will leak out.

If a brandy cask holding about 120 or 130 gallons, is used as a vat, the ingredients should be five pounds of indigo, one pound of soda, five and a half pounds of lime, and five pounds of copperas or green vitriol. Abstain from potash, which always sets the colouring particles, so that they are washed into the river to mere loss, besides attacking the reserve or paste-work.

Dissolve a pound of soda and half a pound of lime, in which solution you may grind your indigo; when ground, put it in the vat, which should be filled with water within a foot of the top. Then dissolve in hot water five pounds of English green copperas, which must also be turned into the vat; then slack your lime with a small quantity of water, and turn it in powder into the vat; then throw in the grounds of the soda, lime, and indigo; stir the whole together, and let it rest covered all night. Early in the morning stir it, and about nine o'clock it will be ready to use, if it has been left to settle four hours. If the vat should not be in order for some hours afterward, dissolve half a pound of copperas in four or five quarts of water. The vat should be of a yellowish green; if too yellow, a small quantity of lime will correct it.

When this vat has once been set, and you wish to refresh it, it should not be done with more than a pound of copperas and about three-fourths of a pound of lime at a time. When the vat has been served with five pounds of indigo and ten pounds of lime, put in no more, or at least very sparingly; should it blacken with too much copperas, add lime till it is brought about, and becomes again green. When the vat is black, it wants copperas; when too yellow, it requires lime.

Pencil Blue is made with one pound of indigo, as much potash, as much red orpiment, and two pounds of lime; they may all be ground well together if time presses, and boiled in three or four gallons of water, keeping it stirred all the time. Indeed the water need not actually boil, but near it. To one quart of this solution one pound of gum Senegal is put to thicken it. If you are not in haste, dissolve the potash and lime, and grind the indigo in the clear solution with the orpiment, in which case, if the water be warm, it suffices; it need not boil. When in order for printing or penciling, it is of a fine green, with a beautiful scum at the top. Linen, cotton, and even silk, may be dyed in this liquor when diluted, but it does not answer well for woollen.

(Upon these processes of Homassel, I would remark, that the acid paste-work is acted upon by soda and lime, almost as soon and as effectually as by potash; and it is the business of the printer to use such a paste, as will stand the usual blue vat. Such a vat as he recommends, however, may keep the indigo in perfect solution if the lime be good. As to his pencil blue, the quantity of orpiment is in my opinion a fourth too much, and the lime nearly twice as much as is necessary, *if it be good.* Nor can silk be safely dyed where the liquor is so strong of the caustic alkali. Homassel's receipts are manifestly the result of practice as a dyer, but I suspect he was not quite so well acquainted with printing. *T. C.*)

Having now given all the known processes, for the woollen blue dye vat—the cotton blue dye vat—the pencil blue—and the China blue of the callicoe printers, I shall give a summary of the proportions used in the respective processes of the English, French, German and Swedish dyers, in setting the vats with indigo; and then my own remarks.

Proportions of the ingredients used for the INDIGO BLUE VAT FOR DYEING WOOLLENS, by the *English* dyers.

Indigo, by weight, two parts.
Potash two parts.
Bran sifted two parts.
Madder one part.

By the *French* dyers.

The vat described by *Messrs. Berthollet*, from D'Orval and Ribaucourt, is nearly the same as the above, except the proportion of madder is smaller, for which it is so much the worse.

The vat used by *M. Homassel*, whom I regard as good authority, consists of,

Indigo one part.
Pearl ash two parts, (which I think half a part at least too much. *T. C.*)

Bran, about three quarts to the pound of indigo.

Madder half a part.

Proportions for the *Blue Indigo Callicoe Vat.*

English. Indigo, one part.

Fresh, clear, green copperas, two parts.

Fresh lime, two parts and a half. This is good.

Another English.

Indigo one part.

Potash two parts.

Lime four parts.

Copperas two parts.

I consider this as a bad process: first, because the potash acts too speedily on paste-work, and because two parts of potash are more than sufficient to dissolve the indigo, especially with lime; and because the potash may be well deprived of all its carbonic acid by an equal part of lime, if good.

The *French* CALLICOE BLUE VATS.

Messrs. *Berthollets'* vat.

Indigo one part.

Lime two parts.

Green copperas two parts.

This vat has the advantage of experience, but I am persuaded that the lime is in too small proportion if it be not quite hot from the kiln, in which case it may be enough.

M. *Homassel's* vat.

Indigo five parts.

Soda one part.

Lime five parts and a half.

Copperas five parts.

The soda appears to me no better than pearl ash; and the lime in proportion rather too small.

The *Rouen* vat for callicoe, according to M. Quatremere.

Indigo, steeped for eight days in strong soap-ley, one part.

Lime one part. (Too little. *T. C.*)

Green copperas one part and three fourths.

The *French* callicoe vat according to M. Pileur d'Apligny.

Indigo one part, boiled in a ley made of

Lime one part and potash two parts. Then,

One other part of lime in hot water.

Green copperas two parts.

Swedish vat proposed by Bergman. Opuscula vol. 5, p. 43.

Indigo one part.

Green copperas one part. (Too little. *T. C.*)

Lime two parts.

German vat. Gulich.

Indigo one part.

Lime three parts.

Green copperas three parts. (Too much. *T. C.*)

Orpiment one part and a half. (Unnecessary. *T. C.*)

German vat. Haussman.

Indigo twelve to twenty parts.

Lime three times as much.

Green copperas twice and a half the weight of indigo.

PENCIL BLUE. *English.*

Indigo one part and a half.

Potash one part.

Lime one part and a half.

Orpiment about half a part.

Another.

Indigo one part.

Pearl ashes and lime each half a part;

Orpiment half a part.—Both these proportions are too small.

French. Homassel.

Indigo one part.

Potash one part.

Lime two parts.

Red orpiment one part.

German. Haussman and Oberkampf.

Indigo eight to ten parts.

Potash fifteen parts, or once and a half the weight of indigo.

Lime three-fourths the weight of indigo. (Better an equal weight. *T. C.*)

Orpiment three-fourths the weight of indigo.

Proportion of water varies from twelve to twenty times the weight of indigo.

German, according to Gulich.

Indigo one part.

Potash four parts. (Nearly three parts too much. *T. C.*)

Lime one part.

Orpiment one and a half part.

Gulich uses this also for the indigo vat for dyeing woollens; but so much alkali is not only unnecessary to dissolve the indigo, but it would act on the cloth. *T. C.*

German. Haussman.

Indigo sixteen parts.

Potash thirty parts. (Somewhat too much. *T. C.*)

Lime twelve parts.

Orpiment twelve parts.

Swedish. Bergman. 5 Opusc. 43.

Strong soap-ley two quarts. (Bad for uncertainty. *T. C.*)

Indigo three drachms.

Orpiment six drachms.

China Blue. *English.*

Indigo twelve parts.

Green copperas ten parts.

Iron liquor four parts. (Bad for uncertainty.)

Lime twelve parts. (Too little. *T. C.*)

Such are the varieties in the processes used in different work-shops in the same and in different countries: varieties, that show a certain latitude of proportions, within whose limits success in the result may reasonably be expected. I well know that the public calls for a book on dyeing, wherein the author will confine himself to one process, and that the best in use. But who is to judge of that? *I know no man* who, as yet, has sufficient pretensions both from theory and experience to decide. All the receipts I have given, are the receipts of actual practice. Each has its advocate, who is of opinion that he understands his business as well as any other dyer whatever; and each succeeds. I think therefore I should have been unjustifiable, in confining this book to one set of processes, selected by myself, when men of great knowledge and experience in business, differ on each process from each other. It is a presumption, I have thought it right to avoid. But, I have read enough, and seen enough, to have an opinion of my own; and I shall submit that to the reader, for him to adopt or reject as he sees fit. I have put all the processes for dyeing blue together (except in an extract I shall make on callicoe printing, by and by) because I think they throw great light on each other; and he who means to understand his business, will study them all.

On the Blue Dye for Woollens, by the Editor. It appears to me, that the common vat wherein the indigo is deoxyded by means of madder and bran, and then dissolved in alkali, is the best for the woollen dye. We certainly can do without pastel and woad. The other vats, wherein the indigo is deprived of oxygen by copperas, are best adapted to the callicoe dyeing.

I am satisfied, however, that lime is an addition, absolutely necessary to give the alkali its full effect. Indigo is not perfectly soluble in carbonated alkali, although it is so in caustic or pure alkali. I am satisfied also, that pearl ash is one fourth less in value for the purpose, weight for weight, than potash.

Hence my proportions for a vat of whatever size, are,

Indigo, ground into a fine paste, and passed through a fine sieve, by weight, one part.

Bran one part: Madder half a part. These two ingredients to be put in first, having been previously boiled for three or four hours.

Potash one part and a quarter.

Lime one part.

Bruise the potash in small pieces, then add the lime, and pour on hot water, two gallons to the pound of potash. Let it remain covered till the alkali is all dissolved, then pour it into the vat, sediment and all, after the bran and madder are put in. The indigo should be put in last.

I have already suggested that, in my opinion, hay might be substituted for madder: but it has not been tried. Nor has the effect of yeast, been sufficiently tried.

For callicoe printers, I think the potash may be dispensed with, and that a good vat may be well made with

Indigo one part.

Copperas two parts.

Lime two parts and a half, *if fresh and good.*

But if the dyer should be attached to his potash, then

Indigo one part.

Potash half a part.

Lime two parts.

Copperas two parts.

I do not disapprove of Gulich's addition of a little orpiment, but I have not known it tried.

It is very material that the lime should be fresh, and put in with the copperas, before the potash is put in.

The copperas vat may be made without lime by means of potash, but not so cheaply or so well. For the sulphat of potash formed in decomposing the copperas, is made at greater expense than the sulphat of lime.

Pencil Blue.

Indigo one part.

A clear strong ley, drawn from potash, one part and a quarter, and lime one part.

Orpiment two thirds of a part.

The China blue for dipping in alternate vats, is sufficiently well given already.

There is a vat described made of urine; common enough in the back country, but although it be apparently cheaper than a potash vat, I do not think it is really so, for I suspect some of the indigo is wasted for want of a sufficient solvent. However, as all the books contain an account of such a vat, I shall insert the preparation; protesting against the use of it, wherever wood ashes and lime can be procured, as troublesome, filthy, and wasteful of indigo; but it has this advantage, it does not spoil by age, on the contrary it improves.

This vat may be set either with hot or cold urine. The proportions vary according to the shade required, from twenty to thirty gallons to each pound of indigo. The indigo is to be ground up with urine; the urine made hot and scummed, is then to be poured on the indigo in the vat. It is to be well stirred twice a day; as the urine ferments, and becomes decomposed, it acts on the indigo, which becomes dissolved in the urine: this usually happens in eight or ten days. Some add a quart of vinegar for each pound of indigo and some alum and tartar to the indigo, but I see no use in the one addition or the other: but the vat is the better for four ounces of madder, and as much bran to each pound weight of indigo.

The Indigo Vat with Urine, according to Homassel. This is set variously: some prepare the urine in a boiler, before they turn it into the cask; others leave it to ferment by itself at leisure in the cask appropriated for a vat. They then take the clear part, and heat it without boiling, and scum it. Four ounces of good indigo are used to a pipe (tonne:) and as much alum as indigo. It is well stirred and covered, the door of the fire-place shut, and so left till next day, when it ought to put on the green colour. If it has not come to, by this time, put in a wine glass full of brandy and as much vinegar mixed together, which operates as a ferment, and brings on the liquor in seven or eight hours. When it is in order, it is left to rest, and used when it is wanted. When once in order, it continues so, and improves by keeping; the only difficulty is to bring it once into order, and it is valued for its age. When this urine vat is used, it is well warmed, and charged with indigo and alum, in the proportion of a pound of each to every thirty pounds of wool to be dyed. It should not be employed till twenty-four hours after it is in order; the wool is plunged in ,and worked under the liquor, and left there for an hour, the vat being covered; this is done as often as the required shade of colour calls for it. The vat should not be altered, but always left to rest, and to grow cold in its original state.

In country places, the girls dye blue thus: they fill a large earthen pot with scummed urine, in which they put an ounce of indigo and an ounce of alum; this mixture is heated on hot embers at first, and warmed whenever it is to be used. The wool is previously well scoured, and freed from its grease, by means of a weak ley of fresh wood ashes.

Such are the various processes for dyeing blue with woad and with indigo, which differ from each other, because every work-shop has its own receipt, and no set of experiments has been instituted to ascertain directly and accurately the best proportion of ingredients: this still remains a desideratum of great consequence, though it would cost much time, trouble, and expense.

Of the *Saxon Blue:* or blue produced by dissolving indigo in the acid of vitriol or sulphur. This was first discovered by counsellor Barth at Grossenhayn in Saxony, about the year 1748, and was for a long time kept secret. It is chiefly used for the silk dye, but always also for Saxon blues and greens on woollen.

For Woollen. Let the cloth macerate in a hot solution of alum and tartar, three ounces of alum and one of tartar to a pound of woollen; this is usual, but I do not consider it of any use; for the indigo seems to have no affinity for these mordants.

Make your Saxon blue thus. Purchase oil of vitriol, colourless, that will weigh in a Florence flask twenty-nine ounces and a half avoirdupois to the wine pint; or it should be to water in weight as 1,85 to 1. The stronger your oil of vitriol, the better will be the solution. If it be not strong and colourless, boil it in a glass vessel in a sand bath, till it becomes so, adding while hot by degrees about four or five grains of nitre to each pound of oil of vitriol: the acid of the nitre is gradually decomposed, and carries off the carbonic matter that discolours the oil of vitriol; the small quantity of alkali remaining, does no harm.

Grind *very fine* in water, the indigo meant to be employed; wash the paste through a sieve; boil it in water containing a small quantity of alkali to dissolve all the dirty and extraneous matter that the indigo may contain. Wash it with hot water, while the indigo continues to give a dirty tinge to the water. Then dry it perfectly, but not in too great a heat. To six pounds of oil of vitriol, add by degrees one pound of such indigo well ground but dry; stirring it continually with a glass stick or a hard-burnt tobacco pipe, and not with wood; it should be made in a platina, a glass, a porcelain, or hard burnt stone-ware vessel; taking care that no kind of dirt gets in. The indigo thus dissolved may be used for dyeing in the proportion of from one to two or more ounces of the solution per pound of cloth, according to the depth of colour required. Keep it in a glass bottle, with a glass stopper, for use. When the cloth is dyed, it should be rinced sufficiently to carry away all superfluous acid: whether this has been sufficiently done can be ascertained by pressing the cloth upon a piece of paper tinged with blue litmus, or archil, which if any acid remain, will be turned red. This colour will stand the air, but will not stand washing. Some people add pearl ash to the solution, but I think it does harm.

Navy Blue. For twenty yards of fulled cloth use twenty ounces of green copperas and four ounces of blue copperas. Dissolve these in a copper by themselves. When the cloth is moistened with warm water and evenly pressed to squeeze out the superfluous moisture, put your cloth in the liquor and there work it about occasionally for an hour and a half: take it out, let it drain over the copper, cool it over the folding board, and let remain for twenty-four hours. The blue copperas is often omitted, but the colour is the better for using it.

Boil or rather scald, for at least three hours, six pounds of logwood in water, so as to make a sufficient quantity of solution to work your cloth in. When the logwood liquor is at a full scald or near boiling, enter your cloth: let it be worked three quarters of an hour: take it out; drain it; cool it on the folding board; the colour will be better if the cloth be opened and aired well.

Bring your copperas liquor to a full scald; enter your cloth in it, let it stay therein three quarters of an hour. Drain it; cool it; enter it again into the logwood liquor, and let it be worked therein, till you obtain the required colour. Drain, cool, air it, and rince it well. Repeat these processes if necessary.

This is a full, cheap colour; but it will not stand air, or washing, or wearing, like the indigo or woad colours.

Some dyers, after preparing or mordanting the cloth, dye it, not in a strong but in a weak solution of logwood, strengthened by additions of logwood liquor after each dipping, till the colour is obtained.

The cloth should be kept open while running on the winch or reel; otherwise the colour will be apt to be spotted: if cloth lies in the dye pressed by its own weight, it will not in general take an even colour. This remark applies to almost all colours. Nor should the cloth rest on the winch, but be kept in motion, particularly for half a dozen turns at first.

Black. The processes and proportions are so various, and depend so much on the local, the occasional, and the relative dearness and cheapness of the materials, that one process may be expedient at one time and place, and another at another. One process may be good in England, another in France, another in

America. One process may be good in time of peace, another in time of war. One may be eligible in a sea-port town, another in the country.

For instance; during the late war, the English dyers could afford to give a blue ground to their blacks, when the French could hardly do it; for indigo was plenty in England and not in France. To be sure they used their pastel and woad vats, because they grow the drug in their own country, and so might we.

In Pennsylvania, a back country dyer could procure his own alder bark, walnut bark, or sumach, when a sea-port dyer could obtain none imported; and so on.

I shall proceed therefore to give the various processes of the French and English dyers, whether for fine or coarse goods.

Fine goods are universally first dyed blue, either with woad or indigo; of course they require less of the other colouring ingredients.

Hellot's process is this. The cloth being dyed blue, take eighteen pounds (eight kilogrammes) of logwood, and as much powdered nut galls, for each hundred weight of 112 pounds of cloth; (fifty kilogrammes.) The ground or chipped logwood, and bruised galls, should be put in bags, and boiled in a sufficient quantity of water for twelve hours.

Lade out into another boiler, one third of this liquor, with one kilogramme or about two pounds and a quarter avoirdupois of verdigris: scald the cloth in this during two hours; it must not boil; it must be winced or reeled all the time. Take the cloth out; drain it; cool it on the folding board.

To the liquor add one other third of the decoction of logwood and galls; also four kilogrammes or about nine pounds of green copperas: lower the heat, let the copperas dissolve, and in about half an hour afterwards again enter the cloth, which must be well winced therein for at least one hour; take out the cloth; drain it; cool it on the folding board, (and air it. *T. C.*)

Press well the bags in the first boiler; team out the last third of the decoction out of the first, into the second boiler; add about twenty pounds of sumach; bring the liquor to a boiling heat for a quarter of an hour; throw in about two pounds and a quarter of green copperas; when dissolved, let the liquor cool a little; again enter the cloth, and wince it therein for at least an hour; drain it; cool it on the folding-board; rince it in clear water; air it.

Bring it again to the boiler, at a heat a little short of a scald; wince it therein a full hour; drain, cool, air it, wash it well in the river or stream, full it till the water comes off quite clear.

Prepare a dye liquor of weld, which should only be permitted to boil for a few minutes; cool it with cold water; enter the cloth for an hour; drain, cool, wash, air, &c. as before.

On this process of Hellot's, (which I translate from Berthollet, because the English book purporting to be Hellot's art of dyeing, is often extremely incorrect) I would observe, that if the cloth be dyed a good blue first, the proportion of ingredients are rather large; it seems to me they may be diminished nearly one fourth: secondly, I think that much advantage is to be found in airing the goods well between each dipping, for *the black is never perfect, or insoluble in water*, till it be well exposed to the air; thirdly, I fully agree with Lewis and Berthollet, that the last working in weld liquor, is totally unnecessary; fourthly, I think the proportion of logwood might be a little increased at the expense of the other ingredients; for the soft and velvety lustre depends more on the logwood, than on the galls and sumach, although these last afford a much more permanent dye; fifthly, I think the last working should be in the liquor, with a small quantity of Gallipoli oil, to give the soft feel to the cloth, which is so great a recommendation; always premising, an effectual scouring. *T. C.*

Hellot found also that a good black might be produced thus:

For eighteen metres, or about twenty yards of fulled cloth, dyed blue, take about two pounds of fustic, two and a half pounds of logwood, and eleven pounds of sumach. Boil them for two or three hours. Enter the cloth at a full scald and work it for three hours; raise the cloth; drain it; throw in eleven pounds of green copperas; let it dissolve; enter it again; work it for two hours; drain it; cool it on the fold-board; air it well; return it into the boiler with the woods and copperas; work it for an hour; drain, cool, air, wash it. It is full as permanent, but not so velvety a black as the preceding. (For the reasons I have assigned above. *T. C.*)

Another process, for cheap cloths. Omit the blue ground; give them in lieu of it a ground of walnut peel, or walnut rind (brou de noix;) then give a black with logwood, and sumach as the dye woods, and green copperas as the mordant. (I am fully persuaded of the use whether in high priced or cheap cloths, of a small proportion of verdigris: and I am strongly inclined to believe, that Aleppo galls are a cheap article in fact, though seemingly dear, from the experiment stated in the section on mordants. *T. C.*)

Homassel's process. For each hundred pounds of wool, put into a boiler, ten pounds logwood, as much sumach, one (*botte*, I do not know exactly the quantity, I conjecture from circumstances eight or ten pounds) of alder bark, well ground; and a pound of bruised blue galls. If the wool be strong enough to bear it, you may put it in the boiler with all the woods, and boil the whole for four hours, stirring them frequently with a rounded stick or bar of wood. Woollen yarn should be made up in parcels of about two pounds each. At this first operation, the wool should acquire the colour of walnut peel, or of scorched paper. Take the hanks of wool out; hang them up to drain over the copper; squeeze them; open them to air; empty the wood and dregs out of the boiler by means of a copper cullender; fill up the boiler with water sufficient to work the wool. Throw in five pounds of green copperas; increase the fire, but there must be no boiling-heat; sweep off the sediment round the boiler; stir the liquor; enter the wool again as at first by means of a stick through the loops; work the separate parcels thus for at least an hour and a half; take them out, drain, cool, air them as before; the more patience in opening them to the air, the deeper, the more permanent, and the fuller will the black strike: keep the boiler still hot; again enter the goods with three pounds more of copperas; go through the same process as at the last mentioned or second immersion, giving the cloth now a second airing; before the copperas was put in, no airing was necessary. Dye, drain, cool, open, air again; being three immersions or dyeings after the copperas, and four in all. No airing is necessary till the copperas be used.

Now put in two pounds more of copperas; and one pound of tallow, lard, or some fat oil; (Gallipoli is the best *T. C.*) when the copperas is dissolved and the fat melted, enter the goods and proceed as in the last process to dye them, but let them stay in the copper all night, before you open them and air them. The fat prevents the copperas from drying the goods, and makes them soft to the touch.

Dyers by profession, dye in the same boiler, their silk and their wool; in which case they do not use the fat at the fourth immersion; but instead of it refresh the liquor with some logwood, sumach and alder bark, and they give five or six airings. Other dyers are contented to dye their blacks at twice in ten days, and keep their silks after the first wool-black, till they give them another; in this manner the silks and the wool too are better dyed. The fat can be used for the wool, after the silks are finished.

Oak balls, acorns, oak saw-dust, and tan, were prohibited by Colbert; but they are of great use in dyeing linen and flax; and any harshness they may be supposed to give, may be counteracted by tallow or fat.

If when you use the same quantity of logwood, sumach, and alder bark, you employ about six per cent. of oak balls, or the bark of acorns, the silks will require but one galling or preparation in the woods previous to the copperas, and four or five airings after the copperas; then when the silks are done, the woollens may receive another dipping with fat or oil.

A black dyer on woollen should have a new hat before him as a pattern of colour. (Then he ought to employ verdigris with his copperas, or he will never come up to the hat dye. The hat dye is as follows:

For twenty or four and twenty dozen, boil, or rather keep at a full scald, one hundred pounds of logwood, twelve pounds of galls, twelve pounds of gum, ten pounds of green copperas and six pounds of verdigris. Ten or twelve dozen are dyed first, they are kept in the dye an hour and a half: they are then taken out and well aired; this is repeated four times, the exposure to the air being never omitted or slighted; then the bath is refreshed with a small quantity of the drugs in like proportion, and the hats are again dyed, cooled, and *aired* twice more; the dye is again refreshed in like manner, and the hats dyed, cooled and aired twice more; in all eight times. Sometimes sumach and alder bark are substituted for part of the galls: all this depends upon their comparative price, for when galls are cheap, they are clearly the best ingredient. There is no process for dyeing woollen *so good* as this in my opinion, except that the gum, though necessary to hats, is unnecessary to woollens. The superiority in the colour of hats to that of woollen cloth, is owing first to the superior quantity of verdigris; secondly to the more frequent dippings and *airings. T. C.*)

The black liquor will serve for all kinds of grays. The colour called Boue de Paris, (a kind of mud colour) is dyed by first giving a ground with soot, and then a dipping in the black dye after the woollens are dyed. Every variety of gray, can be well dyed with an old or spent liquor of black, another of soot, and another of archil.

The black bath or liquor, will have done its duty when it serves after black for the sandal wood browns; indeed all browns may be finished in the old black liquor: so may the Saxon greens meant to be turned into bottle greens.

At the Gobelins, all blacks are forbidden, because they acquire a rusty colour. (There is no good reason for this, if the colours intended for tapestry are blued first. *T. C.*)

On this process of Homassel, I have to observe, first, that the colour is not and cannot be so good as those that are dyed upon a blue ground. Secondly, that his frequent and perfect airings after the copperas, though taking up time, are not merely judicious, but absolutely essential to make the colour strike deep, to prevent its being washed away, and to produce a full black. The gallo-tannat of iron is colourless in solution till it be oxygenated. Common ink is so. Thirdly, the employment of a small quantity of verdigris would certainly improve the process. Fourthly, the proportions of ingredients might be beneficially augmented one fourth. *T. C.*

The process for dyeing black, of Mr. Haigh of Leeds. Fill a vessel sufficiently large with soft water, and for every hundred weight of cloth, put in thirty pounds of logwood chips; with half a pail of elder (he means alder) bark, and six pounds of sumach; boil these ingredients together for half an hour (two hours are little enough, *T. C.*) when the cloth may be entered (the copper being first cooled by the addition of cold water) and boiled an hour and a half, being constantly turned on the winch to prevent an unevenness of dye. This operation being ended, which is called a preparation, or stuffing the blacks, (the *engallage* of the French, *T. C.*), I shall proceed to the finishing.

A small tub is to be placed by 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 liquor into the copper; the cloth is turned here at a boiling heat, one hour, (too short a time, *T. C.*) 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. (It should be well aired. *T. C.*) While the second cooling is going on, six pounds of logwood, ten pounds of bark (that is I presume alder bark, *T. C.*) and two pounds of argill (I presume argol or tartar, *T. C.*) with ten pounds of soda or common ashes, and three pounds of copperas, must be put to the liquor; these ingredients must be made to boil one hour, when the goods must be turned and worked one hour.

Keep the winch perpetually turning; always observing that the small portion of air which the goods receive by turning on the winch, contributes much to the beauty of the colour. (Hence the propriety of giving the goods a thorough airing, after each dyeing in liquor containing copperas. *T. C.*) 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 argill (argol or tartar) 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 is, if a too great quantity of logwood is not 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. (All this reasoning is at best extremely dubious. I give no credit at present either to the use of argol, ashes, or chamberley; but experiments are wanting. *T. C.*)

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 be previously 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 winch one minute; it must be thrown off the 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 lists; each taking hold of one end with their left hand, to be continued till cold before it be returned.

(On this process of Mr. Haigh, I would remark, that I am not persuaded of the use of the alkaline liquors; they make the colour of the drugs more fugitive, and they certainly precipitate the copperas. Nor can a good logwood black be dyed at all, without verdigris or blue vitriol. *T. C.*)

A process for black, by Asa Ellis of Brookfield, Massachusetts. For twenty pounds of fulled cloth, take one bushel of yellow oak bark; (I presume he means the bark of the black oak, which dyes yellow, *T. C.*) or if that cannot be obtained, an equal quantity of walnut bark. Boil it four or five hours. Then take out the bark and add two pounds of good copperas; let it dissolve; then dip the cloth for half an hour; cool and repeat three or four times; the cloth will then appear of a heavy or dead olive colour; rince the cloth well; air it; fill the copper two thirds with boiling water, and add strong logwood liquor by a pail full at a time, until by repeated dippings your cloth has acquired a good colour. Then rince the cloth for dressing.

This will do for dyeing silk. (The essential point of airing the cloth is omitted. There should also be four ounces of verdigris or blue vitriol. *T. C.*)

Another American process. Use six ounces of logwood, as much sumach, and two ounces of fustic for each pound of woollen; boil these drugs for a couple of hours; then put in a little chamberley, which throws the sumach to the top; scum it off, and throw it into a tub with some water, which may be used to fill up the copper. Enter your woollen, and wince it for a couple of hours; then put in per pound of woollen, three ounces and a half of green copperas, and half an ounce of blue copperas; re-enter your woollen; work it in this liquor for an hour, rather under a boiling heat; take out the woollen; cool it; open it; air it well; repeat this two or three times more; then drain, cool, air, and wash your woollen.

(This is a good receipt, excluding the chamberley, which injures the fastness of the colour, as I think. *T. C.*)

Another. Dye your fine cloth a blue ground. For each pound of cloth use one third of a pound of logwood, the same quantity of sumach, one eighth of a pound of black oak bark, as much madder, and one sixteenth of a pound of Aleppo galls. Boil these ingredients for two hours at the least, then strain the liquor; cool it below a boiling heat; enter your cloth, and wince it well in this liquor at a scalding heat for two hours; you need not air it yet; only drain and cool it.

Then, add to the liquor three ounces for each pound of woollen cloth, of green copperas, and half an ounce of verdigris; let them dissolve in the liquor, and again enter your cloth at a scalding heat but not more; wince it therein for one hour; take it out; drain and press it to get out the superfluous liquor; open it; air it for a full hour; enter it again, and do the same; when cooled and aired, throw into the liquor, for each pound of woollen, half an ounce of green copperas, and the eighth of an ounce of verdigris; bring the liquor to a scald; work the goods for an hour as before; drain, cool, open and air them; repeat if necessary. Now put into the liquor about a gallon of Gallipoli oil for about a hundred and twenty pounds weight of cloth; enter the cloth at a scald; wince it for an hour; take it out, drain, open, air and full it. If the colour be not good at four dippings, give it another, before the oil is used.

I regard this as the best of the receipts for producing a good black, except the common hatter's dye which is similar to it. *T. C.*

Common blacks for coarse goods may be prepared with sumach and fustic, or with sumach and oak bark, or sumach and alder bark, or sumach and walnut peel, or sumach and walnut bark; boiling the drugs for two hours at least; then enter the goods into the bath or liquor at a scalding heat, wincing them for two hours; then drain and cool the woollen; then put in green copperas and wince the goods for an hour in the bath or liquor so prepared; then drain, open and air them; then run them through the liquor again in the same manner, and repeat the process a third time; airing them well always after copperas; then blacken them in the old liquor of a black-dye bath, adding a pail full of logwood and a little blue vitriol.

In this way all the old liquors or baths may be used up, and nothing lost. *T. C.*

In fulling fine cloths after they are dyed, a little soap in the water is of service, to take out not only superfluous colour, but superfluous oil. The cloth must be fulled till the water comes away perfectly clear.

Good cloths, will require not less than one preparation; three separate dippings and airings at least after the copperas is put in; and then a fourth with the oil. *T. C.*

In the black dye, the sumach, bark and galls with the copperas, give the *permanent* black, but it is of a brownish hue; the logwood gives the *lustre and velvety appearance;* the verdigris or blue vitriol (verdigris is best) gives the *blue*-black; and the oil or fat, gives the *softness* to the touch, for which fine cloths are distinguished. *T. C.*

The black dye for woollens, will answer for silks, except that they require the bath to be somewhat stronger, the heat to be less, and no oil. *T. C.*

I have tried repeatedly to give a brilliant blue tint to fine blacks by means of prussiat of potash, and have succeeded; but not I think in point of expense. *T. C.*

Of Gray colours on Woollen. The ground work of all grays, is the black dye: a diluted black, is a simple gray. The black dye is ink; when diluted, it produces gray colours of a tinge more or less deep, in proportion as the bath is less or more diluted, and as the cloth is permitted to remain a longer or shorter time.

Mere astringents, such as galls, sumach, alder bark, white oak bark, give brownish grays with copperas; quercitron gives a gray with an olive tinge; logwood and copperas give a gray of another tinge; with a small quantity of verdigris or blue vitriol, it gives a blue tint; all these tints may be varied into drabs, olives, browns, and chocolates, by the yellow dye drugs and madder.

Before I give the processes for *gray* colours, I must present the reader with *Homassel's* mordant for fast and bright colours of this description, which I know by experience to be deserving of the recommendation he gives it, but it is expensive.

Take of nitric acid and dilute it with an equal weight of water; put in it two ounces of filings of steel (iron is as good. *T. C.*) and let the steel dissolve for two days: it will then be ready for use: the residuum exposed to a strong heat in an open crucible will make the English crocus martis.

This process is very unscientific. Steel is not so good as iron; nor will two ounces saturate a pound of nitric acid. The solution should be thus made:

Put into the nitric acid thus diluted, by a small quantity at a time, as much malleable iron as it will dissolve; after letting it stand for twenty-four hours, decant it into another bottle for use. Keep it close stopt from the air. This solution makes brighter colours and faster colours than green copperas, that is sulphat of iron; but the preparation is dearer. *T. C.*

This is used with galls, with madder, with cochineal, and wherever a gray is meant to predominate.

Common Gray; is the black dye diluted; or a bath of galls, after nitrat of iron.

Raven Gray. Copperas with one fourth of alum; then logwood liquor; repeated alternate dippings, first in one, then in the other.

Mud Gray. Boil some soot in water, and ground the cloth with it: then enter it in a dilute black dye.

Pearl Gray. In a diluted black dye mix some archil. (Orseille, well known to the silk dyers.)

Another. Pearl gray is a light brown bearing on a blue. It appears to have passed but a small change from the white. Particular care must be taken that all the utensils are clean. Boil the water and add to it for twenty yards of fulled cloth, one tea-spoonful of nut galls powdered and sifted; boil them for half an hour. Then enter the cloth moistened with hot water, and wince it for half an hour. Take it out and cool it; add to the liquor another tea-spoonful of nut galls; dip and cool the cloth as before; again put in the same quantity of nut galls, and dip and cool a third time.

Now add to the liquor, a piece of green copperas about the size of a small nutmeg, and a piece of alum about the size of a walnut, and when these are dissolved, a small tea-spoonful of the solution of indigo in oil of vitriol; then dip your cloth as before; do so again, adding another small tea-spoonful of the same solution; and again without any addition. If your cloth lacks any thing of the required tint, add of the ingredients in very small quantities, as you see fit. (In substance from Asa Ellis.) This is a good receipt. *T. C.*

Another. (Haigh of Leeds.) For pearl colour or silver gray, 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 ash, 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 about an hour, often stirring it; when the water begins to boil, put in three ounces of alum which will throw the filth of the water to the top, when it must be scummed off with the bowl. Wash the worsted in this liquor about forty minutes, when it must be taken out, and three or four pails of the logwood liquor added to the alum 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 alum or ashes are used, the colour will be imperfect, for the alum 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 used in too great quantity, would make the colour too red; this may seem a contradiction, but practice will confirm my remark.

(Of these receipts, which are very different in their composition, I prefer Mr. Asa Ellis's. *T. C.*)

Mouse Gray. Soot; then logwood with alum and copperas.

Roach Gray. Logwood, copperas and alum.

Slate Gray. Logwood, green copperas, and blue copperas.

Cinder Gray. Soot; logwood, alum and copperas.

Greenish Gray. Diluted black dye with soot; or black dye and fustic.

It would be well for a dyer (says Homassel) to bear in mind, that all the colours imaginable, are formed out of blue, red and yellow; that black with logwood, is frequently a substitute for blue; that no gray can be produced without copperas or a solution of iron; that all gray colours are decidedly the better for a slight previous ground of common *soot;* that colours are faster and brighter for a previous ground or preparation, without which they will look faded, meagre, hungry.

For expensive cloths, and delicate colours, in which gray is meant to predominate, the nitrat of iron, that is, iron dissolved in aqua fortis, is much superior to the sulphat of iron, or green copperas: but it is too expensive for common work.

Process for dyeing Scarlet on Woollen; and first of the composition. The French scarlets, like the French blacks, have usually carried away the palm of superiority. But every dyer has his own recipe for scarlet. I have seen and observed the process at Messrs. Godwin's and Co. in London, where Dr. Bancroft made his ineffectual experiments, and after giving the common processes, I shall make my own remarks.

Hellot's process for the composition. This is copied in the dyer's assistant, by James Haigh of Leeds.

As it is this composition which gives a fine bright fire colour to the cochineal, which without the addition of this acid solution would be crimson, I shall from my own experience (Hellot's) give the best method of making this composition.

I take eight ounces of spirit of nitre, and weaken it by adding an equal quantity of river water. I then dissolve by degrees, half an ounce of sal ammoniac, very white, in order to make an aqua regis; for it is well known that spirit of nitre alone, is not a proper menstruum for tin. Lastly I add only two drachms of salt-petre of the third drying: this might be omitted, but I am persuaded it contributes to blend the colour, and make it more uniform. In this weak aqua regis, I dissolve an ounce of English tin, previously granulated by dropping it when melted from a certain height into a bason of cold water. These grains I drop into the solution one by one, waiting till the first is dissolved before I put in a second, in order to preserve the red vapours which rise in a great quantity, and which would be lost were the metal to be dissolved too precipitately. (All this theory about preserving the red vapours is good for nothing, but the practice is good. *T. C.*) It is necessary to preserve this red vapour, which as Kunckel observed in his time, contributed to the vivacity of the colour. This is doubtless a much more tedious method than that used by the dyers, who throw their aqua fortis immediately on the tin grains, and who when it produces a rapid fermentation and a quantity of vapour, allay it with cold water. When my tin is thus gradually dissolved, the scarlet composition is complete, and the liquor is of the colour of a solution of gold. I use the finest tin without alloy, such as the first production of the furnaces of Cornwall, consequently there is neither dust or black sediment at the bottom. This solution of tin, though so very transparent when just made, becomes milky in the violent summer heat. The dyers are generally of opinion that it is then turned, and no longer good. I found, however, that this apparent defect made no difference. Besides, in cold weather it resumes its former transparency, provided it be prepared with the several precautions which I have just directed. I must likewise add, that it should be preserved in flasks well stopped with glass stoppers, to prevent the volatile parts from evaporating. The dyer's composition, for want of this attention, is frequently of no use in twelve or fifteen days. I give them the best method, and if they expect perfection they must alter their present defective method.

The dyers have a stone vessel with a wide mouth, in which they put two pounds of sal ammoniac, two ounces of refined saltpetre, and two pounds of granulated tin. They put into a separate vessel four pints of water, half a pint of which they throw on the mixture in the stone vessel. They afterwards add a pound and a half of common aqua fortis, which produces a violent fermentation; when the ebullition ceases, they add as much more aqua fortis, and immediately afterward, another pound. After this they pour on it the remainder of the four pounds of water; they cover the vessel well, and let it stand till the next day. The saltpetre and sal ammoniac may be dissolved in aqua fortis before the tin is added, but this they say is the same thing, though it is certain that the last is the best method. Others mix the water and the aqua fortis together, which mixture they throw on the tin and sal ammoniac. Others, in short, observe different proportions.

The day after preparing this composition, they make the preparation for scarlet. For one pound of worsted they put into a small copper ten gallons of clear water. When the water is a little more than warm, they add two ounces of cream of tartar in fine powder, and a drachm and a half of pulverized cochineal sifted. They keep a quick fire, and when the liquor is ready to boil, add two ounces of the composition, which acid immediately changes the colour of the crimson to a blood colour. As soon as the liquor begins to boil, they plunge the worsted, previously steeped in hot water and squeezed. It is then stirred without ceasing, and suffered to boil during an hour and a half; after which it is taken out, gently squeezed, and washed in cold water. The worsted when taken out, is of a tolerably bright flesh colour, or even some shades darker, according to the goodness of the cochineal, and the strength of the composition. The colour of the liquor is so entirely imbibed by the worsted, that it remains almost as clear as water. This is called the scarlet boiling; a preparation absolutely necessary, and without which the cochineal dye would not hold.

In order to finish, there must be another preparation of very clear water, as the goodness of the water is of infinite consequence to the perfection of the colour. They add at the same time half an ounce of starch, and when the liquor is better than warm, six and a half drachms of well pulverized and sifted cochineal is added to it. Two ounces of the composition is poured into the liquor a little before it boils, which as at first immediately changes the colour. You wait till it begins to bubble, and then dip the worsted. It should be constantly stirred as at first, and in the same manner suffered to boil for an hour and a half; after which it is taken out, squeezed, rinced at the river, and then the scarlet is in perfection.

One ounce of cochineal to a pound of wool will give it a fine colour, and make it sufficiently deep, provided it be managed with attention to my directions, and that there remain no colour in the liquor. If nevertheless, you would have it deeper, you may add a drachm or two more of the cochineal; but a greater quantity would destroy all its brightness and vivacity.

Though I have ascertained the quantity of the composition as well for the preparation as for dyeing, this quantity should not be considered as invariable. The aqua fortis generally used by the dyers, is seldom of an equal strength; consequently, if it be always mixed with an equal quantity of water, it will not always produce the same effect. There are certainly some methods of ascertaining the different degrees of the acidity of the aqua fortis; as for example, to use that acid, only two ounces of which will dissolve one ounce of silver; by observing this method, you might succeed in making a composition that would always be the same; but then the quality of cochineal would occasion other varieties. However, the little difference which this generally produces in the scarlet shade, is not of much consequence; besides, there is a method of remedying this defect, and bringing it precisely to what colour you please.

If the composition be weak, and less of it be added than I have directed, the scarlet will be rather deeper and stronger; but if on the contrary, there be a little too much, it will have more of the orange colour, more of what is called *fire*. In order to give it this shade, a little more of the composition may be added after the first, if the worsted appears to have imbibed too deep a colour. But the wool should be taken out first, and the composition well stirred in the copper, for if it happens to touch the wool before it be well mixed, it would spot. If on the contrary, the scarlet be too fiery, that is, too much on the orange, or too rusty, there is nothing to be done, but when it is entirely finished, to dip it in hot water; this will crimson it a little; that is, it will diminish the brightness of the orange; but if this be not found sufficient, it will be necessary to put a little Roman alum into the hot water. (If the water crimsons the colour, it is owing to saline impurities, such as calcareous salts contained in it. *T. C.*)

When you would dye a regular series of scarlet shades on worsted, half the quantity of cochineal and of the composition, used for a full scarlet, will be sufficient. You also diminish in proportion the cream of tartar in the *preparation*. The worsted should be divided into as many skeins as you would have shades; and when the *preparation* is made, you dip the skein intended for the lightest shade, which should remain but a very little time; the next shade should afterwards be put in, and suffered to remain some little time longer, and so on to the darkest shade: the worsteds are then washed, and the liquor prepared in order to finish them. As soon as the liquor is in a proper state, every shade is dipped one after the other, beginning with the lightest. If you perceive any skip in the gradation of shades, the skein which appears deficient in colour, should get another dip. This deficiency is easily perceived, and a very little practice enables you to sort them perfectly.

One circumstance in the art of dyeing, which deserves attention, but which I have not yet mentioned, is, an enquiry concerning the materials of which the cauldron is made. Dyers are divided in this particular. Their cauldrons in Languedoc are made of fine tin. Such are also used by several dyers at Paris; but M. Julienne, whose scarlet is very highly esteemed, makes use of brass cauldrons. These are also used in the dyeing manufactory of St. Denis. M. Julienne is careful only to suspend a large pack-thread net with small meshes in his cauldron, to prevent the stuff from touching. At St. Denis, instead of a net they use a large open wicker basket; but this is less convenient than the net, because it requires a man at each side of the copper to keep it even, and to prevent it when loaded with the stuff from rising to the surface of the liquor.

This practice, so different with regard to the materials of the cauldron, determined me to make an experiment. I took two ells of white Sedan cloth, which I dyed in two cauldrons, one of copper, furnished with a pack-thread net, and the other of tin. I weighed the cochineal, the composition, and other ingredients, with as much accuracy as possible. They boiled exactly the sáme time. In short I was sufficiently attentive to make the operation the same in every particular; that in case of any perceptible difference, it could only be attributed to the different materials of the cauldrons. After the first boiling, the two patterns were absolutely alike, except that the piece dyed in the tin cauldron, was rather more marbled and not quite so even as the other; but this in all probability might be occasioned by their not having been equally cleansed at the mill. I finished each piece in its proper cauldron; and they were both of them very beautiful. Nevertheless it was very evident, that the cloth which had been dyed in the tin, was more fiery, and the other rather more crimsoned. They might have been easily brought to the same shade, but this was not my object. From this experiment it appears, that with a copper cauldron, the quantity of the composition should be increased; but then the cloth becomes hard to the touch. Those who dye in copper, to prevent this evil, add a little turmeric, which is a drug only used for false colours, and therefore prohibited by the regulations to dyers in grain, but which gives scarlet that dazzling fiery colour, so much the fashion at present. It is however, if you have any suspicion, easy to discover the deception by cutting the pattern with a pair of scissars. If it has no turmeric, the cut edge will appear white, otherwise it will be yellow. When the close texture is equally dyed with the superficies, let the colour be what it will, they say the colour *cuts;* and the contrary, when the middle of the texture remains white. Legitimate scarlet never cuts. I call it legitimate, and the other false, because that dyed with the addition of the turmeric, is more liable to fade. But as the taste for colours is so variable, as the bright scarlets are at present the mode, and as it is necessary in order to please the buyer, that it should have a yellow cast, it would be better to authorize the use of the turmeric, though a false colour, than to allow too large a quantity of the composition, by which the cloth is injured; being more liable not only to dirt, but also to tear, as the fibres of the wool are rendered brittle by the acid.

I must also add, that a copper cauldron should be kept extremely clean. I have myself frequently failed in scarlet patterns, by neglecting to clean the cauldron. I cannot, in this place, forbear condemning the practice even of some eminent dyers, who at about six o'clock in the evening make their *preparation* in a copper cauldron; and in order to gain time, keep it hot till day light the next morning, when they dip their stuffs. The *preparation* must undoubtedly corrode the copper during the night, and consequently by introducing coppery particles into the cloth, injure the scarlet. They will tell us, that they do not put in the composition till immediately before the cloth is dipped; but this is no apology, for the cream of tartar, added on the preceding evening, being sufficiently acid to corrode the copper, forms a verdigris, which dissolves, it is true, as soon as it is formed, but which nevertheless produces the same effect.

As tin is absolutely necessary in the scarlet dye, it were much better to have a cauldron made of this metal, which would infallibly contribute to the beauty of the colour. But these cauldrons, if sufficiently large, cost three or four thousand livres; an object of consideration, especially as they may melt in the first operation, if not carefully attended to by the workman. Besides, it would be very difficult to cast a vessel of so large a size, without flaws, which would require to be filled. It is absolutely necessary that they be made of block tin. If the flaws should be filled with solder, which contains a mixture of lead, many parts of the cauldron will retain the lead, which being corroded by the acid composition, will tarnish the scarlet. Hence there are inconveniences in every particular: nevertheless if it were possible to procure a skilful workman, capable of casting a cauldron of melac (molucca, *T. C.*) without flaws, it would certainly be preferable to every other. (A common tin boiler, where the joints are soldered with a solder consisting chiefly of tin, answers all the purposes, if kept clean, and frequently examined: but if the iron become exposed to rust, through want of care, it greatly hurts the colour. Perhaps tinned copper is the best upon the whole. The bottom is frequently made of copper. *T. C.*) For though the acid of the composition should in some parts corrode it, the detached particles will do no harm, as I have already observed.

There is no danger of melting a tin cauldron, except when it is emptied in order to fill it with the fresh liquor; I shall therefore add the precautions necessary to prevent this evil. In the first place, the fire should be taken entirely from the furnace, and the remaining embers quenched with water. Part of the liquor should then be taken out with a bucket, while the remainder should be dashed about with a shovel, by another person, in order to keep the upper part of the cauldron continually moist; at the same time cooling what remains in the cauldron with cold water. In this manner it should be continued, till you can touch the bottom without being burnt. It should then be entirely emptied, and all the sediment taken up with a moist spunge. This attention will preserve your cauldron.

Having given the method of dyeing worsteds in scarlet, and of making the shades required for all kinds of tapestry, I shall now add the method of dyeing several pieces of stuff at the same time; and shall in this place, describe the practice used in Languedoc, as it was communicated to me by M. De Fondieres, then inspector general of the manufactories. I made the experiment myself with several ells of stuff, and succeeded perfectly well, though the colour was not quite so fine as the scarlet of Gobelins.

It is necessary to observe, that woollens are never dyed scarlet in the fleece, for the two following reasons. The first is, or ought to regard all stuffs of simply one colour; those of many colours are called mixt stuffs. This kind of stuffs is never dyed in the wool, especially when the colours are bright and fine; because in the course of the fabrication, the spinning, twisting or weaving, it would be almost impossible to prevent some white or other coloured wool from mixing, which though ever so trifling, would injure the stuff. For which reasons, reds, blues, yellows, greens, or any of these unmixed colours, should not be dyed till after they have been manufactured.

The second reason is peculiar to scarlet, or rather to the cochineal, which being heightened by an acid, cannot stand the fulling, without losing much of its colour, or being at least excessively crimsoned. For the soap, which contains an alkaline salt, destroys the vivacity produced by the acids. Hence it is evident, that neither cloth or stuffs should be dyed scarlet, till they have been fulled and dressed.

For example, in order to dye five pieces of Carcassionne cloth at the same time, each piece being five quarters broad, and fifteen or sixteen ells in length, it is necessary to observe the following proportions. You begin by making the composition in a very different manner from the preceding process, viz. twelve pounds of aqua fortis put into a stone jar, or glazed vessel, with twenty-four pounds of water, and one pound and a half of tin grains (granulated tin) added. The solution goes on more or less slow, according to the acidity of the aqua fortis, and should stand for twelve hours at least. During this time, a kind of blackish dirt falls to the bottom; the top should be then drained off the sediment: this liquor is of a clear lemon colour, and is preserved by itself. This process evidently differs from the first, by the quantity of water mixed with the aqua fortis, and by the small portion of tin, of which scarce any remains in the liquor; for the aqua fortis, not being in itself a solvent for tin, only corrodes and reduces it to a calx, provided neither saltpetre, or sal ammoniac be added, which would convert it into an aqua regia. The effect of this composition is not, however, different from others, and is perceptible to those, who from experience are competent judges of this colour. The composition without sal ammoniac, has been for a long time used by the manufacturers of Carcassionne, who doubtless imagined that its effect was owing to a supposed sulphur of tin, and may be preserved from putrefaction for thirty hours in winter, and only twenty-four in summer. It then grows turbid, forms a cloud, which falls to the bottom of the vessel in a white sediment. This sediment is a small portion of the tin which was suspended in an acid not prepared for the solution; the composition which ought to be yellow, becomes clear as water, and if employed in this state never succeeds, but produces the same effect as if it had been milky. The late M. Barron, pretended to be the first at Carcassionne who made the discovery, that sal ammoniac was necessary to prevent the tin from precipitating. Hence it follows, that there was not in this city a creature who knew that aqua regia was the only actual solvent for tin. (The precipitate, is tin too highly oxyded to remain dissolved. *T. C.*)

When the composition is prepared, as I have now described, according to M. de Fondieres, you put for the quantity of cloth last mentioned, about sixty cubic feet of water into a large copper; when the water grows warm, you add a sack full of bran: it is sometimes necessary to use sour water; they will either of them do as they say to correct the water, that is to absorb the earthy and alkaline substances, which as I have already said, when present in water, crimson the tinge of the cochineal. (A small quantity of alum should be added, and the water well scummed while boiling. *T. C.*) We should be well informed concerning the nature of the water employed, in order to know whether these correctives be necessary. Be it as it may, when the water is a little more than warm, add ten pounds of crystals or cream of tartar pulverized; that is to say, two pounds to each piece of cloth. (Very clean white tartar might answer the purpose. *T. C.*) The liquor should be then violently stirred, and when rather hot, you should put into it half a pound of pulverized cochineal, mixing it well together; and immediately afterwards pour into it twenty-seven pounds of the composition, very clear, which also requires to be well stirred. So soon as it begins to boil, the cloth being immersed, should boil very fast for two hours, and during that time should be kept in continued motion on the winch, and when taken out, pass it through the hands by the listing, in order to open and give it air. It is afterwards carried to the river and well washed.

In order perfectly to understand the method of stirring the cloth, it is necessary to recollect what has been said in the beginning of this work, viz. that a kind of reel or winch with a handle for turning, should be placed horizontally on the iron hooks, which are fixt in the fellies that support the edge of the cauldron. You first join the several ends of each piece of stuff to be dyed at the same time, and as soon as they are immersed, you carefully keep the end of the first piece in your hand, you then lay it on the reel, which should be turned till the end of the last piece appears. It is then turned the contrary way, and in this manner every piece will be dyed as evenly as possible.

When the cloth has been well washed, the cauldron should be emptied and fresh liquor prepared, to which you must add, if necessary, a bag of bran (and a little alum, *T. C.*) or some sour water; but if the quality of the water be very good, there is no occasion for any addition. When the liquor is ready to boil, you put in eight pounds and a quarter of cochineal pulverized and sifted. The whole is then mixed together as even as possible; but when you cease to stir, you must mind when the cochineal rises to the surface, forming a kind of scum of the colour of wine lees. As soon as this scum begins to divide, you pour in eighteen or twenty pounds of the composition. You should have a vessel full of cold water near the cauldron to throw in, lest after putting in the composition it should rise above the edge, as is sometimes the case.

The composition being put in the copper and the whole well mixed, turn the winch quick for two or three turns, that every piece may imbibe the cochineal equally. It is then turned more slowly, in order to let the water boil. It should boil very fast for two hours, constantly turning and keeping the cloth down with a stick. The cloth is then taken out, and passed through the hands by the listing, in order to give it air and to cool it; it is afterwards washed at the river, dryed and dressed.

Hence it appears that for every piece of Languedoc cloth, five quarters wide and sixteen ells long, designed for the Levant, there is required a pound and three quarters of cochineal; which quantity is sufficient to give the cloth a very fine colour. But if you still require an orange tint, and increase the quantity of cochineal, you must increase the quantity of the composition, which would injure the cloth without improving the colour. (These remarks give great weight to Dr. Bancroft's proposal of flaming with quercitron. *T. C.*)

There is a considerable advantage in having a great quantity of stuff to dye at the same time. As for example, when the first five pieces are finished, there remains a certain quantity of the cochineal, which supposing seven pounds at first, may amount to twelve ounces; so that cloth being put into this second liquor, will imbibe the same shade of rose colour, as if you had coloured a fresh liquor with twelve ounces of cochineal. The quantity remaining, however, may vary very much according to the nature of the cochineal, or according to the fineness of the powder, but I shall speak more particularly of this, before the conclusion of this chapter. Though the quantity of colour remaining in the liquor may be very inconsiderable, it nevertheless deserves attention on account of the dearness of this drug. Of this liquor therefore, a preparation may be made, for five pieces of cloth; and it will require less of the cochineal and less of the composition in proportion, as near as you can guess, to the quantity of these remaining in the liquor. This is also a saving of fuel and time; but it is impossible to give positive directions on this subject, which must be submitted to the dyer's discretion; for having dyed rose colour after the scarlet, you may make a third preparation, which will dye a flesh colour. If there should not be time to make these two or three preparations in twenty-four hours, the liquor spoils. Some dyers put Roman alum into the liquor to prevent its spoiling, but this changes it to a crimson.

Scarlets thus crimsoned in the same liquor in which they have been dyed, are never so bright as those which are done in a fresh colour. Drugs which reciprocally destroy each other's effect, are more efficacious when dyed in succession.

When you dye cloths of different qualities, or any kind of stuffs, the best method is to weigh them, and for every hundred pounds of cloth, to allow six pounds of crystals or cream of tartar, eighteen pounds of the composition in the *preparation*, and the same quantity in the finishing; and in each of them six pounds and a quarter of cochineal; that is, two ounces of cochineal in all, for each pound of woollen cloth. In small expe-ments, use one ounce of cream of tartar, six ounces of composition, and one ounce of cochineal for the preparation, and then another ounce of cochineal for the finishing, to a pound of wool. Some of the Paris dyers succeed very well by putting two-thirds of the composition, and a quarter of the cochineal in the *preparation*, and the remaining third of the composi-tion, and three-fourths of the cochineal in the *finishing*.

It is not the custom to put crystals or cream of tar-tar in the finishing, but I am convinced by experience, that it does no harm, provided that at most you put but half the weight of the cochineal, and it made the colour in my opinion more permanent. There have been dyers who have dyed scarlet at three times; in this case they make two *preparations*, and then finish; but they always use the same quantity of drugs.

I observed in the preceding chapter (says Hellot) that the kermes were so little used for brown or Vene-tian scarlets, that these kind of colours were made with cochineal. For this purpose the preparation is made as usual, and for the dyeing, they add to the liquor eight pounds of alum to every hundred pounds of stuff. This alum is dissolved in a separate cauldron with a sufficient quantity of water. It must be thrown into the liquor before the cochineal. The remainder is done precisely the same as in common scarlet: it gives the cloth the same colour as Venetian scarlet, but it is not by any means so permanent as the colour obtained from kermes.

All alkaline salts crimson scarlet; but it is more generally the custom to use alum; for these alkaline salts are no addition to the permanency of the colour, and may possibly injure the stuffs; for all animal substances are attacked by fixed alkalies. The alum by being deprived of its phlegm by calcination, will more certainly crimson. The liquor which had been used for crimsoning is red, and still redder in proportion as the scarlet is more crimsoned, so that the colours part with much of their base in the liquor, by which they are darkened. It is however impossible to darken *in grain* without salts. The late M. Barron, in a memoire which he presented to the Royal Academy of Sciences, remarks, that he succeeded better with the salt of urine than with any other salt, for uniting the colour and preserving its brightness and fulness; but as he observed, it is very inconvenient to make any quantity of this salt. (Then why not use the urine itself. *T. C.*)

I said in the beginning of this chapter, that the choice of water for the dyeing of scarlet was of importance. The greatest part of the common waters sadden, because they almost always contain a quantity of stony or calcareous earth, and sometimes of sulphureous or vitriolic acid. These are commonly called hard waters; by this term they mean waters that will not dissolve soap, and in which it is not easy to dress vegetables. By absorbing or precipitating these heterogeneous substances, all waters are rendered equally good. If the matter be alkaline, a little sour water will produce this effect. Five or six cubic feet of this sour water (an English cubic foot of water weighs one thousand ounces or sixty-two and a half pounds avoirdupois weight at the freezing point: as a pint of water weighs one pound avoirdupois, a cubic foot will be equal to sixty-two pints and a half, or 7,781 gallons, somewhat more than seven gallons and three quarters, *T. C.*) added to sixty or seventy cubic feet of other water before it is boiled, will cause the alkaline earth to rise in a scum, which may easily be taken off the liquor. A sack full of any white mucilaginous root cut in small bits, or if dry, powdered, will also, if the sack be left to soak in the water for half or three quarters of an hour, correct a doubtful water; bran, as I said above, will answer the same purpose tolerably well. (A little alum is necessary. *T. C.*)

What I have said in this chapter, is meant for the instruction of those who wish to acquire a knowledge of dyeing; I shall now endeavour to satisfy the philosopher, and present him with the experiments by which I discovered this invisible mechanism, if I may be allowed the expression, of these various preparations.

Strong acids destroy the colour of an infusion of cochineal. Alkalies turn it purple.

Any solution of iron turns such an infusion into an ash gray.

Nitrat of zinc changes it into a violet slate colour.

Sugar of lead produces a tarnished lilac, or laylock.

Sulphat of potash, produces an agate gray. So does sulphat of soda, or Glauber's salt.

Nitrat of bismuth, a beautiful bright turtle gray.

Nitrat of copper, a dirty crimson.

Nitrat of silver, a cinnamon.

Gold in aqua regia, a marron.

Nitrat of mercury, a similar colour.

Fixed salt of urine, a clear ash colour.

Extract of bismuth (I do not know what is meant by extract, unless it be the solution in aqua fortis or aqua regia, *T. C.*) produces a violet as fine as if the cloth, previous to the application of red, had been dyed an azure blue.

(All the preceding experiments are uncertain, because the tinge may be in some degree owing to the impurity of the acids in respect of iron. The solution of bismuth is coming daily into repute as a mordant, owing to the brilliancy of the tints it produces. *T. C.*)

Before the conclusion of this chapter, I shall make some observations, which will not I think be unacceptable to the reader. Neither the dirt of the street nor acid substances, will spot scarlet if immediately washed off with a clean towel and water; but if suffered to dry, a violet colour is produced by dirt, which cannot be corrected, without a vegetable acid, such as vinegar, lemon juice, or a weak solution of white tartar made warm; but if these acids are not managed with great care, they will leave a yellow spot in taking off a dark one. I have before observed, that acids will rust and destroy even the red of cochineal. A red cloak extremely spotted with dirt may be cleaned with sour water. For some kind of spots it is necessary to dip the stuffs in the liquor that remains after dyeing scarlet, but for others you are obliged to discharge the colour and dye it again.

Alkalies have not alone the property of destroying the scarlet colour. A piece of scarlet cloth put into the *preparation* for this colour, will be discharged in such a manner, that if it boil but for one hour with three pieces of white cloth, it will be difficult to distinguish that which was scarlet from the others.

If you dip a piece of scarlet cloth in the preparation water it will lose all its colour, which can be restored by dyeing it again in cochineal liquor, but not with the same brightness. Scarlet cloth always loses some of its brightness in dressing, because it lays the fibres of the nap, almost parallel with the weft.

(Such is the account of the scarlet dye given by *Hellot;* which I have extracted nearly at length, because although it is far from being the best account of the process, either in theory or in practice, it contains a great number of very useful practical observations, and it is an account also, which if followed, will enable a person to dye a good scarlet. I proceed now to the more modern processes of Berthollet and Homassel. *T. C.*)

On the Scarlet Dye of Messrs. Berthollet. Scarlet is the most beautiful of dyed colours. The public taste is not constant as to the tint which is preferred. Sometimes a deep and perfect red is in demand, more frequently a flame colour.

Before we proceed to the method of dyeing scarlet, it will be proper to describe the method, or rather the various methods of making the composition, or solution of tin.

On this subject, every dyer has his own receipt; and indeed the results of different processes are different. It is of great consequence however, that each artist should adhere to one uniform mode of making it for his own purposes, whatever mode he may think fit to adopt; otherwise, he can derive no benefit for the future, from observations he may make on processes that are past.

The old dyers, and indeed many at present, use nothing but aqua fortis, which is frequently an impure acid approaching to an aqua regia; owing to the impure state of the nitre used, which contains a variable quantity of common salt, from which the gunpowder makers find it absolutely necessary to purify the nitre they make use of. Hence aqua fortis thus made, can never be always of the same quality.

Pure nitric acid (aqua fortis) never holds the tin in solution unless it be greatly diluted, and unless the vessel in which the solution is made, be placed in cold water. In this case, the metal is at the lowest state of oxydation, according to the observation of Proust; but it soon precipitates in the form a white sediment, even at a common temperature.

Vogler used for the scarlet dye, a solution thus made, but he prevented the tin from being precipitated, by using either common salt or sal ammoniac; but one might as well employ aqua regia at once, which demands less attention.

If a stronger nitric acid be employed, or if heat be used, the tin passes to its highest state of oxydation, and is entirely precipitated. (This precipitate indicates the weight of tin that there may be in an alloy or mixture of metals, for in the state of this precipitate, the tin has taken up forty parts of oxygen for one hundred parts of tin. The oxygen is obtained from the decomposition of the nitric acid.)

Hellot takes thirty-two parts of nitric acid diluted with an equal weight of pure water. In this acid he dissolves gradually two parts of sal ammoniac white and pure, and one part of common nitre; and then, by a small quantity at a time, two parts of granulated tin.

Scheffer dissolved one part of tin in four parts by weight of aqua regia, or nitro-muriatic acid.

Macquer dissolved three parts of tin in eight parts of nitric acid, in which he mixed one part of sal ammoniac dissolved in six parts of water.

Gulich saturated the nitro-muriatic acid he employed with tin put in by degrees.

Pœrner used other proportions.

These solutions, so different in their preparation, must of course have different properties; but one essential object is not obtained, namely, an uniform preparation of this composition; uniform as to the kind of acid, the strength of the acid, and the proportion of tin and of other ingredients if any such are used. For this purpose it is absolutely necessary to have pure nitric acid, and of a given strength.

Take therefore nitric acid, which weighs 1,5 or half as much more as water under the same bulk, (the nitric acid of this country seldom weighs more than 1,33, or a third more than water, *T. C.*) dissolve in it one-eighth part of clean white sal ammoniac or muriat of ammonia, and add by very small quantities at a time an eighth part of tin; dilute this mixture with one-fourth of its weight of water. Common tin often contains lead and copper, and therefore the best English tin is to be preferred. Care must be taken in granulating it, by pouring it in water, to avoid the particles being thrown out; the water should be stirred with a small broom during the granulation.

When the tin is dissolved, there is usually a small deposit of black powder, from which the solution must be decanted.

Solutions which contain a great proportion of tin, are brown, and give deeper and less brilliant colours; though such solutions are occasionally wanted. Such a solution, highly charged with tin, may be obtained by distilling in a retort at a strong heat equal parts of sal ammoniac and oxyd of tin; the residuum dissolved and filtered, and then evaporated till it crystallizes, furnishes a triple salt of muriatic acid, ammonia, and oxyd of tin, which requires the addition of a little muriatic acid to prevent the tin from precipitating.

As the solution of tin is apt to become gelatinous, from the gradual oxydation of the tin, partly by the nitric acid, and partly by imbibing oxygen from the atmosphere, it is best not to make too much of it at a time: this gelatinous effect is sooner produced in summer than in winter. (To prevent this, the tin solution should be kept in a cool place, in a dark place, in a greenish glass bottle, well stopped with a glass stopper, with a little butter round the juncture to exclude the air. *T. C.*)

Long experience has shown, that if the solution be made so hastily and violently that the nitric acid is much decomposed, and many red vapours produced, the colour is never so good on the cloth, as when the composition is made slowly, patiently, in a cool place, the tin put in by a grain or two at a time, and the composition used soon after it is made.

(Such are the judicious directions of the M. M. Bertholle's on the scarlet composition. *Homassel* merely recommends a weak nitric acid, without indicating the strength: he dissolves two ounces of sal ammoniac, or two ounces of common salt, which (according to him) is indifferent, and two ounces of granulated English tin, in a pound of this nitric acid. But the composition is so important that I shall give at length my own ideas concerning it: premising that common salt ought to be rejected, since one bushel of it will vary in weight from fifty-six to eighty-two pounds. First of all, buy the strongest nitric acid (colourless aqua fortis) you can get. It is easy to buy weak nitric acid, but difficult to get it strong. In London or Paris you may procure this acid, which shall weigh 1,5 or once and a half in weight as much as water, but not here. But though it is difficult to get it strong, it is easy to make it weak. The dyer therefore must accomodate himself to the state of the country, and having purchased his nitric acid, let him reduce it to 1,25 or once and a quarter the weight of water, and never use any nitric acid of any other strength. To try this, let him fill a Florence flask up to some certain mark in the neck with rain water, and in a room where the thermometer stands at from 60 to 65° of Fahrenheit, let him weigh separately the flask and the water accurately; and this weight of the flask and the water will form a perpetual standard. When he buys his aqua fortis, let him fill the Florence flask up to the same height, and weigh it. Suppose the flask and water weighed twenty ounces, and the flask weighed two ounces: then the water would weigh eighteen ounces. Suppose the flask and the nitric acid weighed twenty-eight ounces, then a bulk of nitric acid equal to the water, would weigh twenty-six ounces. But the standard I recommend is twenty-two and a half ounces, that is eighteen and one-fourth of eighteen, or four and a half. Then pour out your strong nitric acid and add a very small quantity of water at a time, till your acid filled up to the mark in the flask shall weigh, flask and all, only twenty-four and a half ounces. However troublesome this may appear, a little practice will render it easy; and uniformity in the composition is so essential, that it will well repay the trouble.

To one pound weight of nitric acid so reduced to 1,25, or once and a quarter the weight of water, put two ounces of clean sal ammoniac dissolved in half a pint of water; and when this is dissolved, add by a very few grains at a time two ounces of granulated tin. The more the tin crackles in bending it backward and forward, the purer it is. To granulate it, melt it, and pour it when melted, through some twigs into water. If it dissolves too quickly and with many red vapours, put in smaller bits at a time; conduct the solution in a cool place, and set the glass bottle containing the composition in cold water. It ought to take a couple of days. When the tin is all dissolved, add to the composition a little more than half a pint of clean cold rain water: so that the pound of acid thus mixed and diluted, will now measure one quart in bulk. But, before the acid or the sal ammoniac be used, it should be tested, to detect the presence of iron, by means of tincture of galls and prussiat of lime or of potash. If the dyer is not chemist enough for this, he should get a chemist to do this for him; for aqua fortis often contains iron, which will infallibly give a dark tinge to the scarlet. In like manner, the *water* used by a scarlet dyer should be tried; for if it contain either iron, or much calcareous salts, the scarlet will be saddened. Generally, mountain streams in a siliceous country, are much preferable.

Again; before the nitric acid or aqua fortis be used, it should be tried, not only for iron, but as it almost always contains volatile sulphureous acid and muriatic acid, the former at least ought to be gotten rid of by means of nitrat of barytes. The muriatic acid in aqua fortis, owing to the saltpetre used being generally impure from a mixture of common salt, is not of so much consequence. But it can easily be gotten rid of, by nitrat of silver.

I believe the preceding observations are of importance to the perfection of the colour; and upon much reflection, I am satisfied that in this country particularly, my method of making the composition, is upon the whole preferable.

I proceed now to M. Berthollet's method of dyeing scarlet. *T. C.*)

It is in vain to expect any required shade from the proportions indicated in the common receipts; for the cochineal varies in quality, and the composition is liable to great variety in strength, but by means of trials in the small way, the proportions necessary to any required colour may easily be ascertained.

The scarlet colour is dyed at twice; the first part of the process is called the *preparation*, (bouillon) the second the colouring or *finishing*, (la rougie.)

For one hundred weight (one hundred and twelve pounds) of woollen cloth, throw into warm water, six pounds and three quarters of pure tartar (cream of tartar); stir the bath or liquor well; then add ,551 or somewhat better than half a pound of cochineal in fine powder. Stir it well; then add five pounds and a half of a clear solution of tin, and again stir the liquor. When the whole is about to boil, enter the cloth, which must be turned on the wince with great rapidity three or four times, and afterward more slowly. After thus turning it in the boiling liquor for two hours, take it out, air it, and wash it in the river.

Empty the cauldron to prepare the bath or liquor for the *finishing*. Heat the water, and when near boiling, throw in five pounds and a half of pulverized and sifted cochineal; it must be well mixed and stirred in; when you leave off stirring, and a crust appears on top of the liquor, which breaks spontaneously in several places, then pour in fifteen pounds and a quarter of the composition. If the liquor should then boil up to the edge of the cauldron, throw in some cold water.

The composition being well mixed, the cloth is turned into the bath, taking care to wince it rapidly for three or four turns; then more gently, but still not slowly, in the liquor during an hour, keeping it sunk in the liquor by sticks as often as it rises up; take it out, air it, cool, wash it, and dry it.

These proportions are not always the same; the process detailed by Hellot is somewhat different from the above. Some dyers never take the cloth permanently out of the *preparation* liquor, but merely refresh it with the necessary quantity of cochineal boiled apart, and with the due proportion of the composition. This saves time and fuel, and a good colour is thus obtained.

Generally a bright flame colour is in demand; in which case, a little fustic or turmeric is added to the preparation. When this is the case, it can be discovered by cutting the cloth, the inside of which will show marks of the yellow dye, for in the common process the cochineal does not penetrate quite through the cloth. (I have no doubt about the preference of quercitron to turmeric or fustic. *T. C.*)

A tin cauldron or boiler is to be preferred, for the acid of the composition is apt to attack the copper or brass. But owing to the ease with which tin vessels are melted, copper and brass are frequently used; in which case, they must be kept scrupulously clean, the acid liquor must be turned out the instant it is done with; nor must the cloth touch the sides of the vessel, for which purpose net work, or wicker work must be employed inside the boiler. (I see no objection to tinned copper. *T. C.*)

Scheffer prescribes for the preparation bath, one part by weight of the composition to ten parts of cloth, with a tenth also of starch, and a tenth of tartar. He remarks that the starch serves to render the colour more uniform. He recommends to throw into the water when it boils a quantity of cochineal equal to $\frac{1}{128}$th part of the weight of the cloth, to stir it well, to boil the cloth in it, and then cool and rince it. Then to boil it in the finishing bath with $\frac{1}{32}$d of starch, $\frac{1}{24}$th of the solution of tin or composition, $\frac{1}{32}$d of tartar, and $\frac{1}{18}$th of cochineal. The proportion of composition used by Scheffer is much less than that used by Hellot, but his composition contains more tin than Hellot's.

Pœrner describes three principal processes, according to the shades more or less deep, or more or less orange, which you wish to give to the scarlet, which consist in varying the quantities of composition and of tin, and of adding or omitting the tartar which contributes to the yellow or flame coloured hue of the scarlet.

For the purpose of conducting the scarlet dye properly, and to be able to vary the process according to the shade of colour required, it is necessary to become acquainted with the peculiar effect produced by each of the ingredients employed.

If the proportion of composition be too small, all the cochineal will not be taken up, and the water in the bath will be coloured: if too large, it reacts on the colour of the cochineal, dissolves it, and renders it liable to be washed out; hence the colour comes out weak and faded. But if the cochineal be in proportion to the tin, the colour will be full and rich when they are used plentifully. The tartar gives the yellow tinge which with the crimson of the cochineal produces the flame colour so generally in demand.

Although it be true that a scarlet colour can be dyed at one operation, and although for small quantities of cloth and light shades, this may be desirable, yet in a large way, it is found by experience most eligible to dye the cloth at two processes, namely, a *preparation* and a *finishing* (bouillon, et rougie.)

If the yellow tint should predominate too much, it is corrected by running the cloth when dyed through hot water; this effect is owing to some small proportion of calcareous salts contained in the water, which if perfectly pure would not alter the colour at all. (If the water is so pure as not to produce this effect of slightly crimsoning the colour when too yellow, put about half an ounce or an ounce at the utmost of pearl ash into a hundred gallons of water, which will operate as a corrective. *T. C.*)

The bath or liquor is seldom worked out exactly; it generally contains some of the mordant combined with some of the colouring matters. Nothing but experience can teach how far these remains can be used, or what cloths they are fit to give a ground to.

Besides the tartar, a yellow tinge or flame colour can be given, and frugally given, by dyeing the cloth in an old bath wherein scarlet has been dyed, and which is not used up, with a quantity of fustic or quercitron, to give a yellow ground; and then pass the cloth through the preparation and finishing as usual. This is what Bancroft recommends: but however reasonable this may be, it is not yet in common practice.

So a bath not quite spent may be used to dye a *pomegranate* colour with fustic. Then refresh the bath with a little of the composition and cochineal, in the same relative proportions as for scarlet.

A little more fustic with some tartar and composition will produce a *Capucin* colour, and various tinges of *orange*, *gold*, *jonquill*, &c. according to the proportions of fustic, composition and tartar you incline to use: these colours may also be varied with a little madder; in this way *rose colours*, *cherry reds*, and the varieties of red and yellow may be produced.

So the *claret gray* may be dyed in an old scarlet bath, with a few pulverized galls, and then after passing the cloth through it the usual time, adding a mordant of green copperas. For light and delicate colours, such as orange, lobster, lilac, mallow, cherry, rose, they are better dyed at once in one bath than in two. The cloth need be no more than wetted in hot water and pressed in the usual manner, then entered into the bath, without being first passed through a mordant. The colour takes more slowly, but as certainly. So far Berthollet.

Homassel's Process. To employ cochineal in dyeing, it is absolutely necessary that it should be well ground and then sifted through a fine sieve: all the particles that do not pass the sieve, are found at the close of the operation undissolved, and without having parted with their colouring matter.

The colour produced by cochineal with alum and tartar, is crimson. The wool must first be boiled in the mordant of alum and tartar, (two to four ounces of alum per pound of wool, according to the fulness of colour required, and half the quantity of tartar, *T. C.*) then rince the wool. Have ready for one hundred pounds of wool, a boiler that will hold fifty buckets of water; when the water boils, put in an ounce of sifted cochineal to a pound of wool, or more if the colour be expected very deep. Let the cochineal boil ten minutes, and then stir the liquor, and enter the wool, which must be worked very quickly in the liquor, and constantly during one hour and a half; and during a quarter of an hour also, even after all the cochineal seems exhausted. Then take out the woollen, wash and dry it.

Rose colours are dyed the same way, only one half or one quarter of the cochineal is used, and from one ounce to half an ounce per pound of wool, of the scarlet or tin composition is added. Some dyers dye their rose colours thus: they take of alum two ounces, cream of tartar one ounce, scarlet composition (solution of tin that is) one ounce, sifted cochineal a quarter of an ounce, for each pound of wool: boil the cochineal for a quarter of an hour; dissolve in a separate vessel the alum and tartar, to which when dissolved add the composition, stir this liquor well, and then add it to the cochineal liquor, and enter the goods, which must be worked in the mixture for an hour and a half. No rose colour will require half an ounce of cochineal; one third of an ounce, if good, is the fullest proportion.

As to *Scarlets.* The drugs used to a specimen of scarlet can easily be distinguished by the magnifying glass, however united the colours may appear to the eye. The tint of the cochineal, the madder, the turmeric, are all separable by this means.

A good and true scarlet is dyed with cochineal: the false scarlets are dyed with madder and turmeric. (Or brazil, brazilletto, peach, &c. and turmeric. *T. C.*) The scarlets usually sold, are thus dyed. A boiler or cauldron of fifty buckets is used for a hundred pounds of wool. For each pound of wool, there are employed two ounces of cream of tartar, two ounces of scarlet composition, one quarter of an ounce of madder, one-eighth of an ounce of turmeric, and one quarter of an ounce of cochineal sifted.

Let the whole boil five minutes before you put in the cloth, which ought to be well moistened in hot water and pressed as usual. Enter the goods and keep them worked in the liquor as rapidly as you can, for else they are apt to be spotted; and although this defect disappears frequently during the process, it is better avoided. In this mixed liquor, the cloth ought to be worked for two hours and a half.

The woollen yarn or cloth is now raised out of the bath, drained and cooled. The boiler is emptied, and charged afresh with water, which is made to boil; then three quarters of an ounce of sifted cochineal per pound of wool, is thrown in and the cochineal permitted to boil (being stirred) for five minutes; then put in for each pound of wool two ounces of scarlet composition; stir it well; enter the yarn, and work it till the colour is exhausted, and a few minutes longer. Some dyers (not without reason) do not permit this liquor to boil, but so soon as the cochineal scum appears on the su face, they throw a little cold water in; the liquor is also cooled by the woollen let down into it, and in this state the goods are worked rapidly and without ceasing in the cauldron, till the heat is brought up, and the goods are fully dyed: this happens in ten minutes or a quarter of an hour; and when the required tinge is obtained the goods are taken out, for a longer continuance in a boiling heat would detract from the vivacity of the colour. All this the eye can easily discern in practice.

In this bath by means of additional turmeric, Jubeb and orange colours of all kinds of shades may be dyed. But in regular dye-houses, these colours are dyed thus: To the finishing bath of scarlet already used, add by way of refreshment, two ounces of cream of tartar, two ounces of scarlet composition, and two gros (one fourth of an ounce) of cochineal for each pound of woollen; also one eighth of an ounce of turmeric and one quarter of an ounce of madder. Such a bath will also serve exceedingly well for fresh cloth for scarlet: which if not enough in quantity for a finishing, may be kept even a fortnight or three weeks, till others come round. (But not in a copper or brass boiler. *T. C.*)

A dyer who would acquire reputation for his scarlets, even if he has but a hundred pounds to dye, should dye them at four times, giving the first twenty-five pounds, a quarter of an ounce of cochineal per pound in addition to the usual quantity, which can be distributed by subsequent operations through the three other twenty-five pounds, that come in succession. When dyed in the finish, wash and dry the goods.

The process of the London dyers, is much the same as the French.

To each pound of the weaker or single aqua fortis, add two ounces of common salt, or of sal ammoniac (the last is the best, if it were for no other reason than that its strength is uniform under the same weight, which is not the case of common salt. *T. C.*) then add about half the quantity of water that there is of aqua fortis; in this mixture dissolve two ounces of granulated tin very slowly; the solution ought to occupy three days, and the tin dissolved therein will be about one fourteenth part of the solution in weight. According to the depth of colour required, from eighteen to twenty-five pounds in weight of this composition are used to a hundred pounds weight of cloth.

In the first boiling, or *preparation*, two-thirds of the composition are used, in conjunction with eight pounds of crude tartar or argol, in a vessel of block tin; these are put in a sufficient quantity of good water. Hard waters that contain calcareous salts, sadden the colour, and produce a rose-coloured tint; such water should be previously boiled with bran (and a little alum, *T. C.*) and scummed before it is used. Into this water, after the tartar is dissolved and the proportion of composition put in, throw six or eight ounces of powdered and sifted cochineal, then enter the cloth when the liquor is nearly ready to boil, and wince it very quickly at first, and afterwards more slowly while the liquor continues to boil for an hour and a half or two hours. Then take it out, drain it and rince it in clean water; but not with repetitions. The cloth will now have acquired a flesh colour, and will be ready for the second or dyeing process.

For this purpose a tin vessel is nearly filled with clean water, and when this appears about ready to boil, five, or (if a *full* colour is wanted and twenty to twenty-five pounds of the composition are intended to be used) five and a half pounds of powdered and sifted cochineal are put into the water and stirred for five minutes, when the remaining two-thirds of the composition is also thrown in and the whole well stirred: now enter the flesh-coloured cloth, and wince it very rapidly for five or ten minutes, in order that both ends may receive an equal portion of the dye, after which it may be turned slowly for half an hour, or during ten minutes after the liquor appears exhausted of colour. It is then to be taken out, rinced and dried.

Fine cloths take from six pounds to six pounds and a half of cochineal, and from twenty-two to twenty-five pounds of the composition prepared as above, for each hundred pounds weight of cloth: but the same quantity of coarse goods seldom have more than two pounds and three quarters to three pounds of cochineal bestowed on them.

A false scarlet can be given to coarse goods, by grounding them with alum and tartar, and madder, then finishing with cochineal and brazil or brazilletto, with the composition or tin mordant.

Although the common and better method is to dye the goods at twice, first in the preparation, then in the finishing or dyeing liquor, they may be dyed in case of emergency, at once.

(The fault of the preceding process, is, that we know not the strength, that is, the specific gravity of single aqua fortis. The use of common argol, or crude tartar, instead of cream of tartar, which is only crude tartar dissolved, filtered and crystallized, deserves to be followed. *T. C.*)

The process I (*T. C.*) would recommend, would be the preceding, excepting that as my composition made with acid of 1,25 and diluted with an equal weight of water is not so strong, weight for weight, it will require for one hundred pounds of fine cloth, twenty-five or thirty pounds weight of composition and six to seven pounds of sifted cochineal.

(I am persuaded that cochineal may be saved, first by giving the cloth a yellow dye of fustic or quercitron in the preparation, and by the use of Brazil wood, either then or in the finishing. *T. C.*)

The colour called *Barry Red* is made with half the quantity of the ingredients of scarlet with the addition of two ounces of alum per pound of woollen; the cloth is dipped three times. There is neither tartar, nor any yellow colour employed.

I would not be doing justice to the subject to omit the proposals of Dr. Bancroft, who has made so many experiments on this subject. But as they have not yet received, so far as I know, the sanction of the generality of dye-houses, I can mention them merely as proposals and experiments undoubtedly worth trying, but not to be relied on till they have been tried. If they succeed, they will no doubt greatly diminish the expense of this expensive dye.

Take three pounds of muriatic acid or spirit of salt, of the specific gravity 1,16 (remember, spirit of salt as commonly made, contains iron, and therefore it ought to be tried with this view. *T. C.*) put to it about eight or ten ounces of granulated tin; for the proportions are not yet precisely ascertained; add by degrees two pounds of common pellucid oil of vitriol; the solution should be made in a capacious glass vessel. These acids gradually and slowly mixed, will act upon the tin in the common temperature of the atmosphere. This solution of tin, will remain undecomposed and transparent for years.

For one hundred pounds weight of cloth, use in the first liquor or preparation, in a tin boiler with a sufficient quantity of water, eight pounds weight of this murio-sulphat of tin, to be put in when the water is about to boil. Turn the cloth in this bath for a quarter of an hour; then take it out, and add to the liquor four pounds of sifted cochineal, and two pounds and a half of quercitron bark in powder, and having mixed them well for five minutes, return the cloth into the liquor, making it boil, and continue the operation till the colour be duly raised, and the dyeing liquor exhausted, which will be the case in about fifteen or twenty minutes; after which the cloth may be taken out and rinced as usual. In this way the time, labour, and fuel necessary for filling and heating the dyeing vessel a second time will be saved; the operation much more speedily finished than in the common way; and there will be a saving of all the tartar, as well as of two-thirds of the cost of the *spirit* (composition) or nitro-muriat of tin commonly used; which for dyeing one hundred pounds of wool will amount to ten shillings sterling, whereas eight pounds of the muriosulphat of tin will only cost about three shillings sterling. (That is in London in the year 1812.) There will moreover be a saving of at least one-fourth of the cochineal commonly employed (which is usually computed at one ounce for every pound of cloth) and the colour will certainly be not inferior to that which is dyed at much more trouble and expense in the ordinary way. When a *rose* colour is wanted, it may be readily and cheaply dyed in this way, only omitting the quercitron bark, instead of the complex method now practised, of first producing a scarlet, and then changing it to a rose by the volatile alkali contained in stale urine, set free or decomposed by potash or lime. Even if any one should still *unwisely* choose to continue the dyeing of scarlet without quercitron bark, he need only employ the usual proportions of tartar and cochineal, with a suitable quantity of the murio-sulphat of tin, which while it costs so much less, will be more effectual than the dyers' spirit.

(Such is Dr. Bancroft's proposal, which well deserves to be tried here. He says, it has been tried with success by many dyers in Yorkshire and in Lancashire. If the acid does not act too much on the cloth, this will turn out a great improvement. The following additional remarks on this proposed improvement, are worth consideration. *T. C.*)

Several hundreds of experiments, says Dr. Bancroft, vol. i, p. 361, warrant my assertion that at least one fourth of the cochineal generally employed in dyeing scarlet, may be saved by obtaining so much yellow as is necessary to compose this colour, from quercitron bark: and indeed nothing can be more self evident, than that such an effect ought cæteris paribus to result necessarily from this combination of different colouring matters, suited to produce the compound colour in question. Let it be remembered that the cochineal crimson, though capable of being changed by the acid of tartar toward the yellow hue on the one hand, is also capable by different means, of being changed towards a blue on the other, and of thereby producing a purple without the aid of indigo, or any other blue colouring matter. Yet I am confident that nobody would believe that a pound of cochineal so employed, is capable *alone* of dyeing as much cloth, of any particular shade of purple, as might be dyed with it, if the whole of its colouring matter were employed solely in furnishing the crimson part of the purple, whilst the blue part of the purple was obtained from indigo.

To say that a pound of cochineal *alone*, would produce as much effect or colour as a pound of cochineal and a pound of indigo *together*, would be an improbability much too obvious and palpable for human belief; and there would be a similar improbability in alleging, that a pound of cochineal employed in giving another compound colour (scarlet) could alone produce as much effect as a pound of cochineal and a pound of quercitron bark, when the colour of this last was employed only in furnishing one of the component parts of the scarlet, for which a considerable portion of the colouring matter of the cochineal must otherwise have been expended. This certainly happens in the new mode of dyeing scarlet now proposed, because the colour produced with the addition of quercitron yellow inclines no more toward a yellow, than the scarlet produced by yellowing a part of the cochineal colour in the usual method with tartar. I retain therefore at this moment as much confidence as I ever had, in the reality and importance of my proposed improvements in this respect.

The scarlet composed of cochineal crimson and quercitron yellow, is moreover attended with this advantage, that it may be dyed upon wool and woollen yarn, without any danger of its being changed to a rose or a crimson by the process of fulling, as always happens to scarlet dyed in the usual manner. This last being in fact nothing but a crimson or rose colour, yellowed by some specific action of the acid of tartar on the cochineal, is liable to be made crimson again by the application of many chemical agents, which readily overcome the changeable yellow produced by the tartar, and particularly by calcareous earth, soap, alkaline salts, &c. But where the cochineal colouring matter is applied and fixed merely as a *crimson or rose* colour, and is rendered scarlet by the superaddition of a very permanent quercitron yellow, capable of resisting the strongest acids and alkalies, which it does when dyed with solutions of tin, no such change can take place; because the cochineal colour having never ceased to be crimson, cannot be rendered more so, and therefore cannot suffer by those impressions or applications, which frequently change or spot scarlets, dyed according to the present practice.

(I refer to Bancroft, vol. i. p. 353, for the rest of his observations on the scarlet dye, and the use of his new invented composition. I cannot help thinking however, that the remarks I have just copied, are so obvious and reasonable, that it is almost impossible to refuse assent to them; and I have no hesitation whatever in recommending the rejection of tartar, and the employment of the cheap articles of weld, fustic, turmeric, or quercitron (especially the last) for the purpose of yellowing the cochineal, instead of that expensive drug cochineal itself. I say nothing about substituting the murio-sulphat of tin, for the nitro-muriat, because I have no experience to guide me. *T. C.*)

The following processes for common scarlet and rose colour, are from Homassel.

Scarlet Preparation. Clean out the boiler with great accuracy; even if necessary with vitriolic acid, and afterwards with ashes. Rince it, even if it has been well cleaned the day before. Moisten the cloth in hot but not in *boiling* water. *Remember that all cloths prepared with alum or alum and tartar should be washed* (read for washed, rinced. *T. C.*) *before they are dyed, nor will any fine colour be obtained in a bath that has served for an alum preparation.* Make up your bath with two ounces of cream of tartar, a quarter of an ounce of madder, the eighth of an ounce of turmeric and a quarter of an ounce of sifted cochineal for each pound of woollen. Boil for two hours and a half, then raise the woollen, cool it, and wash it at the river.

Scarlet Finishing or colouring bath. A fresh bath well cleaned and filled with water; two ounces of scarlet composition, three fourths of an ounce of sifted cochineal; let the liquor boil four minutes; cool it with some cold water down to a scald; enter the goods and work them for ten minutes.

Rose Colour. Preparation bath of alum; from a quarter to half an ounce of cochineal per pound, according to the price; one ounce of scarlet composition.

Light Crimson. Preparation bath of alum; then an ounce of cochineal per pound of cloth. (As to the above precaution of Homassel, about the scrupulous washing of cloths after they are prepared or mordanted, I am far from being satisfied that it is a point absolutely determined: for it has been ascertained that all the alum may be washed out. If the crystallized lumps only be washed away, it is an improvement, otherwise not. Bancroft dyes with quercitron without even rincing his cloths after the preparation or mordant. The letting the cloths remain in a damp place after preparing them, may be of use in aiding by time, the mutual action of the cloth and the base of the mordant. *T. C.*)

Of the Venetian Scarlet, or the scarlet from the Kermes insect, (*Coccus Ilicis.*) The colouring matter is soluble in water and in alcohol, of a deep red colour. To dye scarlet with this substance, more solid, but not so brilliant as the cochineal scarlet; boil your yarn for half an hour in bran water, then for two hours in a bath composed of alum one fifth of the weight of the yarn, and tartar one tenth, or half as much. Put the yarn moist as it is but not wet, in a bag, and let it lay for a week in a cool under-ground place. Then prepare a bath of water that should not exceed a full scalding heat, or 150° of Fahrenheit's thermometer; for Kermes, like madder, at a great heat gives out a yellow colour; put to this warm bath a quantity of kermes equal to three-fourths of the weight of the wool; work the yarn in this bath for an hour; rince it; and finish in a half spent scarlet bath for a very few minutes. Cloth will not require so much either of the salts, or of the kermes as yarn, by one-fourth.

Hellot prescribes to dye some refuse wool for a few moments first, which takes up a kind of black fecula, after which the wool is dyed of a brighter colour.

In my opinion the process would be improved thus; put to the preparation bath of alum and tartar mordants, one twenty-fifth of the weight of the cloth of quercitron bark; then proceed as above, and when the cloth is dyed, run it through warm water in which you have previously dissolved a pound of white soap to about fifty pounds weight of wool. *T. C.*

The half scarlet, is dyed with alum and tartar in the preparation, and finished in a colour-bath of half madder and half kermes, at 150° of Fahrenheit. It may then be run through a half spent cochineal vat.

But the effect of acid liquors on kermes is to turn the red into a cinnamon colour, so that it must not be kept in the scarlet finishing but for a minute or two. Indeed if my proposal of giving a slight ground of yellow be adopted, the safest way is to add to the kermes bath, a small quantity of Brazil or cochineal.

The proper colour of kermes is a blood red, much more fast than any colour from cochineal, and therefore the disuse of kermes is to be regretted. *T. C.*

The Scarlet from Stick Lac. This is a fast colour not used alone, but employed in France to give solidity to cochineal colours. The stick lac contains about one-sixth of colouring matter. A small quantity of the lac in powder is thrown into the scarlet finishing bath, after the cochineal has been boiled and the bath cooled; for the lac will not bear a very hot liquor. I do not find however that its efficacy is of importance sufficient to bring it into general use. It is used to dye morocco leather, but for this purpose, kermes and cochineal are equally used.

Of the Reds from Brazil, Brazilletto, Nicaragua, Peach and Redwood. These are seldom employed to give a red colour alone: their best use is to heighten and give brilliancy to madder reds. But a crimson red is often dyed with Brazil.

For this purpose make a strong decoction of rasped Brazil wood tied up in a bag: the colour is faster and not weaker for the decoction being old, although it puts on a kind of orange colour.

To make a decoction of Brazil, put the rasped or chipped wood into a bag, and boil it for three hours: empty your coloured liquor into another vessel, and pour more water on the Brazil wood, with one third or half an ounce of pearl ash in this last liquor to each pound of the wood: boil for three hours, and mix the two liquors together: if this decoction be kept for a month it is not the worse.

Cloths or yarn, that are to be dyed in Brazil or Brazilletto, should not have a greater proportion of tartar to alum than one fourth part, for the acids are apt to turn the colour yellow. *T. C.*

Homassel's process is this. Woollen cloth one hundred pounds; alum twenty-two pounds; gray tartar eleven pounds; (which is twice as much as Hellot or Berthollet or I would recommend.) Boil the cloth two hours and a half; you may keep it a long time in a cellar and the decoction also; (deposèe le bouillon un mois à la cave.)

When you dye, rince the cloth at the river, and to thirty buckets of water, add two buckets of Brazil liquor, which has been made for a month: dye in it thirty pounds of woollen, and it will produce a crimson. The second thirty pounds run through the same finishing, will produce a scarlet; the third parcel of thirty pounds will also be scarlet. Remember to add two buckets of Brazil liquor to the bath for each thirty pounds of cloth or yarn; and that the liquor must never boil. The scarlet can be rosed or crimsoned by running it through warm water, containing a fourth part of urine.

The liquor must be scummed, and the cloth examined while it is dyeing, by wringing out one end of it; for the colour appears two or three shades deeper when wet, than dry. The dye of these woods is rendered faster, by a small quantity of galls.

Of Reds from Madder. This is the colouring substance principally to be depended on for permanent reds. The madder commonly used, is the Zealand grapp, or as we call it crop madder, dried and ground. The Smyrna madder roots, are confined to the dyeing of Turkey or Adrianople red; but fresh madder roots give a better colour than the Zealand crop madder; though Berthollet says otherwise. It is a root that would grow and indeed does grow excellently well in Pennsylvania.

Madder is a colouring drug so important, that a knowledge of its properties is indispensable to a dyer who would understand his business. I shall therefore give an account of madder, chiefly from Mr. Watt of Birmingham.

A. Crop madder is a drug of an orange-brown colour, in powder, not coherent; it attracts the moisture of the air, and by this means gradually loses its properties until it becomes spoiled.

B. Water, whether hot or cold, extracts the colour of madder, but a considerable quantity is required for this purpose. The colouring matter of madder consists of two kinds, a red colour, and a fawn colour. Cold water will dissolve the red colour and leave the fawn colour unaffected. According to the experiments of Sir H. Englefield, two ounces of madder will require five pints of water at the common temperature to extract the red colour. At what degree of the thermometer the fawn colour is extricated, has not been precisely ascertained; every dyer knows that his madder bath must not boil; in my opinion the heat ought not to exceed from 160° to 170° of Fahrenheit, otherwise the fawn or brown tint will predominate too much: 155° is hot enough.

C. When the watery extract is slowly evaporated in an open vessel, a pellicle forms at the surface, and falls down to the bottom, and so on, till the evaporation ceases.

D. The extract thus formed, is of a dull brown colour: it is but slightly soluble in water, to which it imparts a brownish tinge.

E. When the infusion is evaporated in an open vessel with the neck so high that the vapours condense and fall back, pellicles form of a deep brown colour, easily soluble in water, which acquires a brown tinge.

F. Alum put into the red watery infusion, forms a deep red precipitate, leaving the water of a yellowish brown.

G. Alkaline carbonats throw down a precipitate from this yellowish brown liquor, of a blood-red, deeper according to the quantity of alum that had been employed at first. In this manner lakes of a blood-red colour can be obtained, but not to equal the colour of cochineal. As an oil colour it is transparent, but in water opake.

H. If a superabundance of alkali be employed, the precipitate is dissolved and the liquor becomes red.

I. The alkali of soda, does not produce so fine a colour as the alkali of potash.

K. Calcareous earth, produces a duller colour than the alkalies.

L. A few drops of alkali in the water of B, extracts much colour of a brownish red.

From this slightly alkaline infusion,

1. Alum throws down a deep brown lake.
2. Acids added to this liquor, occasion no precipitate, but change the infusion to a yellowish brown.
3. This infusion being evaporated to dryness, forms a gummy extract, which dissolves easily in water.

M. If the infusion B, instead of being alkaline, be made with a few drops of mineral acid, the colour is yellowish.

1. This yellow liquor by long digestion becomes of a greenish brown, and the yellow seems destroyed.
2. The addition of an alkali, re-establishes the

red colour, and then by evaporation, an extract is obtained, soluble in water.

N. If in the water used for the infusion B, you put carbonat of magnesia, a blood-red colour is produced; and on evaporation, a deep red extract is procured, soluble in water.

1. If this infusion made with magnesia, be used as an ink and exposed to the sun, it becomes yellow.
2. Alum precipitates from this infusion a small quantity of ill coloured lake.
3. The alkalies produce in it a deeper colour and more fixed.

O. The infusion made in a solution of alum, is of an orange yellow. This infusion being precipitated by an alkali, gives a red lake not so good as F.

P. A solution of sugar of lead added to the infusion B, forms a reddish brown precipitate. A solution of nitrat of mercury, a brown purple precipitate. A solution of sulphat of iron, a lively brown precipitate. A solution of sulphat of zinc was not tried. A solution of sulphat of manganese, a brown purple precipitate. A solution of nitro-muriat of tin was not tried.

Q. The infusion B being mixed while hot with an infusion of cochineal, a precipitate appeared of a brownish red colour, inclining to deep purple; the quantity of this precipitate was increased by continuing the boiling; it did not dissolve easily in water.

1. A sample of cloth dipt in the acetat of alumine or printer's mordant, and then dyed in this mixture, took a red brown colour, which after being boiled in a solution of soap, changed into a tolerable good red.
2. The solution of soap was of a deep red colour, but it produced a very indifferent tinge on paper.

The preceding facts we owe chiefly to Mr. Watt.

Sir Harry Englefield's madder lake, is thus made: Put two ounces of madder in a bag, press it and bruise it in a china or porcelain or stone-ware vessel, with repeated portions of cold water till all the colour is forced out. This will require about five pints of water. The madder remaining will weigh five drachms, so that the red colouring matter in two ounces of madder will weigh nearly eleven drachms (troy weight.) Mix all the coloured liquors together, and add to them a solution of one ounce and a half of pearl ashes, and then one ounce of alum in solution. Wash the precipitate well with warm water, and dry it on filtering paper or a chalk stone.

M. Merimè, a painter, has made several interesting experiments on madder, with a view of improving his own art, and obtaining a lake which should combine solidity with brilliancy. The result of his experiments which may be of use to the dyer, he has communicated to us (Messrs. Berthollet.)

He separated the pellicle which serves as a kind of bark to the madder root, from sap and from the woody part, and he obtained from both the one and the other a lake approaching in vivacity to carmine, but much more solid, after he had submitted them to washings which separated a substance that gave a fawn colour. The woody part yielded more than the bark. His process after the preliminary washings, was, to keep the madder in digestion in a slight solution of alum: after that he precipitated, by an alkali, this coloured aluminous solution.

Hence it appears that madder must be considered as consisting of two different substances, one fawn coloured, the other red: each of these substances may combine with the stuff, but we want the red colour only. The fawn coloured part seems most soluble in water, but its fixity on the stuff may be augmented by its affinity to the red part.

The different additions which we make to the madder, and the multiplied processes to which we submit this drug on some occasions, may possibly be of no other service than to separate this fawn colour from the red.

The red colouring matter of madder, seems soluble in water in small quantity only, so that the solution cannot be much condensed: if the proportion of this substance be much increased, we increase, also in greater proportion, the more soluble fawn coloured part.

The solution of tin gives but dead colours with madder. It revives the colour of the Turkey red indeed, but that seems to be in a part of the process when all the fawn colour of the madder is washed away during the process.

After these remarks on the component parts of this useful drug, I proceed to the method of dyeing with it.

The cloth or wool must be prepared in a mordant liquor of alum and tartar. Every dye shop has its own proportions. Upon the principle of the preceding experiments, it is clear that all acids have a tendency to convert the red of madder into a brownish yellow: and experience in the dye house confirms the theory. Therefore, for a moderately full, but not the deepest red, I prefer (*T. C.*) three ounces of alum and one ounce of tartar (red or white appears to me indifferent) to each pound of wool or yarn or cloth. The goods should be boiled in this; and they will be the better for being left for a week either in the liquor, or taken out and drained and left in an underground room.

For the finishing or colouring bath, use three-fourths of a pound of madder, one ounce of galls, and one ounce of brazil to each pound of woollen. The bath should not be brought beyond a scalding heat, that is 140 or 145° of the common thermometer of Fahrenheit. I can just bear my hand in water of 130°, but a dyer accustomed to warm liquors can bear ten degrees more of heat. At this heat it should be kept, and the cloth winced in it for an hour. The colour is improved by a little brazil or brazilletto wood in the above proportion, but the hue thus given is fugitive. It is improved too by the use of a pound of white soap, and a couple of ounces of potash in the water for one hundred pounds weight of wool, to rince it in after it is dyed, or when fulled. For a full colour, use four ounces of alum, one ounce and a half of tartar, and eighteen or twenty ounces of madder.

It is not found that the scarlet composition (the nitro-muriat of tin) does any good to the colour, either in the dyeing or after.

Any mixture of sour water, with the madder, however common, does no good, but harm.

The great value of madder, is chiefly known to the cotton dyer and callicoe printer. Archil is sometimes used for fugitive reds, but as it never ought to be used, I omit it in the woollen dye.

Having gone through the scarlets, crimsons, rose colours and reds on woollen, I proceed to the colour next in similarity as a self-colour, the pink.

Of the Dyeing of Pink on Woollens. Carthamus, safflower, or bastard saffron, is grown in Egypt, in the Levant, in Thuringia, and various parts of Germany and France, and might be grown in Pennsylvania and the southern states. It contains two colours; a dull yellow, soluble in cold water, and a pink colour soluble in alkaline salts. It is seldom used on woollen, because colours near to it in tint, more permanent and equally beautiful, may be procured by cochineal, and it requires the woollen to be as white as possible, in order to have the colour in its utmost brilliancy: but as a *true pink* can no otherwise be dyed, I shall give the process as well as I can. I have repeatedly dyed it on cotton, but never on woollen, so as to ascertain the proper proportions. The processes for dyeing this colour on silk, I shall give from Macquer and Homassel, but the following transcript of my own notes, will contain some remarks not included in their account. What the English call a pink, the French call a rose colour.

One pound of woollen bleached as white as possible, will require four pounds of safflower to dye it a good pink.

Let the safflower be put into a very clean and strong linen bag that will hold twelve pounds. In this bag, put eight pounds of safflower. Let a man carry it to the river and tramp it with his feet in the current for four or five hours, till all appearance of yellow colour be washed away. The water must be clear and soft. As this will be done at a dyer's, he must take care and wash it in that part of the stream that is above the works. The man should have a pole to rest himself upon, while he tramps it.

Or, a trough may be used for this purpose, through which a current of pure water is turned; in this case two cords should hang from the beams of the ceiling, by which the man can take hold, and support his body in some degree, while he tramps with his feet. This operation might be contrived to take place by means of stampers or a fulling mill, but I think not so safely. One man can thoroughly wash two bags of eight pounds each in one day, but not much more.

When the water comes away clear, empty the washed safflower into a trough lined with tin or lead, or any other similar vessel.

Dissolve for sixteen pounds of safflower, two pounds of good pearl ash, in as much hot water as will serve to make the safflower into a liquid kind of paste: skim the solution, pour it off clear from the sediment; and when hardly blood warm, pour it on the safflower, and let this liquid mass remain together three or four hours.

The great point in dyeing pink, is, so to apportion your alkali to the safflower, that all the colour may be extracted, but no more alkali used than is absolutely necessary for the purpose; for the acid necessary to saturate an over proportion of alkali, greatly adds to the expense. It is with this view that Berthollet prescribes no more than an ounce of pearl ash to the pound of safflower, which I am persuaded is greatly too little.

Have ready a frame of wood, on which is tied some clean, strong, white callicoe as a filter: the frame should rest on the edges of the vessel wherein you dye your goods: the callicoe need not be stretched very tight; if it sinks in the middle, so much the better; on this filtering frame put the safflower and alkali, and wash it well with as much water as will be necessary to work your woollen in.

This alkaline liquor of safflower, is of a yellowish colour, and requires to be neutralized with an acid. Of acids, lemon juice is the only one I know of, that brings out the colour in full perfection. Next to that, is cream of tartar; next to that, is distilled vinegar. Hence it becomes an object of importance not to exceed greatly in the quantity of alkali, or to put in your acid at random. To avoid this, attend to the following directions, that I found necessary in point of economy.

Lemon juice is purchased in casks in the West Indies.

The silk dyers use a lichen called archil, for most of their fine colours.

Take a pinch of archil, add to it some boiling water, and a very small quantity of pearl ash, the size of a garden pea for instance, just to turn the decoction of archil blue. This is the litmus of the chemist.

Dye white blotting paper, or pieces of white cotton or linen rags, in this blue liquor, and dry them. Keep them by you as tests of alkalescence and acidity.

Suppose you have sixteen pounds of safflower, (original weight,) then you will have to saturate two pounds of pearl ash with lemon juice. Put in two quarts of lemon juice, by a pint at a time, on account of the effervescence that will take place. When the effervescence is over, dip a piece of rag or paper tinged blue with archil into the liquor; if the colour does not change, put in half a pint more of lemon juice; try it again after stirring it; and so on, adding acid by degrees till you find the blue colour on the paper begin to turn red. Then stop. Just at this point also, all effervescence ceases on the addition of fresh acid. You may now enter your goods at any degree of heat from 60° of Fahrenheit's thermometer to 90°. Work them in the liquor till all the colour is taken up, and the liquor in the vat is not coloured any longer. Wring the wool, wash it in clean water and dry it. The colour is improved in tint by running it again through a water slightly acidulated with lemon juice.

If the colour be not deep enough, as when full poppy reds are required, you must repeat the process with a liquor containing the colouring matter of a pound more of safflower per pound of woollen.

Very dilute sulphuric and nitric acids are also used instead of lemon juice, but the colour is manifestly inferior.

The pink dye can also be procured by soaking pink rags in an alkaline liquor, which may be treated with lime or lemon juice as above. It is the fecula of the carthamus liquor, precipitated by lemon juice, dried at a very gentle heat, and when dry, ground up with fine white talc, that forms the basis of the Spanish wool, and the rouge with which females paint their faces.

Of Red mixed with Blue Colours. Violets, Purples, Lilacs, Colombines, &c. According to Hellot and Berthollet, stuffs dyed scarlet, take a superadded blue dye unequally. They must be dyed of a light or sky blue first. Then give them a mordant or preparation liquor of alum and tartar, two ounces and a half of alum, and one ounce of tartar; work them in this for an hour; drain them and cool them; then run them through a dyeing or finishing bath of cochineal, from one half to two-thirds as strong as you want it for scarlet, according to the shade of purple you require. Violet requires not so deep a blue and not so deep a red as purple. Frequently these colours are finished in a scarlet bath, adding to the bath the quantity of tartar and of cochineal that may be thought necessary.

Lilacs, pidgeon's breast, mallow, &c. are usually passed through the liquors that have served for violets, adding some alum and tartar. The blue ground is made of such a tint, and the cochineal added in the finishing, in such proportion as the colour requires.

When you want a reddish shade, as for peach blossom, add a little of the scarlet composition or nitro-muriat of tin.

When you want a very bright tint, though you may diminish the quantity of cochineal, you must not diminish the quantity of tartar.

It is obvious that the various shades required may be obtained by slight variations of the blue ground, and of the proportions of cochineal, alum and tartar; also by using brazil or madder, or a mixture of these, with or without the cochineal.

Processes of *Homassel* for violets and purples.

The finest tints of these colours can only be made, by means of a mordant or composition of bismuth dissolved in the nitric acid. To make this solution, proceed thus. Dissolve gradually in the strongest nitric acid, bismuth carefully reduced to a coarse powder in a mortar, taking care that there be no dirt, or extraneous matter, particularly no ferruginous matter. Add the powdered bismuth by degrees to the nitric acid to the amount of two ounces of the semi-metal to a pound of the acid: (this is too small a proportion by one ounce at least, *T. C.*) Add no water, no sal ammoniac. When all is dissolved, pour it off clear into a bottle with a glass stopper. Make no more than you want to use at a time, for it is very apt to oxygenate by exposure to air. This mordant requires no alum or tartar to the cloth; use about two ounces of this solution in water to the pound of cloth, and for bright colours, about half an ounce of cochineal also to the pound.

Common Violet. A blue-vat ground; then a preparation of alum. Dye with half an ounce of cochineal per pound of wool.

Another. A light blue ground; then half an ounce of cochineal, and two ounces of solution of bismuth per pound of woollen. Boil for an hour.

Light Violet. Half an ounce of cochineal per pound, after a preparation of two ounces of solution of bismuth per pound of woollen for half an hour; without any previous blue ground.

Common English Process for Fast Purple. Alum, four ounces, tartar, two ounces, as the mordant or preparation for a pound of wool; boil for an hour and a half; drain, cool and rince the cloth: then enter it into a finishing or dye liquor of madder three-fourths of a pound, red wood two ounces for each pound of wool. Do not let the liquor exceed the heat of 145° of Fahrenheit's thermometer. Wince your pieces for an hour. Then drain, cool and rince them, and give them a single dip in the blue vat.

Common Purple. English. For each pound of cloth use a mordant or preparation of two ounces of alum, one ounce of tartar, and one-eighth of an ounce of blue copperas; boil for two hours; then drain and rince the cloth, and dye it in a bath of six ounces of logwood to the pound of woollen. This is reddened by alum, and blued by blue copperas.

Claret. Add to the above dye liquor half an ounce madder and one-fourth of an ounce brazilletto, or cam wood, or red wood, per pound of cloth.

It is evident that with cochineal, kermes, or lac, the colour will be finer, but neither so cheap or so fast as with madder; and so with brazil or brazilletto.

Of the various shades of Black with Red.—A grayish Red. Homassel. Nitrat of iron (iron dissolved very gradually in aqua fortis, and kept close stopped) and cochineal. All grays will be fast colours, if they are dyed with nitrat of iron instead of sulphat of iron, which in fastness and brilliancy is far inferior to the nitrat.

Common Grayish Red. Sulphat of iron and madder, with a little red wood.

It is evident that these colours may be varied according to the proportions of red and black, and the ingredients used for each.

Of Yellow Colours.—The substances that dye yellow on woollen, are Weld, Quercitron, Fustic, Turmeric. I say nothing about the Sarrette, Sarratula, or Saw Wort, the Yellow Broom, the Golden Rod, the Berberry Root, the Lombardy Poplar, the Hiccory, the Fenugreek, the Polygonum Persicana or Arsesmart, and a hundred other articles that may be used. But if a dyer on wool can be supplied with Weld, Fustic, and Quercitron, I do not think he stands in much need of any other drug. Where weld cannot be had, saw wort and golden rod come near it in point of colour.

I have mentioned these substances and their general qualities and properties, when I noticed the various dyeing drugs at the beginning of this work. For further information, I refer to Dr. Bancroft's book, under the respective heads.

Weld: this plant is used for bright greenish yellows, and where a fast colour is required. The properties of its decoction are as follow (from Berthollet.)

First. When full charged with colour, it is of a slightly brownish yellow; when diluted, it passes to a greenish yellow.

Second. If to this decoction some alkali be added, a small ash coloured precipitate, insoluble in alkalies, falls down.

Third. Acids render the colour paler, and throw down a precipitate soluble in alkalies; this solution of the precipitate is of a yellow, bordering upon brown.

Fourth. Alum forms a yellowish precipitate. The supernatant liquor is of a lemon colour. If an alkali be added to this liquor, a light yellowish precipitate is formed, but the liquor remains coloured.

Fifth. Common salt and muriat of ammonia, trouble the liquor and render the colour deeper. By degrees a yellowish precipitate is formed, and the supernatant liquor is of a greenish yellow.

Sixth. Solution of tin produces an abundant precipitate of a light yellow colour; the supernatant liquor is of a brownish yellow.

Seventh. Sulphat of iron produces an abundant grayish black precipitate; the supernatant liquor is of a brownish colour.

Eighth. Sulphat of copper forms a greenish brown precipitate, and the supernatant liquor is a pale green. (Copper, that is verdigris and blue vitriol in small quantities, agree very well as mordants with weld. *T. C.*)

Process of Dyeing with Weld, by Hellot. Preparation or mordant liquor. Alum, four ounces, tartar, one ounce; boil the usual time; about an hour and a half; drain the cloth; rince it; dye it in a bath of five pounds of weld to one pound of cloth, if you want a full colour. (Hellot goes even so far as six pounds of weld, which I deem two pounds too much. *T. C.*)

For a lighter yellow, half the above quantity of ingredients.

Other *French* dyers use half the quantity of tartar that they do of alum; the colour is brighter for it, and the tint greener, but not so deep with equal proportions of weld. The colour is heightened and made fuller by the addition of one pound of whiting, or powdered chalk in the dyeing liquor for each hundred pounds weight of wool.

For lighter shades, it is better to use fresh preparation and dyeing liquors, diminishing the quantity of ingredients in the same proportion, than to use the old and spent baths or liquors; in this latter case, the colour is never so bright: but they may do for drabs, olives, and browns of various kinds.

Common salt, and ground plaister of paris, also make the colour of the finishing or dye liquor deeper than otherwise it would be. Tartar weakens it; the salts of iron convert it into a brown. The vivacity of the colour is improved by the tin composition.

On Yellow Colours, by Homassel. Weld, Broom, Yellow Berries, Fustic, Chimney-soot, Iron, Birch

Bark, Quercitron, Turmeric, Safflower, Berberry, are all employed to produce yellow colours, according to circumstances. But in dyeing wool, they seldom use any thing but weld, fustic, soot, turmeric, and fustet, or young fustic (Venetian sumach). For the fresher tints they use weld; for duller yellows and Saxon greens, the yellow woods; for golden yellows, weld and soot; or better still, old fustic and young fustic. Soot serves to give a preliminary tint, or ground to several varieties of yellows, according to circumstances. Turmeric, though often employed in scarlets and carnations, is so fugitive in the sun and air, that it is unpleasant to use it.

Weld gives a fast and beautiful colour for yellows and fast greens. The method of dyeing with weld is this. Fill a boiler with weld as full as you can, for a hundred pounds of cloth will take not less than an equal weight of weld, and for very deep yellows you require four times as much. Before the weld liquor boils, you must dye the cloths intended for light and bright yellows. It is good to wash them first at the river, to detach the grosser particles of alum that merely stick to the cloth. It is an useful precaution to empty into another boiler as much of the dye liquor as is necessary to dye the light yellows, for the alum washed off into the dye liquor will injure it and weaken it. When you do so, you need not let this dye liquor for the light yellows boil more than ten minutes; throw in some cold water to bring it to a scald, and dye your cloth.

When the weld is taken out of the first boiler, boil it again in another, with four ounces of potash, which has the property of extracting all the colour from the weld; when the weld is exhausted take it out, and use this second boiling, either to dye fresh goods, or to strengthen the first liquor.

It is the alum and tartar that give fastness to the weld colour. (A little verdigris is an improvement. *T. C.*) Weld is also boiled in bags, which are kept down with a heavy cross of wood till the colour is extracted.

Yellow from *Fustic*. The fustic should be used in chips inclosed in a bag that they may not tear the cloth. (No wood ought to be used at all, unless ground or rasped. *T. C.*) In a boiler of twenty-five buckets of water, put fifty pounds of fustic, which you boil for three hours. (If rasped, two hours are enough. *T. C.*)

Empty the liquor into a wooden pipe or tun; boil the fustic in a second liquor, and empty this also into the tun. Never let any dye liquor remain with the wood in your boiler, even for a quarter of an hour, for the wood is apt to re-absorb the colour. It should be laded off while boiling, and strained through a wicker basket with a cloth. For like reason, take care that you throw no wood into the tun.

The finishing liquor or dyeing bath of fustic, should be used not later than two or three days after it is made, for it is apt to spoil.

This dye is used also for Saxon greens. The wool is boiled in a preparation of two ounces of alum per pound of wool, for an hour and a half. You add to the same water liquor, fustic, and Saxon blue, in proportion to the shade of colour you require. The wood should be put into bags, for if the colour inclines too much to yellow, they can be easily taken out in time, and replaced if needful. (It is better to have a separate fustic liquor, which you can add as occasion requires. *T. C.*)

For a tolerably full Saxon green, use four ounces of fustic, and one ounce of the solution of indigo; you may put your alum, fustic, and indigo, all at once into the liquor, and boil your woollen in it for two hours or two hours and a half. This method has perfectly succeeded with me (Homassel.) The cloth should be well washed after the operation.

Of *Soot* in yellow colours. Soot is so far from being a despicable ingredient in dyeing, that when it balls well in handling it, you may be sure it will give out an useful colour. The colours of tapestry borders cannot receive their golden tint without soot. The colour of ozier and wicker baskets require soot, so do all the landscape colours in tapestry.

Although the colour produced from soot is very solid, it must never be used in conjunction with the mineral acids, which degrade it.

In a boiler of thirty buckets of water, put from ten to twenty buckets of soot. Boil it for two hours, till the soot no longer rises up on boiling: fill the boiler with water, and let it remain for an hour, that the soot may subside. In this liquor pass the yellow cloth which has been already dyed with three or four pounds of weld to one pound of cloth. The colour is browned in proportion as the cloth is permitted to remain in the liquor; which may be from half an hour to two hours, at a pretty high degree of heat, not boiling.

If intended for browns, wash the cloth in the river, and give them afterward a tint of madder, and of black, according to your pattern. Or in some cases, in a fresh but weak indigo vat, when you want it for green flies, &c. in tapestry.

(The use of soot is too little known in England and this country; but it is of more use as it seems to me in drabs, olives, and browns, than in yellows. *T. C.*)

Of *Turmeric* Yellow. This colouri s so fugitive in the sun, that it flies even in the drying. It is of use almost alone in scarlets and carnations; where the nitric acid contributes to fix it.

A tolerably good and fast yellow, that is, one that will resist the sun and air tolerably, but not hot water, can be given by turmeric four parts, in nitric acid ten parts by weight, which has already dissolved one part of yellow orpiment. (I do not understand the use of the orpiment. Nitric acid alone will give a yellow colour to all animal substances. *T. C.*)

The spirituous tincture of turmeric is very rich: but it is used for muslin and silk chiefly: it will not do for woollen.

English Process for Yellow.—Preparation, three ounces of alum, and one ounce of tartar ground fine per pound of woollen. Boil for a couple of hours: drain, cool, and rince the cloth: then dye it in a bath made of fustic, weld, or quercitron: if you use fustic, take something more than weight for weight of the wool; if quercitron bark, take one third the weight; or from that to one half; if weld, use three pounds of it to a pound of wool. These drugs may be mixed in any proportion you choose, as fustic with weld, or quercitron with either of them. Weld furnishes upon the whole the best colour; next to that, quercitron bark; which, considering its richness and fastness of colour, is upon the whole the cheapest drug. Mixed with fustic, quercitron greatly improves the colour. It would be a saving for full fast yellows to use two pounds of weld and a quarter of a pound of quercitron.

If you want a bright yellow of a greenish cast, use only weld, and add a quarter of an ounce per pound of blue copperas or verdigris, to the preparation. Boil in the dye colour for three hours. Increasing the tartar also greens the tint of yellow.

If you want lighter shades, lessen proportionably both the mordants and the dye stuffs.—If a *very* full colour, increase all the drugs one fourth.

Dr. Bancroft, who has had great experience of dyeing with quercitron bark, prescribes three or four ounces of alum without tartar, as the mordant for a pound of woollen. Boil the cloth in it a couple of hours; take it out, drain it, *but do not rince it:* then dye it in a bath of quercitron bark of an equal weight with the alum used. Then at the close of the dyeing, throw in a pound of whiting for a hundred pounds of wool.

Another yellow, *by the same.* For one hundred pounds of wool, take seven or eight pounds of Dr.

Bancroft's murio-sulphat of tin described in the section of scarlet; add to it in the preparation bath, five pounds of alum; dye with ten pounds of quercitron bark.

If a *greenish* yellow be wanted, use tartar for the purpose, thus; take for one hundred pounds of wool, six pounds of murio-sulphat of tin, six pounds of alum, four pounds of tartar; boil in this preparation; dye with eight pounds of quercitron bark.

The bark should be tied up in a coarse cotton bag, that will hold a third more; the bag should have a rope to it, to drag it backward and forward in the liquor and diffuse the colour.

(I am fully persuaded that the proportion of quercitron bark prescribed by Dr. Bancroft, is greatly too small for a full colour: twice the quantity he prescribes would not be too much. The bark he used for his experiments, consisted, I dare say, of selected samples. *T. C.*)

Buff Yellow. Although this may be dyed with the usual yellow drugs, it can be better and faster dyed by means of iron stain. That is, by staining the whole cloth with one universal iron mould.

For fine work. Dip your cloth in water impregnated with a strong solution of iron slowly made in aqua fortis diluted with an equal quantity of water; which when made must be used in a few days or else kept from the air. It will require two gallons for one hundred pounds weight of cloth, mixed with a sufficient quantity of warm water. Turn the cloth in it for a quarter of an hour. Drain it: then run it through a mixture of lime water, three or four pecks of lime to water enough to turn the cloth in: or instead of lime you may use three pounds of potash to the same quantity of water: then expose the cloth after washing it to the air until the greenish colour turns to a buff. Then repeat these alternate dippings, washings, and airings, till the colour is produced. The callicoe printers use lime and potash alternately.

For common goods, dissolve for one hundred pounds of woollen twenty pounds of green copperas in water, then work the goods in this liquor warm for a quarter of an hour: then in a bath either of lime water or potash. Proceed as above, always airing the goods to give time for the colour to become buff, after each immersion in the lime or the potash liquor.

This colour diluted is a most excellent ground for grays, and for all colours in which gray is meant to form a part. *T. C.*

Of Yellow with Red. This combination in various proportions gives the orange, aurora, marigold, lobster, pomegranate, and other similar colours.

It is useless to give particular proportions for shades so various. It may be well to remark,

First, that for bright and lively colours, these mixtures may be made followers to use up the baths or dye liquors of scarlet, crimson, Brazil, Brazilletto and the other brighter coloured woods.

Secondly, for fast colours, the common processes in which turmeric is used for the yellow, ought absolutely to be rejected. Weld, quercitron or fustic may be used: of these the quercitron is the cheapest in proportion to the quantity and quality of the colour, and really deserves very nearly, to take the place of all other yellows in dyeing woollen.

Thirdly, tartar, like all acids, has the property of yellowing red colours.

Fourthly, for common work, alum and tartar, with quercitron and madder, may be used. The alum about two ounces and tartar one ounce to the pound of woollen, on the average.

Fifthly, the red ought to be dyed first: it is easier by this means to hit the required tint, than if the red were dyed last.

Sixthly, if you dye to pattern, dye specimen pieces first.

The adding or leaving out the tartar, the addition of a minute quantity of sulphat of iron or of copper to the preparation liquor, will vary the shades greatly, where colours of a saddened tint are wanted.

I insert a few varieties from Homassel.

Orange and Aurora. Scarlet bath, with the addition of turmeric (rather of weld or quercitron. *T. C.*)

Mordorè. Preparation of alum: dye-bath, madder and weld. If the colour should be too lively, sadden it with walnut peel, or rind.

Carmelite. The same, but with a proportion of walnut rind.

Wood Colour. Alum bath: walnut peel and madder.

Hazle. Light ground of walnut peel: then alum bath with a small quantity of madder. Or a light dye of scarlet upon walnut peel ground.

Of Yellow with Black: olives and drabs.

Dark Olive. For one pound of woollen, one ounce of green copperas, the eighth of an ounce of blue copperas, two ounces of alum: boil for two hours, rince moderately: then enter the goods into a dye-bath of six ounces of fustic, four ounces of logwood, and two ounces of sumach: boil for an hour.

Light Olive. For one pound of woollen, one ounce and a half of alum, half an ounce of green copperas, the eighth of an ounce of blue copperas: dye with six ounces fustic, an ounce of logwood and an ounce of sumach.

In the back country of Pennsylvania they dye olive with equal parts of green copperas and alum, and equal parts of black oak and hickory bark.

Greenish Olive. For a pound of woollen, one ounce of green copperas, two ounces of alum, half an ounce of blue copperas. The dye drugs as in dark olive.

Bottle Green. Increase the proportion of green and blue copperas and of logwood, each about one eighth. Or dye first in walnut peel, then in Saxon blue.

Drab. For a pound of woollen, take two ounces of alum, one ounce of green copperas: dye with eight ounces of fustic, and two of sumach. The colour will be saddened by increasing the proportion of copperas and sumach and diminishing the alum. Sumach gives a reddish brown tinge with alum, though its natural colour is greenish.

Forrest Drab. For twenty yards of fulled cloth, your copper being filled with pure water, put in one pailful of sumach, one pound of fustic, half a pail of alder bark, and two ounces of nut galls, well pounded. Boil them together three hours. Dip your cloth half an hour and then cool it; repeat this twice more, but the last time put into the bath about an ounce of powdered alum. See that the scum is taken off every time you dip.

Take out the cloth and add a small handful of copperas to the dye; then dip the cloth half an hour; take up and cool. Thus proceed till the colour desired is obtained. But note that you must increase the quantity of copperas every time you dip. Rince the cloth well when dyed.

By adding a little yellow oak, hemlock or butternut bark, and boiling it well, a cheap and good brown colour may be produced, which many people prefer for common use. (*Asa Ellis.*)

Dark Drab Brown. (From the same.) For twenty yards of fulled cloth, put into the copper half a bushel of hemlock bark, and a peck of yellow oak bark, or walnut bark; boil them till the strength of the bark is exhausted, and then take the bark out. Dip and cool two or three times, as in laying the ground of other dyes; then raise the colour with copperas, dipping and cooling until it becomes as dark as you desire.

Savoy Brown. To each pound of wool, take one ounce and a half of alum and half an ounce of tartar, dissolve them, and boil the wool in this mordant for two hours: drain it, and rince it to take off superfluous alum: dye it in a bath of two ounces quercitron, six ounces fustic, and one ounce red-wood, at about 180° of Fahrenheit for an hour and a half. Wash it and dry it. Refresh the alum liquor with an ounce of alum per pound, and work the wool in it for half an hour; drain, rince slightly, dye in a liquor of six ounces madder to the pound of wool, entering the cloth at a blood heat, and keeping the madder liquor not exceeding 160° of Fahrenheit, for an hour. Drain, and wash the woollen.

Then make a bath of two ounces of logwood and half an ounce of green copperas to the pound of woollen, enter the goods at a boiling heat, and continue them an hour. The shades given by red-wood and logwood will not stand the sun and air. Nothing but madder gives a fast colour. You may sadden with sumach.

Snuff Brown. To each pound of wool, mordant with an ounce of green copperas, half an ounce of alum, and half an ounce of tartar in the usual way: rince moderately. Dye with two ounces madder, one ounce red-wood, four ounces fustic and two ounces sumach per pound, at about 180° of Fahrenheit. Take out the goods, drain and wash them. A little more alum will brighten and a little more copperas sadden the colour. The goods may be dyed first, and then the mordant put in, as in the following process.

London Brown. For each pound of woollen, boil two ounces madder, two ounces red-wood, four ounces logwood, and as much sumach for an hour; then enter the goods and boil for an hour. Raise the goods out of the liquor, and add to it a solution of an ounce and a half of copperas and half an ounce of alum. Enter the goods again, and work them till the required colour is obtained.

It is common to add alkali or urine to heighten the colour, but I am of opinion they always do harm by causing the colour to change more easily in the air.

All these colours may of course be varied in shade, by slight variations in the proportion of ingredients used. For this no particular directions can be given, nor are they needed.

I do not approve of dyeing first and mordanting afterwards, so much as the contrary practice; but it answers better on woollen than cotton, and better where the quantity of mordant is small. But alternate dippings are best where a good colour is wanted. The most durable browns, however, are those dyed with walnut rind and madder, or sumach and madder: walnut rind deserves great attention.

Brown, Nankin, Cinnamon, &c. Walnut rind; walnut peel; the green external shell of the walnut, is the substance chiefly used for dyeing brown or fawn colour. Sometimes the walnut root is used, which has nearly the same properties. Sometimes this colour is produced by alder bark, and also by sumach. The walnut rind is the best and most convenient substance, as it can be used either with or without a mordant. It is the better for being gathered and kept for two years before it be used.

Brown from walnut rind. Boil in water for half an hour, a sufficient quantity of walnut rind to produce the colour you wish. With cloth, begin with the deepest colour, with yarn begin with the lightest. The cloth and yarn must be moist with hot water before you enter them into the dye. Add walnut rind according as you find the bath requires it.

The preparation of the cloth in alum water, about two ounces to the pound, makes the colour take more fully, and be more lively.

The addition of a small quantity of green copperas saddens the colour, turning it to a brownish black. (*Hellot.*)

On the *Brown of Walnut Rind*, by *Homassel.* The outer green rind or peel of the walnut, is employed only for fast colours. The leaf and the root of the walnut have the same properties with the rind, but they are not so rich in colour.

In the season when this fruit is beaten off the trees, tun-casks or cisterns must be filled with the rind, and then the vessels filled with water. They may thus stay and ferment for six months if you please, or even for three years; but the vessels must always be kept filled with water; and the walnut peels must never be stirred; if either of these precautions be neglected, worms will breed in the walnut peel, and its properties will be injured. Mere putrefaction will not injure the colour.

Carnation colours, whatever be their delicacy or their force, can never be of the good dye (that is fast colours) if the principal brown or light ground be not dyed with walnut rind. In defect of this ingredient, a black tint must be used, but the black of a light shade is of the false tint (fugitive.) Now whatever the skill of the workman may be who employs this fugitive colour, he can gain no credit by it, for it will alter before it has received the last finish.

Carnation colours, as they are called, are so various, that they admit of twenty-five thousand shades: hence some idea may be formed of the immense consumption, as a dyeing ingredient, of walnut rind.

The method of using walnut rind, is this. To thirty buckets of water in a boiler, put ten or twelve buckets of walnut rind or peel, which should be boiled for three hours. Lade out the walnut peel into baskets that they may drain, and then throw them away. Fill the boiler to the top, and keep a gentle fire under it so as to keep the liquor below a boiling heat. This heat causes a thick oily scum to rise, and at the moment when this is about to separate by the boiling of the water, let it be scummed off very clear, so that not a trace of it remains; for if this be not done, there will be spots on the cloth that cannot be effaced. The cloths may be entered without being wetted, and without any aluminous mordant as a preparation. (But the colour is improved by such an aluminous preparation. *T. C.*)

The woollen cloth and yarn intended for brown or fawn colour, may be worked in this walnut liquor, till they have acquired the wished for tint. This bath is excellent for bottle greens, and other brown mixtures of Saxon greens. After having produced browns of this description, the same bath or liquor is excellent also as a ground for many other colours, as hazle, flesh colour, Paris mud, fast gray, &c. &c.

A skilful dyer may finish all the colours that have been previously grounded with walnut, at a very little expense.

To finish *common browns* grounded with walnut rind, after washing them at the river, run them through a hot alum preparation (of an ounce to the pound of wool, *T. C.*) and then finish with a small quantity of madder: (about two ounces to the pound of cloth. *T. C.*)

The colour thus produced with walnut rind and madder, is unalterable, and resists all proof. The hazle colour, dyed in the same way, is as solid as the brown.

Flesh Colours, are finished with a small quantity of madder in a scarlet vat nearly worked out.

Paris mud, is finished with a little logwood and copperas; but if the colour be required to stand, it must be finished with a small quantity of nitrat of iron, and galls. (Nitric acid is so dear in this country, that nitrat of iron, though excellent, can seldom be used. *T. C.*)

Grays intended to be fast, must be finished in the same manner.

Amiens Gray, is finished with a solution of indigo prepared with Spanish white. (Les gris d'Amiens avec un dissolution d'indigo preparée au blanc d'Espagne: I do not understand this: blanc d'Espagne or Spanish white, is nothing but a very finely washed whiting, which may be of use to take off the superfluous quantity of sulphuric acid, but common whiting would answer this purpose. *T. C.*)

American Gray, is finished in the same manner, with the addition of a soot bath. In a word, walnut rind or husk, and soot, are of such extensive and indispensable use in the practice of dyeing, that I may venture to say (says Homassel) without exaggeration, that these colours are to the dyer, what the foundations of a building are to the mason, who means to erect upon them the most beautiful structures.

Of Sumach for the Browns. (Hellot.) This drug is used much in the same manner as the walnut rind, but its colour is not so deep, and is somewhat greenish. It is of a brown colour when used with alum. It is an astringent substance, and is used as a substitute for galls, but it requires a great deal more in quantity. The colour of sumach is solid and permanent. It may be mixed with galls, or alder bark, or walnut rind, or all of them, in the production of browns and fawn colours; the various hues of these colours must be judged of by the eye, but they are not difficult to manage.

Of Sumach. (Berthollet.) Rhus coriaria, a shrub grown in Syria, Palestine, Spain and Portugal. The shoots are cut to the roots; they are then dried, and ground in a mill for the use of dyers and tanners. The sumach cultivated near Montpelier is called rondou or redoul. Bancroft says the Pennsylvania sumach is the rhus glabrum: but almost all the kinds grow here.

The infusion of sumach, which is of a greenish fawn colour, becomes brown on exposure to the air. When fresh, potash produces but little change in it; acids brighten and weaken the colour; solution of alum produces a precipitate not abundant; the supernatant liquor is yellow.

Sugar of lead produces an abundant yellow-brown precipitate, brown at the top; the supernatant liquor is a light yellow.

Sulphat of copper gives an abundant precipitate of a greenish yellow, which after some hours is changed into a greenish brown; the supernatant liquor is clear but slightly yellow.

Common sulphat of zinc (which always contains iron, *T. C.*) muddies and blackens the liquor; a deep blue precipitate is deposited. Pure sulphat of zinc deepens the colour, and gives a fawn coloured brownish precipitate.

Common salt produces at first no sensible change, but after some hours the liquor becomes troubled, and the colour lighter.

Sumach acts upon a solution of silver, just as galls do, and the reduction of the metal is promoted by the action of light.

By itself, sumach affords a greenish fawn colour; but it gives several shades on cotton according to the mordant used. Thus as we have already said, with concentrated acetat of iron, it gives a black; with diluted acetat of iron various shades of gray. With acetat of alumine, a yellow with a tint of green, very fast; so that in a pattern the gray, yellow, brown, and black may all be produced by raising in sumach.

To dye cloth, or woollen yarn with this drug, heat the water to about 50° of Reaumur, 145° of Fahrenheit; throw in the sumach, enter the goods and work them for fifteen or twenty minutes, raising the heat a little. If the heat be too much raised, or the goods kept in too long, the colour is weakened instead of being deepened; and those that have been prepared with iron, in a short time lose their colour altogether.

This effect may be observed, but in a less marked manner, in several other dyes, which require the goods to be taken out the instant the required colour is obtained. Also, for the purpose of dyeing evenly, but a few pieces should be dyed together at a time. (Berthollet.)

Alder or owler bark for browns. This substance is more used than spoken of. It is, like sumach, an astringent, and gives out a brown colour, which with an alum mordant is good and fast. With copperas of iron, it gives a brownish black; and when diluted, a mud colour. The cotton dyers use it more than the dyers on woollen, but it is a drug of considerable value, from its cheapness, and the permanence of the colour it affords. When sumach is scarce it supplies its place.

As walnut peel, sumach, alder bark, and soot, each give a different shade of brown, the colours of which brown is the basis may be varied at pleasure, with these dyeing ingredients and different proportions of alum and green copperas, with or without madder. If in lieu of madder, quercitron, weld, or fustic be used, you get the different tints of drab; and with a shade of blue, olive, bottle greens, goose dung greens, &c. Walnut, sumach, alder and soot are all fast colours, and calculated to do credit to the dyer.

Every dyer should keep by him a specimen of every colour he dyes, with the ingredients and the proportions; these should be pasted or sewed in a book, having a book for each class of colours; he may then know at any distance of time, the ingredients necessary, with their proportions, for any particular shade of colour. In this way, he will never be at a loss to dye to pattern, which otherwise he can never be sure of without previous trials, which always occasion waste of time.

The false dye, or fugitive shades of brown, are made with red saunders, or some of the red woods, in lieu of madder. The fugitive and cheap bottle greens, have their blue tinge given, either by the solution of indigo in sulphuric acid, or by logwood and blue copperas. It is in some cases desirable to use these for cheapness, but I am well persuaded, it is not the permanent interest of a dyer to do so. I shall give some of these processes immediately.

Yellow and Brown with Blue. Fast Green. Dip the cloth in the blue vat, giving the shade of blue you require; either the pastel vat or the indigo vat will produce a fast colour; drain, open, and air the cloth till it acquires the blue colour from the air: then wash it well, but not before: for if the cloth be washed before it be *blue*, the indigo will wash out.

Proceed to give a yellow dye, with the usual mordants of alum and tartar for the preparation; the quantity of these salts may be less for a green than for a yellow; so may the quantity of weld or quercitron, using them however in the same relative proportions as for yellows; thus, if for cloth intended to be a full yellow, you use three ounces of alum, and one of tartar, or for the deepest yellow four ounces of alum and two of tartar, with from three to four pounds of weld per pound of woollen, a green will seldom require more than half the quantity. Quercitron, according to Dr. Bancroft, is used in more than a full proportion, when it amounts to double the weight of alum employed; but as I have said before, I think he gives more credit to his patent drug in this respect than it deserves.

No blue is a fast colour but that from the woad (pastel) vat, or from the indigo vat: nor is any yellow fast, but that from weld or quercitron: that is of the drugs in common use; I believe the hickory and the barberry root give out very fast and bright yellows. Fustic is so cheap that it is commonly employed, but it ought not to be used for fine cloths.

Most dyers, dye both their shades of blue and of yellow at two dippings each, beginning with the deepest shade; in this case the cloth need not be long in the dye-copper.

It is common, in a regular dye-house, to dye cloths a succession of shades, which, where there is much business, is convenient.

For clear and light colours, the yellow-copper ought not to boil.

Greens may be saddened with a little copperas of iron, either with or without an additional astringent of galls or sumach.

The blue should be dyed first, whether the blue vat be used, or the sulphat of indigo: for the yellow dye is injured both by the alkali of the one, and the acid of the other.

Saxon Green. Homassel. Two ounces of alum per pound of woollen. Boil the cloth in it for an hour:

take it out, drain it; put into the boiler one ounce of the solution of indigo per pound of cloth, and four ounces of fustic. Boil these for an hour and a half. If you dye to pattern increase or diminish accordingly. Saxon greens are also frequently dyed with turmeric for the yellow colour.

(I have great respect for a practical book like Homassel's, but I greatly object to every part of this process. First, there is no reason why the usual dose of tartar should be omitted in the preparation. Secondly, I object to the yellow being dyed first, for the acid of the indigo solution will certainly impair it. Thirdly, I object to the indigo solution being *boiled* in the liquor, for it will certainly act on the copper and sadden the colour. Fourthly, I protest against all use of a drug so fugitive as turmeric in the woollen dye. *T. C.*)

Same Colour. Berthollet. Experience has taught us that this colour can be dyed more expeditiously than by the former practice. A preparation is given to the cloth in the usual way of dyeing yellows; the cloth is then washed; (it ought to be no more than rinced at any rate, *T. C.*) put into the same preparation liquor, fustic in chips according to the shade required; the fustic must be enclosed in a bag; (in England all woods are used rasped, *T. C.*) boil this for an hour and a half; take out the bag; cool the bath so that you bear your hand in it; (this will vary from 130° to 140° or even 145° of Fahrenheit's thermometer, *T. C.*) pour in about twenty ounces troy weight of the solution of indigo, for every twenty-five yards of cloth. Turn the cloth quickly at first, and then more slowly; take the cloth out of the dye-vessel before the liquor boils. It is, however, a good practice to put in but two-thirds of the solution at first, then to give the cloth two or three turns in the liquor and then put in the other third; the colour is more even in this way.

If you perceive that the colour does not take well, throw in a little powdered calcined alum. (There is no use in calcining it, but to make it dissolve a few minutes sooner. *T. C.*)

The apple green, is usually dyed after the Saxon green, refreshing it with a third of the original quantity of ingredients; and cooling the bath. The cloth may be turned in it, till the heat approaches boiling.

It is evident that several shades of green may be dyed, according not only to the proportions of the ingredients, but the kinds of yellow dye-stuff employed. But fustic is generally preferred, because the acid of the solution acts less upon it, than upon the other yellow drugs, whose colour it enfeebles and in part discharges.

To avoid this, (says Berthollet) Bancroft proposes to dye the cloth blue first; to rince it well in clear water; then to give it a preparation of three parts of washed chalk, or whiting, and ten or twelve parts of alum, to a hundred parts by weight of cloth; at the end of a quarter of an hour, he adds one part of the chalk, and another part in six minutes afterward, and then another, till a good green be produced. He advises also, as others do, to add chalk to the sulphat of alumine (alum), but by this means he decomposes the alum, and precipitates the basis of this salt. The effect of carbonat of lime (chalk or whiting) is very different from that of the alkalies on alum; for these, whether caustic or carbonated, are able to redissolve the alumine precipitated, which whiting or chalk cannot; for it is converted into a sulphat of lime or gypsum. The sulphuric acid of the solution of indigo, may be neutralized by chalk, after the cloth is dyed blue, before it be alumed for the yellow.

(All this difficulty is owing to the wish to save time by doing at once, what in my opinion, can only be well done at twice. Dye the cloth first any shade you require of Saxon blue. Rince it; or if you will, run it through whiting and water first, and then rince it. Then dye it yellow with fustic or any other dye-wood in the usual way; for the acid can now no longer act either on the alum or the yellow colour. *T. C.*)

It is objected to Saxon blue, that it has a greenish tinge, which is probably owing to some peculiar action of the acid on the particles of indigo: (it is not; it is owing principally to impurities in the indigo which ought previously to be washed out; very little of this tinge will be seen, if the solution be made with the precautions I have recommended, under the article of Saxon blue. *T. C.*) It is objected also that this kind of dye is not solid. In England the dyers have endeavoured to make it approach in solidity, as well as brilliancy, to the vat blue. Gulich gives a process for the English Saxon blue and green, of which he boasts much.

He employs a cold vat for dyeing his blue, composed of three parts good quick lime, three parts green copperas, one part and a half of orpiment, and one part indigo. The indigo, ground and sifted in the usual manner, is put into a wooden vat with the necessary quantity of water; the lime is added, and the vat well raked; after resting some hours, the copperas reduced to powder (or better in solution) is put in; it is again raked, and left to repose for a few hours; then the orpiment in powder is thrown in; it is again raked, and left to rest for a few hours.

When the liquor is well coloured, and clear under the froth, the goods are dyed in the usual way. He recommends this particularly for silk; and is of opinion that the want of success in a cold vat among the silk dyers, has been owing to a want of orpiment. (Berthollet.)

Another. Haigh of Leeds. Eight ounces of indigo is sufficient for four pounds of oil of vitriol for green, and would even dye a pea green if used very hot, and therefore would not do for blue. (He recommends twelve ounces of indigo to this quantity of oil of vitriol for blue; but in fact he knows little about it. These are receipts that will do tolerably well for Saxon blue, but I know of no good one except that which I have given under the head of Saxon blue. *T. C.*) The indigo is better suspended in this liquor than when twelve ounces are used, and is supposed to go further in green. (That is, the impurities of unwashed indigo carbonate the oil of vitriol and give it a brownish-yellow tinge, which with the blue, makes a green. *T. C.*) The goods being well scoured, are to be alumed. For this purpose, two pounds of alum are 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 fustic chips are put to boil. (In a bag. *T. C.*) If there are any to be dyed a pea-green, it is best to dye them first; not as practised in some dye-houses; for this 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 alum liquor after they are dyed, in order to clear them of the stuff, and render the colour brighter. The liquor is not to be hotter than the hand can be borne in. (140° of Fahrenheit.) Observe also, if the alum was put in (as is the custom in some dye-houses) with the fustic, it would retard its working so well. For alum being an acid, would discharge if used with, as well as to prepare for, fustic.

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

(I have already given my opinion, that the blue should be dyed first, and then rinced in whiting and water. Then prepared with alum and tartar for an hour and a half: then dyed in the usual way with quercitron or fustic. *T. C.*)

I do not think it necessary to give any particular details on the intermixture of yellow and red, yellow and brown, yellow and black, brown and red, brown and black, and so on, because they are sufficiently obvious and easy; and no directions can be given which the eye of a tolerable dyer will not anticipate. It may be worth while to state briefly the general effects of *the primitive colours taken three by three* from Haigh's Dyer's Assistant.

From blue, red, and yellow, the red olives and greenish grays are made. In the mixture where blue is a shade, it is usual to begin with it. The stuff is afterward boiled to give it the other colours, in which it is alternately dipped. Sometimes they are mixed together, which may be done, if they require the same preparation, as madder red and yellow. As to cochineal and kermes, they are seldom used in these common colours, but only in light colours, which have a bloom or vinous hue, and are required to be bright. In this case they are not 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 grayed a little, which is lastly done by passing them through the browning.

Olives are made from blue, red and brown, from the deepest to the lightest; and by giving a light shade of red, the slated grays, lavender grays and such like are produced.

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

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

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

From the red, yellow, and brown, proceed the orange, gold colour, marigold, dead-leaf, old carnations, burnt cinnamon, and tobacco.

From the red, yellow, and black, pretty nearly the same as the last, and the deep feuille-mort (dead-leaf;) as also the ox hair and brown nut, and others of the like kind.

The preceding is a sufficient specimen of the varieties that may be produced by a mixture of several colours: it is seldom that practice extends further than these.

I am not well acquainted with the following singular process, either in theory or in practice: I copy it from Homassel, whose book, both on account of the author and editor, is entitled to as much attention as any other treatise on dyeing I am acquainted with.

On the Produce of Woollen Flocks. Du produit de la Bourre.

First operation. Wash the flocks well in a wicker basket at the river: then boil them for five hours in alum, at the rate of pound for pound. Take out the flocks; leave it in an underground room or cellar (cave) during one month to feed upon the alum. (Is it possible that half so much alum can be of use? *T. C.*)

Second operation. Wash the flocks at the river scrupulously and with great care. (It is impossible that this can be proper, unless too much alum has been used or rather wasted in the first operation. Indeed, I cannot see how the wool can be benefited by an aluming beyond four or six ounces to the pound of wool. I am fully persuaded, that until colouring matter is brought to act upon the alum, it is not decomposed: it rests intermingled with the fibres of the wool, in the form of alum, and can be completely washed out by water. Hence I object in all cases to these careful and scrupulous preliminary washings. *T. C.*) This manœuvre takes much time to cleanse it well in close wicker baskets. The flocks are then dyed in a bath of two pounds of good madder to each pound of flocks. They are put in while the water is warm, the liquor is heated gently and gradually; it is kept under a boiling heat as usual for madder, during three hours; it is then taken out, cooled and washed at the river with the same precautions as have been prescribed for washing after the aluming. It is then spread out on planks in an upper floor to dry. The flocks thus prepared, are employed in commerce.

Third operation. The solution (fonte) of the flocks, forms a third operation, which must be begun at four o'clock in the morning, so as to be finished at eight o'clock at night. A boiler is half filled, and two pounds of potash (cendres gravelées, ashes from calcined wine lees) are used to each pound of flocks. There must not be more water than a small bucket full, to each pound of flocks. When the potash is well melted, put in the flocks. Have ready at the side of the boiler, a barrel containing urine in the proportion of a small bucket full to each pound of flocks. The liquor in the boiler, must be well stirred, and boiled till the flocks are completely dissolved: the liquor will then swell up, and be apt to boil over, and will be of the consistence of milk soup. It must then be checked by letting the urine run into the boiler through a pipe not thicker than a straw. This operation, which from beginning to end requires sixteen hours, demands that the urine shall be ten hours in running out of the barrel, and that the boiling shall continue five hours afterwards. When the operation is finished, there ought not to be in the boiler more than two quarts of fluid substance for each original pound of flocks, except the sediment, which is not calculated. Twenty-five years ago, this liquor was sold to the makers and dealers in feathers and plumes at a pound sterling the bottle.

With this solution of flocks, rose colours are dyed upon woollen, as beautiful as with safflower upon silk, by diluting the liquor in warm water, but they are not solid.

The sediment, which often makes half the quantity of the mass, is used for orange tints.

General Remarks on the Woollen Dye.

Having thus finished all the processes I think necessary to detail upon the subject of dyeing woollen, I would sum up with some remarks that for the most part have been directly made or hinted at before in the preceding pages.

First, in impregnating woollen with alum, I do not believe that there is any use in employing more than six (or rather four) ounces to the pound; because the quantity of madder or other colouring drug which the cloth will take up, can be fully precipitated by that quantity of alum. I put a solution of one part alum, to a boiled decoction of four parts madder: an additional quantity of alum solution threw down no precipitate.

Secondly, the cloth after aluming may be rinced to get off small lumps of alum, but if it be washed scrupulously, all the alum will be washed out: for the cloth does not decompose it: it is only decomposed and fixed on the cloth, by the action of the colouring matter of the drugs used.

Thirdly, it is of use to keep the cloths after aluming in a damp place, because by this means the alum is prevented from crystallizing and more equally diffused in solution throughout the cloth.

Fourthly, in general a tolerably full colour will be obtained by three ounces of alum and one of tartar to a pound of the cloth: but the colour may be increased in intensity to the amount of four but hardly of six ounces: that is, if the proportion of colouring drug be increased in proportion. The tartar I think prevents the alum from crystallizing.

Fifthly, I think woollen requires tartar; and that in general one half of tartar to one of alum, is not too much: but where acids weaken the colour less may be used.

Sixthly, in the dye-bath, a heat beyond 180° of Fahrenheit is not desirable: for madder, it ought not to go beyond 150° to 160°.

ON DYEING SILK.

SILK is not of so decidedly animal a nature as woollen, as to its properties in dyeing. It unites very well to alum, but the acid of nitre decomposes it, and prevents its retaining the colouring matter. It has little affinity with sulphuric acid; but if it be forced to receive a dye by means of this acid, it loses its lustre in the air in a very short time.

The colouring matters used in dyeing wool, are employed also to dye silk: but the method of managing the dyeing drugs upon silk is very different. For many colours, you must not employ a degree of heat beyond the thirtieth degree of Reaumur's thermometer, (equal to about 100° of Fahrenheit,) and always in troughs (Baquets.) The necessary dexterity in handling silk stuffs, can only be acquired by long apprenticeship; but as to the mere dyeing, that can soon be taught to any one accustomed to dye woollen. Indeed I never knew a good silk dyer who had not been a woollen dyer; a good workman ought to be both.

On boiling raw and unbleached Silk. Homassel. In the first place, you must divide it into hanks of a pound weight each, strung upon ozier or wicker. Pass a string or cord through ten of these hanks. When the hanks are at half twist, put them into a bag or pocket of thick linen, open at the side; put three strings (thirty hanks) into one pocket, arranged one on the other, in such a way that there is no danger of their entangling while they boil. Then sew up the side of the pocket.

For one hundred pounds of silk put into a boiler from thirty to thirty-six buckets of soft river water, or such as will mix well with soap. Take for each pound of silk, four ounces of good white soap, cut it in pieces, and dissolve it in the water. When the soap is perfectly dissolved, put more water into the boiler to cool it; then put in the pockets of silk, and keep the liquor not at a boiling heat, but at such a degree as will make the soap and water boil up like milk over the fire just about to boil over. But if the heat be kept up to the full boiling point, the silk will open and become furzy; and if it be permitted to touch the sides of the boiler, it will burn; in which case you occasion yourself a great deal of trouble, and incur the hazard of spoiling the whole batch.

In this manner you keep up the boiling not less than four hours, keeping the pockets constantly stirred and turned one over the other, and preventing their resting against the sides of the boiler: if they burn at all, you must take out the pockets, open them, examine the silk, and then if you think fit, return it into the boiler again sewed up, calculating and allowing for the time this operation takes.

At the end of four hours take out the pockets of silk with two poles, beat them, open the pockets, and hang up the hanks by the cord or strings that were passed through them, to drain and cool. Then wring them upon the pegs, so that they can be handled, and then wash them thoroughly at the river.

When the silk is washed, it must be spread out in the water, by a turn of the wrist every time it is turned, changing hands. It must then be well beaten or beetled on a flat stone, turning it so as to expose it in all parts, before it is again plunged into the river. It is absolutely necessary that the workmen should understand and be able to manage the different turns of the wrist in handling and working silk, otherwise they will entangle it, and make no good work. To acquire this dexterity, the silk dyer should make his apprentice boys exercise themselves at it during their leisure hours, with a parcel of Grenada silk tied up in hanks and worked in a trough. This is very essential to the interest of the boys, for a workman who knows how to handle silk, will earn more wages than one who merely knows how to dye it. The most essential parts of the management of silk, is to know how to wash it well, to wring it well, and to smooth it well (lisser.) Silk not well washed, is very troublesome. If you dye it in a vat, the soap is extricated from the silk, and mixes with the dye stuff in such a manner as to precipitate the colour, so that you can hardly recover the tone of the vat again. I know of no enemy so dreadful to the warm indigo vat, as soap.

Silk which is alumed without being well washed, takes the alum imperfectly, so that when it comes to be dyed, it is stronger of colour in some places than others, and appears spotted.

A parcel of silk, not dexterously wrung, and the fibres laid smooth and even, does not dry equally and perfectly; and when dyed, it is apt to spot. If you pass it into an indigo vat, the colour will disappear in those places where it is moist; you must then discharge the colour, and begin your labour anew. When you take a hank of silk in the left hand, and turn it upon the stick, it soaks up too much water where the hand presses it, and if it be not dextrously and evenly turned upon the stick by a turn of the wrist, it will become spotted in the places that are pressed by the hand, when it is dyed. Hence it is evident that the art of handling the silk in a workman-like manner, is of the first importance to the dyeing of it well. All this can only be attained by example and practice. When the silk is well washed, and beaten at the river, it sometimes happens that you discover spots where the natural gum-resin of the unbleached silk has not been thoroughly removed; the workman calls this *biscuit*, because those places have not been sufficiently boiled. This may arise from the hanks having been too closely confined in the pockets, or that they have not been sufficiently stirred and moved in the boiler, by bringing the bottom pockets to the top in rotation continually, or that the heat has not been sufficient, or that the quantity or quality of the soap has been deficient. In this case, the spotted hanks must be separated, and boiled over again, either in a separate quantity of soap and water expressly prepared, or with other hanks intended to be still further bleached for white silk. The above described process being sufficient for silk meant to be dyed, but not for silk meant to be made up white. As yet, it is only ungummed.

For the boiling of silk, it is necessary to use the best white soap, which goes farthest, and is cheapest upon the whole. Some coarse soaps unite with the gum-resin of the silk and form a varnish difficult to be dissolved.

Fat soaps (soft soaps) are sometimes used for the purpose of boiling silk, but the operation is not perfect; and the colour not so good at first, is apt to redden by time and exposure.

Silk loses from twenty-five to thirty per cent in boiling, to deprive it of its gum-resin. Hence it should be remembered, that in dyeing, one pound of silk weighs and means only twelve ounces.

The soap suds used to boil silk, soon putrefies and becomes good for nothing, (except perhaps as a manure. *T. C.*) If the silk is heaped when warm out of the suds, before it is washed, it will heat, putrefy, and generate worms, which however will not feed on the silk, but on the soap and gum only. Such silk will be harsh.

If your water be muddy when you want to wash the soap and gum out of the silk, you may clear it either by boiling some bran in it and scumming it, or by putting a pound of common soap to about thirty buckets of water, and boiling and scumming it.

(It has been proposed to substitute soda for soap, but it is not used, nor do I understand the advantage or superiority of this substitute. *T. C.*)

Of White Silk. String your hanks two on a stick. Prepare an oval boiler; dissolve in soft water in this boiler, soap in the proportion of one part soap to silk four parts by weight. When the soap is melted, cool the suds with cold water, and draw out most of the fire from under the boiler. Place the hanks of unbleached, ungummed silk suspended on their sticks on this boiler. Turn them in the boiler, so as to moisten them thoroughly and equally, till the gum entirely disappears in that part which was in the boiler. For this purpose, keep the sticks moving downward and upward in the soap liquor, as if you were washing the silk in the soap suds, which are to be kept nearly at a boiling heat. In about half an hour, the portion of the silk thus worked in the boiler will be deprived of its gum: take it out, and enter the rest, and proceed in the same manner.

When all is deprived of its gum, it is washed, wrung, and sewed up in pockets to be boiled again for white. The boiler is emptied, and cleaned, so that no gummy matter remains in it. Charge it again with water and soap, as before, four ounces to the pound of silk.

As whites are of different shades, silver white, thread white, bonnet white, blue white, a quantity of indigo finely ground and passed through a sieve, is put in the boiler, according to the tone of colour required. Boil for four hours with exactly the same management and manœuvre as with the raw silk.

When the silk will take too much time to deprive it of its gum by means of dipping the hanks on sticks, or that you have no oval boiler fit for the purpose, you may make the raw silk up into loose bundles, and boil it in the first soap for half an hour; but this method is never so certain as when it is handled upon the sticks. If in a boiling of raw silk after four hours, you are liable to biscuit spots, (imperfectly deprived of the gum,) you must give it half an hour more boiling. This renders the management of it on sticks passed through the hanks so convenient, where the progress can be so much better observed.

When the silks are sufficiently boiled, take them out, open the pockets, wring them on the peg, expose them in a room to be sulphured for twelve hours, when you may withdraw and dry them. Silks meant to be made up white, are not washed out of the brimstone vapour, unless they are meant to be dyed. (I think this is dangerous practice. *T. C.*)

When the silks come out of the sulphur room, they are not always conformable to pattern: sometimes they are not blue enough: in this case mix a little Saxon blue with well water, and run them through that and dry them. If they are too blue, which can be seen by wringing a hank upon the peg till it is dry, before you sulphur it, prepare a bath of white soap and water, two ounces of soap to the pound. Work the hanks in this, till they have given out their superfluous blue: then wring them, and without washing send them to the brimstone room.

Bonnet whites are never sulphured: the acid would rust the needles. In lieu of this, when they come out of the white soap-boiling, they receive another boiling in soap with a little blue. They are then wrung, and dried quickly.

Bonnet grays are made after the silk is white: they are prepared in numbers from the lightest shade to the deepest. For this purpose the dyers rince them in the water which has been used to rince the black silks, either diluted or not, as occasion may require. They must be washed afterward; for the soap, and the iron with which the black dye is charged, will otherwise have a bad effect on the silk. But as the hosiers do not pay more for the grays than for the whites, some dyers are skilful enough to dye their grays on the whites without washing. The soap and the black dye unite, and adhere to the silk, adding to the weight of it; which is their inducement to proceed in this manner, as the dyer gains by the additional weight.

If the soap suds which have served to boil the silks are not quite spoiled, they are used together with the third soap bath of the white silks, as a first boiling for the raw or unbleached silk, adding only two ounces of fresh soap to the pound. It is supposed that a hundred pounds of whitened silk will yield no more than seventy-five pounds; and no more is delivered to the merchant. The rest is the affair of the dyer.

White silk intended for any kind of manufactures, except that made up at the hosiers—that meant to be dyed—or that meant to be watered, is usually sulphured.

Of Sulphuring. Macquer. The hanks should be spread on perches seven or eight feet from the ground, choosing for this purpose a high room without a chimney, or an elevated barn, where you can procure a current of air when you want it.

A pound and a half of roll brimstone, broken into small lumps, is lighted on earthen pans: when one piece is lighted, it will communicate with the others: there should be a few ashes in the bottom of the pans.

Shut the room, and close the chimney, if there be one, to prevent the vapour from being dissipated. It should burn all night. Next morning the windows should be opened to admit the air, and dissipate the vapour. This current of air is sufficient in summer time to dry the silk. But in winter, as soon as the vapour is dissipated, the windows should be again shut, and chafing dishes or a brazier of charcoal introduced to dry the goods. (The chafing dishes or brazier, should have perforated covers, to prevent the dust from flying about. *T. C.*) It is of great consequence that the door and windows of the room should open outward, otherwise it would be unpleasant to go in, when the vapour required to be dissipated. If in dressing, the silk sticks or adheres together, it is not sufficiently dry.

The sulphuring destroys the yellow tinge of the silk: it gives it firmness, and occasions that rustling noise which is so much desired. When this hardness of fibre and rustling is not wanted, as when silks are meant to be watered, it can be taken away by dipping the silk in hot water; this indeed takes away the harshness in question, but silks to be dyed or watered, should never be sulphured.

If when sulphured, the silk is not blue enough, it must be blued with a small quantity of Saxon blue, without being again soaped. For blueing, use hard water: soft water sometimes produces a reddish tinge on the silk.

Some stuffs, as silk laces, blonds, and gauzes are manufactured of raw silk: for these articles the silk need only be soaked for a short time in warm water, containing a little soap and blue, then washed in clean water, and sulphured. But when the silk is naturally white, like that of nankin, it requires no such operation.

Of Aluming. Keep by you a cask containing alum liquor, made by putting about two pounds of alum to four gallons of water; or strong enough to be unpleasantly astringent on putting it to your tongue.

Having washed the silk, it is beetled; and the better to clear it from any remaining soap, drain it on the pegs, and tie it up in hanks as for boiling. The hanks are then dipped in the alum liquor one after another, taking care to prevent them from tangling and twisting together. They should be loosely tied, that every thread may be evenly dipt. In this situation it should remain from night to morning. After this it is taken out, and when wrung by hand over the tub, it is rinced at the river, and beetled as long as necessary. (A process that I think may be dispensed with. A slight rincing seems to me enough. *T. C.*) In some manufactories, instead of steeping, the hanks are worked in the liquor hung upon rods or sticks. The quantity you can alum at once depends on the size of your vessel. When a good deal of silk has been alumed, the alum liquor must be renewed and refreshed. When it becomes offensive by frequent dipping, use it up as much as possible for browns, maroons, and such like colours, and then throw the rest away.

The cask should be frequently stirred and swept, to detach all the particles of crystallized alum from the sides of it: some dyers prefer its remaining, but the soap also remaining in the silk sticks to the sides, and it is this in general that produces the bad smell in the casks.

Silk should always be alumed cold: if alumed in warm liquor, it is apt to lose its lustre. It is better to make the alum liquor strong than weak; the alum combines with the silk in this case more evenly and surely. (After aluming, the silk must be sufficiently washed to prevent any crystallized alum sticking to it, but no more. *T. C.*)

Of Annatto. Usually called in the shops here, Spanish Annatto; but it is a kind of gum-resin that comes from Cayenne. The French call it Rocou. It gives nearly the same colours as iron, more lively, but less deep, and less solid. It resists washing tolerably, but it flies before the sun and air. Almost all the colours that annatto can give, can be produced by iron; still annatto is generally and extensively used, for orange, aurora, mordorè, gold, and buff colours.

Take by weight equal parts of annatto and pearl ash or potash, and four ounces of each for a pound of silk meant to be dyed a full orange colour. Put the necessary quantity into a boiler of soft water, large in proportion to the quantity of silk you mean to dye at once.

In dyeing, the pound of silk is only twelve ounces, allowing four ounces deficiency in weight by bleaching the raw silk. A hank of silk is fifteen ounces. But equal weights of the annatto and bleached silk, is about the proper proportion. The annatto should be cut in pieces, and put into a copper cullender, about ten inches deep, that will hold three or four gallons. The cullender must have two handles; the annatto being put in the cullender, this last is sunk into the warm water in the boiler, into which the alkaline salt has been previously put to melt, and rubbed through the holes of the cullender with a stick; when every thing has passed through that the water will dissolve, bring the liquor to a boil: if the dull brick colour of the crude annatto is not conquered, although all the alkali is dissolved, it is a sign that a little more of the pot or pearl ash is needed. The annatto will be uniformly dissolved in about twenty minutes: the liquor must then be cooled with cold water, and the silks dyed in the liquor under a scalding heat, till they acquire the colour of the specimen, which may be ascertained by wringing hard a hank of it, and observing the tint when thus nearly dried. The colour should be brought up deeper than the specimen, because much false colour will be washed and beetled out when the silk after being dyed is carried to the river. It should be twice beetled, else the colour is apt to smear. The hanks should be wrung upon the peg over the boiler, to save the colour. Annatto dissolved in alkali, will keep good a long time.

It is not necessary to wash the goods out of their soap, when they are intended to be dyed in annatto, because soap and annatto agree very well together. (Nankin breeches are refreshed by putting a teaspoonful of an alkaline solution of annatto, into the last soap suds. *T. C.*)

When you have dyed any quantity of silk in annatto liquor thus made, put it by, and if it be not strong enough for your next parcel, it may be refreshed with more annatto; but when you thus refresh the annatto bath, do not put more than eight ounces of alkali to twelve of annatto.

Coquelicot. Give your bleached silk a good ground of fresh annatto: wash and beetle it; wring it. Leave it loosely in the alum liquor cask, taking care, as in all other cases of silks that are alumed, that no part be exposed to the air; otherwise the alum water penetrating one part more than another, the silk will spot in the dyeing.

When the silk has remained immersed in the alum liquor for twelve hours, take it out and wash it at the river. When the annattoed silks are taken out of the alum liquor, they will have put on a bright red, which is owing to the acid of the alum, which always reddens and enlivens annatto colours.

When the annattoed silk has been thus alumed, and washed after aluming, pass it through a bath of brazil wood at the heat of 100° of Fahrenheit, and bring your silk to the tint of the pattern, trying it by wringing a specimen on the peg.

To make this colour in perfection, the brazil liquor should be two or three months old; by which time it will have acquired its perfection of colour. When dyed, it is taken to the river, washed, and evenly wrung: then dried upon poles in the shade.

An *Aurora colour* is dyed with annatto alone. It can be reddened at pleasure by alum or by any acid. But this reddened colour will be browned again by soap.

Mordorè. When the silk has taken an aurora colour, been washed and alumed as usual, it is then rinced at the river, and a fresh hot liquor prepared, to which is added some decoction of fustic and decoction of logwood. The silk is returned into the liquor. If too red, it can be saddened with a little green copperas.

Orange, is produced by using a little more annatto than is necessary for aurora, and reddening it slightly, by vinegar, tartar, alum, or any other acid. If a still redder and deeper tinge be wanting, it can be given by a little decoction of brazil or carthamus. Old baths of brazil, and carthamus or safflower, can be used up for these colours.

Gold and Buff, can be dyed after an aurora colour in the same bath. Either with or without a little fustic liquor.

All annatto colours should be well washed and beetled after they are dyed, on account of small grains of sediment that are apt to smear the cloth and prevent the uniformity of the dye. For nice work, the alkalized annatto should be filtered through a piece of callicoe and the sediment ground with alkali, and again washed through.

In dyeing annatto colours, as alkalies make them yellow, and acids turn them reddish or salmon colour, the colour will incline more to an orange by lessening the quantity of alkali.

Alkalized annatto, is Scot's patent nankin dye.

The following properties of annatto, are noticed by Berthollet.

The experiments of Le Blond and Vauquelin have shown that the following preparation of annatto is far better than that usually sold.

Let the grains of annatto (the seeds of the Bixa Orellana of Linnæus) be washed till all the colour is extracted, which is external only: let it then be precipitated by vinegar; the precipitate may then be deprived of moisture by filtering, and thus made up in cakes. The annatto thus prepared, they say, is more easily worked, gives brighter, richer, and more even colours than the common annatto; and is worth four times as much.

Spirit of wine dissolves annatto better than water; hence it is used to give a yellow orange colour to varnishes.

Alkali dissolves it, but better by heat than cold.

Acids form an orange coloured precipitate from this liquor; this precipitate is soluble again in alkalies.

Muriat of soda, common salt, and muriat of ammonia, produce no sensible change in the colour.

Solution of alum affords a considerable orange coloured precipitate, deeper than that which is formed by acids. The supernatant liquor retains a greenish yellow colour.

Sulphat of iron produces a brown orange precipitate: the liquor retains a pale yellow colour.

Sulphat of copper, produces a brown yellow precipitate, lighter than that with iron. The liquor of a greenish yellow.

Solution of tin produces a lemon yellow, that subsides very slowly.

Of Puce Colour. (Flea colour.) There are many shades of puce colour dyed on silk, but the finest and richest is the following. Having dyed your silk a coquelicot colour, give it as strong a decoction of indigo as it can take up. That is, dye a ground of annatto, in a bath prepared with fresh annatto so as to fill the silk; wash it and beetle it; soak it for a night in alum liquor; rince it and beetle it; for if any crystallized alum sticks to the silk, the colour will be spotted. Then dye it in a strong decoction of brazil wood, old if you have it; if not, fresh made; neither wash nor beetle it; then dye it out of the brazil liquor in a strong logwood liquor fresh made; wash it and dry it.

Brown Puce, is dyed with annatto; wash it; alum it; then without brazil, dye it at once after aluming and rincing, in a strong decoction of logwood. Care must be taken, that the silk when dyed with annatto should be very well washed, else the alkali of the annatto will decompose the alum, and the alum liquor will also be coloured by the annatto.

Of Young Fustic, Fustet, Venetian Sumach. This is used in the silk dye, boiled like logwood. Its colour is absolutely the same as that of walnut rind; only this last does not require a mordant, and young fustic does. (I think this imported drug may be discarded. *T. C.*) This drug is used for specimen patterns: it unites well with brazil, weld, and logwood, the principal dyeing ingredients which are used for specimens.

Fustet or young fustic, is also used for puce colours and browns, but they are never so full as with a ground of annatto. Indeed a good silk dyer may dispense with young fustic even for his pattern colours, if he understands how to alum upon annatto.

Carmelite. Dye in an old bath of annatto; wash well; alum as usual; a small quantity of brazil; then with the logwood liquor, hot. Do not mix the logwood and brazil; dye with brazil first. Also, remember in all cases never to dye alumed silk in a very hot bath, for when hot the alum quits the silk, the colour penetrates it with difficulty, and if you have to dye again with some other decoction, you may be obliged to alum the silk over again.

Prune Colours: there are several shades of these. To dye them, alum your silk, wash, ground with a strong decoction of brazil, then without washing dye in a logwood liquor. When the colour is raised in this manner, for the purpose of fixing it, and reducing its too great brilliancy, throw in a little old annatto, unless the pattern require great vivacity of colour, in which case dispense with the annatto. Do not, as many do, mix your logwood and brazil.

Many *Violets* are dyed on Grenada silk, by aluming and logwood simply. So Grenada colours, Grenadines, and false crimsons, are made by aluming and then dyeing with brazil. The brazil decoction should be old, the logwood decoction fresh.

These logwood violets are rather dull. Soap turns them of a bluish colour, of course so do alkalies.

The logwood decoction may be a few days old, but it must not be kept so long as the brazil liquor. This last will bear to be kept two or three months; but if the logwood decoction be kept a month, its dark brown red colour is by the air converted into a fawn colour which spoils it.

Logwood violets are best dyed cold, or very moderately warm. When dyed hot the colour is rough, uneven, and tarnished.

Violets are also dyed with logwood and verdigris, thus: the silk being well washed out of the soap, dissolve in water an ounce of verdigris for each pound of silk; it is usually directed to be dissolved in cold water, but it may be best dissolved in hot water, which may then be suffered to cool.

Let the silk be immersed in this liquor for an hour or two. This gives no perceptible colour. The silk is then wrung, and put on rods or sticks, if in hanks. Make a decoction of logwood and dye the silk in it, without previous washing.

The silk is then taken out, and when dipped in a clear solution of alum, acquires a red colour, that with the previous blue makes a violet. The more alum the redder the colour. Any acid would produce the same effect, but alum is preferred. The silk having acquired the colour you wish, is wrung over the liquor, washed, and again *moderately* wrung on the peg, that the colour may remain on drying; for if it be wrung hard, the part most squeezed will be the lightest, and the others will appear dark and coppery: this is an inconvenience to which logwood colours are liable, and should be attended to, not only in this colour, but also in the logwood violets that are dyed without verdigris.

Logwood violets with verdigris, are not more brilliant or faster than others; but the verdigris serves as a mordant. The logwood blue thus produced by verdigris, is fugitive, and by no means to be compared with the blue of pastel or indigo.

The most brilliant *violet* on silk is made, not with logwood, but with *archil*, orseille: using one pound of archil to one pound of silk. The silk is prepared as usual upon sticks or rods. Boil the archil for five minutes, or ten at the utmost, then cool the liquor to a scald with cold water. Enter the silk quickly, and keep it dipped in the bath for fifteen minutes, then take out the hanks, wring them moderately so as not to lose the liquor; if the colour is not yet deep enough, make the liquor boil again before you put in the silk, then lower the heat as before with cold water, and enter the silk again. You may repeat this boiling three or four times. When the violets are raised to a colour sufficiently deep, wash them at the river, and if when washed they are too red, pass them through some water in which a little pearl ash is dissolved. Potash and soda do not very well agree with silk.

All archil colours must be wrung in such a manner that they are equally moist, and they must be equally dried: for I have often observed accidents in the dyeing. To remedy these, you must heat your archil liquor, and dye the piece over again, then run it through pearl ash and water, and dry it out of this last liquor.

A violet bath of archil, will do afterwards for laylocks, pearl grays and such colours: it can be refreshed with a little archil.

(The Dutch archil is the litmus, so useful to a chemist. *T. C.*)

Violet with Brazil Wood and Archil. Alum the silk in the usual way, dip it in a decoction of brazil, wash and beetle it, then dip it in archil liquor; again wash and beetle it. Then give it a slight dip in the blue vat; wring it, wash it and dry it.

The Dutch violets are dyed with archil, and then dipped in the blue vat. The brazil saves the archil, but should only be used when a deep shade is wanted. It gives a good ground for the archil in this case, but the colour is not so lively as when archil alone is used: for the aluming which is necessary as a mordant to the brazil, saddens the colour.

Fine violets are never dyed on raw silk.

Of Purples and July-flowers. Alum the boiled silk as usual. Dye it for two hours in two ounces of cochineal to the pound of silk: wash and beetle it. If a purple inclining to blue is wanted, it requires only to be dipped in a weak blue vat, after which wring evenly, and dry the silk with all possible expedition, which is a precaution absolutely necessary for all colours dipped in the vat. But the vat is apt to produce too dark a shade, and therefore the liquor of the vat can be diluted with water in another vessel, and the silk dipped in this solution, according to the required colour.

About half an ounce of white arsenic is usually added to each pound of silk, to assist in turning the colour.

The shade next to *purple* is *July-flower* or gilly-flower; then *grisdelin*, then lighter still, *peach blossom:* all these are made with somewhat smaller proportions of the ingredients, or are made followers to the deeper colours.

False purples are alumed slightly, then dipped in a decoction of brazil, then in a decoction of archil, which last alone would be too violet. For browning the colour, logwood is used in the brazil liquor, for dark shades, and in the archil liquor for light ones.

The lightest tints of purple may be produced with brazil alone, and after that with a slight alkaline solution; but the addition of a little archil is the best mode of dyeing these shades.

Maroons, *Cinnamon*, *Wine Lees*, are colours produced by logwood, fustic and brazil woods. For cinnamon, the boiled silk is alumed, then a decoction of each of these woods is made separately. The fustic decoction makes the base of the liquor, to which add about one-fourth of decoction of brazil, and one-eighteenth of decoction of logwood.

This liquor should be of a temperate heat, the silk is then entered, and when the liquor is exhausted of colour and the colour even, it is wrung by the hand; it is then put on rods or sticks, a second liquor made, in which the proportions of these three decoctions are made according to the tint called for. Fustic gives the yellow, brazil the red, logwood the darker shades.

Maroons are produced exactly in the same way, only the colour being darker, the proportion of logwood is increased. So of the other colours of similar tint: their varieties can be produced by varying the proportions of these decoctions.

The fustic liquor spoils soon and therefore should be used fresh: if kept too long, it becomes slimy, tarnished, and puts on an olive hue; when it does so, it may be somewhat restored by reheating.

Many dyers wash the silk out of the aluming, at the river, before it is dipped, and then by one liquor produce these several colours; but the following method seems better, because the first liquor is a sufficient wash, and the silk retaining more of the alum takes the dye better. Besides, as it is impossible to produce these shades but by perpetual handling, the second liquor may be useful in rectifying the defects of the first, and in finishing the colour, especially the fustic ground, which requires the alum to assist in raising it sufficiently, for fustic will neither dye a fast or a bright colour without a sufficient mordant. You may therefore dye in the fustic without washing, only wringing evenly and moderately, then wash after the fustic, and dye in the brazil and logwood separately. The marones and cinnamons may be obtained by a different method.

When the silk is boiled, or bleached for dyeing, the grounds of the annatto may be dissolved in the same soap liquor that had been last used for clearing the silk. The annatto should be strained through the cullender. When boiled for about a quarter of an hour, it should be left to settle: the silk is then returned into this liquor without having been washed; it then acquires a yellow ground. It is afterwards washed and beetled at the river and then alumed as usual. After this, the fustic, brazil and logwood liquors are given for the cinnamon, but for the marones the brazil is omitted, unless they seem to want red: but remember that the alum always reddens the annatto. If they are too red without the brazil, the colour can be saddened by a very small quantity of copperas, which gives it a greenish colour: you must therefore use your logwood decoction cautiously, that you may be able by means of copperas, to correct the reddish colour of the annatto.

This method may be more advantageous than the first, as the annatto reddened with alum, is much more solid than the red of brazil.

If you dye raw silk, brown or marone, the natural yellow of the silk is no prejudice to the colour, but otherwise; for it serves as a ground.

Having dipped the silk as usual, proceed as for boiled silk.

Genoa Crimson. (Hellot.) At Genoa the silks intended for crimson are boiled in a much less quantity of soap than those intended for any other colour. Twenty pounds of soap sufficing for a hundred pounds of silk meant for the crimson dye. For any other colour, the Genoese use forty or fifty.

When the silk is boiled it is dipped in the alum liquor, and to a quantity of silk which when raw weighed seventy-two pounds, they put from sixteen to eighteen pounds of roach alum finely powdered, in a copper full of cold water. When the alum is perfectly dissolved, they put in the silk, and let it soak in the alum liquor four hours, or longer, without any inconvenience: the crimson requires more perfect aluming than any other colour. When taken out of the alum liquor it is shook and dressed on the pegs, but without wringing, which would leave it not sufficiently impregnated with the alum.

Of the seventy-two pounds of silk above mentioned, thirty-two pounds is organzine, the remainder woof. At Genoa it is the custom to allow two ounces of cochineal to twelve of organzine, if designed for the warp of damask furniture, and one ounce and three quarters of cochineal for the woof; supposing it necessary to the beauty of the colour, that the warp should be something fuller than the woof; and to bring the colour of the damask to still more perfection, they add to the organzine a quarter of an ounce of cochineal to every pound of silk, that is, instead of two ounces they add two ounces and a quarter, adding no more to the woof than an ounce and three quarters.

As the above thirty-two pounds of organzine should be of the finest colour, they allow two ounces and a quarter of cochineal to every pound of silk: so that upon the whole they use one hundred and forty-two ounces of cochineal, or eleven pounds ten ounces: viz. seventy-two ounces to thirty-two pounds of organzine, and seventy ounces to forty pounds of woof.

In order to dye these seventy-two pounds of silk alumed as above, they make use of an oval copper, containing when full, two hundred quarts of water; they fill this two-thirds full of soft water, adding to it two ounces of tartar, as much saffranum or safflower, and two pounds and a half of Aleppo galls.

They wait till the drugs have boiled two minutes in this liquor, after which they add eleven pounds ten ounces of cochineal finely powdered and sifted; and while one of the workmen by degrees makes it sink to the bottom, another keeps violently stirring the liquor with a stick to promote the solution.

This done, they fill the vessel with clean water, to about a foot of the edge; immediately afterwards dipping the thirty-two pounds of organzine divided on fourteen rods. They let it remain till the vessel which they fill with clear water, and under which they put a large fire, is ready to boil. They then (to make the silk take the colour more evenly) raise the rods without ceasing one after another, that each may alternately reach the bottom of the copper, which being but two-thirds full, the upper part of the silk would else remain out of the liquor, the rods being supported on the edge of the copper.

When the liquor is ready to boil, the forty pounds of woof divided on eighteen rods, are dipped; raising the rods both of the organzine and the woof one after another for half an hour, that each may alternately reach the bottom; so that when the workman comes to the last, he returns to the first, and so on successively.

After the first half hour, they stop for a quarter of an hour between every operation, the workman still raising the rods from the first to the last, five or six times repeated in the space of an hour and a half; all the time keeping a good fire under the copper. The organzine is then steeped in this liquor two hours and a quarter, and the woof only two hours. The fire is then drawn from under the copper, and the workman taking out one dip of the organzine and another of the woof, wrings and dries them as much as he can to see if the colour be what he wishes; if not, the silk is left for half an hour longer in the copper. The silk is then taken out, wrung on the peg; washed several times in clear water, wrung again and dried.

It must be observed with regard to the organzine and woof, that though dyed in the same liquor, they are not however of the same shade at the conclusion of the operation, the organzine being deeper from staying a quarter of an hour longer in the cochineal liquor.

It is not the custom at Genoa, to wash the silk out of the cochineal with soap and water; on the contrary, they are persuaded that this practice dulls the brightness of the colour, and that the water, both for the cochineal liquor, and washing afterward, should be the finest spring water; for they remark that the crimson dyed in summer with cistern water, is by no means so bright as the crimsons dyed at other seasons when the fountains are full.

According to the dyers of Genoa there is a kind of cochineal, which, though apparently beautiful, is not so in effect. That in using this cochineal it is necessary to alum the silk as much as possible, and to add to it more tartar than before mentioned. It is, however, impossible to lay down any certain rules as to this matter, as the dyer himself will judge of the quality of the cochineal fit for his use. The necessity of using the very best cochineal is so well known, that the Genoese manufacturers do themselves furnish to the dyers, the cochineal intended for the parcel of silk they send.

Fine Crimson (cochineal crimson.) Macquer. Silk intended for this crimson, should have only twenty pounds of soap to the hundred pounds of silk, and no blue. For the small quantity of natural colour still remaining in the silk, is favourable to the colour, which is enlivened by yellow.

Soak your silk when boiled, washed, and beetled, in strong alum water for a whole night: then wash and beetle it again.

Fill a long boiler, or trough of metal, two-thirds full of soft water. Boil it. Throw in from one to two ounces per pound of silk, of white nut galls well bruised, and from two ounces and a half to three ounces of sifted cochineal. It is seldom necessary to use quite three ounces. Let all boil together. When boiled add an ounce of scarlet composition for each pound of cochineal.

Make your composition thus: aqua fortis one pound, sal ammoniac two ounces, dissolved in twelve ounces of water. Add this to the aqua fortis, and dissolve in the mixture, by a little at a time, six ounces of grain tin. This composition is purposely intended to contain more tin than the scarlet composition for woollen, but it is absolutely necessary.

This composition being put in the liquor, the vessel is filled up; it should hold eight or ten quarts to each pound of silk, if fine: coarse silk requires less. In this liquor turn the silk uniformly, about half a dozen times. Then bring the liquor to a boil and work the silk in it for two hours. After this draw the fire, let the liquor gradually cool, keeping the silk immersed in it for several hours, or even from night to morning. Then take it out, wash it, beetle it twice; wring it, and put it on the perches to dry.

It can be saddened with copperas according to the shade required. It should be turned in the copperas liquor, and wrung out of it, and dried if you will without washing. The copperas deprives the cochineal of its yellow colour and gives it a violet hue. Nothing but copperas is fit to sadden cochineal scarlets, which it does by means chiefly of the nut galls employed in this dye.

This is the best method of obtaining a beautiful shade of crimson, but as many dyers proceed in the old way, we shall describe it. In the above process the crimson is fired by means of tin composition; and it can be done by means of tartar; but in the common way, it is done by means of annatto, about an ounce to a pound, washed through a cullender. In other respects the process is the same as above given.

The cochineal used, is always the best picked cochineal, which is in all respects the cheapest.

Although tartar is of use to give the flame colour to cochineal, yet it does not produce it so well as the tin composition. But if you use an over proportion of tartar to enliven the colour, it weakens and dissolves it.

Nut galls do not produce a good effect, unless you want to sadden the red instead of enlivening it; but custom sanctions the proportions we have prescribed. But nut galls give the silk that rustling property heard and felt on handling it: an effect which cannot be produced with brazil wood, of which the colour is greatly injured by nut galls. So that you may be sure when you find this rustling, that it is a cochineal colour.

Galls moreover greatly add to the weight of the silk, making it take up more colour. So that even when it is useless for the tint of colour, the dyers add it for the profit it affords them. White galls injure the colour less than black. The colour is much more improved by permitting the silk to soak for some hours in the liquor, than by working it: but it requires to be well washed and beetled after soaking.

If the silk were not twice beetled before dyeing, a quantity of superfluous alum would remain in the silk, which would injure the colour of the bath or dye liquor.

Cochineal crimson is distinguished from brazil crimson, first, by the rustling of the dyed silk. Secondly, drop a drop of vinegar on the silk: if dyed with cochineal it will not change: if dyed with brazil, it will turn yellow.

Of the False or Brazil Crimson. This is not quite so beautiful, far less durable, more changeable, but much cheaper than the red or crimson produced by cochineal. It is therefore on some occasions a desirable mode of dyeing red.

The silk unbleached, should be boiled with twenty pounds of soap to the hundred pounds of silk. It should be alumed as usual, but not quite so strongly as for grain or cochineal crimson. When alumed it should be washed and cooled at the river.

Heat some water in the copper; meanwhile prepare a trough with a strong decoction of brazil wood, half a bucket, more or less, to the pound of silk; add to it warm water sufficient to work the silk in; enter the silk; work it in this liquor till it takes a red, which will be more crimson if the water be hard, and less so if soft water be used. Sadden this colour, by running the silk through a warm solution of a pound of pearl ash to forty or fifty pounds of silk. Then wash it, dry it and so forth.

The brazil decoction is usually made in the proportion of a hundred and fifty pounds of chipped brazil, to sixty buckets of water, boiled for three hours. Then turn out the decoction into a barrel, and pour hot water again on the chips and boil them; thus should four decoctions in all be taken from one parcel of chips. (If the wood be, as it ought to be, rasped, it can be exhausted at twice and will go much further. *T. C.*) The decoctions should, or may be mixed together: but when a black skin forms on the surface, it should be taken off. The last decoction is of as good a colour though not so strong as the first. It is usual to keep it a fortnight or three weeks, till it undergoes a kind of fermentation that greatly improves the colour. Some dyers let it stand three or four months, till it becomes thick and oily: but for silk, it does not improve after three weeks. When used fresh it gives a more rosy colour, and does not go so far. Hard water, and alkaline salts, crimson the colour of brazil. The brazil of St. Martha, is redder and deeper coloured than that of Fernambouca, but it is not so good.

Orange Reds; Cherry Reds; Pink Reds: are made by mixtures of cochineal or brazil red with yellows: or with the pink of safflower. The yellow being annatto or turmeric.

Violet Crimson of Italy. The silk being alumed as for red crimson, take it out of the aluming and dye it with cochineal. For this purpose dissolve two ounces of gum arabic in the copper, and take for every pound of silk two ounces of cochineal, one-third of an ounce of agaric, and as much turmeric. Mix and pour them into your copper; when they begin to boil, and the gum is perfectly dissolved, arrange your silk on the rods, and immerse it in the copper, let it boil for two hours, and it is then dyed. Let it grow cold, wash it and wring it on the peg, then wash it again lightly. To make it violet plunge it into the blue vat to make it a fine violet. Then wash it well in clear water, and dry it when opened and spread out, in the air, but not in the sun. (I doubt whether the silk ought ever to be brought to a full boiling heat. *T. C.*)

Half Violet. For one pound of silk, use one pound and a half of archil, mix it well in the liquor; make it boil for a quarter of an hour, dip the silk quickly; let it cool; wash at the river, and you will have a half violet or laylock more or less full.

Fine Crimson. Homassel. (N. B. Fine crimsons are cochineal crimsons.) These crimsons are dyed upon boiled silk. Sometimes the hue of the pattern is such, that the silk must be boiled expressly for this colour, as we may want to give it a ground of annatto.

Crimsons are also dyed on silk bleached for white; they all take the same quantity of cochineal, but the silks boiled out of their gum, and grounded with annatto, will be deeper than those dyed upon white.

The silks are alumed very strongly, and washed several times at the river, (which I think only serves to wash away the alum. *T. C.*) Fill your copper with clear water two-thirds full; arrange all your silk on rods or sticks. Bruise and sift your cochineal, two ounces to the pound; adding also one ounce of white nut galls. Boil the cochineal and galls a quarter of an hour, not more. (This is not enough to get out half the virtue of the galls. *T. C.*) Fill the boiler, arrange your hanks of silk, resting them on the edge of the boiler. Half an hour afterward, raise the fire so as to make the liquor boil an hour or more. This colour requires two hours in all in the boiler: at the end of this time, the colour ought to have acquired its perfect shade.

When fine crimsons are washed and dyed, they ought to have the same handling as roses and bright coquelicots: that is, they should rustle when handled.

It may be well to remark, that the patterns do not always require a deep crimson, but frequently a crimson bearing upon yellow. In that case, you may put into the copper with the cochineal and galls, a quarter of an ounce of scarlet composition to the pound of silk; sometimes a little more.

Bright Violets, are made by giving crimsons a dip in the blue vat. For this purpose, the crimson should be as deep as possible. In entering them into the blue vat, take care to observe the precautions I have suggested upon blue dyeing, otherwise you will be apt to subject yourself to a serious loss, both of the crimson and the colour of the vat.

Bright Puces, are dyed on the same principles with annatto crimsons; but in lieu of white galls, put in two ounces per pound of black galls: when the crimson is thus dyed, it is brought to a puce colour by a little copperas dissolved in cold water.

You must take care in stringing and working the hanks, otherwise they will streak by taking the air unequally.

The copperas also must be previously dissolved, and added by a little at a time, raising all the silk out of the bath or liquor every time you put any of the solution in; stirring it to mix it equally. When the puce colour is sufficiently raised, wash and dry the goods.

Light shades of brown are also given upon crimson; but they do not answer to the beauty of brown colours: this shows that for silks dyed in cochineal the colours must be full and deep to have their proper effect; and that all silk dyed with less than two ounces of cochineal to the pound of silk, has not yet received its perfect hue.

Of Scarlet on Silk. Homassel. To dye scarlet on silk, take as many pounds of wool as you mean to dye of silk. The wool at sixteen, the silk at twelve ounces to the pound. Dye this woollen yarn of a scarlet colour as follows.

For the preparation bath, use for each pound of woollen yarn one ounce of cochineal, a quarter of an ounce of madder, three-eighths of an ounce of turmeric, two ounces of cream of tartar, and three ounces of scarlet composition. (Tin in aqua regia.)

Boil the yarn two hours and a half; wash and beetle it at the river, and then give it the red dye without drying it. For this red dye, use an ounce of cochineal, three ounces of composition, an eighth of an ounce of turmeric, and a quarter of an ounce of madder.

You may boil for a little more than ten minutes without danger of tarnishing, to make the yarn take up the cochineal as fully as possible. Then take it out of the liquor, wash it, beetle it, and dry it.

Then charge a boiler about the same size with water; put into it four ounces of alum per pound of wool, and boil the coloured wool in it, till the colour is all extracted. Take out the wool, cool the bath to a scald, enter the silk bleached white by boiling, and it will take up all the colour which has been extracted from the wool.

If they are not sufficiently yellow, they may be enlivened with safflower and lemon juice, which also enlivens the cochineal colour. Or the silk may be tinged with turmeric dissolved in spirit of wine with lemon juice. If the colour be not red enough, the reason is that you have attempted to dye too much silk for your proportion of colouring materials.

Of Pink from safflower. Homassel. This plant is grown in the departments of Aude and Herault, in France. It contains two colours, a dull yellow that is perfectly soluble in water, and a pink-red soluble in alkaline salts. The yellow colour is sometimes, but not often used, for it is not so cheap or convenient as turmeric.

The saffranum or safflower, cannot be used for reds till all the yellow colour is completely extracted. For which purpose it is put in a bag, and tramped either in the current of the river or in a trough through which a current of water passes. Two bags of safflower, containing eight pounds each, will occupy the whole day of a man accustomed to this operation. The beauty of the colour depends on the accuracy of this washing. In the country, the bags can be fastened to a water wheel, and left in that situation the whole day, when the yellow colour will be sufficiently extracted. Take care you do not wash it just below a bleachery, lest the alkali used for bleaching, should extract all the colour.

The safflower is then put on a cloth stretched on a frame, and two ounces per pound of potash, or even two ounces and a half; it is best put on in powder, and well mixed with the safflower; if you are not pressed for time, let them remain together for two hours before you add any water. (I do not think this practice so good as that, where the potash, dissolved in a small quantity of water, is mixed with the safflower, and made into a kind of paste. *T. C.*) There must be a tub underneath to catch the drops of liquid that soak through. When the safflower is well mixed with the alkali, pour water on it, and wash the mixture just as you would a quantity of wood ashes to make a ley. The liquid should be in quantity proportioned to the silk you mean to dye. The safflower is not exhausted till it assumes the colour of wet bran.

The liquor that passes is not of a red colour, but a brownish yellow, and you would in vain attempt to dye with this. The colour would run off from the silk as it ran off from the safflower. The alkali that holds it in solution must be neutralized by an acid of some kind. The best acid is lemon juice. If you have none of this or of vinegar, add with caution very dilute nitric or sulphuric acid, taking care that the fermentation or effervescence is not too suddenly excited. When this effervescence is over, the liquor assumes a bright rose colour. (In England this colour is called pink, I believe exclusively. *T. C.*)

The silk dyed in this liquor, should be bleached white, without blueing. There must be no remains of the natural yellow of unbleached or half bleached silk. The silk is worked in this bath, till it has extracted all the colour. It should be used cold.

These rose colours are numbered from one to ten, which vary in their price, according to the depth of colour, and the price of safflower. The deepest colour is the Coquelicot, which cannot be dyed of a full tint under four pounds or four pounds and a half of saffron to the pound of silk. Sometimes a ground of annatto is given before the safflower is dyed. The acid reddens the annatto as well as the safflower.

To ascertain exactly the ground of annatto necessary to be given previous to the safflower, when you dye to pattern, tear off a small piece of the pattern, let it soak in water wherein some alkali is dissolved: the alkali will wash out all the pink colour of the safflower, and leave behind the yellowish colour of the annatto. Keep this by you in a moist state, and then you can give to the silk you mean to dye, precisely the same tone of annatto colour.

If in dyeing your silk, you have failed in any respect, soak it in a dilute alkaline solution, and this will extract all the pink colour; which you may again neutralize with an acid, and use for dyeing afresh.

It may be useful sometimes to brighten the colour by passing it through warm lemon juice and water, or vinegar and water; even warm.

Of all acids for the purpose, lemon juice is the best: but it is sometimes difficult to be procured, and it will not pay to use the juice of fresh lemons for the purpose. (I am persuaded from experience, that next to vinegar the best acid is cream of tartar, in point of quality combined with cheapness. I have not tried acid of sorrel. Common vinegar does not produce a good colour, but a better than any of the mineral acids, such as the sulphuric, nitric or muriatic. Distilled vinegar mixed with lemon juice, produces a tolerable good colour; next in beauty to lemon or lime juice. In France they procure the lemon juice from

Provence: we might procure it in our seaport towns from the West Indies. *T. C.*)

The merchants who deal in "Vegetable Rouge," where the colour requires to be produced of the utmost brilliancy, always precipitate the safflower pink with filtered lemon juice. Some make use of vinegar, but the colour is inferior. They proceed thus:

They use the best safflower, and the purest pearl ash. (They should use the salt of tartar, for pearl ash now and then contains iron. *T. C.*) The safflower is very accurately washed in the purest water: they make their safflower ley very strong, subjecting the safflower to a press, to procure all the liquid colour. To three parts by measure of the alkaline ley of safflower, they use one part of lemon juice. This they leave to settle in china bowls, till the supernatant liquor is quite clear, which they draw off by means of a glass siphon.

When they have drawn off as much of the fluid as they can by this means, they add together the sediments of the operation, which have now acquired a certain consistence. On this sediment, still liquid, they place a piece of very fine white muslin, or any other kind of filtering cloth that will soak up the moisture, and prevent the sediment from passing through: on this muslin, cut to the size of the surface it is to cover, (for if it hangs over the sides, the liquor and the colour will filter over,) they put clean blotting paper, and on the top of that a sponge, which occasionally they press gently, so as to imbibe the moisture; by this means the colour is dried, free from dust and access of air. When sufficiently dry, it is put into china cups, and packed up for sale.

The colour may be dried on straw filters fabricated on purpose, and in the form of grains.

For the rouge used by women, the finest Venetian talc is reduced to an impalpable powder (etant rapè sur de la Perelle. I do not know what the Perelle is. *T. C.*) which is dyed to whatever depth of colour you please with the coloured liquor of the precipitated safflower. It is then dried on small earthen or china cups made on purpose, and thus sold.

Of the False Poppy or Fire Colour, of brazil wood. Ratine. This colour is produced on boiled silks as for common colours. It should have the annatto ground of a tolerable shade, stronger than for the fine poppy, because the red of brazil wood is yellower than the red of safflower; the shade given by this ground, is almost a demi-aurora. It is however adviseable as well for the false as the solid poppy, when a proper ground is obtained, to keep a skein by way of pattern, and to serve for a future guide.

Give a full colour of annatto as a ground. Wash and beetle it. Alum it as usual; wash and beetle it; then dye it with brazil to the shade you wish; adding to the brazil liquor, a small quantity of soap and water. If you want it browned, add a decoction of logwood to the decoction of brazil.

The soap added to the brazil, improves the shade of the colour, and takes off the harshness to the touch, which the aluming is apt to give. Some dyers instead of soap, throw in a small quantity of powdered nut galls, which they think produces the same effect; but the greater number prefer soap. (Macquer.)

False Rose Colours. Alum your boiled silk, wash it as usual after wringing it: then dye it in decoction of brazil. This is a very inferior colour, but as all kinds of colour are wanted, so is this sometimes among the rest.

I do not know whether the other red woods have been tried. I suspect the nearest imitation of safflower pink, may be given by peach wood, which the English printers now use for a second chemical red, and which I have suspected in the pink reds of some Swiss prints. Safflower, however, would be cheap enough in America, if it were grown there; which it surely can be, as well as in France.

Of Black. Homassel. All silk dyers have a boiler or cauldron on purpose for black. (So should all woollen and cotton dyers. *T. C.*)

This black vat, holding about thirty-six buckets, is filled with the hatters' black dye (which I have already given, *T. C.*) to which they add twenty pounds iron filings, twenty pounds of agaric, (I do not know why this is used in preference to galls: it is a fungus of the oak, *T. C.*) twelve pounds of green copperas, and six pounds of gum arabic: this vat remains always thus filled, being from time to time refreshed with similar ingredients in the same proportion.

To dye silk black, four ounces of galls are boiled in water during two hours for each pound of silk. Wet the silk in the clear part of this bath or liquor before you enter the silk. Then plunge the silk in this gall liquor, where it may remain eight or ten hours. Take it out, wring it; heat the gall liquor again; and again plunge in the silk as before in the clear part of the liquor, letting it remain the same length of time.

The silk being thus twice galled, heat to boiling the black liquor in the black vat, stirring it well, that the sediment may not burn to the bottom, for it would occasion the bottom to burn out. Dye the galled silk in this colour, repeatedly, airing it also after each dyeing, until the colour is what you wish.

The gum and the galls give an addition of twenty-five per cent, which, as the dyer returns to the merchant weight for weight of silk, allows a good profit on the black dye.

Raw silk is not galled, it is dyed at once in the black without any preparation: the liquor should be hot.

Before the silks are returned to the merchant, each skein should be wrung on the peg, to soften the silk, made harsh by the dye; it also improves its appearance. Then weigh it. The manufacturer or merchant is not entitled to more than weight for weight.

When the silk is dyed it is sent to the silk dresser to give it softness and lustre. This is done principally, by twisting the skeins against each other, in pig-tail fashion; they are then separated and made up in parcels of about a pound each. (See hereafter the process of softening black silk. *T. C.*)

Such is Homassel's process. I should substitute sumach for agaric. Lewis in his Commercium Philosophico-technicum, says that the colour is improved by the addition of logwood and verdigris, which I can easily believe.

The processes for dyeing silk black given by Macquer, as the methods usually followed by the silk dyers, are so complicated, and so unscientific, that I think it needless to copy them. Berthollet, however, has given the substance of them, with the obvious remark, that many of the ingredients are now disused, although each dye-shop has its own receipt for the purpose.

The following observations however, of Messrs. Berthollet, (father and son) are worth translating.

Macquer describes a process for dyeing black much more simple, which is used for dyeing the black silks and velvets of Genoa; and somewhat improved in the following receipt, which has been practised with success at Tours.

For fifty pounds of silk (I presume boiled, or half bleached) proceed thus. Take ten pounds of powdered Aleppo galls, and boil them for an hour in a sufficient quantity of water. (An hour is hardly enough if they are only bruised. *T. C.*) Let the liquor rest till the galls have fallen to the bottom, when they are to be taken out. Then put in fifteen pounds of green copperas, six pounds of iron filings, and ten pounds of gum. The gum broken into small lumps, is put into a cullender with two handles, which must be suspended in the boiler by sticks so as not to touch the bottom. (The gum is directed to be the gum of the country, such as plumb tree or cherry tree gum. It is a large proportion, if gum arabic or senegal be employed. *T. C.*) The gum is left to dissolve during an hour, stirring it from time to time. If at the end of that time, there still remains some gum in the cullender, it is a sign that the liquor has taken up enough; if not, a pound or two more must be put in the cullender, which is left continually suspended in the boiler, except when you are about to dye; and when you have finished dyeing it must be restored to its place in the boiler: during all these operations the liquor is kept not at a boiling, but scalding heat.

The previous galling is performed with a third part of the weight of the silk of Aleppo galls, boiled as usual for about two hours; the silk is left in it to soak for six hours. (This galling should be repeated as Homassel prescribes. I believe this repetition is always necessary, whatever proportion of galls be used. This receipt is very different from the English translation of Macquer. *T. C.*) Lewis says he has repeated this process, adding more green copperas, and repeating the immersions several times. (Indeed, as I have urged repeatedly under the article of dyeing black on woollen, no good colour can be expected, unless by means of repeated immersions in the black dye, and patient airings afterward. *T. C.*)

The quantity of sulphat of iron, says Berthollet, is doubtless too small: and Lewis thinks the gum in too great a proportion, which may be; but the gum nevertheless keeps up the proper state of the bath: an additional proportion of sulphat of iron can be put in, at each renewed boiling, if it be necessary.

This process will give a good colour, says Lewis, *without* logwood and verdigris, but a better *with* these ingredients; which is doubtless true.

The quantity of galls here prescribed, must make this dye very expensive. It is of importance therefore to diminish the quantity. This object is attempted to be attained in the following process of M. D'Angles, which was one of the prize dissertations offered to the academy of Lyons in 1776.

Make a strong decoction of walnut rind, by boiling it for a full quarter of an hour; then draw the fire, and when the ebullition subsides, put in the silk previously boiled or half bleached, and moistened in warm water. Let the silk soak in this liquor, till it has imbibed as much colour as it will take up. Wring it upon the peg, and wash it at the river: do not wring it very hard. Then dye it a logwood blue, with the proportion of one-sixteenth the weight of the silk of verdigris dissolved in cold water, wherein soak the silk for two hours; then dye it in a strong decoction of logwood; wring it slightly, and wash it at the river. A light black does not require galling; but if a deep black be required, the silk must be galled, with a decoction of one half its weight of galls, boiled in the usual way till the galls are quite soft.

To prepare the dye liquor, let two pounds and a quarter of galls, and three pounds and a quarter of sumach, macerate in a gentle heat, in one hundred quarts of water, for twelve hours. When the liquor is clear, and the sediment taken out, dissolve in it three pounds and a quarter of sulphat of iron, and as much gum arabic: when all is perfectly dissolved, enter the silk and let it be worked in this dye liquor for two hours, when it must be taken out, opened and well aired till it has acquired as deep a black as the air will give it: then let it dry, and again pass it through the dye liquor for two hours; again open it, air it, wash it, beetle it twice, and then dry it. Pass it again into the same dye liquor, and let it remain four or five hours: drain it, wash and beetle it twice (taking care, however, previously to air it well.) The heat should not exceed 125° of Fahrenheit's thermometer. Also, before the two last dyeings, add to the dye liquor about three quarters of a pound of sulphat of iron and as much gum arabic. (If the stuff be not previously galled, this quantity of sulphat of iron is very great in proportion to the galls and sumach. *T. C.*)

To deprive the silk of the harshness which this process is apt to give, it is boiled in a solution of soap, or in a decoction of weld. M. D'Angles prefers the latter, (for which in this country quercitron may be substituted.)

M. D'Angles asserts, that if the silk be previously dyed blue in the indigo vat, it will only take a mealy kind of black with the usual black dye; but if it first receives a blue ground with logwood and verdigris, a full velvety black is obtained. He says also, that the walnut rind softens the silk. That although a good black can be obtained when the silk is first grounded with walnut rind, and then dyed in the black dye above described, yet the logwood and verdigris prevents the necessity of so much green copperas or sulphat of iron, which makes the silk harsh to the touch, and wears it. He is also of opinion that the nut galls are of use indeed to give weight to the silk, but that in point of colour they can be superseded by a sufficient quantity of sumach.

(All these remarks of M. D'Angles, are so reasonable, that I have no doubt of the truth of them; nor do I see any objection to his process but the expense of the galls, which is made up by the additional weight they give to the silk, where the dyer delivers his silk by weight. The objection I have to the process is, that the quantity of sulphat of iron prescribed, amounts to four pounds, and the galls and sumach together to no more than about five pounds. If the silk be previously galled this may be remedied, but I hold it universally true that the proportion of galls ought to be at the very least three times that of the sulphat of iron. Dr. Lewis has ascertained by direct experiment, that a less proportion will not make a permanent ink; and I know of no difference between ink and the black dye for silk. In all other respects I have no doubt of the propriety of this process of M. D'Angles, except indeed that in galling the silk one half its weight of galls is a very unnecessary quantity. There are no experiments yet made to determine, what quantity of galls a given portion of silk, woollen, or cotton will take up to produce saturation; the same of alum. But I suspect, that if the galls or the alum are in greater proportion than the fourth of the weight of the cloth, they are wasted. Until this be tried, what I have suggested is conjecture only; except as to the aluming of woollen, on which point I ascertained that no proportion of alum beyond a fourth appeared of any use, or to give any additional weight. I think three ounces to the pound nearly the proper proportion. More can be taken up when tartar is used than without; the tartar seems to obstruct the crystallization of the alum.

Upon the whole, it appears to me that the best process for black on silk is, to give the silk a ground of walnut rind: then a deep logwood blue, which can be done by adding the verdigris to the logwood decoction and dissolving it therein; then the black dye, either of Homassel, or any other wherein the galls are in proportion to the copperas as four to one: this will take three separate immersions at least in the black dye, with subsequent airings, and washings: always recollecting that if the goods of whatever kind are not aired out of the black dye, that black dye will be in part washed out. Unoxygenated gallat of iron is soluble in water, does not precipitate, is not black; gallat of iron exposed to the atmosphere becomes black, precipitates, and is not easily washed away. The gallat of iron in the dye bath is but imperfectly oxygenated. *T. C.*)

Although Macquer says that the process he gives for dyeing black, is the common process used at several dye-houses, and that it has succeeded with him, yet no chemist surely can read the following list of drugs to be put into the dye copper, without being persuaded that the theory of the art was very little understood by those who thus practised it.

2 pounds of black nut galls pounded,
4 pounds of sumach,
4 pounds of cummin seed,
5 pounds of buck-thorn berries,
6 pounds of pomegranate rinds pounded,
1 pound of bitter apple,
2 pounds of pounded agaric,
2 pounds of coque de Levant, (coculus indicus)
5 pounds of linseed.

Then,

8 ounces of pounded litharge,
8 ounces of pounded antimony,
8 ounces of pounded plomb de mer,
8 ounces of white arsenic,
8 ounces of crystal mineral,
8 ounces of rock salt,
8 ounces of fenugreek,
8 ounces of corrosive sublimate,
8 pounds of copperas,
20 pounds of gum arabic.

But, however complicated and unscientific the process recommended even by so good a chemist as Macquer may be, there are remarks and variations in it well worth attention. Thus he employs a considerable quantity of vinegar, which I think obstructs the inconvenient crystallization of the alum, and with the iron filings makes an acetat of iron. He directs the silk to soak in the gall liquor three days. He uses verdigris in considerable quantity. He galls twice, but with an extravagant proportion of galls: viz. three quarters of a pound to the pound of silk, if he did not assure us, that some dyers use a pound and a half of galls to the pound. He uses a sufficient quantity of logwood and copperas to give the required blue black. He insists with great propriety on at least three dippings in the black dye, and scrupulously airing the silk after each dipping.

Nor are the following remarks without their use.

Silk dyers never dye black but by coppers; that is when they have a sufficient quantity of silk for three dips if for heavy black, but if light black, only two dips, which is done in the following manner.

If heavy black, a third of the silk is put upon rods, and three times returned into the black ground; it is afterwards wrung on the peg over the copper; this is done by giving it three twists; in this manner three hanks may be wrung at once; because it should be done gently, and only to drain; it is again put upon rods, and suspended between two perches to air.

While the first silk is airing, the second third part is dipped in the same manner, and afterwards the third portion, always in the same manner. It must be remembered that while the silk is on the rods, it should be turned from time to time to give it air.

When the last third part is wrung, the first part is put in, and then the two others successively for three times, always airing each time. This is commonly called giving the three wrings, and these three wrings are called one fire or heating.

The light blacks should also have three wrings to one fire.

The black ground is again heated after each fire, giving an addition of copperas and gum. This operation is thrice done for the heavy blacks, that is three fires, each fire consisting of three wrings; but for light blacks only twice, each also consisting of three wrings.

It must be observed that at every reheating, it is requisite to change the order of dipping in such a manner that each may in its turn have the first of the liquor. If the black dye is strong and good, the heavy blacks may be done with two fires only; and for the light blacks, one wringing less may do for each heating.

When blacks are finished, they are returned in a trough of cold water by dips one after another; this is the rincing; they are then twice or thrice beetled at the river. When washed, put them on the cords, only take care not to press them too much.

Of Softening Black. Macquer. The silk, when taken out of the black dye, is extremely harsh; which is by no means wonderful, considering the number of acids and corrosives in its composition. It is therefore necessary to soften it in the following manner.

Dissolve about five pounds of soap, in two buckets of water, and while the soap is dissolving, throw in a handful of aniseed or any aromatic plant. (Not I presume for the same purpose as the soap. *T. C.*) It should boil till the soap is entirely dissolved. In mean time a trough should be provided full of cold water, and large enough to dip all the silk at the same time. The soap water should be strained through linen, the whole mixed well together, and the silk put in, where it should remain a full quarter of an hour. It is then taken out, wrung on the peg, and dried as usual. As the quantity of soap can do no harm, too much is better than too little. This softening is very necessary, in order to divest the black silk of that stiffness and rustling which is so prejudicial in the manufacture of black goods. (I think that a moderate washing afterwards would be necessary; for the soap remaining on the silk, would certainly render it liable to attract dust, and contribute to soil it. I do not see why the practice of the woollen dyers is not at least as good; viz. adding a small quantity of oil to soften the goods. Macquer does not say for what quantity of silk five pounds of soap should be used. It appears to me enough for fifty pounds of silk. *T. C.*)

Of Nut Grays, Thorn Grays, Black and Iron Grays. Macquer. All these colours, except black gray, are produced without aluming. The silk being washed from the soap, beetled, and drained on the peg, a liquor is made of fustic, logwood, archil and copperas. Fustic gives the ground, archil the red, logwood darkens, and the copperas softens all these colours, turns them gray, and at the same time serves instead of alum to extract the several colours. As there is an infinite variety of grays without any positive names and produced by the same methods, it would be endless to enter into a detail that would be to no practical purpose.

Suffice it to remark, that in producing a reddish gray the archil should predominate: for those more gray, the logwood; and for those still more rusty and rather greenish, fustic.

In general, when obliged to complete the colour with logwood, it should be used rather sparingly, because it is apt in drying to darken too much, differing in this particular from all other colours.

(Grays are made by grounding them in a very weak or dilute black dye. The different shades of gray can be given by additions to this ground: thus, for *pearl gray*, a very dilute logwood blue, on the black gray: for *dove*, a very slight tinge of red on the black gray, and so on. On these shades, no dyer can be much at a loss. *T. C.*)

Of Indigo Blue upon Silk. The first observation to be made is, that the raw silk ought to be previously boiled in soap and water, thirty pounds to the hundred weight; and that by scrupulous washing and beetling, every part of the silk should be perfectly freed from soap; for soap spoils the indigo vat, and occasions the goods to be spotted.

The vats are conical, such as are commonly used for the blue dye of woollen by our back country dyers, and mounted in the same manner. There should be three vats of different degrees of strength, and size: a vat of ten buckets to be charged with a pound of indigo, one of twelve buckets to be charged with three pounds, and one of fifteen buckets to be charged with six pounds of indigo. The first and smallest vat should be kept weak; it can be strengthened, when necessary, by means of the third.

The vats are charged exactly as for woollen, that is, the indigo is ground and sifted carefully. Then from three-fourths of a pound to a pound and a half of pot or pearl ash, half a pound of madder, and about three quarters of a pound of bran, are used to one pound of indigo. Generally the flour is washed out of the bran, as the dyers think it is too glutinous otherwise. The indigo vat is made up at twice, or at two brevets, as the French term it. The quantity of alkali to the indigo varies as usual in different dye-houses. Homassel prescribes half a pound, Macquer three quarters of a pound, Berthollet a pound, and then a brevet or refreshing of one sixth of a pound. My own opinion is, that although to ensure the perfect solution of all the indigo, one pound and a quarter of potash will be necessary to one pound of the finest indigo; yet for the silk vat, a pound is the better proportion, on account of the action of the alkali on the silk.

The management of the vat is much the same as in the case of the woollen indigo vat.

When the silk is entered into the vat, it should be done by a hank at a time, of not more at the utmost than eight or ten ounces weight; it should be worked on a peg under the liquor, and after being turned four or five times, taken out to air, that it may acquire the indigo blue: this will not take more than half a minute or less; it should then be dipped again and worked in the liquor until it has acquired the colour you wish. When you work your first hank in the liquor, mind how many turns you give it in the dye, and how often you take it out to air it, and give exactly the same work to each succeeding hank, else your colour will be deeper on some hanks than on others in the same parcel.

When a bundle of silk is dyed in the vat, and taken out, wring it well but expeditiously with the hand; and do not permit it to turn blue in the air, but carry it to the water without delay and let it be deprived of its green colour there. For this purpose, you ought to have at hand two tubs of water, and begin to wash the silk in one, and finish the washing in another. If there should be a dry wind or current of air, your silk will not be dyed evenly, if you do not wring it dry quickly, or carry it to a room warmed by a stove, in which there is mounted a swing ventilator, which must be kept in motion till the silk has acquired its blue, otherwise it will spot.

Indeed all silk dyed blue, should be dried in ten minutes; and it should be shaken and kept in constant motion all the time it is drying, otherwise it will turn blue unevenly and in streaks. It is for this reason that on taking it out of the vat, it is necessary to plunge it into water to take off the green colour; (the air in the water answering this purpose: a little sulphuric acid would ensure and expedite this use of the water. *T. C.*) But no deep blue can be given by the indigo vat alone. It must be dyed after a strong grounding with archil. But before you dye with archil, you must from time to time try the strength of your vat, to know the depth of the archil colour that you must previously give. And when you have dyed the ground of archil, you must wash it well and beetle it well, before you dye the blue. All these directions are necessary, as well as dexterity in handling and turning the silk, otherwise there is great hazard of its being spoiled.

To dye silk in the blue vat, employs four workmen. One dyes and washes it; another wrings it carefully and equally; a third opens it; a fourth moves the swing fan. The man who wrings it should wring it ten or twelve times quickly.

When the silk is opened, the strings of the hanks should be cut that the air may have access to every part of it. Every part of the operation after the silk is taken out of the vat should be performed rapidly, and the silk dried in ten minutes, or it will spot. Fine dry weather should be chosen for this operation: if any wet falls on the silk it will spot it red.

When silk is to be dipped of various shades, the silk meant for the darkest shade should be dyed in the freshest vat, and so on, continuing to dip in the same manner; only as the vat weakens, the silk should be left in a little longer each time, till the vat is so much exhausted, that even after two or three minutes or a little more, the shade appears still weaker. The vat thus exhausted, serves for the lighter shades.

After dyeing a quantity of silk, the vat is apt to tire, and lose its green colour; in which case it is necessary to refresh the vat with pearl ash, madder and bran, in the original proportions, about a fourth part of the first dose. This brevet, as it is called, should be boiled together for a few minutes before it is put in the vat, which should then be well raked up, covered, and suffered to rest for a few hours before it is used again.

The blues are divided by dyers into five, *light* blue, *sky* blue, *middle* blue, *king's* blue, *Turkey* blue. The two last require a previous ground of archil.

Raw silk takes a deeper colour than boiled silk: therefore dye this last, first.

False Blues are also made by means of logwood and verdigris: an ounce of verdigris to the pound of silk, is dissolved in water, in which the silk is well soaked. It is then drained and dried, and dyed in cold logwood liquor strong in proportion to the shade. Blue vitriol is also used for this purpose: it makes a colour somewhat different from verdigris. Homassel directs but one half ounce to the pound of silk, with a little alum if you want a reddish tint on the blue. Soak in the blue vitriol liquor, and dye without washing in cold logwood liquor.

Sometimes, an archil liquor is superadded to the logwood blue, and then the silk is dipped in an indigo vat.

Deep blues are also given upon a ground of brazil, for which you previously alum the silk as usual. Then dip it in the blue vat. This indeed is rather a violet, than a blue.

Light blues may also be dyed in an indigo vat, but it is not often that dyers are able to manage a vat so weak as is necessary for this purpose. Hence they are usually made followers, after deep blues have been dyed. (I see no reason why the callicoe printers' vat should not answer; or still better, a diluted pencil blue. Gulich's recommendation to the silk dyer, to add orpiment to the cold vat of lime and copperas, deserves to be tried. *T. C.*)

Nothing is easier than to make a temporary blue vat in the first vessel that is at hand, by means of liver of sulphur; this substance is made by fusing together in a crucible or an earthen pot, equal parts of sulphur and potash previously ground together; or rather pearl ash, which is usually drier. Or you may boil together equal parts of sulphur and potash till they are mutually dissolved. Take equal parts of indigo and liver of sulphur, and half a part of potash, and dissolve them together in a close vessel of any kind by a moderate heat. This can be diluted with warm water, and when cold, used for dyeing. Should it become black by too much heat, or any other cause, add a small quantity of lime and red orpiment. When you use this, take care to scum it, otherwise the silk will be spotted. When you have dyed with it, put it by well covered. When you want to dye again with it, warm it, adding a little lime and orpiment. This succedaneum, however, is not necessary to dyers who understand how to keep the common indigo vat in good order, though weak.

Saxon Blue, is dyed on silk with sulphat of indigo in the same manner as on woollen.

Of Yellow on silk. The raw silk should be boiled with about twenty-five pounds of soap to the hundred pounds. Then washed, and beetled, and alumed in the usual way: after aluming wash it; put it on rods in hanks of half a pound each. Then dye with two pounds of weld to the pound of silk: keep the weld down by heavy pieces of wood. Boil it till all the colour is extracted: take out the weld, and dye the silk when the liquor is about 120° of Fahrenheit. Some dyers use a small quantity of pearl ash with the weld, which heightens the colour, but does not add to its permanency. (Though I am of opinion it aids the aluming, by suddenly fixing it before any of the alum is dissolved in the bath. *T. C.*) Work the silk in the weld liquor till you have obtained your colour. Macquer directs two baths or liquors to be made from the weld, and the silk to be dyed first in one and then in the other; but I do not see the advantage of it. Homassel, however, gives the same directions under the head of bottle green, which see.

I presume that although quercitron was not known in Macquer's time, it may be made to supersede weld in most cases, using half a pound to the pound of silk.

If you want a lemon colour, you can best obtain it by weld, using a little verdigris and less alum.

If you want a jonquil, you must give a ground of annatto.

For many shades of yellow, the French or yellow berries (graines d'Avignon) may be used; and in point of price they will answer for the cheaper goods.

The brightness of the colour will be best obtained by using white silk, but in general the natural yellow of the silk, that is not quite discharged by boiling the raw silk in soap and water, does no injury to yellow colours.

Auroras, oranges, mordorès, &c. are dyed with annatto or rocou, as before mentioned. But other shades may be given, by the mixture of red and yellows, whether of weld or quercitron.

It does not appear that tin answers as a mordant on silk with the same effect as it does on woollen. Bismuth has not been tried so far as I know. Nor the acetat of iron for black in lieu of the sulphat of iron. Though in Macquer's black process, there is something like it.

In this country, weld can hardly be used till we grow it ourselves. Indeed I do not see why a dyer, who must live for the most part out of town, cannot appropriate one field to madder, another to weld, and another to safflower, for his own consumption. *T. C.*

Green. Macquer. This colour, composed of blue and yellow, is with difficulty produced on silk, because the blue vat is liable to spot, and to give a party colour, an inconvenience more perceptible in green than blue. Greens are produced in the following manner.

The boiling of silk for this colour, is the same as for common colours.

There are several shades of green known to the dyers: thus a sea green or Tourville green, has twenty-five or thirty gradations, from the weakest, called Pistachio green, to the darkest called Terasse green.

To produce these greens after boiling, the silk is strongly alumed; it is then cooled at the river, and distributed into hanks of about four or five ounces. This precaution is necessary for giving the yellow ground to all silk intended for green; because thus distributed in smaller hanks, the silk is more evenly dyed, which with regard to green is of the greatest consequence. The weld is then boiled as in the directions concerning yellow.

The weld having boiled, a liquor of it is prepared with clean water strong enough to give a good lemon ground. The silk should be then returned in this liquor with great care, because an uneven ground would be very discernible in the green. When the ground seems nearly full enough, some threads of the silk are dipped in the blue vat to try whether the colour of the ground be sufficiently full for the shade. If not, some of the weld decoction is added and again tried.

When the colour comes out good, the silk is cooled at the river, and once beetled; it is then wrung and formed into hanks convenient for dipping in the vat. Being dipped skein by skein as for blues, it is wrung with equal care and quickness and with the same precautions.

The fifteen or sixteen lighter shades of this green, only require to be dipped in the vat to be completely finished. As to the Pistachio green, if the vat be yet too strong, the silk should be taken out, and carefully opened and aired, but not washed. It is then worked in the hands, that is, held in one hand and struck with the other, by which means the silk being disentangled and aired, the colour becomes equally clear. A few threads are then rinced, and if the colour be right the whole is washed.

For the dark shades, when the weld is exhausted a little logwood is added to the liquor; and for the darkest, some decoction of fustic also: the silk is afterward washed and beetled, then dipped in the vat; always remembering that the perfection of the colour greatly depends on washing and drying quickly, when it comes out of the vat.

There are many other shades, differing from the sea green, because they have a yellow cast: they are however produced by the same ingredients: for example, the willow green. These greens when alumed are dipped in a very strong weld liquor, and when exhausted, the fustic or rocou (annatto) is used, added to the same liquor to complete the shade. If the colour requires darkening, a little logwood may be added after the fustic or annatto: they are afterwards dipped in the vat.

The second shade of green is the meadow or emerald green. These are alumed as for the sea greens; after having cooled and rinced the silk at the river, it is dipped and worked in the weld liquor that had been previously used for a sea green. When the colour seems even, some threads are put into the vat to try the effect of the ground: if the green be too blue, it is again put into the decoction of the weld, or a fresh one. The vat is then stirred, and the silk again entered, till by making a fresh essay you find the ground proper to the shade required.

The only difference between the meadow and the emerald greens is, that the first is rather the darkest.

In manufactories where savory (this is a mistake; the original is *sarrette*, *serratula tinctoria*, in English, *saw-wort*, *T. C.*) is easily procured, it is used in these kind of shades in preference to weld, the saw-wort yielding more juice than the weld; or rather because the stuff when dry, retains the same colour which it had taken from the liquor; whilst on the contrary, the colour of the weld always grows yellower and redder in the drying. (This is in some degree prevented by mixing a little verdigris, or blue vitriol, with the alum. *T. C.*) Genestrolle, genista tinctoria, dyers' broom, is sometimes used instead of weld, only in larger proportion.

All the other shades of green, are varied by the addition of logwood or not, according to the tint. The dyers' broom is either used alone, or mixed with weld, producing the same colour. The saw-wort is preferable to either; except where logwood, fustic, or annatto, are also to be employed.

Green. Homassel. All greens that are made simply from yellow and blue, are made in the same manner, using the materials according to their strength. But for landscape greens, a mixture is necessary to give them something of a red tint in addition. This is done by mixing a small quantity of brazil with the weld liquor.

In all natural colours, there may be observed a delicate grayish tint, which hitherto has never been imitated but with very dilute black colour or logwood and copperas.

For greens, boil the weld; and let it cool, that the alum on the silk may not dissolve in the hot liquor. You give a yellow ground, deep in proportion as your pattern requires. To hit this more exactly, you try a small specimen every now and then in the blue vat; dry it quickly by squeezing out the colour by means of your thumb nail and finger. When you have hit the required shade, wash your welded silk at the river, for weld like soap is poison to the indigo vat. Then dye in the blue vat in the same manner, and with the same precautions as you do for blues and violets: the least variation will render your silk streaked or spotted.

Mixed greens, that require brazil, or Venice sumach (fustet), ought to receive the colour of these drugs, either on the weld yellow, or previous to welding. For when once the silk has entered the indigo vat, it is un-alumed; nor can it then take any other colour but black, which stripes without any additional mordant; or else by means of logwood and copperas. These two colours are always given upon the blue, but no other.

Silk may be alumed, in the proportion of four ounces of alum to the pound of silk. The alum liquor should never be hotter than 120° of Fahrenheit at the utmost; if it be, your silk is spoiled: the silk may be immersed in it a quarter of an hour. (I think an hour is little enough. *T. C.*)

Of Bottle Green. Homassel. There are in commerce, several shades of this colour, all managed in the same way. The silk must be well alumed, in a strong liquor. Then washed. Then dyed in a weld liquor; after the weld has boiled five or six minutes, it must be taken out in baskets, and the liquor suffered to cool—from 110° to 120° of Fahrenheit at the farthest.

If the silk be common stuff, it must not be beetled after aluming; but otherwise if it be fine. It should be twice welded pretty strongly, and will then be of a rich golden yellow. Then without washing, dye it in a decoction of logwood, till you have obtained a brown tint as deep as you wish. If the silk be not sufficiently alumed, the logwood liquor will sometimes produce a brownish red so strong that the weld yellow is not sufficiently brought out. In this case, some alum must be put in the weld decoction to make the logwood strike properly, and then pass the bottle greens through soap and water, or in an old vat, where the alkaki blues the logwood. You may if you please, omit putting alum in the weld decoction. If the cloths are deprived of their alum in welding, you may compel the logwood to strike by means of verdigris dissolved in hot water.

It is necessary to observe, that the weld should boil twice: first for five or six minutes, then for at least half an hour. If you wish for a strong weld decoction, after the last half hour's boiling, take out the weld, and add a fresh bundle to the same decoction.

American Green. This colour is no more than a weaker shade of bottle green. It requires much less weld, and logwood, and a very small quantity of green copperas.

Olive. Boil the silk in soap and water as usual, to get rid of its gum. Wash and beetle it; alum it strongly; then dye it in weld liquor very strong, in the same manner as for yellows, adding to this liquor when exhausted some logwood, and when the logwood is exhausted a small quantity of the solution of pearl ash, which greens the liquor and gives it an olive cast. The silk is again dipped in this liquor, and then drained, put on the rods and dried.

There are two shades of olive; one the green olive above mentioned, the other a reddish and rusty olive. For this second shade, having given the weld, some fustic and logwood may be added without pearl ash. The logwood should be used in greatest proportion for the deepest shades.

The indigo vat would make the colour too blue; the blue shade is deep enough by means of the effect of the pearl ash on the logwood.

Fustic gives a *drab* colour, when previously alumed, and then passed through logwood and copperas.

ON THE DYEING OF COTTON.

COTTON, considered with respect to the art of dyeing, differs from woollen in the following particulars.

First, it receives the colouring matter of dyeing drugs, and retains it with less permanency than woollen. Take a piece of linsey-woolsey, or of cotton woven with woollen, and boil it in a decoction of weld or quercitron, or madder, the woollen will receive a dye, while the cotton and linen are nearly white.

Secondly, it will not therefore form so quick, probably not so strong a chemical combination with colouring matter as woollen will.

Thirdly, it will however combine (intermediately by means of mordants) with a greater quantity of colouring matter than woollen will, to produce the same shade of colour: thus, to produce the fullest tinge of Turkey red, a pound and a half of madder at least, is required per pound of cotton: the same depth of colour can be given on woollen with the proportion of a pound of madder.

Fourthly, cotton resists the operation of acids and of alkalies more than woollen does: thus, boil a piece of cotton and woollen cloth in a strong alkaline ley; in five minutes the woollen threads will be dissolved, the cotton will remain, the liquor will contain a soap of wool.

Fifthly, cotton will receive a full colour from any drug that requires a mordant or preparation, such as madder, weld, quercitron, fustic, logwood, galls, sumach, walnut or alder bark, with a preparation of alum in the proportion of one-fourth of the weight of cotton.

Sixthly, whereas woollen requires for a full and a fast colour, a mixture of tartar, so as either to form a tartrite of alumine, or else to render the alum more decomposable by means of the double affinity of the supertartrite of potash (which, I cannot tell) cotton requires no tartar. The aluminous mordant is just as good for cotton, alone, as with tartar.

Seventhly, the most efficacious mordant for cotton has been found by experience to be the acetat of alumine, which should be made in the proportion of one pound and a quarter of sugar of lead to one pound of common alum (free from iron.) But this is too expensive a mordant for the dyer, and is confined to the callicoe printer; it has not, however, been as yet fully ascertained, whether acetat of lime in about double weight to the alum, would not produce a mordant equally good and cheap. I have seldom been able to get it by vinegar and whiting free from iron. The proportion of sugar of lead to alum, I have ascertained, by direct experiment, to be nearly one part and a half of sugar of lead, to one of alum.

Eighthly, cotton goods may be made to approach in dyeing properties to woollen, by impregnating them with animal substances and astringents: as with blood, urine, cow or sheep's dung, glue, &c. and galls, sumach, or bark.

Ninthly, cotton goods do not require to be perfectly bleached for any but very delicate colours, such as scarlet, crimson, pink, purple, light blue, &c. Common colours will do better on half bleached cotton, which will answer even for that finest of colours the Adrianople red.

Tenthly, the looser twisted cotton receives, generally, a fuller and finer colour from the same ingredients, than hard twist.

On the Bleaching of Cotton Goods. Wherein first of half bleaching them for common colours: next of bleaching them white for the more delicate tints.

Cotton goods may be sufficiently bleached for dyeing common colours thus. Gather them up in the usual loose knot: throw them into a keer or keeve (cuir or cuve) sunk in the ground and rising about six inches or a foot above ground, in common water. The water should cover them; for this purpose they should be pressed down with a board and weights on it. The paste and sowings used in weaving, will begin to ferment in a couple of days in winter, and sooner in summer. Six hours after the bubbles of fermentation begin to appear, take them out, carry them to the dash wheel, dash them well, run them through the squeezers, gather them up in the usual loose knot, without laying them down on the green to bleach, and put them into the bouking keer.

To about one thousand pounds weight of cotton goods, use thirty pounds of potash, and five pounds of soap. The keer should hold two thousand weight of goods in the gray, and then sixty pounds of potash and ten pounds of soap will be wanted. Let this ley be cohobated in the usual way on the cloth, well covered with a layer of twisted pieces, and also a coarse and open cloth over all. The pump is used to pump up the ley upon the top of the cloth, through which it pucolates and runs out at the bottom spigot into the boiler, whence it is again pumped up; and so on for twelve hours. The cloth, moist with the hot ley, remains in the keer all night. In the morning carry it to the dash wheel, and dash it well. The dash wheel should be six feet and a half diameter, two feet and a half wide, and make two revolutions per minute. See the plate in Brewster's Encyclopædia. Then throw it into a souring keer, sunk in the ground to within a foot, holding vitriolic (sulphuric) acid and water in the proportion of one part oil of vitriol of spec. gravity 1,85 to about fifty parts water: or, let the mixture be of the strength of common vinegar. In this country it will require not more than forty parts water to one of oil of vitriol, such as is usually sold. In this acid liquor, let the goods stay from eighteen to twenty-four hours. Then carry them to the dash wheel; dash them well, and without squeezing, lay them down on the grass for three days on each side. Then take them up, again dash them well, squeeze them, and then dry, and make them up. If a further degree of whiteness is wanted, bouk them again the usual time with thirty pounds of pearl ash per thousand pounds of cloth, with the addition also of about five pounds of soap. Dash, squeeze, sour, dash, bleach on the grass for two days, dash again and make them up.

This will produce a degree of cleanness, and whiteness, fully sufficient for all common purposes.

If the goods are required to be bleached white, proceed thus.

First, steep in common water for two or three days; dash, and squeeze. Take care not to let them ferment too long, or they will rot.

Secondly, Bouk early in the morning with forty pounds of potash and five pounds of soap per thousand pounds weight of cloth: dash them well in the morning.

Note. Callicoes of twenty-eight yards and a half, of quality sufficient for good common work, ought to weigh in the gray, unbleached, seven pounds and a quarter each, and when bleached six pounds and a half each. About two hundred and thirty callicoes are usually bouked at once with seventy pounds of potash.

Gray muslinets of forty-two or forty-three yards, will weigh unbleached about eleven pounds.

Half yard velverets, gray, undressed, about sixteen pounds.

Do. dressed and half bleached, about eleven pounds.

Muslin cords, gray, unbleached about twenty-three pounds, bleached seventeen pounds.

Of course these goods vary in weight with the circumstances of the trade.

Thirdly, lay the goods down on the grass during three days, turning them each day; then dash and squeeze.

Fourthly, bouk with thirty-five pounds of pearl ash and five pounds of soap; dash and squeeze. (The first bouking should be of potash, the succeeding ones of pearl ash.)

Fifthly, lay down on the grass for three days, turning them each day. Dash and squeeze.

Sixthly, sour in sulphuric acid and water of the strength of vinegar for two days: dash and squeeze.

Seventhly, bouk with twenty-five pounds of pearl ash, and five pounds of white soap per thousand weight of cloth: dash and squeeze. This will make of soap and alkali together, half a pound to each piece of callicoe.

Eighthly, lay the goods on the grass for three days as before. Then without washing or squeezing them, when they are dry,

Ninthly, bleach in oxymuriatic acid, oxymuriat of lime, or oxymuriat of potash.

Tenthly, dash, and lay them down on the grass for a day.

The above process is the same nearly with one which I formerly communicated to Dr. Mease, who published it under the article "Bleaching" in his edition of the Domestic Encyclopædia.

As to the method of making the oxymuriatic acid, and the oxymuriat of potash and of lime, I refer the reader to the article Bleaching in the Domestic Encyclopædia; to two papers on the oxymuriats in my edition of the Emporium, and to the articles Bleaching, in Rees, and in Brewster's Encyclopædia. The method of bleaching with oxymuriatic acid made from red lead, beyond all doubt the most expeditious, the most convenient and the cheapest, is my own, exclusively. It is not known in England, unless by two or three gentlemen formerly concerned with me.

The above is the method of bleaching calculated for the climate of England. I am persuaded, that the efficacy of the sun in this country, may supersede the necessity of oxymuriatic acid, or any of its combinations.

Goods that require to be fired, will take a little longer time, and perhaps a slight bouking and souring in addition. But under the preceding process, the goods can be got out in a fortnight from the gray, which is early enough for the usual routine of work. I think too that the warm sun of this country, and wetting the goods on the green, may supersede a bouking and souring now and then.

As to the proposed methods of bleaching by steam, by sulphuret of potash, and by oxymuriat of magnesia, I have no faith in their pre-eminence over the well-tried common method above detailed. As to the oxymuriat of magnesia, whatever advantage it may possess is fully counteracted by the extravagance of its price here. As to the danger of the oxymuriatic acid uncombined rotting the cloth, I can only say that having directed the bleaching of very many thousand pieces, I have no reason to make the complaint. But in truth, the excessive whiteness, required by the English dealers in cotton goods, is not desirable.

It is purchased very much at the expense of the cloth, and in this country we may well dispense with it. Indeed, unless for cotton twist, I would discard the oxymuriats altogether.

I am perfectly satisfied that the alkali would be greatly improved, and might be diminished one-fourth, by using lime to draw a caustic ley, but I am afraid of its abuse.

Of the Blue Dye on Cotton. I have nothing to say as to the preparation of the vats for dyeing blue on cotton, having exhausted that subject, in the section relating to the dyeing of woollen a blue colour, in the various vats there described, and meaning to say what I wish in addition, under the head Dipping and Paste Work, by and by, which the reader ought not to pass over.

In general, the blue upon cotton is dyed in the cold vats, where the indigo being disoxygenated or deoxyded by means of green copperas, (sulphat of iron) or yellow orpiment, is dissolved by means of potash or lime, generally by lime alone. I do not see much objection to dyeing a blue upon cotton by means of the common indigo vat, of bran, madder, and potash, but common usage and experience rather sanctions the cold vat. Gulich's practice of using orpiment with the copperas in the cold vat, deserves to be verified.

In dyeing cotton, the light shades are usually dyed first: very full blues are seldom wanted unless for Guineas, which require to be so deep that the coppery hue is perceptible on casting your eye along the piece.

No mordant is necessary for an indigo blue: nor unless the shade required be very light, need the goods be bleached quite white. But they must be very clean from dirt and sowings.

A false, fugitive and fraudulent blue on cotton, even as deep as a Guinea blue, can be dyed with logwood and blue copperas.

Of Dyeing Cotton a Black Colour. The first thing necessary is to prepare the iron liquor, which may be made, either with vinegar from cyder, or brewed purposely from grain, or made with pyroligneous acid. In England it has long been a separate trade.

In a large cask of size or in number proportionate to the work in the establishment, put a quantity of old refuse iron of any kind; pour on it vinegar made from cyder, or brewed from any kind of grain; let it stand till the acid becomes saturated with the iron, which usually requires three months to be good. The older it is, the better. The stronger the vinegar, the better.

If pyroligneous acid be used, it must be used merely to supply the place of vinegar.

Pyroligneous acid, now in common use in Manchester, and other parts of England where cotton manufactures are established, is usually the refuse of the making of charcoal.

Formerly in the gunpowder manufactures, the charcoal used, was made in the common way of open fires: of late years it has been made in close vessels, wherein it is made more perfectly, and all the products of the distillation are saved.

The products of the distillation of wood, are a gas, or air, called by the chemists carburetted hydrogen, which is permitted to escape: together with this gas, an empyreumatic fetid oil comes over, which collects at the top; and also an acid liquor, which is the pyroligneous acid.

The wood is cut up in small billets, put into a cylinder of iron, open at one end, to which end a cover is fitted, and where the wood is put in; after which the cover is put on. At the other end a large tube is adapted, and the fire is made under the cylinder. The wood thus exposed to heat, is distilled. The end of the tube goes into a hogshead containing some water, and is permitted to enter the water about six inches; the gas that comes over is permitted to escape through a tube inserted in the top of the hogshead. The oil separates and swims on the top of the water, the acid liquor mixes with the water, which by repeated distillations becomes strongly impregnated with the acid of the wood. The charcoal, especially if near a gunpowder manufactory, will pay all the expense of this process. This acid liquor is an empyreumatic vinegar, which perfectly answers to dissolve the iron, and is used for that purpose. The smell attending this acid is of no consequence, and the solution of iron is equally valuable and efficacious as if common vinegar had been used.

No good and permanent black can be dyed on cotton, unless by means of the acetat or pyrolignat of iron*. The sulphat of iron, or green copperas, is

* An acetat of iron for sudden experiments can be well made thus: dissolve in as small a quantity of hot water as possible one

detrimental when used alone, to the texture of the cloth, and never gives a full and lively black with the common astringents.

To dye a good and permanent black upon cotton, I should recommend the following process, after the cloth or yarn has received a light indigo blue.

Make an astringent bath by boiling for an hour and a half, two ounces of galls, four ounces of sumach and as much alder bark to the pound of cotton; strain the liquor clear: in this liquor work your goods for an hour or more at about a scalding heat; take out the cotton, and if yarn put it into a tub with as much of the liquor as will cover it and let it remain for some hours. Then drain and wring it, but do not dry it. Work it in iron liquor five or six quarts to the pound according to the strength of it, at the heat of 120°, for an hour; drain it, open, air it, and when well aired, rince it in water.

Refresh your astringent bath, pouring into it the liquor from the tub, with one ounce of madder and as much quercitron to the pound of cotton; bring it to the heat of about 160° or even 180°. Work the cotton in this bath for an hour; drain, and wring it.

Refresh your iron liquor with an ounce of green copperas and half an ounce of blue copperas to the pound; work the goods in it as before; wring them, open, air, and rince them.

part of green copperas: dissolve in as small a quantity of hot water as possible one part and a quarter of sugar of lead: stir them about and filtre the solution. For printing, thicken it with bruised gum arabic.

Refresh your astringent bath, with a decoction of four ounces of logwood to the pound of cotton. Dye the goods in this bath, till the colour is exhausted; wring them, open, air, and wash them well.

Dip them again in the same bath (the last mentioned) with two ounces Gallipoli oil to the pound of cotton. Wash and dry.

Airing the goods after each dyeing, is indispensable to a fine colour: I add madder, quercitron and logwood to the astringents, because I do not believe a perfect black can be procured by any one colouring drug alone. The oil improves the cotton both to the sight and the touch.

This process will dye a good black, and I should prefer it, but so will any of those that I am about to mention, which I insert that the artist may exercise his own judgment in choosing.

For common blacks upon cotton, Mr. Wilson of Manchester, the best cotton dyer of his day, (and who first introduced the Adrianople or Turkey red, long before the chamber of manufactures of that town purchased the secret from M. Borell, a dyer from Rouen) dyed his blacks on cotton in the following manner.

The cotton goods were perfectly freed from dirt and sowens, by a half bleach, which is essential. The goods were then passed through a bath of galls and sumach for an hour at a boiling heat: they were then drained and cooled. Then passed through a preparation or mordant bath of acetat of iron, (the common iron liquor, made at that time with brewed vinegar and iron, and used at six months old. Each dyer knew by experience and repeated trials, the strength of his own iron liquor; it was not then (1788) a separate trade to make iron liquor, as it is now.) The goods were then drained and aired: after that they were again passed through the astringent bath refreshed with alder bark: again through the iron liquor; and lastly through a bath at a boiling heat, of logwood with a small quantity of verdigris. After each dyeing operation, however, the goods were drained, opened, aired, and dried in the shade; for each dyeing process is incomplete until the air strikes as full a black as the materials are capable of giving. In this process, the blue tinge is given to the black by the logwood and verdigris. It will do very well for common blacks, but the former process is better for high priced goods.

The Rouen process from Pileur D'Apligny, is worth inserting.

In the states of Genoa, Florence and Naples, every manufacturing city has a place of reserve called the seraglio, where at the public expense, eight or ten vats are constantly supported. These vats (containing iron dissolved in vinegar) have been set from three to four hundred years more or less; that is, prepared for the dipping of silk designed for black, and only requiring to be supplied with proper materials in proportion as they are diminished by use. The ground remaining always the same, acts as a kind of leaven, by which the fermentation of the necessary additional drugs is assisted.

The process at Rouen for dyeing linen and cotton thread black, is first to give it a sky blue ground, and then to wring and dry. It is afterwards galled, a quarter of a pound of galls for every pound of the substance, as for reds: having remained four and twenty hours in the gall liquor, it is then wrung and dried.

About five quarts of the black liquor (strong iron liquor, *T. C.*) is then poured into a trough; in this liquor the cotton is dipped and worked with the hand pound by pound, for about a quarter of an hour, and then wrung and aired. This operation is twice repeated, adding each time a fresh quantity of the black liquor carefully skimmed; it is again aired, wrung, washed at the river, well drained and dried.

When this cotton is to be dyed, about one pound of the bark or rind of the alder tree for every pound of thread, is put into a copper and boiled in a sufficient quantity of water during one hour; about half the liquor that had been used for the galling is then added, with about half the weight of alder bark or of sumach. The whole is again boiled for two hours, after which it is strained through a sieve. When it is cold, the cotton is dipped in it on the rods and worked pound by pound; from time to time airing, and returning it into the liquor, where having remained twenty-four hours, it is wrung and dried.

For softening this cotton when too harsh, it is the custom to soak it in the remainder of the weld liquor, that had been used for other colours, adding a little of the logwood liquor. It is then taken out and instantly plunged into a trough of warm water, into which had been poured, an ounce of olive oil for every pound of the substance.

I shall now (says D'Apligny) describe a process by which I myself have succeeded perfectly. It is necessary to begin by cleansing the thread, then by galling in the same manner as for reds, aluming afterwards, and then dipping in a weld liquor. When taken out of this liquor, it must be dyed in a decoction of logwood to which has been added a quarter of a pound (a very large quantity, *T. C.*) of blue vitriol for every pound of the substance. It is then taken out, washed at the river, wrung, and washed several times, but not wrung hard. It is at last dyed in a madder liquor, about half a pound of madder to the pound of materials to be dyed. By this process we may rest assured of obtaining a very beautiful and permanent black, that will not be liable to be discharged, provided that after having been dyed, the thread be dipped in a boiling soap liquor.

(The first of these processes is a good one; but the reader may rest assured that a colour depending chiefly on logwood and blue vitriol, can never be a very permanent one. These substances will answer to brighten the black, but there must be previously a tolerable black without them. *T. C.*)

In dyeing common blacks, they may be frugally passed through old baths of drab and olive colours, so as to work up the remains of half spent liquors, that nothing may be lost.

Upon the black dye on cotton, I would remark,

First, that no good black can be dyed, with green copperas or sulphat of iron alone.

Secondly, that the proper mordant, is clear iron liquor, or iron dissolved to saturation in a vegetable acid; but toward the last part of the process, a small quantity of green copperas with a much smaller of verdigris, or blue vitriol, may be added with advantage.

Thirdly, I believe a perfect black cannot be dyed with any single astringent. For a perfect colour, madder and logwood, and I am inclined to think a small quantity of quercitron also, are necessary, which I have accordingly added.

Fourthly, in the last dye-bath, if the goods are continued too long in the liquor, it is apt to dissolve some of the black.

Fifthly, To give the blue shade so necessary to a full and brilliant black, logwood and verdigris, or logwood and blue copperas (sulphat of copper) are both necessary.

Sixthly, it is indispensable to air the goods after dyeing them out of an astringent liquor. The oxygen of the atmosphere alone, strikes the black, and fixes it.

Seventhly, The addition of a small quantity of grease or oil, is a modern improvement that answers upon cotton as well as upon woollen.

For blacks, it is said that linseed oil may be used, but for no other colour.

Eighthly, I am persuaded, that the modern theories about animalizing cotton are well founded, and will answer for blacks, as well as for other colours. Hence

Ninthly, I think it would be worth while to try the following variation in the process for dyeing black. Commence with a strong iron liquor containing two ounces of alum to the pound of cotton. Make a bath of 120° hot, of a pint of sheep's dung, half an ounce of pearl ash, and a couple of ounces of oil to the pound; work the cotton in this for an hour and a half. Wring and rince. Then through an astringent bath of two ounces galls, two ounces of madder, two ounces of quercitron, and four ounces sumach to the pound, strained. This may boil, for the fawn colour will not hurt a black though it will make a red dull. Then (after wringing, airing, and rincing moderately) through the iron liquor; then again the dung liquor and the astringent liquor as before, only refreshing this last with four ounces logwood, and one verdigris, repeating if necessary the iron liquor.

It is of great importance to give a good and permanent black to cotton goods so much in demand, as all the class of velverets, velveteens, janes, &c.; and although a tolerable good black can be cheaply dyed in the common way, I think they would pay for more care and attention than is usually bestowed upon them.

The processes for grays, muds, dove colours, drabs, olives, chocolates, clarets, &c. depending as in the case of woollen, upon diluted black, with or without the admixture of other colours, such as yellow, green, red, &c. can be sufficiently well understood by those who have attended to the preceding pages: but I shall presently give a separate though brief section on these, founded on the actual practice of Manchester.

Of dyeing Cotton a Scarlet colour. This is very seldom dyed. Dr. Berkenhout's flimsy process, containing nothing new, may be found in 1 Bancroft, p. 398. If this colour be wanted, let it be dyed thus.

Boil the bleached cotton in a preparation of two ounces of alum per pound of cotton, for an hour and a half. Then take it out, drain it, and without rincing, run it through water heated to 110° Fahrenheit, in which fresh blood has been mixed in the proportion of half a pint of blood to a pound of cotton. Do this for an hour: take out the cloth, drain and rince it.

Dye it with an ounce of quercitron to the pound of cloth: drain it, wash it well, and dry it.

Run it for an hour and a half through a boiling preparation, consisting of a sufficient quantity of water, mixed with the common composition for the scarlet dye: drain it, rince it slightly. Then dye it in the common finishing or cochineal scarlet bath, and wash it well. If too red, it can be flamed by running it through a very dilute preparation liquor. If too yellow, run it through hot water with about an ounce of the whitest soap dissolved in it, to twenty pounds of cloth: or the quantity of cochineal may be increased.

The blood certainly makes the colour more permanent, but the colour of cochineal is fugitive upon cotton at the best.

I have never tried a second blood liquor after the tin preparation, but I am of opinion it would be of use. Galls also would render the colour more permanent, but they would sadden it a little. Dr. Bancroft's remarks should be perused.

Brazil Reds on Cotton. False scarlets and crimsons on cotton are usually dyed with brazil. The difference between a scarlet and a crimson, can be made by a previous yellow dye of a very light shade, which gives the flame colour.

For a Crimson with Brazil. Prepare with an ounce of alum to the pound of cloth: run it through a blood liquor made as above: rince it. Run it during an hour and a half through a bath of nearly boiling water, or rather water at 180° of Fahrenheit, impregnated with with a decoction of an ounce of bruised galls to the pound of cloth: wash it. Run it the usual time through a dye liquor of brazil wood, taken out of a decoction made apart, with half a pound of brazil wood to the pound of cloth; use one third of this decoction each time. Rince it. Run it through the common scarlet preparation liquor of tin in aqua regia; let it drain, rince it; then add of the brazil decoction one other third, previously taking out of the old dye-bath as much in quantity. Drain, rince. Again run it through the preparation tin liquor the usual time; drain, rince: then take out of the dye-bath as much of the old liquor as will admit of the remaining third of the brazil decoction, in which let the cloth boil, wincing it as usual, for the usual length of time. Drain, wash. A small quantity of cochineal decoction in the last liquor would improve it.

Dyeing of Pink on Cotton. For the purpose of dyeing this colour on cotton cloth, (which is frequently required mixed with black for the Spanish market,) I refer to the method already given for dyeing woollens with carthamus or safflower. The black is usually dyed first with paste work, or else printed as a blotch ground with chemical black, and then dyed with the alkaline solution of safflower, and then in a solution of white tartar: or these two solutions may be mixed.

Where lime or lemon juice can be cheaply obtained, they are preferable to tartar. The mineral acids do not produce a bright colour.

This colour will not stand washing with soap, nor long exposure to air.

Of Madder Red upon Cotton; and first of the common madder red.

Rouen Process: from Pileur D'Apligny. The cotton being cleansed, or half bleached, the next operation is galling, then aluming, then dyeing, then enlivening.

Galling. Use one quarter of a pound of bruised white galls, boiled till they are quite soft, in six quarts of water to each pound of cotton. It will take about two hours to boil the galls. Strain the liquor or draw it off clear, which will now be about five quarts; divide the cotton into hanks of about half a pound each, tied separately, and having laded into a separate vessel five quarts of the gall liquor, soak thoroughly two hanks of the cotton in it. Then take them out, lay them in another tub, and pour the gall liquor upon them: do the same to two more hanks, till the whole are thoroughly soaked, taking care each time to stir the gall liquor, that the whole may be soaked equally. Let them remain in this gall liquor twenty-four hours; take them out hank by hank, wring them moderately, and let them dry.

Aluming. Bruise and dissolve in hot water a quarter of a pound of alum for each pound of cloth. The solution must amount to five quarts for a pound of cotton. It is customary to add to this solution arsenic, white tartar, and kelp, dissolved in water, (which as they are worse than unnecessary, I omit. *T. C.*)

Proceed with this alum solution exactly as you did with the galling, soaking the cotton in the same way, for the same time, then wring and dry it slowly, to give time for the alum to combine with the cloth.

Dyeing. This should not be done with more than ten pounds at a time, if you would be sure of dyeing them equally. They should be dyed in a copper of an oblong square shape, two feet deep. For ten pounds weight of cotton it should hold sixty gallons. Heat the water to a scald, and then put in six pounds and a quarter of good madder; when the madder is equally diffused through the water, enter the cotton by means of sticks or rods passed through the strings, and work them regularly in the liquor, turning them upside down successively in rotation for three quarters of an hour at a regular heat, but without boiling. Then raise the cotton, and let it rest on the side of the copper, till you put in about a quart of a solution of kelp or barilla; stir the liquor, enter the cotton again, keep it immersed, and boil it for a quarter of an hour. Then raise it, wring it, wash it, and wring it again.

Two days afterwards, refresh the madder bath with five pounds of madder, making in all eleven pounds and a quarter to ten pounds of yarn. Work the cotton in this a second time, just as at first, but without any alkaline lixivium.

To brighten or enliven the colour. Boil the dyed cotton in water with a small quantity of solution of kelp or barilla. Then wash it, wring it, and spread it on the grass, where the colour is still further improved.

Editor's Process: for a full rich colour. Prepare the cotton in a clear mordant liquor of four ounces of alum and two ounces of sugar of lead, to the pound of cotton, bruising the alum and dissolving it in no more water than is needful conveniently to work the goods. They should soak (after being well worked) immersed in this hot solution for six hours. Take them out, wring them over the vessel, so that no moisture will drop from them: let them thus rest in a damp place for twelve hours, for the remaining moisture to equalize itself.

Prepare a bath of half an ounce pearl ash, two ounces galls, six ounces sumach, and four ounces madder, to the pound of cotton; keep it at a full scald for two hours, or till the galls are quite soft: separate the galls, madder and sumach by a sieve. Enter the cotton, and keep it worked regularly in this liquor at a full scald, for at least an hour and a half. Then drain, wring it, rince it, and wring it again.

Prepare a dye liquor of sixteen ounces of madder, and half a pint of blood, to the pound of cotton. Enter the cotton at 150°, and keep it at that heat, or not beyond 160° of Fahrenheit, well worked in the liquor for a full hour or more, if need be. The white scum or froth will show when the bath is exhausted. Drain, wring, rince, wring the cotton, and dry it.

Run the cotton again through the alum bath, only refreshing this last, with one ounce of alum to the pound of cotton; and then through the astringent bath: and dye it again with four ounces of madder and half an ounce of brazil to the pound of cotton, and a little more blood, a gill to the pound.

If the cotton be in hanks or skeins, it is probable that it will have to go through processes that will answer for enlivening it: but if you wish it enlivened, boil it for twenty minutes, or half an hour, in a solution of white soap, an ounce to the pound of cotton. Then wash and dry it in the shade, or in a stove not heated beyond 100° at the utmost.

The brazil colour is fastened by the blood and galls.

For cheap goods and common colours, make them the followers of fine goods, so as to use up the materials not quite spent, and employ upon them a quantity of ingredients lessened in proportion to the expense you choose to lay on them. But as sheep's dung and blood certainly contribute to the fixity of the madder red, if not of almost every other colour upon cotton, I would employ the one or the other.

Generally, the blood and the dung are neglected, or rather they are not in use, but I am well satisfied that the colour is more full and more permanent when they are used; and as the articles are cheap, there is no sufficient reason for omitting them. It is impossible to reflect on the usual practice of the callicoe printers, and on the theory of animalizing cotton, which the Turkey-red must suggest, without being convinced that these substances are of great use. Blood, cow dung, sheep's dung, a solution of common glue, may be used for one and the same purpose; I prefer them in the order here stated.

The common prejudices are in favour of the Zealand grapp, or crop madder, which is certainly a good article, when well grown and well cured, well ground, and well preserved, tightly packed in close casks. Moisture spoils it. But, I have used enough of the Smyrna madder roots, to know that a better colour can be obtained from them, than from the common crop madder. This last will not produce a genuine Turkey red. The roots are indispensable. I know too, that madder, which while I am writing, sells here at Carlisle at a dollar a pound, can be grown at Carlisle as well as in Holland. It requires, to be sure, more hands to bring it into market than a common crop, but a farmer would not be ill paid for his ground and labour at ten cents a pound.

I now proceed to the colour which, of all others, is the most complicated, and the fastest of beautiful colours, the Turkey red. Mr. Wilson, of Manchester, whom I well knew, in the year 1782 or 1783, was at the expense of sending a man to the Levant, to learn how to dye this colour, and he brought home, if not the process, the principles. Mr. Wilson dyed a madder red, and indeed every other colour, in a manner hardly, if at all, exceeded by any knowledge of the present day. Indeed he went to the expense of the printer's mordant for his common madder reds. In the year 1765, the French government published an imperfect account, which may be seen in D'Apligny, but the dyers of Rouen, from 1780 to 1790, dyed it so well, that they obtained almost a monopoly of the market.

About the year 1785 or 1786, a M. Borell, who had worked at Rouen, sold the process to the chamber of manufactures at Manchester, where it has since been dyed as well as a :y where else. The process of Borell has been published by Mr. Henry of Manchester. In 1790, a M. Papillon sold to the dyers at Glasgow another Turkey-red process; Bancroft has given it (vol. 2, p. 186) with remarks; but as I prefer Borell's upon the whole, and have my own remarks to make on it, I shall give it here; the more especially as Turkey or Adrianople red is the only process of the cotton dyer which throws light on the theory of cotton dyeing, and points out the real path that leads to future improvement.

The process I am about to give differs from Dr. Bancroft's, which is Papillon's, and which I disapprove of in many respects: I extract the following from Mr. Henry's paper, who copied it from a process purchased of M. Borell, who dyed the colour very well; and who went through the process in the dye house of John Philips and Company. 3 Manchester Transactions, p. 380 et seq.

"It is proper to premise that all the wooden vessels employed should be made of deal, or some white wood free from astringent matter; (that the cotton should not be more than half bleached, or rather perfectly cleansed from dirt and sowens. *T. C.*) and that the most convenient quantity to operate on, in proportion to the ingredients used in the several operations, is sixty-six pounds of cotton.

"From sixty pounds of Alicant barilla, a lixivium or ley is drawn by means of soft water, amounting to sixty gallons; and then by the pouring on of fresh water, a second ley is formed, measuring forty gallons; after this a third ley is also extracted from the same barilla, the quantity of which should be about fifty-two gallons.

" A liquor is also prepared consisting of four gallons of sheep's dung, collected after it has been excreted from the animal, and before it has been exposed to rain, dissolved in twenty gallons of water, and strained through a hair sieve to separate it from the grosser parts.

" These preparatory measures being taken, the *first* operation consists in adding nine pounds of Gallipoli oil to eight gallons of the second barilla liquor; this forms a kind of soap, to which are to be added, twenty-four gallons of the first barilla liquor, twelve gallons of the dung liquor, and forty-eight gallons of soft water. Into this liquor, when nearly of a scalding heat, the cotton is to be put, room being made for it by taking out about twenty gallons of the liquor, which is to be gradually returned into the pan in proportion to the waste by evaporation, and the whole is to be kept boiling during five hours, after which the cotton is taken out of the pan, suspended over it to drain, and then well wrung, washed in clear water, and hung on smooth poles to dry, either in the open air or in the stove room; but the former is to be prefered if the weather be fair.

" The liquor wrung out of the cotton, is to be preserved, together with the remainder in the pan, for a future operation; and at this time sixteen gallons of soft water are to be added to the dung liquor.

"The *second* operation consists in pouring three pounds and a half of Gallipoli oil into a bucket containing four gallons of the second barilla liquor, and adding this mixture to six gallons of the first barilla liquor, and four gallons of the dung liquor: of this composition two or three gallons are to be put into a tub, and in it about a pound and a quarter of the cotton is to be well soaked, and afterwards wrung, but not too closely, over a tub kept for that purpose. A similar portion of cotton is then to be treated in the same way, and so on till the whole has passed through the mixture, adding about a pint or three half pints of liquor, on the immersion of every fresh parcel of cotton. The cotton is then to be thoroughly dried, which also it must be after the subsequent operations; and these are to be conducted in the same manner with respect to the manipulations, (workings or handlings of the goods,) as in the present one.

"In the *third* operation, the liquor which had been wrung out of the cotton, is to be poured back into the tub in which the soaking has been performed: and to this are to be added of Gallipoli oil three pounds and a half, and of the second barilla, dung, and first barilla liquors, four gallons each. After this operation the dung liquor is to be strengthened by the addition of about two handfuls of sheep's dung diluted with a little water.

"The *fourth* operation is similar to the third: the liquor which remains is to be set aside for the purpose of mixing with the residuary liquor after the eighth operation, to be used for other cotton in any subsequent process.

"The dung liquor is omitted in the *fifth* operation, and the mixture employed in the three following operations is called the *white* liquor, to distinguish it from that used in the four preceding parts of the process, which from the colour imparted by the dung is named the *green* liquor.

"The same quantity of oil as before is to be mixed in a bucket with four gallons of the second barilla liquor, and poured into a tub, where are to be added to it three gallons more of the same liquor, and four gallons of the first barilla ley. About four gallons of this liquor remain after the wringing, and these are to be added in the

"*Sixth* operation, to the same quantity of oil, first mixed with four gallons of the second ley, and then with two gallons (more or less in proportion to the quantity of white liquor remaining after the preceding operation) of the same ley, and four gallons of the first.

"In the *seventh* operation the quantities of all the ingredients are the same as in the sixth. The residuum of the white liquor, after the three last operations, will be about eight gallons, and is to be preserved to be used in the fourteenth operation.

"The *eighth* operation consists in heating the third barilla liquor, amounting to fifty gallons, to about the warmth of new milk, removing it when thus warmed from the copper to a tub; immersing the whole of the cotton therein, and suffering it to remain for twelve hours or longer. It is then to be taken out and laid on a cloth spread on four or five sticks placed across a large tub, into which the liquor drains as it runs from the cotton. The cotton is then to be well wrung, and afterwards thoroughly washed, that no loose oil may remain, which would be injurious to the next operation.

"The wringing tub and peg are now to be well washed, and a fresh set of poles used: for if any oil were to come into contact with the cotton in the next parts of the process, it would receive a blackish tinge in the dyeing.

"The galling forms the *ninth* operation. Sixteen pounds of galls, or if blue galls be used, a somewhat smaller proportion, are put into twenty-four gallons of water nearly boiling. The liquor is then brought to boil and the ebullition continued for fifteen minutes; but as soon as the boiling commences, the fire should be withdrawn, as the heat already received will keep it up for a sufficient time, and the galls will not settle if the boiling be too violent. The liquor is to be carried to the wringing tub in the quantity of three or four gallons at a time, according as it is soaked up by the cotton, till one half of it has been thus employed; and the cotton is to be worked in it as hot as possible, by means of a stick passed through the skeins: after this it is to be dried either wholly or in part in the open air; if it cannot be thus completed, (for rain would in this state, and especially as the cotton approaches to dryness, be highly prejudicial,) the drying must be finished in a stove room. The liquor which has been wrung out is to be added to the remaining half in the copper.

"For the *tenth* operation, this remaining decoction of galls is to be heated; the thick sediment at the bottom being previously separated by a hair sieve, and the cotton again treated as in the ninth operation.

"The *eleventh* operation is the aluming of the cotton. Thirty pounds of Roman alum, finely powdered, is put into sixteen gallons of water, gradually heated and continually stirred. When it becomes so hot that the operator cannot easily bear his hand in it, the fire is to be removed. Six gallons of the first barilla liquor, are then to be added by degrees, and the whole agitated till the solution is complete. The cotton is to be placed in the wringing tub, about three gallons poured on it, and in proportion as the solution is soaked up, more is to be added till about one half of it is employed. The cotton having been thoroughly worked in the alum liquor, is to be well wrung and dried, and the portion which is wrung out, is to be returned to the remainder in the pan, and used in the *twelfth* operation, which is performed exactly in the same manner with the eleventh. After this, the dried cotton is to be well washed by handfuls in running water, the workman holding in each hand about twenty ounces of cotton for two minutes. Each portion is then wrung and separated, washed and wrung again, and laid upon a coarse cloth. The whole is then carried up from the river, wrung a third time, and hung to dry. The cotton will now be ready for the *thirteenth* operation, in which the colouring substance is applied to the cotton.

"The cotton is first divided into four equal parts, each of which is to be dyed separately: and these are subdivided into skeins or parcels of about a pound and a quarter each. The copper pan is then to be filled with water within about six inches of the top; and twenty-six pounds of Smyrna, or rather of Cyprus madder, added to it. So soon as the water becomes milk warm, fourteen pounds of sheep's blood as fresh as it can be procured are to be stirred into it: when the liquor is so warm that the workman can just bear his hand in it, one-fourth part of the cotton is to be put into it, suspended on sticks, by means of which it is moved backwards and forwards in the pan every five minutes, and the skeins are to be inverted every ten minutes, so that they may receive the dye equally in every part. This business is continued for about fifty minutes. The cotton is then hung on five sticks only, and so suspended by strings as to be wholly immersed in the liquor, which is now to be made to boil, and continued boiling for forty-five or fifty minutes. A white froth about this time appears on the surface, and is a sign that the madder is exhausted of its colouring matter, and the cotton can receive no benefit, though it will get no injury through continuing longer in the liquor. It is then to be withdrawn, carried to be well washed in the river or wash wheel, and then wrung and dried.

"The other three-fourths of the cotton are then to be successive dyed in the same manner, fresh ingredients being used for each parcel.

"The *fourteenth* operation is represented as highly essential to the success of the process: should it be omitted, the colour it is said would not only be so unfixed as to lose much in the subsequent operation, but would likewise require more time for the enlivening (avivage.) About eight gallons of the white liquor, which remained after the seventh operation, and were directed to be reserved, are now to be mixed with four gallons of the first barilla ley. Two gallons of this mixture being put into the wringing tub, the whole of the cotton is to be washed in it, adding more liquor in proportion as it is soaked up by the cotton, which is afterwards to be wrung, washed and dried. (This amounts to soaking the dyed cotton in a solution of imperfect soap, made with carbonated soda and oil. *T. C.*)

"To this succeeds the *fifteenth* and last operation, namely, that of enlivening or reviving the colour. The copper pan being about half filled with water, twenty-eight or thirty gallons of the liquor remaining after the first operation, are to be added, so that the liquor may reach to within six inches of the top. When the liquor is nearly boiling, the cotton is to be put in, being previously formed into parcels of about two pounds and a half each; nearly four ounces being kept separate for a purpose to be hereafter described.

"The cotton is be well pressed down in the pan, and confined by sticks. The pan is covered with a wooden lid, having a small hole, through which the small portion of cotton reserved for that purpose, may be occasionally withdrawn, in order to observe the progress of the operation. This hole has a moveable cover.

The lid is then to be secured by a strong cross of wood with a straight piece over it, and the sides made close, so as to confine the vapour, by laying round the edges of the lid, a quantity of damp linen cloth. The fire is then to be raised, so as to make the liquor boil; and the boiling to be continued for nine hours.

"The process is finished by taking the cotton out of the liquor, wringing, washing and drying it. But the drying is never to be performed either in a stove room or in strong sunshine. The colour will be most brilliant if the cotton be dried in the shade, with free access of air."

It appears from the account of the gentlemen appointed at Manchester to superintend and repeat M. Borell's process, that the cotton had increased to the amount of one-fifth of its original weight, previous to the maddering or imparting the colouring matter, though it had been well washed previous to that opetion. This increase arose assuredly, from the effect produced by the oil, and by the galls, in combining with the earth of alum and fixing upon the cloth. For there is no doubt whatever, but the alum would be decomposed by both these substances, and insoluble compounds would be thus formed.

The reader having attended to Borell's process, as I have thus given it, which I well know to be sufficient to produce a good colour, living at Manchester at the time and long after, and being attentive to the proceedings that took place on the occasion, I wish him carefully to read over the process of Papillon, as detailed by Dr. Bancroft, with the Doctor's remarks upon it, wherewith I fully agree. If a man will be a dyer and understand his business, he must study and repeat in a small way the Turkey red process, which however complicated, and in many respects unscientific, is the most instructive process in the whole art of dyeing upon cotton.

I mean this book to consist of practice and not of theory; but some remarks and explanations—some reason for prefering one process to another, is indispensable. But it would lead me beyond my proposed limits of remark, if I were to discuss at length, all the circumstances that induce me to make the following observations on the Turkey red dye.

1. The *decreasage* or half bleaching may be done in the common way at a bleacher's, better than in the first step of the Adrianople red. The goods should be perfectly clean from all kind of dirt and no more.

2. The Gallipoli oil is used commonly for cheapness; but it has a far better recommendation. It consists of the dregs and mucilaginous part of olive oil after the clear part long left to settle, is drawn off. It is in my opinion of value in the Turkey red, in proportion to the mucilage it contains: for chemists know that mucilage forms an insoluble substance with tannin, as well as gelatine.

The Gallipoli oil might be superseded by the oil of poppies, of the sun-flower, or by the oil of the Benny nut, which I think is sesamum. But I am inclined to believe, that whale oil, spermaceti oil, or hogs lard, would answer a purpose at least equally good. I think the tannin of the galls would unite more insolubly with the animal mucilage of these impure oils, than with vegetable oils.

3. The intent of mixing alkali with the oils is to form an *imperfect* soap. Papillon's proposal of adding lime, although it sharpens the alkali, is unscientific. We do not want to form a perfect soap: such a soap could not be easily decomposed. The substance wanted is that kind of uniform but still imperfect mixture, which the common carbonated alkali will form with the oil: the oil must not separate by the addition of water, but it must not be in perfect chemical union.

4. Alicant barilla is an extravagant article, that ought never to be used at all unless by the soap makers: it does not contain one-fourth of its weight of pure alkali in general. From an ounce, or 480 grains, 115,2 grains of pure soda were procured. The rest consists of neutral salts and other impurities. I am persuaded (not from practice, for the process is so troublesome, that dyers do not like to vary from the receipt) that one-third of the weight of potash would effectually answer all the purposes.

5. In Borell's process about one pound of barilla to the pound of cotton is used in 152 gallons of water. About thirty pounds of Gallipoli oil, as much alum, and sixteen pounds of galls, are used to sixty-six pounds of cotton. This does not vary materially from Papillon, whose oil of vitriol and sal ammoniac are manifestly deceptions. Borell uses somewhat more than a pound and a half of madder per pound of cotton. It appears to me that the alum is in proportion unnecessarily large.

Papillon uses one hundred pounds of barilla, one hundred pounds of lime, twenty pounds of pearl ash, fifty pounds of oil, twenty-five pounds of galls, fifty pounds of alum, and (if I understand it rightly) two hundred and fifty pounds of madder. An enormous proportion both of alum and madder. At Rouen they use, according to Vitalis, two pounds of madder per pound of cotton; a quantity, of which I am well persuaded, one fourth at least is wasted. I do not believe that cotton can be made to take up per pound, the colouring matter of more than a pound and a half of good madder.

6. I greatly approve of the two distinct processes of animalization, in this dye: first with the sheep's dung, secondly, with the blood. I know the effect is not only good but indispensable to the perfection of the colour, and I strongly incline to recommend this practice to be extended to all madder reds and colours of which madder red is the basis. It well deserves to be tried also on blacks; a colour, which on cotton is apt to wear very rusty.

7. Whether the alkali added to the alum liquor is of use, I am not prepared to affirm or deny. It will certainly precipitate the earth of alum: whether that can be taken up again and uniformly combined with the cloth appears to me uncertain.

8. The avivage or enlivening, is a very clumsy part of the process. I know by experience of my own in a large way on the Turkey red, that the best and simplest avivage, (brightening, or enlivening after dyeing) is by boiling the dyed goods in soft

water with an ounce of white soap to the pound of dyed cotton.

This process is so dear, from its tediousness and complication, that I have made many attempts to shorten it, and make it come cheaper. When madder is two shillings sterling per pound, this colour cannot be dyed much under five shillings sterling per pound. No brilliant Turkey red can be procured from grappe or crop madder. The Lizari madder roots, or the madder from Cyprus, are necessary. But a colour nearly approaching to the Turkey red, I have dyed thus.

The Editor's Process for dyeing an imitation of Turkey red.

Take your half bleached cotton hanks. Work them for an hour and a half in a bath composed of two ounces of bruised galls and six ounces of sumach to the pound, boiled for two hours previously, and strained through a sieve. Wring them, open, and cool. While they are very slightly but uniformly moist, boil them in an alum bath of two ounces of alum to the pound of cotton for about an hour; drain, wring the cotton moderately, so as to leave it equally moist: then run it for half an hour through a warm sheep's dung liquor, of a pint of fresh dung to the pound of cotton; mix the dung with a sufficient quantity of water at the heat of about 115° or 120°. Then stream or rince the cotton in clear water immediately out of the dung liquor.

Fill up the astringent bath of galls and sumach with a sufficient quantity of water to work the cotton in, and then break into it four ounces of madder to the pound; bring the liquor to a scald, or from 150 to 160° of the thermometer, and work the cotton in it at this degree of heat for an hour, or till the froth is no longer coloured by the madder. Drain, wring, and rince the cotton well: dry it in a moderate heat not exceeding 115° of Fahrenheit's thermometer.

Prepare a solution of the acetat of alumine or common mordant used by the callicoe printers, thus: for each pound of cotton, take four ounces of alum, and five ounces of sugar of lead; dissolve the alum and the sugar of lead separately, each in one quart of hot water, and when dissolved add the two hot solutions together, stirring them for five minutes. Let them settle for an hour: pour off the clear liquor; wash the remainder in a quart of hot water, let it stand for an hour; pour off the clear liquor and add it to the first or strongest portion. You will now have not quite three quarts of liquor for each pound of cotton. Put this liquor in a copper with two quarts more of water, and heat it; when blood warm enter your cotton, and work it for half an hour at a heat you can bear your hand in, or about 130° of Fahrenheit, by which time the cotton will be thoroughly soaked; take it out, lay it in a tub, and when this preparation liquor is brought to a full scald, team it upon the cotton, and let the cotton remain soaking in this liquor all night, covered with cloth to keep in the heat. Then drain it, wring it, and run it for twenty minutes through a blood-warm liquor of sheep's dung. Then immediately rince it, and wring it again, leaving it moderately but evenly moist.

Now dye it in a bath at 160° (not higher) of twenty ounces of madder, and half an ounce of brazil, and half a pint of blood to the pound of cotton, till the madder colour is exhausted. (If the colour is not full, run it through the printers' liquor again with water enough to work the cotton in, and then through a madder bath with two ounces of madder and half an ounce of brazil to the pound.) Enliven by boiling in white soap and water, an ounce to the pound of cotton, for a quarter of an hour.

A good colour and fast may be dyed thus. Steep for six hours or more in a bath of printers' liquor, made as above, using four ounces of alum to the pound of cotton. Drain, wring. Then run it through a moderately hot sheep's dung liquor; rince it; then dye with fourteen ounces of madder and half a pint of blood to the pound of cotton. Wash the dyed cotton and dry it. Then run it again through printers' liquor and sheep's dung. Then dye with ten ounces of madder, and half an ounce brazil to the pound. Wash and dry. Enliven with an ounce of fine white soap to the pound of cotton, boiling it in water so mixed with soap for half an hour. The brazil improves the hue of the dye. A little olive oil in the enlivening would improve the cotton both to the sight and the touch.

Haussman's method of dyeing Madder Red. Dissolve one part potash in four parts boiling water, and add half a part of lime. Dissolve separately one part alum in two parts boiling water, pour the clear alkaline solution into the solution of alum, which will be first precipitated and then the precipitate will be redissolved.

Mix with this liquor a thirty-third part of linseed oil, and shake it well. Let the skeins remain immersed therein for some hours; press them equally, and hang them on poles to dry in a warm place. When dry wash them well in clear water. Repeat this operation (the immersion and the drying). Dye with madder from an equal weight to thrice the weight of the cotton, adding always one part of chalk or whiting to six of madder. Repeated immersions and dyeings will make the colour fuller and faster. If you dye with three pounds of madder to one pound of cotton, this last will require at least three immersions in the oily liquor.

On this process I would observe, that I do not know that it has been employed. Fish oil or Gallipoli oil would doubtless answer as well as linseed oil. The proportion of a thirty-third part of oil must not be exceeded. Haussman sometimes gives four pounds of madder to one of cotton. It is certainly a mistake not to employ galls. The experiment has not been repeated that I know of.

The proper proportion of water to madder in a madder bath, is from ten to twelve quarts to the pound of madder; a very concentrated decoction does not give out the colour freely.

This colour is not so bright or so fast as the Turkey red, but it is a better colour than the common madder red in all respects; and intermediate between the printers' red upon printed callicoes, and the Turkey red.

It may be taken for granted, that cotton is made to approach the nature of woollen, and all dyed colours upon cotton are rendered more permanent than otherwise they would be, by the use of blood, and sheep or cow dung, or of a solution of glue. Soaking in oil also makes the colour somewhat more fixed. After making this observation, founded on the practice of the callicoe printers, and on the method of dyeing Turkey red, I shall not insist on the use of these animal substances in the other dyes, because I believe they have never yet been adopted, although I am fully convinced that they ought to be.

Browns and Chocolates, are dyed with various proportions of iron liquor mixed with the alum. They are merely mixtures of black and red, wherein the black colour is produced by iron.

Violets. The cotton being dyed a light blue, is galled with two ounces of galls, and four of sumach; in this liquor they remain for a dozen hours: drain, wring them: then prepare them with half an ounce of alum and a quarter of an ounce of verdigris; drain, wring, rince and dry them: prepare a bath of half a pound of logwood for each pound of cotton: dye them in one half of this logwood liquor; take them out and wring them. Run them again through the alum liquor, refreshed with half an ounce of alum: drain and wring them. Then dye them in the other half of the logwood liquor with half an ounce of red-wood.

In this dye, which is not very permanent, you may alter the proportion of the ingredients, according to the shade of colour required.

Permanent violets can be dyed with madder and logwood, after preparing in iron liquor, with alum and blue vitriol: or still better, by giving a ground of blue in the blue vat, and then dyeing a red with madder and brazil or brazilletto.

It is impossible to give directions for all the various shades of browns, chocolates, purples and violets, as slight variations in the proportions of the ingredients may be easily made to suit each tint of colour.

Of the Yellow Dye upon Cotton. For this colour, it is not necessary that the goods should be more than half bleached.

For a full colour of a bright greenish yellow, use weld.

Prepare in a bath of four ounces to the pound of alum and half an ounce of blue vitriol, by boiling the cloth or yarn in it for an hour, and letting it remain in the liquor till cold. Drain it, wring it so as to be moderately moist. (I should then run it through a sheep's dung liquor at the heat of 120° at the utmost, using a pint of dung, and half an ounce of pearl ash, to the pound of cotton; but this is never done, because the dyers do not improve their own processes by those of the callicoe printers. *T. C.*) Let it remain in this wrung and slightly moist state, for twenty-four hours.

Prepare a dye bath of a pound and a quarter to a pound and a half of weld and two ounces quercitron to the pound of cotton, by boiling the weld and bark in a sufficient quantity of water for two hours; then take out the bundles of weld, and strain the liquor. Enter the goods when the liquor is warm, and bring it up to a scald, at which heat continue the dyeing, till the colour is exhausted or the required shade is obtained. This colour may be enlivened by boiling for half an hour in an ounce of white soap to the pound of cotton.

The shade of yellow may be altered by omitting the blue vitriol or blue copperas, by diminishing the alum, by adding an ounce of pearl ash per pound of cotton to the weld liquor.

D'Apligny, whose directions I have not exactly followed, says that a good yellow may be dyed on cotton by turmeric; and that it can be fixed by means of a solution of sulphur of antimony in fixed alkali. This may be so, but I do not know any thing practically on the subject. I am not sanguine about its success, not having any approbation to bestow upon turmeric.

I say nothing about dyeing cotton yellow with the numerous tribe of yellow drugs that are mentioned in the common books of dyeing, because, as I have said before, two or three drugs easily procured, and with which the dyer is well acquainted, will answer all the required purposes. I know that the hickory, the barberry root, the golden rod, the yellow broom, the poplar, and many others, may be employed for yellows; but a dyer needs only weld, quercitron and fustic (old fustic). Indeed the latter might be discarded, for it is a dull and fugitive colour, and not much cheaper here, if at all, than our native quercitron, which is now the staple yellow of Europe.

When quercitron bark is used instead of weld, Bancroft prescribes at the utmost but eighteen pounds of bark to one hundred pounds of cloth, or of yarn. The quercitron I know goes far in point of colour, but it must be very choice to produce a full colour with a quantity so small. If for eighteen pounds we read twenty-five, I do not think there will be reason to complain of the alteration. The preparation or mordanting, may go on as above directed in the case of weld. But the cloth or cotton, he says, should be entered into the dye bath when cold, and the heat brought up gradually, and a boiling heat should not be used for more than five minutes, because it is apt to brown the colour; which I think is right.

He is of opinion with Chaptal, that a small quantity of lime added to the quercitron bath improves the colour.

He finds that the durability of the colour, both of weld and quercitron, is improved by the additon of a small quantity of sulphat of copper (blue vitriol or blue copperas); but he, with D'Apligny, advises it to be applied in a separate bath after the cotton is dyed. I am not persuaded that the difference is worth the trouble of a separate operation.

He seems to think favourably of Haussman's recommendation of adding chalk to the aluminous solution to destroy the effect of the superfluous acid: I have read so many processes of Haussman in which I put but little faith, that I am not inclined to adopt this. If my method of using the dung liquor with pearl ash, after aluming, be adopted, the chalk is rendered unnecessary. Of the utility of my proposal I entertain no doubt.

Bancroft recommends as an aluminous mordant, the acetat of alumine or printers' liquor, to be substituted instead of the sulphat of alumine, or common alum. For this purpose, he recommends, to obviate the objection of expense, only one pound of sugar of lead to three pounds of alum, though he acknowledges that it requires a pound of sugar of lead to decompose a pound of alum. For my own part, having made experiments to ascertain this important fact, I find that one pound and a quarter of sugar of lead is hardly sufficient, but that it requires nearly one pound and a half of this substance to decompose a pound of alum, and to form a perfect acetat of alumine. A fact which the reader would do well to ascertain for himself. Of this I shall say more when I come to the mordant for callicoe printing.

I have no objection to the acetat of alumine as a mordant, of which I full well know the value; but it is still too dear for common work: nor can this objection be fully obviated, by employing white lead or litharge dissolved in vinegar, though I believe some expense may now and then be thus saved. But common vinegar is foul, and often contains iron; whereas sugar of lead, which is made from distilled vinegar, can always be depended on.

Bancroft recommends using the acetat of alumine in solution, warm and not hot: then to dry the cotton impregnated with it, in a stove heat: then to soak it again in the acetat of alumine: then to moisten, or rather wet it with lime water, to prevent the bad effect of the vinegar on the colouring matter in the dye-bath: then to dry it again in a stove heat: then to soak it again (for a full colour) in the acetat of alumine, and again to moisten it with lime water; then to dry it, and afterwards dye it. I have no objection to all this, but the trouble and the expense.

I think the sheep's dung or cow dung liquor will answer a better purpose than the lime, and it has the sanction of experience in every callicoe printing shop to support it: but I have no objection to two soakings for a full colour.

Of Yellow with Fustic. This is a cheap, and therefore an useful dyeing drug, but the colour is neither so good nor so fast as weld or quercitron.

The common mordant is alum and verdigris in the usual proportion; but fustic is better adapted for drabs and olives than it is for yellow alone. Chaptal says that the muddiness of the fustic colour is owing to an astringent part, or coloured tannat, which can be thrown down by a solution of glue, and then the yellow is as clear and as bright as a weld colour.

Of Buff Colour upon cotton. The finest buff I ever saw I dyed myself on some white velveret with nitrat of iron recently made, and raised it in lime water; but this colour is too dear for common use, though it will pay well enough in fine goods. In Manchester, they use tinned iron plates dissolved in nitric acid, which is no improvement, for the tin is so much oxyded by the aqua fortis, that it falls down in a white insoluble sediment. I do not know that the tin would be any improvement if it could be applied to the cloth, for a buff colour; but to do this, the mordant must be tin plates in aqua regia made with equal parts nitric and muriatic acid, and the tin dissolved slowly.

Common buffs are made by an iron stain, given by dipping the goods in a hot solution of green vitriol; then take them out, wring them, open, and air them; then raise the colour in lime water. Repeat this according to the depth of the colour required. All these buffs stain with tea.

Fugitive buffs are made with fustic and annatto, but this ought not to be used even on the commonest goods.

Nankin Colour. I am not certain whether the imported nankin coloured callicoe be dyed or not. I have seen cotton wool of that colour. Be that as it may, we have no perfect imitation of it. The best I know of is this.

Prepare your cotton in printers' mordant diluted as little as possible, soaking the cotton in the mordant blood warm for several hours. The quantity of mordant used may be in the proportion of four ounces of alum to the pound of cotton, with the necessary portion of sugar of lead. Then wring the cotton, and having made a solution in five quarts of water of two ounces of galls to the pound by boiling them till soft, and then straining the liquor, let it remain till it is at the heat of 120°, and then add a pint of sheep's dung to the pound; work the cotton in this liquor during an hour at this heat, and let it remain soaked therein for a couple of hours more; wring it, and rince it. Then dye it in a decoction of mahogany shavings at the rate of a pound and a half to the pound of cotton, at a full scald or boiling heat, for an hour. Drain and wash it. If you want a deep colour, repeat the whole process.

If the acetat of alumine made as above directed (with about a pound and a quarter of sugar of lead to a pound of alum) should be too dear, Bancroft's proportion may be used of one pound sugar of lead to three pounds of alum; or even alum alone might be used, putting half an ounce of pearl ash into the dung liquor.

Orange. Dye the cloth a crimson with the tin mordant, and brazil, with a little cochineal: then run it again through the mordant and use two ounces of quercitron to the pound of cotton.

Red Cinnamon. Madder will not produce an orange colour, but it will produce a red cinnamon colour. Dye the cotton with alum two parts, blue vitriol half a part, and weld or quercitron in proportion. If weld, use half a pound to the pound of cotton; if quercitron use three or four ounces to the pound. Wash the cotton.

Then refresh your preparation bath with two ounces of alum to the pound; work the goods as usual for an hour: then dye with two ounces of galls and fourteen ounces of madder to the pound. Brighten the colour by boiling for half an hour in an ounce of soap to the pound of cotton.

The following transcript of my notes on dyeing, taken while I attended to those subjects at Manchester, are worth perusal as a summary of the actual processes there for dyeing on cotton. I copy them somewhat enlarged from the Domestic Encyclopedia of Dr. Mease, to whom I gave them.

Drab Colours. The mordant or preparation, two ounces of alum and as much green copperas to the pound of cotton. Dye with fustic and sumach, of each half a pound, for a full colour. There can be no doubt with me but an intervening dung liquor would fasten and deepen the colour.

Greenish Olive. The mordant or preparation, three ounces green copperas, and one ounce of blue copperas. Fustic and logwood, of each half a pound.

Brownish Olive. In lieu of three ounces of fustic and as much logwood in the preceding receipt, added six ounces of sumach. If for a reddish olive, add a couple of ounces of madder, and an ounce of alum in the preparation instead of an ounce of the copperas.

Mud Colour. Prepare with equal parts of alum and copperas, and dye with sumach.

Bloom. Prepare with alum and copperas, three ounces of alum and one of copperas. Or for a fine colour prepare with the common scarlet composition, or tin in nitric acid with sal ammoniac and nitre. Dye with equal parts of logwood and sumach. Tin dissolved in three parts nitric acid, and one muriatic acid, will answer: or equal parts of the two acids.

Purple. Prepare with the common tin mordant. Dye with logwood and brazilletto, adding an ounce of verdigris to the pound of cotton.

Chocolates and Browns. Prepare first with green copperas two ounces to the pound of cotton; then dye with twelve ounces of fustic, and half an ounce of pearl ash: wash and dry: then add to the green copperas liquor, an ounce of blue copperas, and work the goods in it: then dye in logwood liquor, four ounces to the pound: then finish with Brazil and the tin composition if a bright colour be wanted. I think the cloth might be prepared at once and dyed at once, with the above ingredients of green and blue copperas together in the preparation, and fustic and logwood in the dye liquor, and then finished if necessary with tin and brazil.

Fast Buffs. Tinned iron plates, (refuse cuttings of a tinman's shop) dissolved in aqua regia, three parts nitric and one muriatic acid. Then raise the colour in lime water, about half a pint lime to the gallon of liquor. Repeat the process for a full colour.

Nankin. Prepare with alum: add to a decoction of fustic, as much solution of Spanish annatto in pearl ash as is necessary to give the required colour. This is not a colour that will bear washing, the annatto being fugitive.

Another. Prepare with a mordant of three ounces of alum and as much tartar or argol dissolved in water, in proportion of a pound of alum and a pound of argol, to two gallons of water. Immerse the cotton yarn in this hot solution for two hours; drain it; wring it; dye it in a decoction of mahogany shavings pound for pound.

Or, prepare the cotton in the second red of the printer's mordant, then dye with mahogany. Finish by running it through a weak tin mordant.

Chamois. Add a little sumach to the mahogany.

Fast Yellow. Prepare with alum and dye with weld or quercitron. Or prepare in the second red liquor.

Common Yellow. Alum, then dye with quercitron or fustic, and verdigris.

Fast Green. Indigo blue ground, prepared with alum, or second printers' red, and dyed with weld or quercitron.

False Green. Prepare with one ounce alum, and two ounces blue copperas: dye with four ounces fustic and twelve logwood.

Bottle. Instead of fustic, take fustic and sumach equal parts, with a little green copperas in the preparation.

Fast Violets. A light indigo blue; then prepare either with two ounces alum, or a second printers' red, and dye with madder and brazil.

Common Violets. Prepare with alum; dye with logwood.

Plumb Colour. Prepare first with galls an ounce to the pound. Then with alum. Then dye with brazil, and logwood.

Flea or Puce Colour. Dye first with annatto and pearl ash: then prepare with galls; then with alum; dye with logwood and a little brazil.

Coquelicot. A ground of annatto; galls an ounce to the pound; alum two ounces to the pound, or even three ounces; dye with logwood, putting in a little brazil toward the end of the dye.

A more fugitive coquelicot is made with saffron instead of annatto, but a brighter colour.

Grays. Galls, logwood, oak sawdust, according to the required shade; preparation, green copperas, and now and then a very small quantity of blue copperas.

Black. Dye a deep fast buff, raised either in lime or alkali; dye with oak sawdust, logwood, and either galls or sumach, with a little verdigris.

Or, dye a deep raised buff; then with half a pound logwood, two ounces galls, twelve ounces madder, with about six ounces sumach or alder bark. If the colour should not be deep enough, run it again through the astringent liquor with a little verdigris.

Red for Common Reds; gall the cotton; alum it; dye with a pound and a quarter at least of madder to the pound of cotton. The cotton must be a good half-bleach colour.

Or, for very fine and fast reds, soak the cotton for four or six hours in the common printers' mordant for first red; drain and wring it; gall it with three ounces to the pound of galls; dye it with a pound and a half of madder and two ounces brazil to the pound. Brighten with an ounce of soap, boiling it for fifteen minutes, putting in the cotton when the soap is dissolved. This is a good and rich colour, but expensive.

Turkey or Adrianople Red. Boil the gray cotton in water for an hour and a half, with an ounce of soft soap to the pound. Wash it. Dissolve in five quarts of water an ounce of pearl ash, and an ounce of fish oil or Gallipoli oil to each pound of cotton. Let the cotton macerate in this liquor hot, for six hours; wash it. Immerse it during ten days in fish oil. Wring it, rince it well and hang it up to dry. Gall it, with four ounces galls, and as much sumach, to the pound: wring and rince it; run it for an hour and a half through alum liquor, four ounces to the pound. Again through the astringent liquor; again through the alum liquor refreshed with an ounce of alum; then through sheep's dung; rince it immediately; wring it; then dye it in a madder bath of a pound and a half of madder, and half a pint of blood to the pound. Wash it. Brighten in white soap and water.

Pink. With safflower, as I have already directed.

Scarlet and Crimson. Tin in aqua regia as the preparation; then dye with brazil. Again in the preparation, and again dye in brazil with a little cochineal (a quarter of an ounce to the pound) for the finishing. Neither brazilletto, nicaragua, cam, or red-wood as it is called, will produce this colour. You cannot dispense with brazil unless you use cochineal.

SOME OBSERVATIONS

ON

CALLICOE PRINTING.

I HARDLY know any business on which so little has been written, or so little publicly known as callicoe printing. I cannot give here a full description of this very ingenious and important art, for want of some recent information I wait for, and for want of plates to describe the machinery; but my notes and observations taken when I attended to this business myself, will not be without their value at this day. Many processes have been improved, and some new ones invented, but the ground work of the art remains the same.

The following general view of the subject, (a few additional remarks excepted) I owe to Dr. Gregory; it is a good description of the general principles of callicoe printing, and will be a proper preface to what I have to say of my own knowledge.

Callicoe printing (art de fabriquer les Toiles peintes, ou Indiennes) is the art of communicating different colours to particular spots or figures which form a picture or pattern on the surface of the cloth, while the other parts retain their original whiteness. This art has been practised in India for more than two thousand years.

But in London, callicoe printing was not introduced till about the year 1676, since which it has been encouraged by several acts of parliament.

This art depends upon impregnating those parts of the cloth which are to receive a colour, with a chemical composition or *mordant* as it is called, and then dyeing it as usual with some appropriate dye-stuff. The dye-stuff but slightly stains the parts of the cloth, not impregnated with mordant, but the colouring matter attaches itself firmly to that part of the cloth that has received the mordant; so as to form a three-fold chemical union, between the mordant, the colouring matter, and the cloth itself. The cloth itself would form no chemical union with the mordant alone, which by repeated washings in hot water can be washed out—nor with the colouring matter alone, which a boiling in bran and soap and water, would easily discharge; but when the mordant, the colouring matter, and the cloth, meet together at a heat approaching to boiling, an union takes place, which the common processes of washing the cloth in a family when worn and soiled, seldom destroy entirely, though often repeated. The whole surface of the cotton is indeed more or less tinged, but by first boiling it with bran, and then washing and bleaching it for some days on the grass with the wrong side upwards, all the unmordanted parts resume their original colour, while those which have received the mordant retain the colour given. Suppose that a piece of white cotton cloth is to receive red stripes, all the parts where the stripes are to appear, are covered by mechanical contrivances with a solution of the earth of alum in the acid of vinegar, or acetat of alumine, known in a printing shop by the name of printers' mordant, red colour, or red liquor; after this the cloth is dyed after the usual manner with madder. When taken out of the dyeing vessel, it is all of a red colour; but by washing and bleaching, the madder is discharged from every part of the cloth which remains white, except the stripes impregnated with the acetat of alumine which remain red. In the same manner may yellow stripes, or any other wished for figure be given to cloth, by substituting weld, quercitron bark, or fustic for madder.

When different colours are to be given to different parts of the cloth at the same time, it is done by impregnating it with various mordants. Thus if stripes are drawn upon a cotton cloth with acetat of alumine, and other stripes with acetat of iron, and the cloth afterwards dyed in the usual way with madder, and then washed and bleached, it will be coloured *red* and *brown*. The same mordants with quercitron bark give *yellow*, and *olive-drab*.

The mordant chiefly employed in callicoe printing, are acetat of alumine and acetat of iron. These mordants are applied to the cloth, either by *blocks*, on which the pattern is cut, and some old hat or felt fixed to take up a fuller quantity of coloured mordant, or by *rollers*, on which the pattern is cut and which receive the mordant slightly coloured, by being made to touch thick cloth woven for the purpose whereon the mordant is smeared—or by a *pencil* dipped in the mordant, which is thus painted on the cloth. The mordant is slightly coloured that its boundaries may be seen. As these mordants are intended for particular parts only of the cloth, care must be taken that they do not spread to other parts which are intended to be white, and that they do not interfere with one another when several are applied; otherwise all the elegance and beauty of the pattern would be destroyed. It is necessary therefore that the mordants should be of such a degree of consistence, that they will not spread beyond the places of the cloth whereon they are applied. This is done by thickening them with flour either in its common state or dried to a brown colour, or by starch, or latterly in England by the mucilaginous extract of some of the class of lichens, when the pattern is to be printed by a block; they are thickened usually with gum arabic or gum senegal, when they are applied by the pencil. This thickening should never be greater, than is absolutely necessary to prevent the spreading of the mordants: when carried too far, the cotton is apt not to be sufficiently saturated with mordant, and of course the dye takes imperfectly.

In order that the parts of the cloth impregnated with mordant, may be distinguished by their colour, it is usual to tinge the mordants with some colouring matter or other. The printers commonly use the decoction of brazil for this purpose: but Dr. Bancroft has objected to this method, because he thinks that the brazil wood impedes the subsequent process, and is displaced during that operation, by the superior affinity of the dye-stuff of the mordants. Was it not for this superior affinity, the colour would not take at all. Dr. Bancroft advises to colour the mordant with some of the same dye-stuff that is afterwards to be applied, and he cautions against the using of more for this purpose, than is necessary to make the mordant distinguishable from the other parts of the cloth. The reason of this precaution is obvious. If too much dye is mixed with the mordant, a great proportion of the mordant will be combined with colouring matter, which must weaken its affinity for the cloth, and of course prevent it from combining in sufficient quantity to ensure a permanent dye. At present the parched flour suffices for the purpose of colour, and printers dispense with the brazil.

Sometimes these two mordants are mixed together in different proportions; and sometimes one or both are mixed with an infusion of sumach or nut galls. By these contrivances a great many varieties of colour are produced by the same dye stuff. Thus, reds, browns, chocolates, clarets, and even blacks may be dyed in one and the same madder copper, if the cloth be previously impregnated with acetat of alumine unmixed, with acetat of iron with a strong decoction of galls, and with acetat of alumine and of iron mixed together in various proportions. So yellows, drabs, olives and blacks may be in like manner produced from the mordants above mentioned, when the piece is dyed with weld or quercitron, and a little decoction of sumach added toward the last.

After the mordants have been applied, the cloth must be carried to a stove-room, heated something short of a blood heat, to be dried. This heat drives off gradually the acetic acid combined with the mordant, and produces a more complete union between the alumine and the cloth.

When the cloth is sufficiently dried it is to be winced through warm water and cow dung, till the flour, starch or gum used to thicken the mordant, as well as the superfluous part of the mordant itself, not combined with the cloth, are removed. The cow dung serves to entangle these loose parts of the mordants, and to prevent them from combining with those parts of the cloth which are to remain white. (The cow dung serves first, to combine with the mordant and prevent its spreading, by furnishing a small quantity of colouring matter; secondly, it furnishes also animal matter, which makes the mordant combine in greater quantity and more perfectly with the cloth; thirdly, it washes away, by means of warm water, the thickening, and the superfluous mordant. *T. C.*) After this the cloth is thoroughly rinced in clear water, quickly after coming out of the dung liquor.

Almost the only dye stuffs employed by callicoe printers, are indigo, madder, logwood, sumach, weld, quercitron bark, and fustic; and the latter might be dispensed with. Nor is weld used unless for delicate greenish yellows, on fine chintz patterns; although much of it is grown in England, but not quite so good as in France. Quercitron bark has nearly superseded the weld, because it gives colours equally good, and is much cheaper and more convenient, not requiring so great a heat as weld; nor does it stain the white so much as weld. Indigo not requiring any mordant, is usually either dyed with paste-work on reserves, or laid on with a block, or a pencil.

It is prepared by boiling together indigo, and potash made caustic by quicklime, and orpiment: the solution is afterwards thickened with gum. It must be carefully secluded from the air, otherwise the indigo would soon be regenerated, and the solution become useless. Dr. Bancroft has proposed to substitute coarse brown sugar for orpiment: it is equally efficacious in rendering the indigo soluble by deoxyding it, while it likewise serves all the purposes of gum.

Let us now give an example or two of the manner in which the printers give particular colours to callicoes. Some callicoes are printed only with one, some with two, three, or more, even to the number of twelve. The fewer the colours, the fewer are the processes necessary.

First, one of the most common colours on printed cottons, is a kind of *nankin yellow*, of various shades, down to a deep yellowish brown or drab. It is usually in stripes or spots. To produce it, the printers besmear a block cut out into the figure or pattern proposed, with acetat of iron thickened with gum or flour; it is then applied to the cloth in the usual way, which being dried and cleaned, is plunged into an alkaline ley made from potash (or into lime water. *T. C.*) The quantity of acetat of iron is always proportioned to the depth of the shade. Secondly, for *yellow*, the block is besmeared with red colour, or acetat of alumine; it is then run through cow dung, and washed, and dyed with weld, quercitron or fustic; and then boiled in bran and water, and bleached on the grass the wrong side upward. Thirdly, *red* is communicated by the same process, only madder is substituted for the yellow drugs. Fourthly, the fine *light blues* which appear so often on printed callicoes, are produced by applying to the cloth, a block smeared with a composition (paste or reserve) consisting partly of wax, which covers all those parts of the cloth that are to remain white. The cloth is then dyed in a cold indigo vat made with indigo, quicklime and green copperas, which does not affect the parts so protected by the paste or reserve. This is afterwards removed by washing in hot water. Fifthly, *lilac*, flea-brown, and blackish brown, are given by means of acetat of iron; the quantity of which is always proportioned to the depth of the shade. For very deep colours a little sumach is added. The cotton is afterwards dyed in the usual manner with madder, and then branned, and bleached on the grass. Sixthly, *dove colour and drab* are produced by acetat of iron and quercitron bark.

When different colours are to be applied and appear in the same print, a greater number of operations are necessary: two or more blocks are employed, upon each of which that part of the print only is cut, which is to be of some particular colour. These are besmeared with different mordants, and applied to the cloth, which is dyed as usual. Let us suppose, for instance, that these blocks are applied to cotton, one with acetat of alumine, another with acetat of iron, a third with a mixture of these two mordants, and that the cotton is then dyed with quercitron bark, branned and bleached. The parts impregnated with the mordants would have the following colours:

Quercitron bark with	acetat of alumine	would produce	yellow.
	iron		olive, drab or dove.
	the mixture		olive green, olive.

If part of the yellow is pencilled with an indigo blue, a fast green will be produced on the yellow, and other saddened shades of green on the other colours.

If the cotton is dyed with madder, instead of quercitron, the print will exhibit the following colours:

Madder with	acetat of alumine	would produce	red.
	iron		brown, black.
	the mixture		purple, chocolate.

According to the strength of the mordant, and the strength of the dye-liquor. If two or three reds of different intensities are required, it is managed by using the acetat of alumine strong for the deepest red, and diluted for the weaker shades. So a strong concentrated iron liquor, and plenty of madder, will produce a black; if weak, it will be merely a brown. In like manner the shades can be varied, when the same mordants are dyed with weld or quercitron bark. Different shades of colour will also be produced by the same mordants when dyed with logwood, as when we see black, gray, and purple, upon low-priced callicoes.

When a great number of colours are to appear, for instance when those communicated by bark, and those by madder, are wanted at the same time, mordants for part of the pattern are to be applied; the cotton is then to be dyed in the madder bath, branned and bleached: then the rest of the mordants to fill up the pattern are added, and the cloth is again dyed with quercitron bark, branned and bleached. The second dyeing does not much affect the madder colours, because the mordants that render them permanent are already saturated. The yellow tinge is easily removed by the subsequent bleaching.

Sometimes a new mordant is also applied to some of the madder colours, in consequence of which they receive a new permanent colour from the bark. After the last bleaching on the grass, new colours may be added by means of the indigo pencil-blue. The following table will give an idea of the colours that may be given to cotton by these complicated processes.

MADDER DYE.

Mordants.	*Colours produced.*
Acetat of alumine, - - -	Deep red.
diluted, - - -	Second red.
further diluted, - -	Third red.
Acetat of iron, - - - -	Brown or black.
diluted, - - -	Lilac.
Acetat of alumine and iron, -	Purple.

BARK DYE.

Acetat of alumine, - - -	Yellow.
iron, - - - -	Dove, drab.
Lilac and acetat of alumine, -	Olive.
Red and acetat of alumine, - -	Orange.

INDIGO DYE.

Indigo alone, - - - -	Blue.
Indigo on yellow, - - -	Green.
Indigo on brown or drab, -	Bottle green.

Thus may a dozen colours be produced on a single piece by varying these processes. The above require but two dyeings, one with madder, the other with quercitron or weld. (The addition of galls or sumach to the yellows, produces saddened varieties of yellow; and of logwood to madder, changes in the colour which madder alone would produce. *T. C.*)

(The blocks are smeared with the mordant in the following manner. By the side of the printing table stands a tub or drum (chassis) near to the printer. This drum is filled with thickening of paste, starch or gum, according to the required work, Over this thickening is closely and tightly fixed a covering of thick but finely woven cloth, usually manufactured for the purpose. This is kept moist by the thickening which it touches below, and upon which it is pressed every time the printer puts his block upon it. A little boy called a tear-boy has beside him a pot of the required mordant properly made and thickened by the colourman; he dips a brush in this mordant and smears enough on the cloth that forms the drum-head, for the block to take up and apply to the cloth. The printer usually presses the block twice on the drum-head so smeared, and when he fixes it on the cloth gives it a gentle blow with a wooden mallet.

In some cases, callicoes are printed by rollers, made of copper, accurately turned, and engraved with a pattern. Cloth is smeared with a mordant, and the rollers are so made to turn in contact with the smeared cloth, as to fill the pattern with the mordant, of which the superfluous quantity is scraped off by a plate of steel with a fine edge, which hangs loosely upon the roller the whole length of it, and is very accurately fitted to its surface. The motion of the roller against this steel *doctor* as it is called, occasions all the superfluous mordant to be scraped off, after which the callicoe immediately follows, and is printed by the pressure it undergoes between the engraved copper roller and another, immediately above or below it. The callicoe is then dyed in the usual way. Callicoes may thus be printed a single colour, at the rate of a piece every five minutes very easily. Indeed it does not take above a minute for the piece to go through. By means of a series of these rollers, three, and as I have heard even four colours have been printed, but I do not understand that they are much in use for more than a single colour.

In some cases, the pieces are printed not with a mordant alone and then dyed, but with the mordant and colour together, or with a colouring drug, that does not require a mordant; these are colours of application, or as the trade call them, *chemical colours;* a name not very characteristic. This mode of printing being not so permanent as when the colours are dyed, is seldom used unless for common goods, or such as are not likely to undergo frequent washings.

Another mode of printing lately introduced, is called discharging, when by means of an acid, such as the oxygenated muriatic acid, a piece of callicoe dyed throughout, has the colour discharged in certain spots or places that form a pattern upon the cloth. *T. C.*)

These remarks will serve to give the reader an idea of the nature of callicoe printing, and at the same time afford an excellent illustration of the nature of mordants in dyeing.

If it was possible to procure colours sufficiently permanent by applying them at once to the cloth by the block or the pencil, as is the case with the mordants, the art of callicoe printing would be brought to the greatest possible simplicity; but at present this can only be done in one case, that of indigo; every other colour requires dyeing. Compositions indeed may be made by previously combining the dye-stuff and the mordants. Thus *yellow* may be applied at once by employing a mixture of the infusion of quercitron bark and acetat of alumine; *red* by mixing the same mordant with decoction of madder, and so on. The colours applied in this way are unfortunately far inferior in permanency to those produced when the mordant is previously combined with the cloth, and the dye-stuff afterwards applied separately. In this way are actually applied almost all the fugitive colours of common callicoes which washing, or even exposure to air, will destroy. As the application of colours in this way, cannot always be avoided by callicoe printers, every method of rendering them permanent is an object of importance. *Gregory's Encyclopædia*, art. Callicoe.

Such is a general outline of the *theory* of callicoe printing. I proceed now to some notes on the *practice*.

There are few callicoe printers in this country; those who would wish to set up the business, will of course be glad to know, first, what kind of work and what kind of goods they can most conveniently begin with; and secondly, what capital it will require. I should be glad to furnish if I could, *accurate* information on these particulars; but the trade is so new here, that the country furnishes no data. The best I can do is to furnish my own memoranda of five and twenty years ago, from which persons interested in the question will be enabled, however, to form a tolerable judgment of the requisites of the concern.

The following then are the estimates of an establishment of twelve tables at a place and time, where and when common day labour was from twenty-one to twenty-four pence sterling per day, and thirty pence sterling to the common workmen in the bleach-field.

At the period in question, the following drugs sold wholesale at the prices I have set down.

	£.	s.	d.
Madder (Dutch) at all prices, from 50 shillings sterling, to per cwt. - -	5	10	0
The common price given for that used in good work was - - - -	4	10	0

	£.	s.	d.
Weld, per bundle of 28 pounds, - -	0	5	6
Quercitron bark, per ton, - - -	32	0	0
Old fustic, per ton, - - - -	10	0	0
New fustic (Venetian fustic) - -	9	0	0
Logwood, - - - - -	8	0	0
Sumach, per cwt. - - - -	1	2	0
Smyrna madder roots, per cwt. -	2	16	0
Brazil wood, per ton, - - -	100	0	0
Brazilletto, - - - - -	8	10	0
Cam wood, per cwt. rasped, - - -	1	4	0
Bar wood, - - - - -	0	16	0
Peach wood, - - - - -	0	18	0
Safflower, - - - - -	3	10	0
Galls, in sorts, - - - - -	7	10	0
Blue galls, - - - - -	9	10	0
Alder or oller bark, per cwt. about -	0	3	0
Saccharum saturni (acetat of lead)			
Alum in lumps, per cwt. - - -	0	16	6
Guatimala indigo, per pound, - -	0	11	0
Carolina indigo, - - - - -	0	3	6
East India indigo, about - - -	0	5	0

Of this last, as it was just known, little was used.

Gray callicoes, twenty-eight and a half yards long, were bleached for ten pence each, and sold when bleached, wholesale at eleven to twelve pence per yard, or rather twenty-five shillings per piece, for a three months bill. When they required to be fired to burn off the rough nap or pile, the bleacher charged a penny per piece extra. A *gray* callicoe weighed generally seven and a quarter pounds; when *bleached* six and a half pounds. At that time, the printing trade of Manchester and its vicinity, amounted from six thousand to six thousand five hundred callicoes per week.

At that time (as now) no printer found it his advantage to bleach his own callicoes; they were always sent to a regular bleacher, as they now are. So that the printer needed no bleaching establishment as he would here, where for many years he must bleach his own goods. Ashes are now two-thirds higher in price than they were at that time. Oil of vitriol then sold at three pence half-penny sterling per pound when concentrated to twenty-nine and a half ounces to the wine pint, *in glass:* when concentrated as it was in Scotland *in lead*, it could be afforded at three pence per pound. American potash cost three pence half-penny per pound, Dantzick pearl ash four pence.

Such were the prices of common labour, and the drugs necessary to a printer and dyer.

A printer's establishment then, would consist of

His house on the spot.

A bleach-green proportioned to his work, with plenty of running water.

A printing shop; if for a double row of tables, nine yards wide at least: if for a single row, at least five yards wide.

The printing room requires a stove.

There must be a large stove-room adjoining, to hang up the callicoes when printed.

A ware-house, and counting-house.

A drug-room.

A colour-room adjoining.

A dye-house: the fire-places of the coppers, to be on the outside.

Coppers, &c. The coppers should be from four to five feet over: furnished with plugs (not cocks.)

A blue dye-house for paste work, with vats lined with sheet lead.

A dash wheel, or else a streaming-house with running water passing through a trough to wince the pieces in, after souring.

A souring tub.

Plane tree squeezers, and calender.

A room for roller-work.

Wages of Journeymen Printers.

Single black or chocolate, per piece	- -	12*d*
Black and red	- - - - - -	19
Blotched black and red	- - - -	22
Blotched black, red, and purple	- -	30
Black, red and purple	- - - -	28
Black ground chintzes, four colours	- -	39
five do.	- -	48
Light ground chintzes, four colours	- -	36
five do.	- -	45
six do.	- -	54
Three overs of kinds per colour round	- -	8

Apprentices' Prices.

One colour	- - - - - -	6
Two	- - - - - - -	9
Three	- - - - - - -	12
Three	- - - - - - -	13½

Three - - - - - - - -	15*d*
Four colours, light ground - - -	16
Do. - - - - - - -	17 and 18
Five - - - - - - -	20 to 22
Light ground sometimes per colour round -	4

Hence the expense to a printer, at that time, of a piece of callicoe printed chintz-work four colours, would be as follows.

	£.	*s.*	*d.*
The callicoe reckoned at a shilling per yard	1	8	0
Duty at that time - - - - -	0	6	3
Madder mordant, or red colour - -	0	1	0
Madder to raise the reds - - -	0	2	4
Yellow colour (mordant) - - -	0	0	6
Raising the yellow - - - - -	0	0	10
Blue colour - - - - - -	0	1	0
Pencilling blue and green - -	0	3	0
Grounding - - - - - - -	0	1	0
Souring in the first instance, streaming, dunging, squeezing, calendering, making up, cartage, and other articles of labour - - - - -	0	1	0
Rent of the establishment - -	0	2	0
Printing four colours, journeyman's wages - - - - - -	0	3	3
	£. 2	10	2

Common Work, Three Colours.

Value of the callicoe, twenty-eight shillings, duty six shillings and three pence, rent two shillings, printing three colours two shillings and four pence, madder two shillings, colour (that is mordant) six pence, souring, labour, &c. one shilling.—Together, two pounds two shillings and a penny prime cost.

Suppose an establishment of a dozen tables, which is moderate; indeed twice the number would be more frugal.

	£.	s.	d.
Twelve tables cost at that time two guineas each - - - - -	25	4	0
Seventy-two blocks to begin with, or sets of patterns, at three guineas each	226	6	0
Forty tubs and sieves - - - -	12	0	0
Three coppers, from four to five feet top diameter - - - - -	66	0	0
Winces, squeezers, troughs, souring tubs, &c. - - - - -	60	0	0
Stock of drugs - - - -	250	0	0

Cloth, (callicoe) to be calculated at four thousand pieces printed per annum, if kept in full employ. The capital returned in nine months.

A man and boy to each table. (Printer and tear-boy: the latter at three shillings per week.) Pencillers are employed at about the same price, viz. two to three shillings a week.

A colourman.

Two block-cutters.

Two dyers, and two boys.

Two bleachers, and two boys.

Team and driver.

This establishment will hardly afford a pattern-drawer. In London, there are several persons who make it their sole business to devise and sell new patterns, at five shillings sterling per dozen. But as the great profit of this business depends upon the knowing how to choose patterns that are likely to take with the public, and to know by looking at them, the probable expense of cutting and printing them, it is useful to have your own pattern drawer, who may be consulted in cases of hesitation, with your colourman and best printer. A block-cutter or two, to mend the blocks and cut fresh ones, in such a printing establishment in England, is indispensable. A block-cutter used to earn from a guinea to a guinea and a half per week; a pattern-drawer had from a guinea and a half to two guineas.

Such are the data, from whence an intelligent man in this country may sit down and count the cost.

I am not persuaded that a callicoe printing establishment will be for some time an eligible speculation on a large scale. We are not yet (1815) ripe for it, unless, indeed, we print East India coarse callicoes with chemical colours and roller-work. The business will creep on gradually, but it is not in my opinion adviseable to launch out yet. At present every man must be his own bleacher as well as printer. However, the the time is coming on, when we can print our own manufactured callicoes: so that the information here given will not be thrown away: like bread cast upon the waters, it will be found again after many days.

Of the Process of preparing Callicoes, making the Mordants, and printing Raised Colours.

When the goods come from the bleachers, although the colour be good, you cannot depend that all the alkaline and earthy salts are completely washed out: should any such remain, they will act as mordants to the white part of the cloth, and stain it so when dyed, as to make it very troublesome to clear the white, unless at the expense of the pattern colours. Hence every printer finds it absolutely necessary, to immerse his white callicoes in sulphuric acid and water, about the strength of weak vinegar, for several hours before he can venture to print them. This dissolves all the saline substances that may still remain in the cloth, and renders them soluble in the water which is used to wash away this souring. Some bleachers use warm water for the purpose: others wince them for an hour after souring, in a trough through which a stream runs about three feet deep: others use for the purpose the common dash wheel. Much labour and some expense would be saved, by using paper or cloth tinged with litmus, which would show at once whether any acid remains in the callicoe.

When the printer bleaches his own goods, he should finish either with oxymuriatic acid, or with the common vitriolic souring; in which case, nothing is necessary further but washing so well as to be sure that no acid remains, which when concentrated in the heat of the printing-shop, would rot the goods.

The goods being thus soured and well washed, are dried; then calendered with great care to make them smooth, and to lay the threads straight and even. Then they are printed with the mordant for one colour, whether to be raised in madder or yellow, if acetat of alumine, or in iron liquor if to be raised in sumach or logwood. When thus printed with one mordant they are dried; then printed with another and dried; then with another, and so on. When all the mordants are printed that serve for one colouring drug, as madder for instance, the pieces when dry, are winced for half an hour, eight, or at the utmost ten at a time, through hot liquor of sheep's dung or cow dung, using about two common pailfuls to ten pieces. This may be renewed with another pailful of dung for the next eight or ten pieces, and then thrown away. The cow dung acts, first, by preventing the colours from spreading, by washing away superfluous colour. Secondly, by saturating the spot printed with the mordant, with a colour, which the madder, or yellow colour, can displace by superior affinity. Thirdly, by affording animal matter, which forms a triple chemical union with the earth of alum and the cloth. Fourthly, by saturating the remaining acetic acid and precipitating the alum it held in solution on the cloth: this is done by the alkaline properties of the animal dung. Such are the reasonable conjectures on the use of cow dung and sheep's dung; which however are indispensable to a good colour, in whatever way they operate.

The pieces thus winced for half an hour through hot dung liquor, are then streamed or winced without delay over a trough of running water, or else carried to the dash wheel. I prefer the former method: for before the earth of alum is saturated with colour, it seems to me liable to be washed away in part by the mechanical force of the fall of the cloth in the dash wheel: but I cannot speak with any certainty about this. After the dung liquor, the goods are usually laid down on the grass for a day.

The cloth being now printed with all the mordants on which the colouring drug in the dye copper is to act, is dried; and then eight pieces being tacked together, they are dyed together at the same time, by wincing them incessantly for an hour in the copper containing the colouring material.

Of Preparing the Mordants. These are, the acetat of alumine, and the acetat of iron, or what is the same thing, the pyrolignat of iron.

The common method of preparing red colour, that is, the acetat of alumine, is this: dissolve in one gallon of boiling water, three pounds of bruised alum; when dissolved add one pound and a half of sugar of lead; and then, by degrees, four ounces of whiting. The quantity of sugar of lead here employed, is not sufficient to decompose the whole of the alum; hence the use of the whiting, which aids in decomposing the rest of the alum, and prevents its crystallizing, which would spoil the work. The sulphuric acid and the lead form an insoluble salt (a sulphat) of lead, which falls to the bottom: the lime of the chalk, forms an insoluble sulphat of lime, gypsum; but the alumine or earth of alum which the lime separates, falls down also; so that it appears to me, the whole of the alum decomposed by the chalk or whiting, is wasted, and the solution has not half the intended and supposed strength. So much uncertainty prevails on this head, that I instituted a set of experiments to ascertain how much sugar of lead was necessary, completely to decompose a given quantity of alum; and I found that it took one part and a half of sugar of lead, to one part of alum: I found also, not only that the lead of this quantity of sugar of lead, was quite sufficient to detach the sulphuric acid, but the acetic acid was also sufficient to dissolve the alumine. When I had thus thrown down all the sulphat of lead, I added, by a drop at a time, strong sulphuric acid, to ascertain whether the solution contained sugar of lead undecomposed, and I found, indeed, a slight cloud, but too slight to be appreciated; whereas one drop of solution of sugar of lead, dropped in after the sulphuric acid, showed a dense cloud instantaneously. Every printer ought to repeat this important experiment, which is easily made.

Let him weigh out one hundred grains, for instance, of sugar of lead, and as much alum, and grind them together into a fine powder: pour thereon a wine pint of boiling water: stir it till the salts are dissolved. Let the sediment settle for an hour; pour off the clear liquor, and filter the sediment; add the clear liquors together. Now dissolve separately in half a pint of boiling water, fifty grains of sugar of lead: if all the alum be decomposed in the first solution, the addition of more of the sugar of lead will occasion no precipitate; but if alum still remains undecomposed in the first solution, a precipitate will take place, when you add to it a solution of the sugar of lead; precisely for the same reason that it did so at first. Therefore, to the first solution add half of the sugar of lead solution, which will contain twenty-five grains of sugar of lead: a white cloud will arise: stir the liquor, filter it: to the clear liquor thus filtered, add half the remainder, sugar of lead solution: if a precipitate appears, filter again: and so on till on the addition of solution of sugar of lead, no white cloud appears any more.

To satisfy yourself that the solution contains no sugar of lead, which if you proceed cautiously and patiently, and by degrees, it will not, add to it a few drops of solution of common alum: if there be sugar of lead in the liquor, a white cloud consisting of sulphat of lead will appear; if no such cloud appears, you have hit the exact point of saturation; at least you have not added too much sugar of lead. I repeat, that every callicoe printer, and dyer, ought to perform this experiment for himself, over and over, till he has acquired such a facility of performing it, that he becomes satisfied in his own mind, there is no mistake. For if this experiment be just and true, how can a complete decomposition of the alum be made by one half its weight of sugar of lead, which is the usual proportion? Even Bancroft says that equal weights are sufficient, which is not so, if my experiments be right.

Hence it is clear, that one half of the alum used is thrown away; for to prevent its crystallizing, and spoiling the work, pearl ash and whiting are added, which throw down indeed the sulphuric acid, but they throw down the aluminous earth also, which that sulphuric acid held in solution. This mistake has arisen from the expense of sugar of lead.

To supersede this expensive article, three methods have been proposed.

First, to substitute for sugar of lead, common litharge dissolved by heat in common vinegar. This is a coarse kind of sugar of lead in solution. I have never been able to procure common vinegar free from all taint of iron: therefore, such a solution as I have been able to make, might do for browns, chocolates, drabs and olives, but not for good reds.

Secondly, it has been proposed to dissolve whiting or chalk in vinegar; for the sulphat of lime is insoluble to a great degree, like sulphat of lead. I have tried this: my objection is, that the chalk and whiting like the vinegar, are apt to contain iron, and a small part of the sulphat of lime also will be dissolved. Another objection to both these substitutes, is, that they require to be concentrated.

Thirdly, it has been proposed to use the common portion of sugar of lead, together with as much pearl ash or whiting, or both, as will fully decompose the rest of the alum: and then to take up the earth of alum (the alumine) thus precipitated, by vinegar. I think this may be done to advantage, always taking for granted, that you can get vinegar free from iron: If not, it would be almost worth while to distil it.

After all, there is no good substitute for sugar of lead, in good work. But after bestowing much consideration on the subject, I should advise this mordant to be made in the large way, as I have been accustomed to make it in the small way. When I used it in a large way five or six and twenty years ago, I went to the expense of the full proportion of sugar of lead necessary to the complete decomposition of the alum.

Take then, equal parts, three pounds and a half for instance, of alum and of sugar of lead: dissolve them ground together into a powder, in one gallon of a hot mixture of half vinegar and half water: add by degrees while hot three ounces and a half of whiting; taking care that the vinegar and the whiting contain no iron. Stir the whole together, till there is a complete decomposition. Let the sediment subside for six hours; pour off the clear liquor: add to the remaining sediment two quarts of water, which when clear may answer for a third red.

According to my computation (which it is the printer's own fault if he does not verify for himself) more than a pound of undecomposed alum will remain, when three pounds and a half of each salt be taken. This will be prevented from crystallizing partly by the whiting and partly by the vinegar.

Still, this will not be equal to three pounds of alum, four pounds of sugar of lead, and two ounces of whiting, the best of all processes for this mordant.

The acetat of alumine or printer's mordant, made in whatever way, will require to be thickened with starch, with flour, or with gum arabic or senegal: this last is necessary for pencilling. If flour be used, expose it to a degree of heat necessary to turn it to a light chocolate colour, without burning it; stirring it all the while: this improves it as a thickening, and may be made to supersede the use of brazil wood in giving colour to the mordant to enable the printers to see the boundaries of the pattern when the mordant is printed on the piece. In general either brazil or fustic is used for this purpose.

The sulphat of lead which forms the sediment, can be converted either into white lead, by boiling it with carbonat of potash, or into metallic lead, by fluxing it with alkali and charcoal, for which consult the usual docimastic books.

When this aceto-aluminous mordant is intended for yellows, a small proportion (about one twelfth) of blue vitriol should be mixed with the alum, especially when a greenish yellow is wanted, and weld is used.

The acetat of iron is made in England, by persons who have no other occupation. They brew vinegar from grain or from cyder, and pour it on old iron, bought up cheaply for the purpose. It is not reckoned good till it be six months old. Others, especially those who live in the vicinity of gunpowder manufacturers, employ the pyroligneous acid, procured from the distillation of wood in the process of making charcoal, in lieu of vinegar. Indeed I believe this method of making the acetat of iron is becoming general. Plates of the machinery used for procuring the pyroligneous acid are to be found in the new edition of Rees's Encyclopædia. The acetat of iron ought to be very strong and concentrated; and in that state kept clear, and unexposed to the air, by the colourman in his drug-room, in close casks. For the air oxyds the iron too much, and makes it precipitate.

The drug-room ought to be exclusively under the care of the colourman, who ought to have a small room adjoining for the purpose of preparing his compositions or colours: for the drug-room ought not to be exposed to vapour, or gases, or any kind of moisture. It should be well furnished with shelves, pots, pans, scales and weights, and every utensil of that kind. He should have constantly by him, a quarter cask full of well prepared strong *red colour*, that is acetat of alumine slightly tinged with brazil wood; and also a quarter cask full of strong iron liquor, close covered from dust and from the air. That is, where there is an establishment of a dozen tables or more.

Neither will it be quite useless in this country to recommend a practice which I have found useful, but which an old and experienced colourman may deem unnecessary.

Having prepared some white callicoe by souring, washing, and drying in the usual manner, let him divide it neatly into pieces of about four inches square to the amount of a hundred; having thickened his mordants, let him put a spot in the middle of the piece of callicoe, employing all manner of mixtures of mordants; for instance,

Strong acetat of alumine.
Ditto diluted with one third water.
Ditto diluted with one half water.
Ditto diluted with two-thirds water.
Ditto diluted with an equal quantity of water.
Ditto with one water and a half.
Ditto with two waters.
Ditto with two waters and a half.
Ditto with three waters.

Of the above he ought to have three or four specimens of each kind.

Acetat of alumine one part: acetat of iron one fourth of a part.

Acetat of alumine, one part: acetat of iron, half a part.

Acetat of alumine, one part: acetat of iron, three-fourths of a part.

Acetat of alumine one part: acetat of iron one part.

Acetat of alumine, one part: acetat of iron, one part and a half.

Acetat of alumine, one part: acetat of iron, two parts.

Acetat of alumine, one part: acetat of iron, two parts and a half.

Acetat of alumine, one part: acetat of iron, three parts.

Of the above he ought to have three or four specimens of each kind.

Acetat of iron, one part.

Acetat of iron one part: water half a part.

Acetat of iron, one part: water, one part.

Acetat of iron, one part: water, one part and a half.

Acetat of iron, one part: water, two parts.

Acetat of iron, one part: water, two parts and a half.

Acetat of iron, one part: water, three parts.

These should be renewed on every fresh change in the acetat of iron: no good colourman will venture his acetat of iron upon a number of pieces, without a previous trial in the small way.

All the above are necessary for the purpose of madder colours: and every new purchase of madder should be thus tried in the small way, to ascertain its richness in colour and its tint of colour before it is used to the goods: for madder in my time bore various prices, from fifty to a hundred and ten shillings per hundred weight.

Another set of aluminous mordants should be prepared with a small quantity of blue vitriol mixed with the alum, as a mordant for yellows. One set should be prepared for quercitron, one for weld, one for fustic, one for sumach.

Hence three or four sets should be kept in one drawer for madder colours: and another for logwood colours.

The same of both mordants for weld.

The same for quercitron.

The same for fustic.

The same for sumach.

These pieces thus prepared, should be run through hot cow dung, and washed in the usual way.

It is evident that with these preparatory specimens, properly numbered and registered, a colourman, even without much experience, cannot fail of printing any colour to pattern with certainty, and with no risk of spoiling a quantity of goods. It is evident also, that each new purchase of drugs should thus be tried in the small way, before you venture to print to pattern with them, for the quality of the drugs cannot be expected to be always the same.

What is here proposed will not take above a week's labour at the very utmost; and will lay a foundation for accuracy throughout the colourman's department.

The above method of previous trials, is also the best method of making experiments on the colours produced by various vegetables upon cotton, which it would be well to try with a view of ascertaining the riches of our own country.

It is obvious from the preceding suggestions, that all the various shades of raised colours are produced, first, by varying the mordants: secondly, by diluting the mordants: thirdly, by mixing the mordants: fourthly, by varying the dyeing drugs, to wit, madder, brazil, logwood; weld, quercitron, fustic; sumach, galls: fifthly, by mixing the colouring drugs, as a little brazil with madder for a pinky red; a little sumach with madder, for a saddened red; madder with yellow for orange; sumach with yellow for drabs, &c.

Thus, suppose it was required to print a chintz pattern, three reds, a purple or chocolate, black, yellow, olive or drab, blue and green.

First, the cloth is printed with strong red colour (concentrated acetat of alumine) for the first or deep red; then with the same mordant, diluted with an equal quantity of water, for the second red; then with the same mordant, diluted with two or three waters, for the third red. Then with the same mordant mixed with a small quantity of iron liquor, for the chocolate or purple according to the shade: then with the black mordant hereafter given. It is then carried to the stove-room, heated to from 80° to 90 of Fahrenheit, to drive off superfluous acid. Then winced for half an hour in hot cow dung and water, two small pailfuls of dung to eight pieces of callicoe. Then *immediately* rinced, streamed or dashed; then dyed with from one to three pounds of madder to the piece. Six or eight pieces are fastened and dyed together, by being winced in the madder liquor brought up to a scald or about 170°; the winces resting on the brim of a madder copper about four feet six inches wide, or if five feet, so much the better. If the reds are to be of a pink tint, a little brazil is added; if the chocolate is to be deep, or where there is a black, a little sumach, or a little logwood, will produce this effect; though sumach will slightly sadden the second and third reds, and will spoil purples.

The piece thus dyed, is well washed: it is then boiled in bran and water to clear the white; for the same purpose when washed out of the bran and water, it is laid down on the grass, the printed side undermost, to bleach: this will take two or three days.

It is then carefully and evenly calendered or run through rollers, keeping the threads as straight as possible. Then printed with acetat of alumine or red colour, containing a little blue vitriol in the proportion of from one-tenth to one-fifteenth of the alum, for the yellow colour. Then with the red colour (acetat of alumine) mixed with iron liquor, for the drab. It is then dyed or raised in weld or quercitron, according to the quantity of colour in the pattern. These drugs strike a yellow with the red colour, and a drab or olive with the iron liquor, of a tint depending on the proportions in which the latter is mixed with the red colour. Quercitron produces drab with iron, olive with iron and alumine, and black with iron if mixed with a little sumach.

The cloth being thus dyed (that is in the printers' language, raised) is again washed, branned, washed, and bleached. Then it is again run through the rollers as carefully as possible, and the blue and green are pencilled by boys and girls, who earn from a shilling sterling to three shillings per week at this kind of work. The blue colour is made as before directed with indigo, caustic potash, and orpiment. The cloth is then dried and washed, dried again, and made up for the market. Such a piece of chintz work, can seldom be brought into the market from the white state of the callicoe as it comes from the bleachers, under a month: generally it takes in a course of work five and six weeks.

I now proceed to some practical directions on printing, wherein of

First, raised colours: that is, colours produced by dyeing the piece after printing it with mordants.

Secondly, chemical colours: that is, colours applied at once by the block, without dyeing.

Thirdly, dipped blues with paste work.

Fourthly, patterns made by discharging parts of a dyed piece.

Roller work is only peculiar, as to the mechanical operation of printing either the mordant, or the chemical colour: it is however the most profitable mode of printing, particularly at this time, in this country.

Colours to be produced by printing with the mordant here prescribed, and then raised by dyeing the cloth so printed, in a MADDER *copper.*

Black. Take of strong iron liquor, by weight, calculating a pint at a pound, sixteen parts: logwood, four parts: boil them together for an hour. Then add two parts of powdered galls, and half a part of green copperas. Bring them on to a boil in half an hour, and then add one fifth of a part of nitrated iron; that is, iron slowly dissolved in aqua fortis, till the acid will dissolve no more. Strain the whole while hot: thicken with five parts of gum, that is about two and a half pounds to the gallon.

Red. Water one gallon, vinegar half a gallon, alum three pounds, sugar of lead four pounds, whiting two ounces. In my time, the common receipt was, water one gallon, alum three pounds and a half, sugar of lead two pounds, sal prunell or purified nitre four ounces, corrosive sublimate half an ounce, arsenic four ounces, whiting one ounce. The sal prunell is of no use that I know of: the sublimate deepens but saddens the colour. This last composition is manifestly a mixture of common alum and acetat of alumine.

There is great latitude taken by the callicoe printers in the proportions of sugar of lead and alum. The first article is so dear, that there is strong temptation to lessen the quantity. I have known the proportion vary at different works from half a part of sugar of lead to two parts. The one is certainly too little, and the other certainly too much. I know of no criterion but the experiment which determines that the quantity required to convert one part of alum into acetat of alumine and to throw down all the sulphuric acid of common alum, is one part and a half of sugar of lead, very nearly. I have already dwelt on this subject in speaking about mordants.

Pale Red. Water two parts by weight (one pint being a pound), alum one-fifth of a part, white arsenic one-fifth of a part, pearl ash one-sixteenth, chalk one-sixteenth: boil and mix with gum.

This is an old receipt: the proper pale red, is made by diluting strong red to your mind. The strong red being made according to the receipt I have just above given.

Pink Red. This is produced by using a decoction of brazil wood with the alum and sugar of lead instead of water. Or better, by mixing brazil with the madder.

Dark Brown Red. A small quantity of iron liquor mixed with the red colour.

Common Purple. Saltpetre one part; cream of tartar two parts; pearl ash one-fourth of a part; iron liquor twelve parts.

Lilac or Laylock Purple. Iron liquor eight parts; saltpetre one-fourth of a part; cream of tartar one-eighth of a part; corrosive sublimate one-fourth of a part.

Light Purple. The above diluted with an equal quantity of water.

Dark Purple. Iron liquor two parts; sugar of lead one-tenth of a part; water four parts.

Blossom. Iron liquor eight parts; saltpetre one-fourth of a part; when dissolved and hot, add half a part red colour (acetat of alumine.)

Pompadour. Black and red liquor equal parts; thickened with gum dissolved in urine.

All the above purples, lilacs, blossoms, and pompadours, are the better for a little brazil mixed with the madder, otherwise the iron liquor saddens the colour too much. The madder should be good.

Chocolate. Iron liquor two parts; light purple liquor two parts; red colour four parts: or it can be made with iron liquor and red liquor according to the shade.

Puce or Flea Colour. Red colour eight parts; iron liquor four parts; water four parts.

French Gray. Hot iron liquor eight parts; sal ammoniac half a part; water sixty-four parts.

Stone Colour. Saltpetre one part; sugar of lead half a part; green copperas one-fourth of a part; water sixteen parts.

Observations on Raising Madder Colours. The colours being printed and dried, are to be winced through cow dung and water, hot, but not boiling, thirty or forty times: the instant after, they are to be rinced or streamed, or else dashed in the dash wheel: if this be not done soon after the dung liquor, the pieces will be spoiled. They are then to be fastened six together and winced in the madder copper, put in cold, with from a pound to three pounds of madder, and about half a pound of sumach where the colours require to be saddened, or a quarter of a pound of brazil where the colours require to be brightened, per piece: all this depends on the quantity of red in the pattern: blotch grounds will take five pounds of madder per piece. The liquor is to be brought briskly to a full scald but no more, and the pieces are to be winced till the colour is obtained. Six pieces together will produce better work than eight: if you tack ten together, you will run the hazard of spoiling your work.

When dyed, stream and wash the pieces well; then boil them in bran and water at a brisk scald for half an hour; a gallon of bran to a piece, or a little more. Take them out, stream them, and again boil them for twenty minutes in bran and water: then lay them down, the printed side next the grass, till the ground is white. They are then streamed or dashed, and run through plane-tree rollers or squeezers, set, so that no water can be squeezed out after they have run through. But if the squeezers are set thus tight for velverets or such thick goods, they will burst.

Such was the common English practice for raised madder colours in my time. I am not able to say what variations have lately taken place if any: but I think it will be expedient by and by to present to the reader, the French practice for printing and raising madder colours, though I by no means think it equal to the English, wherever there is a difference. It will serve however to show, how much uncertainty there is in the various processes of printing as well as of dyeing.

My opinion is, that the nitre, the sublimate, the arsenic, the sal ammoniac, the common salt, the pearl ash, and even the chalk, may be dispensed with, and all colours dyed with acetat of alumine, and acetat of iron: some little use I acknowledge in chalk, and verdigris, but he is not a good printer who cannot produce a given pattern, with the two mordants above mentioned, acetat of alumine and acetat of iron.

Before I translate Homassel's treatise on callicoe printing, I will finish my own notes and observations: for which purpose I proceed to

Colours that are raised by means of Weld, or Woulds, as the printers call this drug.

Black. Take vinegar three gallons (twenty-four pounds), galls eight pounds, logwood one pound; boil them moderately for an hour, and to every gallon of clear liquor, add when cold, one quart of iron dissolved in aqua fortis. After printing, let the colour lay on for three days.

In this receipt, I see no reason for the vinegar. The nitrat of iron too, though producing a fine colour, is expensive. I propose as a substitute,

Galls and logwood as above; water one gallon, vinegar one gallon, strong iron liquor one gallon, nitrat of iron a quarter of a pint, verdigris one ounce.

Yellow. Water one gallon; alum three pounds; sugar of lead one pound and a half; verdigris two ounces and a half; whiting seven ounces.

I object to this as being a mixture of alumine in the sulphuric and alumine in the acetic acid. I propose as a substitute,

The common printers' red, made hot with two ounces of verdigris finely ground in a pint of vinegar to the gallon. The strong red, if a very full colour be wanting, and diluted, if a weak one.

Light Olive. Six quarts of iron liquor, six ounces verdigris, three pounds of alum, one pound and a half of sugar of lead.

In this receipt the mordant is deficient in sugar of lead, which I think ought to be four pounds instead of a pound and a half, and then less of the aluminous mordant would be required. Thus,

Take printers' red two quarts, iron liquor six quarts, verdigris ground up in a pint of vinegar six ounces.

Middle or Yellow Olive. Increase the relative proportion of printers' red.

Dark Olive. Increase the relative proportion of iron liquor.

Mud Colour. Galls two pounds, water one pint, iron liquor three gallons.

Another. Water eight quarts, iron liquor as much, green copperas four pounds, verdigris six ounces, ground up in a pint of vinegar.

Stone Colour. Vinegar three pints; black colour above described one pint.

To raise the above colours, stove and dung them as directed for madder colours. A velveret will take about half a bundle of woulds. Jeanets and callicoes somewhat less; for a velveret weighs when bleached, about nine pounds, a callicoe about six and a half pounds. Boil the woulds (weld) for three quarters of an hour, then take them out, and keep your piece in the coloured liquor at a scalding heat till the colours are sufficiently raised. Where there are blacks, you must add galls or sumach to the bran liquor in which you afterward boil your pieces. Bran them, and lay them down as directed for madder.

Colours to be raised with Quercitron Bark.

The same mordants answer for quercitron and fustic as for weld. Indeed weld is nearly discarded; it is dearer in the first instance and does not go so far as quercitron; of which from one to two pounds per piece are enough unless for blotch grounds. Twenty-five pounds of good quercitron (Bancroft says eighteen) will dye throughout of a full colour, one hundred pounds of cloth. Quercitron and fustic do not stain the grounds so much as weld, nor does quercitron require so much heat. Bancroft advises a little barilla to be added to the cow dung liquor, about two ounces to a piece of cloth: he says that one pound of tartar to fourteen pounds of bark, tends to keep the white clear.

Sumach is added to the quercitron, when colours are to be saddened.

When galls or sumach are required to be added to raise a black, you may put them either in your dung liquor previous to dyeing, or into the bran liquor afterward. No accurate experiments have been made, to ascertain whether the affinity of the colouring matter of galls or sumach will displace the colouring matter of the weld or quercitron or fustic, or vice versa.

Of Colours to be raised in Weld and Madder conjointly: or in Quercitron and Madder.

Black. Same as for weld or madder: already given.

Mud. Same as for weld or madder.

Orange. Sugar of lead eight pounds, verdigris seven ounces, water four gallons, chalk six ounces, alum six pounds.

Dung, wash, and raise your pieces as directed for weld colours, with weld or quercitron alone: about half a bundle of weld to the piece, or two pounds of quercitron. Wash: then raise the colour again in a madder copper of about two pounds of madder to the piece according to the required colour. Bran as usual.

Colours to be raised in Weld or Quercitron and Logwood.

Black, as for weld.

Mud and Stone. The same, only using a less proportion of iron liquor or black colour, owing to the deeper dye given by logwood.

Green. One gallon of lime water, six ounces of verdigris, four ounces of alum, two ounces sugar of lead, half an ounce of finely ground indigo dissolved in an ounce measure or about two ounces by weight of strong oil of vitriol; add all together and neutralize with whiting. Print with this, and raise as for weld, adding two pounds logwood.

The preceding receipt amounts to no more, than printing with a weak red mordant, mixed with Saxon green liquor. The Saxon green, or solution of indigo in sulphuric acid, strikes a green, while the acetat of alumine imperfectly made, and combined with the verdigris, affords a mordant for the yellow and the logwood. It is not a fast colour. I should substitute the following.

Alum two parts by weight, blue copperas one part, sugar of lead three parts: thicken the clear liquor, and dye with quercitron and logwood. If not green enough, increase the relative proportions of blue vitriol and logwood. Either the one colour or the other, will be fugitive.

Single Blacks to be raised with Logwood and Sumach.

Iron liquor two gallons, nitrat of iron half a pint, verdigris two ounces; grind the verdigris well previously with half a pint of vinegar; mix all together, and set them over the fire to boil; thicken it gradually with about three pounds of flour, well stirred in, till it be quite smooth: after about twenty minutes take it off the fire; put it into an earthen mug to cool. When cold, take off the skin on the top, and use the mixture.

To raise this colour, dung as usual; then wash; then boil in a pound and a half of sumach, and a pound of logwood, per piece. Wash and bran as usual; and bleach. If the white does not come out quite clear, boil again in bran with a small quantity of white soap, and wash. But do not resort to soap without necessity.

Colours to be raised in Lime Water, and Potash.

In these the colour is neutralized *after* their being applied to the cloth: in chemical colours, they are neutralized *before* they are applied. They are much more permanent in the first case.

Black. Vinegar three gallons; galls eight pounds; boil them moderately for an hour and a half; add to each gallon four ounces of green copperas and half a pint of nitrat of iron. (N. B. From Dr. Lewis's experiments on ink, I am induced to believe, that one part of green copperas is fully saturated by four parts of galls.)

Mud. Water one gallon; galls one pound and a half; brazil wood the same quantity. Boil for an hour; strain; then add four ounces of green copperas. I think the galls here, rather in over proportion, if good.

Stone. One quart of chemical black hereafter to be given, omitting the nitrat of iron, and adding one quart water.

Fawn. One pint of chemical black, mixed with five pints of pale red made by diluting strong red colour (acetat of alumine) with four parts water.

Gold. Iron liquor six gallons; green copperas nine pounds: boil for twenty minutes: thicken with three pounds gum, or three pounds and a half flour. (Nitrat of iron produces the brightest colour.)

Buff. Iron liquor six gallons, boiled and mixed with two gallons strong gum water, and well stirred. (Better mixed with a little nitrat of iron.)

Violet. One gallon of fresh, strong logwood liquor, cold; ground alum two pounds; the same quantity of sugar of lead, and four ounces nitre. Add one pint iron liquor. Thicken with gum or flour.

This last colour raised in madder gives a chocolate; with weld, an olive.

For colours that after being thus printed, are to be raised in lime and potash, proceed thus. Run the printed piece soon after it is printed (as soon as it is dry) through a tub or vat of cold water, in which from six to seven pounds of potash are dissolved; and then through another of cold water containing an equal quantity of lime, fresh and good: they should be winced in each vat for about ten minutes or even less. Then wash them. Or, you may let them lay in water over night, and then wash them either in hot or cold water.

Colours to be raised in Lime, Copperas, and Potash.

China Blue. This is a species of indigo dyeing, slightly touched upon in a former part of this book, under the section relating to indigo vats.

Take equal quantities of indigo and copperas, say one pound of each; grind them in gum water, till they become a perfectly fine paste. Let the gum water be about two quarts in all, to bring the colour to a proper consistence. After printing the cloth with this composition, let it undergo the following dippings.

First, for a quarter of an hour, in lime water composed of two pounds of fresh lime to every gallon of water, stirring it all the time.

Secondly, pass the cloth through a strong copperas liquor for the same length of time; employing one pound of green copperas for every gallon of water, letting the sediment subside perfectly before you enter your cloth, to wince it therein. If the copperas be of a light green, fresh made, and not covered with rust by exposure to air, there will be little sediment.

Thirdly, wince your cloth through a strong solution of potash in which an egg will swim, for twenty minutes. Then plunge it into cold water, and wash it thoroughly. If your grounds are not white enough, wince it in a warm weak sulphuric acid liquor, and then wash it well again and dry it. (N. B. This presupposes paste work, or reserve.)

If the piece should be spoiled, which sometimes happens, the colour is best discharged by oxymuriatic acid and caustic alkali alternately. The piece so raised of a blue colour, may again be printed of any other.

Such are my brief notes of practice. But the following article is drawn up with so much care and knowledge of the subject, that I think it well worth inserting from the new edition of Rees's Cyclopædia, especially as that work so far as it is hitherto published, does not contain more than two or three solitary and unconnected articles on dyeing and printing. Article *Dipping*.

"Dipping, in callicoe-printing, a process used in dyeing blue, in which the cloth is immersed or dipped either in a solution of indigo, or of some substance capable of acting on indigo previously applied to the cloth.

"The peculiar nature of indigo unfits it for the purposes of dyeing by the ordinary operations of the art. It consists, as we shall have occasion to show more fully hereafter, of a peculiar vegetable basis united to a portion of oxygen, to which it owes its colour and insolubility. When deprived of this oxygen, by substances whose affinity for it are greater, it becomes soluble in the alkalies and alkaline earths, and in this state readily contracts an union with animal or vegetable stuffs. On this property of the alkalies to dissolve deoxygenated indigo, are founded two processes for dipping or dyeing blue, which form the subject of the present article. The first consists in immersing the cloth in an alkaline solution of indigo, and is employed in dyeing those goods, the ground of which is intended for blue or green. The parts meant to remain white, or which have already received some other colours, being covered with a reserve or paste, to protect them from the effect of the dye.

"This process is very ancient.

"The second is employed in dyeing those goods intended to exhibit a design or pattern in one or more shades of blue, upon a white ground, and is called "China blue," or generally upon the continent, English blue, the process having originated with the callicoe-printers of this country.

"From time immemorial the nations of the east appear to have possessed a mode of dyeing silk handkerchiefs, and other articles of dress, by a rude but simple process, which is practised at this day, and has been adopted, and continues in use, in almost every part of Europe. It consists in tying knots with great address and nicety on the silk in such a manner, that when dyed, the parts enclosed within the knot remain untouched, displaying a ground of red, blue, or any other colour, variously, and oftentimes not inelegantly diversified with flowers of white or yellow, according to the primitive colour of the silk. This mode of dyeing handkerchiefs was introduced by the Saracens into Spain, where it is now practised to a very considerable extent. This, in all probability, was the first rude essay or attempt to imitate the printed linens of Egypt, and was succeeded by the mode now practised in India, of covering with a composition of wax and other ingredients, the parts intended to remain white. Hence we may date the origin of blue dipping, and though the process, as may be supposed, has been considerably improved since its introduction into Europe, yet the ancient practice is still in use; and wax printing is often employed with considerable advantage in the production of particular combinations of dark and light blue, which could not readily be obtained by any other process.

"*Of the Indigo Vat, and the Process of common blue Dipping.*

"The solution of indigo for blue dipping, is made in large oblong vessels of wood, stone, or other materials, to which the name of vats is given. Those which are made of wood require to be very accurately joined, and well secured with bolts and straps of iron; otherwise great loss may arise from the constant leakage, to which, without great precaution, they are subject. In general they are lined with lead, and though the expense in the first instance is four times that of wood, they are eventually much cheaper. They need fewer repairs, and afford absolute security against all loss by leakage, which, in a drug so costly as indigo, is a consideration of great importance. Stone vats have been tried in some places. At Rouen, according to Berthollet, they are constructed of a kind of flint-stone, well secured both outside and inside with a fine cement: and Pileur d'Apligny mentions some he had seen composed of large stone slabs screwed together at the corners, and the joints of which are covered with a kind of mastic varnish. Economy is the chief aim in all these various constructions, as it matters little what the vat is composed of, provided it will hold the dye; and those, in fact are the cheapest, whatever they have cost, that suffer the least to escape.

"The size of the vat varies considerably in different dye-houses, according to the nature and extent of the establishment, and the kind of work they are intended for. Four feet wide, six feet long, and six or seven feet deep, are the dimensions of a well-proportioned vat, calculated for two pieces of callicoe or fifty-six yards of cloth on a frame. Much smaller than the size here given are in use for frames of single pieces, and vats of still larger dimensions are employed by some, whose work and cloth require them one or two feet deeper.

"The vats are all sunk in the earth, down to a level, or nearly so, with the floor of the dye-house. In some few old establishments, they stand two feet, or thereabouts, above the floor, as is universally the case on the continent. In this case, the frames are hoisted in and out by a pulley suspended over the vat, a most awkward and inconvenient practice, which is avoided by sinking them to the level of the floor. The frames are lifted out with ease by the hand, by two men or boys, one at each end, and in a range of six or eight vats, the frames are hoisted out and re-entered in half the time, and with half the trouble required to manage the pullies.

"The number of vats necessary in a well arranged dye-house must depend greatly on the nature and size of the establishment. Eight of the size already given, ranged in one line side by side, form a good series: double or treble that number may be required, but with fewer, a dyer, whose quantity of work is limited, yet various, will find much inconvenience, especially when by long working the dregs or grounds have so accumulated as to require a repose of twenty-four hours at least, after raking up before the vats are fit for work again. It is on this account that deep vats are preferable to shallow ones; the mud subsides in them much sooner, and they require cleaning out and emptying less frequently.

"The nature of the indigo vat is such, that the indigo is revived and precipitated from it whenever it comes in contact with the air. On this account, it is impossible to dye a piece evenly by wincing or working it in the dye liquor, as in other colours. Those parts of the piece which had been most exposed, and on which, of course, most indigo had been precipitated, would exhibit deeper shades than those which had been less. The reserve, or paste, also, for white, when such had been applied, would be disturbed and washed off by the usual manipulations of dyeing.

"On these accounts it is necessary to hook the pieces on a frame in such a manner, that when immersed in the vat, or taken out, the folds shall not touch each other. The frames are of wood, the length and width nearly of the vat, and of a depth sufficient for the width of the goods. The horizontal side-rails at the bottom are fixed, and form the base of the frame, and are furnished with small tenter hooks of copper an inch and a half, or two inches asunder, to which the edge or selvedge of the piece is attached. The upper rails, which are also furnished with hooks, slide in a groove cut in the upright or corner posts, and may be adjusted to the width of any kind of cloth, and are retained in their place by a peg or pin. The piece is hooked in folds from side to side, and so evenly and tightly stretched, that when immersed in the vat every part is equally and alike exposed to the dye, and no one fold can touch another. The number of dips is regulated by the shade of blue required, and when finished, the goods are taken off the hooks and subjected to the ordinary operations of washing, rincing, &c. &c. The solution of indigo, which, as well as the vessel that contains it, is generally called "blue vat" by the dyers, is made with lime and copperas, and in some cases with the addition of a small quantity of potash. In the due proportion of all the ingredients of this solution, and in the treatment of the vat, both during, and after working, consist the chief art of "blue dipping," in the management of which, however, there is less difficulty than in any other branch of blue dyeing whatever. The theory is so simple, and the practice, to those acquainted with the theory, so very obvious, that with common care and observation it is scarcely possible to err.

"Indigo, as we have just before observed, is insoluble in the alkalies and alkaline earths, till deprived of its oxygen. Copperas is employed for this purpose in the vats we are speaking of, and orpiment in others, and in the pencil blue; both these substances having a stronger affinity for oxygen than the base of the indigo. On adding together, therefore, indigo, copperas, and lime, in suitable proportions, the lime in the first instance decomposes the copperas, and precipitates from it the oxyd of iron: this acts on the indigo, deoxygenates it, and renders it soluble in the lime, which, if in sufficient quantity, immediately dissolves it. The oxyd of iron, which has served to deprive the indigo of its oxygen, the sulphat of lime formed by the union of the lime with the acid of the copperas, and any lime in excess or more than necessary to effect the decomposition of the copperas, and the solution of the deoxygenated indigo, all precipitate to the bottom of the vat, and there remains in solution only lime and the base of indigo. There are few dyers and callicoe-printers who do not imagine that the solution of indigo consists of all the substances that have been used in its formation, and that the vat actually holds in solution indigo, copperas, and lime. They are not aware that solutions of these two latter substances are incompatible; they cannot exist together, one or other must predominate, as a very simple experiment will show: Mix clear lime water and copperas water together, and an instant precipitation will take place. As long as any copperas remains in solution, every successive addition of lime water will cause a fresh precipitate, which consists of oxyd of iron, and sulphat of lime, formed by the union of the lime with the acid of the copperas. None of the lime remains in solution. The precipitation ceases only when the whole of the copperas is decomposed, that is, when there is no longer any acid to form an insoluble salt with the lime. The solution will then be found to consist of lime water only. To those in the least acquainted with the principles of chemistry, these observations may appear minute and trifling, but to those ignorant of these simple facts (and the majority of those interested in the subject of the present article are ignorant of them,) the constitution of the blue vat must be wholly unknown, and its management, of course, exposed to all those chances of failure and derangement which must necessarily attend even long experience, when unaccompanied with clear and accurate ideas of the nature and properties of the different substances employed.

"The proportions of indigo, copperas, and lime, necessary to form a blue vat, depend both on the quality of the indigo, and on the strength of the solution required. The quality of indigo varies greatly; some kinds, as the fine Spanish and East India, containing twice, and even thrice, as much colouring matter as the coarser kinds. In general from two to five pounds of good indigo to every hundred gallons of water, are sufficient to form vats for most purposes. They are sometimes, but rarely, required stronger; forty pounds in a vat holding eight hundred gallons, will produce a solution of sufficient intensity to give a black nearly, at four or five immersions.

"The finer the quality of the indigo, the greater the proportion of copperas and lime, necessary to effect its solution. In general, however, one of indigo, two of copperas, and two of lime, are considered as the best proportions, and as such they are given by Berthollet, who, to profound chemical science, unites considerable practical knowledge, and the best information concerning the processes of the dyers and callicoe-printers of France.

"The indigo is previously ground in a mill with water, till it is reduced to a smooth paste of the consistence of cream. In its ordinary state of aggregation, it is scarcely, if at all, attacked by copperas and lime; all therefore that has escaped the action of the mill, and is put into the vat in a lumpy or imperfectly ground state, may be considered as totally lost. Every precaution therefore should be employed to guard against this, and when by rubbing it between the fingers, or on a pane of glass, it appears fine and smooth, and free from small, hard, gritty particles, it may be removed from the mill, mixed up with four or five times its bulk of water, and poured through a fine sieve into the vat. Any lumps which may have escaped grinding are thus retained, and may be returned into the mill with fresh indigo.

"The vat having received its charge of indigo, and been filled up with clean water, the copperas is next added. It is best and most speedily dissolved by suspending it in a wicker basket at the surface of the vat; it is sometimes thrown in, and will, in that case, when it is in large lumps, oftentimes lie undissolved at the bottom of the vat for weeks, in spite of frequent and even daily stirring. When the whole is dissolved, the lime is added, and the vat well raked up, till all its contents are intimately mixed, the lime dissolved, and the copperas decomposed. The action of oxyd of iron upon indigo requires time, and also repose; after the first raking, which should be continued during half an hour at least, it is best to suffer the vat to remain two or three hours undisturbed; the indigo and oxyd of iron fall down to the bottom, and are thus brought more within the sphere of chemical action, than when floating in the whole mass of water in the vat.

"The choice of copperas is not a matter of indifference, as on its peculiar state depends its fitness or not for deoxygenating indigo. Sulphat of iron exists in two states dependent on the quantity of oxygen combined with its oxyd. At its minimum of oxydation, it forms a green solution, and when crystallized, a green salt, the green vitriol, or copperas of commerce; at its maximum, or second state of oxydation, it forms an orange-coloured, uncrystallizable solution possessing very different properties from the former.

"The green solution is distinguished by its great avidity for oxygen, and its disposition to pass to the orange, or fully oxygenated state. It is this affinity for oxygen that fits it for the solution of indigo. The copperas of commerce is however not unfrequently a mixture of the two salts or oxyds, a portion of it either having acquired oxygen, whilst in a state of solution before crystallization, or more frequently perhaps by too great exposure to the air afterwards.

"In this latter case its surface is covered with a reddish orange rust, and a portion of the salt is rendered useless for the blue vat having already acquired its maximum of oxygen. The chief difference in the quality of copperas, is however in the more or less perfect saturation of the acid, forming two distinct salts, which were known and distinguished by manufacturers long before chemists were acquainted with their existence. The first, and least esteemed, is a pale emerald green, and contains a great excess of acid; the other, which is more fully saturated with iron, is a deep full green, and is universally preferred, especially for indigo and China blue vats. Some callicoe-printers imagine that the reddish coloured copperas is the best, or, as they say, the *strongest*, a prejudice which the manufacturer very easily accommodates, by sprinkling a little fine sifted quick lime over the surface, which soon covers it with a coat of orange rust.

"The lime used for the indigo vat should be quick. Fallen lime, when not too old, and too long exposed to the air, is the best. It should be well sifted, and freed from stones and lumps.

"After two or three hours repose, the vat should be again well raked. It will now exhibit signs of incipient solution; instead of black, it will appear of a dark bottle green, and the surface will break into marbled veins of blue. These appearances will increase each time the vat is raked, which should be three or four times a day during two days. At each time the colour of the vat will brighten, and get paler, the marbled or veined appearance become more marked and strong, and when the solution is complete, and ready for working, the colour, when raked up, will be a yellowish green. After a repose of ten or twelve hours, to allow the dregs time to subside, the vat is ready for work.

"It is the practice of some dyers to add potash in equal quantity with indigo to the vat. The only advantage arising from this, is greater concentration of the solution than can be obtained by lime alone; but this is seldom required, and never, indeed, for the purposes of callicoe-printing; on the other hand, if potash be added to a vat containing little indigo, and calculated only for the paler shades of blue, the colour it will produce is less intense, than when lime alone is used, and the hue not at all improved.

"It was formerly the practice to grind the indigo with a solution of caustic potash, and boil it in a strong ley, before adding lime and copperas, and pouring it into the vat. A great deal of trouble, and no advantage whatever attends this process, which is now universally discarded, except by those who regard all improvements as innovations.

"Of the management of the vats both during work and after, we shall have occasion to speak whilst treating of particular kinds of work; which, after the preceding general view of the nature of the processes, and the mode of preparing the indigo vats, we shall now proceed to.

"*Of dark Blue ground, and white.*

"Dark blue grounds, with spots or figures of white, were amongst the first attempts at callicoe-printing in the East, and were produced, as we have before remarked, first, by tying knots on the part intended to remain white, and afterwards by covering them with a composition of wax. This process was subject to great inconveniencies, arising from the unmanageable nature of the composition, which required keeping fluid by heat during the time it was applied, and could only be used in certain plain figures, such as round spots, ovals, &c. The designs were of course rude and similar, little variety being practicable where lines, stalks, leaves, or any object more figured than a spot or oval, could not be obtained.

" At what time the paste or reserve now in general use was introduced, is not known; we are indebted for it to the continent, from whence, indeed, our first knowledge of callicoe-printing was derived. Though the formulæ for this paste differ much, every blue dyer almost, preparing it in a mode peculiar to himself, yet they are all essentially the same, a solution of copper of one kind or another being the principal ingredient.

" If a solution of sulphat, acetat, nitrat, or indeed any soluble salt of copper, properly thickened for printing, be applied to cloth, and when dry, immersed in the blue vat, the part so covered will resist the action of the dye, and remain white. This does not arise from the mere mechanical resistance of the paste, which prevents the solution of indigo from entering the fibres of the cloth, but from the chemical action of the oxyd of copper, which imparting oxygen to the indigo, restores it to its former blue state, in which it possesses neither solubility in lime, nor disposition to unite with the cloth. This effect of the oxyd of copper may be rendered very apparent, by pouring a solution of it into a solution of indigo, which is generally of a yellowish green, or when viewed by transmitted light, of the colour of small beer. The instant the two solutions are mixed, the indigo is revived, and precipitated in its original blue state, having acquired from the copper that principle of which it had been deprived by the solution of sulphat of iron. Every paste, or reserve, therefore, for dark blue grounds, must necessarily contain oxyd of copper; we give the following formulæ as most approved of any in use.

I. To 1 gallon of water add,
4 lbs. of sulphat of copper,
12 lbs. of pipe clay.

Boil the whole up into a thick paste, strain through a cloth, and add to it half a pint of sulphuric acid, and five pints of thick gum water. Mix all well together, and strain again before printing.

II. To 1 gallon of vinegar add,
$1\frac{1}{2}$ lbs. of verdigris,
3 lbs. of sulphat of copper.

Dissolve them over the fire, and thicken with 12 lbs. of pipe clay, finely ground.

"If the paste is not fine and smooth, run it through the mill, and add to it, whilst hot, 8 ounces of linseed oil, and two quarts of thick gum water; strain it carefully through a cloth before printing.

III. To 1 gallon of water add,
2 lbs. of verdigris,
3 lbs. of sulphat of copper,
3 lbs. of nitrous acid,
15 lbs. of pipe clay.

Boil them well in a copper pan, and, if necessary, grind them smooth, and add three quarts of thick gum water. Strain the whole very well before printing.

"The first of these formulæ contains sulphat of copper only, the solubility of which is increased by the addition of a little sulphuric acid, which prevents the crystallization of the paste. The second, which is stronger, contains also acetat of copper, and the third, in addition to both these salts, contains a portion of nitrat of copper formed by the action of the nitrous acid on the verdigris. This is a very powerful paste, and capable of resisting the vat a long time, and forming a white upon a ground nearly black.

"The pipe clay used in thickening, is not merely useful in giving due consistence and body to the paste, so as to render it easily workable, but is very efficacious in resisting the dye; the same solution, thickened with gum only, will scarcely bear three immersions, but with the allowance of pipe clay here directed, will stand ten or twelve. No more gum, indeed, should be added than is just sufficient to break the adhesive nature of the pipe clay, and prevent its clogging up the print or block.

"In working this paste, the mall or mallet should be used very lightly, or not at all, if the pattern will admit of it. A gentle tap with the hand, so as to leave the paste wholly on the surface of the cloth, will produce the best work.

"The cloth may be dipped an hour or two after printing, if required, but the whites are seldom so good as when kept three or four days. The paste gets hard and firm, part of the acid evaporates, and the solution of copper becomes more intimately incorporated with the cloth.

"Dark blues, in general, require from five to ten dips, or immersions, according the shade of blue required, or the strength of the vats employed.

"If the vats are strong, five, or at most six dips, will give a very dark blue, almost black, the intensity of which will be little increased by further dipping; the labour is greatly abridged by employing strong vats, but the whites are liable to great injury, as the solution of indigo, when concentrated, acts very powerfully on the paste. On this account the first vat should invariably be the weakest of the series, and never stronger than is sufficient to produce a full strong blue at seven, or even eight immersions. The second and third vats may be stronger, and so on to the last, which may be the strongest of all. Dark blues may be dipped and finished in the same vat, but it is more convenient to pass them in succession through a series disposed in a line in the manner we have before described.

"When the piece is well hooked, and the frame ready, the vat must be well skimmed before the piece is entered. The surface of the blue vat is always covered with a film of revived indigo, more or less thick, according to the strength of the vat. This film it is necessary to remove before the frame is immersed, otherwise the revived indigo, which is no longer in solution, attaches itself, and adheres to the cloth in patches, producing unevenness in the dye, especially in the first vat. When skimmed, the surface of the vat is dark green, but the blue film reappears in a few minutes; it should not be removed, therefore, till the frame is ready for immersion.

"In five or six minutes the cloth has fully imbibed the dye, and little advantage is gained in general by keeping it longer in the vat. The frame is then lifted out, and placed slantwise in such a manner, that all the liquor which drains from the piece falls down into the vat again. When taken out, the cloth appears of a pale yellowish green, if the vat is weak, but if strong, more inclining to amber. This colour gradually changes, as the indigo, by absorbing oxygen from the atmosphere, becomes revived, and in five minutes the cloth appears uniformly blue; it is then ready for another immersion. Six minutes *in*, and six minutes *out*, is a good general rule for dipping dark blues, as the cloth will in that time have acquired the full effect of the vat, and *the green will also go off* in little more than five minutes, though the vat be very strong. The bottom edge of the piece retains the green hue the longest, because it is longest in draining from the liquor; care must be taken, therefore, never to immerse a piece till the bottom edge has been examined, and found perfectly ready for the dip. The consequence of entering a piece into the vat whilst the bottom edge is green, is, as might be supposed, that the edge will be the palest, the indigo not having been revived and precipitated upon it equally with the rest of the piece.

"In dipping dark blues, the first dip is the most important; and if it fails, the work is inevitably ruined. First, if the vat be too strong, the whites will never be clear and sharp; secondly, if for want of due preparation the cloth does not uniformly receive the dye, the goods will scarcely ever be even when finished. Thirdly, if either from the paste being too strong, or the vat too weak, or not in proper order, the impression starts, or runs at the first immersion, the ground is sure to be freckled and uneven, and the whites bad.

"Against the first source of error, the knowledge of the fact ought to be a sufficient guard; but if unavoidably it should happen that the leading vat is too strong, there is no other remedy than shortening the time of the dip, and keeping the frame in four or five minutes in lieu of six, till the vat becomes reduced in strength.

"Imperfect bleaching, accidental impurity in the cloth, and long and partial exposure to heat and air, are amongst the causes which contribute most to prevent the cloth from receiving the blue dye.

"It is the practice with many printers to give the cloth intended for this purpose an extra preparation, either by boiling in a ley of potash, or a solution of common salt. If the regular bleaching has been perfect, the first is wholly unnecessary, and the second absolutely useless.

"Cloth that has been well bleached may, by long keeping, and partial exposure to the air, dust, and other accidental impurities, become so unfit for dipping, as to require some extra preparation. In this case the modes we have spoken of may be useful inasmuch as washing, soaking in hot water, squeezing, and the other attendant operations are useful; but clean, well bleached, and recently bleached cloth has no need of any such preparation.

"If the paste be too strong, that is, if it contains too much sulphat, acetat, or nitrat of copper, it is liable to start or run in the first vat, especially when laid on in large bodies. This evil, if not too great, may be remedied by gently moving the frame up and down during the first two or three minutes after it is entered. It may also arise from the vat being too weak, and consequently containing too little lime in solution, and may sometimes be remedied by the addition of more lime. If in spite, however, of the motion of the frame, the addition of more lime, or of greater strength to the vat, the paste still continues to run, it is a sign the solution of copper is too strong, and the quantity must immediately be diminished.

"When the green is gone off after the first dip, the frame is then moved on, and dipped in the second vat, taking care to skim it well before the piece is entered. In this way, after each immersion, the frame is moved on to the next succeeding vat, till it has received the number of dips required. This, as we have before observed, depends on the strength of the vat, and the shade of blue wanted; but as, during the process of dipping, the vats continually get weaker, the goods, after a certain time, will require an additional immersion, or even two or three, to get them up to the strength of the first pieces that were entered.

"The strength of a blue vat is not exhausted in the same manner as the weld or madder bath, by the abstraction of the colouring matter from the solution, by the superior affinity of the mordant on the stuff. When a piece of cloth is immersed in the indigo vat, it becomes penetrated in five or six minutes completely with the dye, and will gain nothing, by being suffered to remain longer than is necessary for this purpose. When taken out, it carries with it no more indigo than is contained in that quantity of solution which it has imbibed, and carries out of the vat. But the instant the frame is lifted out, the liquor begins to drain from it back again into the vat, and pours down in small streams, thus exposing the solution completely to the atmospheric air. The indigo is in consequence revived and precipitated, so that the liquor which drains from the piece and falls down into the vat, is for the purpose of dyeing, no better than so much water. Every frame that is entered thus effecting the precipitation of the colouring matter from two, three, or four gallons of the solution; the vat, especially the leading one, soon becomes reduced in strength. The second, third, and successive vats, are weakened in the same manner, and also by the exhausted liquor of the pieces, which at every dip after the first, is exchanged, as it were, for the fresh and strong solution of the vat it is immersed in.

"When the goods have received the last dip, and have acquired their full shade of colour, they are taken off the hooks, and well winced in clean water; they are then, by the successive operations of washing and hot watering, repeated as occasion may require, freed from the paste, and rendered as clean as possible before going into the sours.

"Souring is necessary to free them from the last remains of the paste, and give a brightness and finish to the whites. A solution of sulphuric acid, weak enough to be borne in the mouth without inconvenience, is sufficient to dissolve what oxyd of copper is left in the cloth after good cleaning. The goods are immersed in this ten or fifteen minutes, after which they are well washed and hot watered, and when dry are finished, or ready for any succeeding operations. The excellence of this kind of work depends on the clearness and purity of the white, and on the fulness and evenness of the blue. The directions we have given are, with ordinary care and observation, sufficient for the attainment of this.

When the vats have become exhausted by working, they must be *refreshed*. If a vat contains a tolerable charge of indigo, copperas, and lime, and has been worked only once, raking up alone will be sufficient to put it in a state for working again. When again exhausted, copperas and lime must be added to dissolve the revived indigo. The quantity must depend upon the size of the vat, and the supposed quantity of indigo which it contains. From twenty to forty pounds of copperas, and three-fourths of that quantity of quick lime, may be added at once to a vat of one thousand gallons, or thereabouts, and some idea may be formed of the effect which this should produce, by recollecting that one pound of indigo requires for solution about two pounds of sulphat of iron. It is proper always to have an excess of quick lime in the vat, but it is wholly unnecessary to make those frequent additions of lime without any thing else, which is the practice of many blue dyers. It serves no other purpose than to fill the vat speedily with dregs, which ought to be avoided as much as possible, as when they are accumulated to a certain pitch, it is necessary either to take them out, or suffer the vat to repose from thirty-six to forty-eight hours before it is fit for work after raking.

"If equal quantities of copperas and lime have been used when the vat was formed at first, and three parts lime added for every four of copperas afterwards, any other addition of lime is wholly useless. Some idea may be formed of the state and condition of a vat, by observing its appearance when raked up. In general, if it looks dark green or black, it may be presumed it contains a quantity of revived or undissolved indigo, and copperas and lime are therefore necessary; this blackish appearance may nevertheless be occasioned by a very great excess of copperas, or sulphat of iron, the oxyd of which, when recently precipitated by lime, is dark green; as this, however, could arise only through great ignorance, or accident, it is not often likely to be the case, as the quantity of copperas required to produce this effect must be very great indeed.

"When a vat rakes up yellow, or very pale yellowish green, it is supposed by some to contain too much copperas, and must be corrected by the addition of more lime. It is hardly correct, as we have before observed, to say a vat contains an excess of copperas, since this salt cannot exist in solution with lime. A vat may want lime, and in this case it will be very weak, of a pale yellowish green, produce a very feeble blue, and the paste will invariably *creep*, to use the dyers' phrase, or in other words, will run, and loose the sharpness and smartness of the impression, the moment it is entered in the vat. This may be the case at the time the vat contains a quantity of revived indigo also, and rakes up black, so that no certain conclusion can be drawn from the yellowish appearance aforesaid.

"If a vat be weak, the froth which forms at the top during raking, is pale sky blue; the surface does not speedily break into marble veins, nor is it soon covered with a blue film. A strong well conditioned vat, on the contrary, when raked up, becomes covered directly with a permanent and copious froth, the colour of which varies from a deep blue, when the vat is of ordinary strength, to a bright copper colour, which is always characteristic of a very strong solution, and the surface, when skimmed, is in an instant covered with a thick film of revived indigo. This film, and the deep blue and copper coloured froth, is the best and purest of the indigo, and is called the *flower of the indigo* by the old dyers. In skimming, great care must be taken that this is carefully preserved, and returned again into the vats at the time they are refreshed.

"When a vat becomes so exhausted that further additions of lime and copperas have no effect in increasing the strength, fresh indigo must be added, with the proportions of lime and copperas before indicated.

"If a vat remains several weeks unworked and without raking, it will absorb oxygen enough from the air to precipitate the indigo from the solution, so that, to the depth of ten or twelve inches from the surface, it will consist of lime-water only, and must be well raked up before it is worked.

"When the dregs have accumulated so much as to prevent the vat from clearing in twenty-four, or at most thirty-six hours, and when the frame begins to touch the mud during work, it is time then to empty it out, taking care to dose the vat well with lime and copperas, so as to get out all the indigo before the dregs are thrown away as exhausted.

"*Of Pale Blue.*

"Pale blues are, in general, produced at a single dip; they require less indigo and labour than the preceding style of work, but more care and management to do them well. They are liable to be uneven and spotted in the ground, and the proper tone and shade of colour is a matter of great importance, and also of no small difficulty.

"We shall speak first of pale blues and whites, intended to be finished up with after-colours or not.—The paste for pale blue is precisely similar to that for the dark blue we have been treating of, except that it need not be so strong. Two pounds of sulphat of copper, dissolved in a gallon of water, and thickened with pipe-clay and gum, in the manner of the three pastes we have already given, will form a very good reserve for pale blue. Any other solution of copper will be equally efficacious, but the sulphat, as being the cheapest, may be considered as the best.

"The preparation, or rather the condition of the cloth, is a matter of the greatest importance in pale blue dipping. If imperfectly bleached, or stained or impregnated with any earthy or metallic substance that will obstruct the entrance of the dye, the blue will infallibly be uneven. A difference in the quality of the cotton, in the fineness of the weft, or in the hardness of the twist, of which the cloth is made, will occasion considerable variation in the shade of blue, and defeat every attempt, on the part of the workman, to do justice to his work. To guard as much as possible against this, the cloth, in the first place, should be selected purposely, rejecting all those pieces which show unevenness in weaving, or variation in the quality of the materials.

"The goods should be in the best possible state for printing; fresh from the bleach ground, carefully kept from dust or dirt of any kind, and sufficiently damp to make them take a stiff calendering. As soon after printing as convenient, they should be removed from the warm shop to a cool situation, where they will not get parched and dry, and dipped at furthest the following day.

"All these precautions, however, are inadequate to secure an even and level ground, without recourse to the improved method of dipping, for which we are indebted to the callicoe-printers of London.

"This improvement, whether considered with reference to the particular style of work, of which we are now treating, or its application to other branches of blue dyeing, the most important that has lately been introduced, consists in dipping the goods in clear lime-water before they are entered in the blue vat.

"If the piece becomes uniformly wet throughout, and shows no streaks or patches of white, it may safely be transferred to the blue vat as a piece that will take an even dye. If, however, after remaining five or six minutes in the lime vat, there are parts which are not completely wet, it must be dipped five or six minutes longer, and again taken out and examined. All those pieces which, after two, or, at most, three immersions, still refuse admission to the lime-water, are rejected as unfit for dipping, and the paste being removed by souring, are appropriated to some other course of work to which they are better adapted.

"The vat for pale blues is, in general, the same as for the dark grounds, care being taken to select one that will give the shade of blue required. It is usual to employ the old and nearly exhausted vats for this purpose, but the blue is never so bright and lively as when fresh indigo, and that of the finest quality, is employed.

" The hue is greatly improved by souring, a necessary operation, to free the goods from the paste, and still further, by winching them in a solution of white soap ten or fifteen minutes, at a heat of 120 degrees.

" Mr. Haussman observes, that if the goods are plunged in a weak solution of sulphuric acid immediately on coming out of the vat, the blue is more lively and full than when previously rinced and washed.

" Mr. Chaptal employs for pale blue grounds without white, and for green grounds also, a vat composed of indigo, potash, lime, and orpiment. This solution, which is the same precisely as the pencil-blue of the callicoe-printers, affords a much more delicate colour than that with lime and copperas, the cause of which is not clearly understood, though it most probably arises from the different degrees of deoxydation produced by the two substances.

" This vat is formed by boiling ten pounds of fine Spanish indigo, ten pounds of potash, twenty pounds of quick-lime, and five pounds of orange orpiment, in about thirty gallons of water, and pouring it, when the solution is complete, into the vat containing about eight hundred gallons of water, and twenty or thirty pounds of lime. When worked, it must be raked up well the instant before the frame is entered, and when exhausted, refreshed with additions of the same solution.

" If a piece of cloth, printed with the reserve or paste before described, be dipped in this vat, the copper becomes precipitated and fixed by the sulphuretted hydrogen which it contains, and produces a brown stain instead of a white. It is possible, however, with extraordinary care and management, to succeed in obtaining good whites in this vat, and the following process may be employed with success, though it is still capable of further improvement.

" Prepare a paste by dissolving two pounds of sulphat of copper in one gallon of acetat of alumine, or the common aluminous mordant of the callicoe-printers, add to it one pound of nitrous acid, ahd eight pounds of pipe-clay; boil well and strain it through a fine cloth, and when cold, add as much thick gum-water as is barely necessary to give it the due degree of consistence for working. In printing this paste the mallet should never be used, a gentle tap with the hand, if the block is true and in good order, will leave the paste, as it should be, wholly on the surface of the cloth. Dip six or eight minutes in the lime vat, and when taken out, suffer the piece to drain two or three minutes before entering in the blue vat. The vat should be strong enough to produce the shade required in two minutes, after which the frame should be withdrawn and plunged instantly in a vat of clear water, and moved and agitated therein till the green goes off. When washed and soured, if the work has succeeded, the white will be clear and prominent, and the blue the finest that can be produced on cloth. It is remarkable, that a strong vat produces better whites than a weak one, on this account care must be taken, that the solution be of a proper strength. The utmost nicety is required in preserving the cloth for this vat from dust or dirt of any kind. Goods that have been long bleached, and not carefully secluded from the air, are wholly unfit. They ought, in fact, to be taken fresh from the sours, for every, even the smallest particle of metallic substance that is in the cloth, when dipped in this vat, will produce a brown stain, and if the cloth is uniformly tainted with it, entirely ruin the blue.

"In dipping pale blue grounds, it is sometimes necessary to protect colours that have been previously applied, from the effect of the blue, as red or yellow flowers for example, which would otherwise become purple and green. The solutions of copper cannot be employed for this purpose, as they injure the colours, especially madder reds, or purples, very much, and are not wholly removed without souring, an operation which goods of this description cannot be subjected to.

"The reserve most commonly used, is simply a paste of pipe-clay or Spanish white, boiled to a proper consistence, and mixed with an equal quantity of thick gum-water. This does not affect the colours upon which it is applied, and is easily removed by hot water and washing; but as it opposes merely a mechanical resistance to the dye, and fails the moment it becomes softened, it will not bear a dip of more than one minute or two. This is an inconvenience of great magnitude, when the pale blue ground is much exposed, and not covered with any kind of design calculated to hide unevenness in the dye. The following paste is recommended and used, by some, as capable of resisting much longer than the former:—

One pound of finely ground pipe-clay,
Four ounces of gum arabic,
Two ounces of suet,
Two ounces of wax, and
One ounce of resin.

Boil all these ingredients together, in as much water as will form a paste of sufficient consistence not to run. This paste can only be applied with the pencil, and in large masses. It is removed with great ease by hot water and washing, without any injury to the reds, or other colours it has covered.

"The solutions of lead possess the property, though in a much smaller degree than copper, of resisting the indigo vat, and may be used with advantage for pasting reds and other colours, which are but little injured by them. We have seen the following paste used with great success:—

"Dissolve two pounds of acetat of lead in a gallon of water, add two ounces of tallow, two of wax, and two of resin, and as much pipe-clay and gum as will make it of a proper thickness for printing or pencilling. This paste will resist a dip of three or or four minutes; it must, however, be laid on in good bodies, and succeeds better with the pencil than block.

"In pale blue grounds, with black and white figures, &c. it is often necessary to print both the black and the paste at the same time, to save the expense and trouble of after-grounding. The black for this purpose is generally chemical black, for an account of which we must refer to the article Colour-*making*. The sulphat of copper paste is generally used, but as the goods cannot, on account of the black, be passed through the sours to free them from the oxyd of copper, which imparts a greenish hue to the white, it is better to employ the nitrat of copper, which is cleared by hot watering and washing much more completely.

"If the patterns contain very large masses or bodies of black, the acetat of iron, or what the printers call black colour, must be used, increasing the strength to double that required for an ordinary black; so that when the goods are dipped, and as well cleaned as possible, by repeated washing, &c. they may be passed through water rendered slightly acidulous with nitrous, or what is still better, acetous acid, without materially impairing the strength of the mordant.

" The white is completely freed from the oxyd of copper by this slight souring, and takes no stain in the dye copper, when the black is raised with sumach and logwood.

" It is proper to observe, that the goods, before souring, should be completely freed from all superfluous paste, either of the black or white; and the iron, by repeated hot watering, at a temperature of 140°, oxygenated as highly as possible. In this state it is scarcely soluble, either in nitrous or acetous acids, and will bear weak solutions of them fifteen or twenty minutes.

" *Of Resisting Mordants.*

" When a pale blue is intended to exhibit other colours on the ground, as red, pink, yellow, orange, &c. the paste or reserve is often mixed with a mordant capable of producing these colours in the dye copper.

" The common paste alone will produce a yellow with weld, quercitron bark, fustic, &c. if the piece be simply rinced and washed before dyeing.

" In this case the oxyd of copper which remains in the cloth attracts the colouring matter, and though it is greatly inferior as a mordant, to the acetat of alumine, yet, with care and management, it is capable of producing, with weld, a pale and beautiful yellow. The only difficulty consists in getting the colour even, and this is best attained by employing those solutions of copper which are most soluble, and using them somewhat stronger than is merely necessary to resist the vat.

" When dipped, the goods should be well rinced in the river fifteen or twenty minutes, and afterwards rinced off in a copper of warm water, with a shovelful of cow dung. Too much dung, or too great heat, will injure the yellow; the temperature should not exceed 100°, and after wincing again in the river, they should be dyed at a heat considerably below this, if weld is used, and not exceeding seventy-five or eighty if dyed with bark.

" Oxyd of copper, when dyed at a high temperature, invariably becomes dull, especially when bark or sumach are employed. With weld there is less risk of injuring the brightness of the yellow, but long continued heat impairs it greatly.

" This mordant does not at all answer for reds; with madder it affords a dull wine-coloured dye, and with brazil, peachwood, and cochineal, dull, heavy colours, more inclining to pompadour or chocolate than red. When mixed, even in small proportions, with the common aluminous mordant, its effects are very visible, when dyed with any of the above-mentioned drugs.

"It is nevertheless employed for deep full reds, upon pale blue ground, according to the following formula, which is excellent for a yellow or orange:—

"Dissolve two pounds of acetat of lead, and two and a half pounds of alum, in a gallon of water; pour off the solution from the precipitate, and add eight ounces of sulphat of copper; thicken with one pound and a half of starch, and four pounds of fine pipe-clay. When cool, strain the paste through a cloth or sieve, and give the goods six days age before dipping. Dip three minutes in a well-conditioned vat, and transfer the frame from thence instantly to the water-vat.—Rince off, and prepare for dyeing in the same manner as before directed.

"The following formula is in use for resisting reds or yellows: Dissolve in one gallon of warm water three and a half pounds of acetat of lead, and five pounds of alum; thicken it (with the precipitate in) with the best Senegal gum, and add two ounces of white arsenic, ground as fine as flour; four ounces of common salt, and four ounces of corrosive sublimate. Give the goods two or three days age before dipping, and keep them from three to five minutes in a good vat, or less, if you can get the shade of blue required. Plunge them in the water-vat the instant they are taken up, and rince and finish as before.

"Bark or weld drabs and olives, as they do not so soon show any slight tinge of blue which may have penetrated the paste, may be simply thickened with good starch, and from twelve to sixteen ounces of suet per gallon, to enable them the better to resist the vat. If this should not suffice, from two to four ounces of sulphat of copper may be added, but it must be observed, that this will change the hue of the drab, and make it more an olive. A little pipe-clay, not more than two pounds per gallon, may be employed also with advantage. It is very efficacious in keeping out the dye, and, in so small a quantity, will not materially affect the fullness and evenness of the mordant.

"Solutions of tin, more especially the nitro-muriatic, are employed by some callicoe-printers, in conjunction with the aluminous mordant, for resisting reds and yellows. They are not very powerful in keeping out the blue, and, with madder, afford but feeble colours: the yellow they produce is bright, but pale.

"In general, those solutions which are most efficacious in resisting the vat, are the worst mordants, as those of copper for example; but as they will bear a long dip, and the evenness of the blue is thereby ensured, this advantage, in one colour, is considered as sufficient compensation for want of brilliancy in the other. The common aluminous mordant, thickened with gum and a little pipe-clay, or with starch and pipe-clay, forms infinitely the best mordant, and will resist the vat a few seconds, but not sufficiently long to make the work secure. The recent improvement in this kind of dipping, however, by the use of warm vats, has removed a great many difficulties, and enabled some callicoe-printers to produce work of very superior merit.

"The great and the only advantage attending warm vats, is the celerity with which the dye penetrates the cloth; so that all the effect of a six minutes' dip in a cold vat, may, in a warm one, be obtained in the same number of seconds. The frame, in fact, is plunged in only for a moment, and instantly taken up; and, in this short space, the vat, however strong, has not time to penetrate the paste or mordant.

"The vats may be variously heated, as best suits the nature of the establishment. Steam affords the most easy and efficacious means, and may either be thrown into the vat through a pipe and valves, in which case the steam itself is condensed in, and mingles with the solution of indigo, or the vat may be in part surrounded with a casing, into which the steam may be admitted, and give out its heat, without filling the vat with condensed water.

"The first is the simplest and most economical mode; but it requires certain precautions which the other does not. In the first place, before the steam is admitted into it, the boiler should be *blown*, that is, completely emptied of air; for if it passes along with the steam into a vat, the indigo will be revived, and precipitated from the solution, and the vat rendered unfit for dipping. In the second place, if the vat, when cold, is only of the proper strength, the admission of so much steam, and consequently of condensed water, as will be necessary to raise it to the temperature required, will weaken it considerably; and lastly, some inconvenience may arise from this great accumulation of condensed water, unless due allowance be made before it is admitted, and care be taken never to turn it in when the vat is full.

"The second mode is subject to none of these inconveniencies. The vat can neither be weakened by air from the boiler, nor by condensed water, since the heat is transmitted wholly through the câsing. The expense, however, is very considerable; still it is greatly preferable to the plan which some printers have adopted, of constructing cast iron vats, and heating them by furnaces built underneath.

"The temperature at which they can be employed, varies according to the kind of work, and the power which the paste possesses of resisting a hot vat.

"From 60 to 80° will be sufficient for most purposes, and a vat of tolerable strength will, at the latter temperature, produce a good blue in ten or fifteen seconds.

"*Of coloured Paste.*

"By mixing both colouring matter and mordant with the reserve, we obtain pastes which at the same time communicate colour to the cloth, and resist the blue; not only saving the necessity of dyeing, but enabling us to form combinations of colours, incompatible by any other process. This branch of blue dipping is still in its infancy, and little has yet been done towards its perfection. We shall therefore have little else to do in treating of this part of our subject, but to state the few facts on which it is founded, and suggest some hints for its future improvement.

"If a solution of sulphat or acetat of iron be mixed with the reserve or paste for white, it will, when dipped and rinced off, leave a buff or orange stain, not very strong, indeed, nor always very even; but applicable and useful in some cases. This paste has been long known and employed.

"If instead of acetat of iron a strong decoction of bark, or French or Turkey berries, be mixed with the reserve, a yellow will be obtained, full, but less bright, than when raised in the weld copper.

"Thus by combining different colouring matters with the mordants proper for fixing them on cloth, and also with substances which have the property of resisting the blue dye, various coloured pastes will be obtained.

" The solutions of tin, from their forming combinations with most colouring substances which are but little affected by acids, seem likely to be of considerable use in the composition of pastes of this description. The muriat of tin destroys the resisting power of solutions of copper by de-oxygenating them; but the nitro-muriat, or highly oxygenated solutions, produce rather a contrary effect; they are these which should therefore be tried.

" *Of China Blue.*

" The process for China blue dipping consists in applying finely ground indigo, in its crude and undissolved state, upon the cloth, and fixing it by alternate immersions in solutions of sulphat of iron and lime.

" The same thing takes place upon the cloth, that is effected in the ordinary blue vat when indigo is dissolved; in both cases the indigo is de-oxygenated, and prepared for solution by the copperas, and afterwards dissolved by the lime.

" The different shades of colour in China blue dipping are produced by reducing, more or less, the standard colour, which is prepared in the following manner.

" 1st. Grind in a metal pot with balls, or by any other contrivance, ten pounds of good indigo, eight pounds of good copperas, and five pounds of orpiment, with two gallons of water; when the whole is nearly ground, add two quarts of very thick solution of gum senegal, and grind a few hours longer.

" 2d. Prepare a solution of sulphat of iron by dissolving two pounds in a gallon of water, adding a quarter of an ounce of potashes, and suffering the precipitate, if there is any, to subside. Reduce the ground blue (No. 1) with as much of this clear solution (No. 2) as will bring it to a proper consistence for working, and print with this for the dark full blue. When dipped, this colour will have nearly the effect of black, especially in small bodies.

" For pale blue, reduce the standard with ten, fifteen, or twenty measures of the solution of copperas, and an equal quantity of acetat of iron, or common iron liquor thickened with gum. With fifty, sixty, or even ninety measures of sulphat and acetat of iron, one measure of the standard blue will give very good shades of pale blue. When the pattern, whether block or plate, will not work in gum, a portion of the acetat of iron must be thickened with starch, or flour, and ground up in the mill with its due proportion of the standard. When worked on plates, wooden doctors, especially lime tree, are preferred to steel ones; they clean the plate much better, and give a fine neat impression.

"The vats are of the same form, and generally of the same dimensions, as those before described; they are, however, never lined with lead; wood, or stone, being considered sufficiently secure for solutions of little value, compared with those of indigo. They are disposed in a line, a copperas vat and a lime vat alternately; or when the mode of dipping allows it, a lime vat between two copperas vats, forming a system in which two frames are worked; the lime vat being thus kept constantly employed, the copperas vats only alternately. The copperas vats are made up of different strengths, according to the work intended to be done; strong thick goods, such as Marseilles quilting, &c. require stronger vats than callicoes and muslins. The first require the solution to be of spec. gravity 1040, the latter about 1030. These are the most economical points, but good work may be done at any point between 1025 and 1050. Lower than 1025, the colour will be pale and faint, though even; and higher than 1050 it is liable to be uneven, some parts being very deep and full, and others meally and spoiled.

"The lime vats are set with fine sifted quick lime, recently slacked, in the proportion of one hundred and fifty pounds to one thousand gallons of water.

"When the pieces are hooked, and properly arranged on the frame, they are entered first into the lime, and the dipping proceeds as follows.

1. Entry	in the lime vat	5 minutes.
2.	in copperas vat	30
3.	in lime vat	10
4.	in copperas vat	30
5.	in lime vat	20
6.	in copperas vat	45
7.	in lime vat	45

"During the first five minutes in the lime, the frame must be gently rocked, or moved up and down, then drawn up and tightened. The vat, both now, and at every subsequent dip, is well raked up before the frame is entered. When entered in the copperas vat, rock five or six times, to detach the loose lime from the piece.

"At the second entry in the lime, rock the whole time.

"At the second, and every succeeding entry in the copperas vat, rock five or six times as before, to detach the lime.

"At the third and fourth entry in the lime, rock five or six minutes, and now and then.

"The reason for finishing out of the lime, is to keep the frames and hooks free from the rust and incrustation of the copperas, which it loosens, and renders more easy to detach and clean; with respect to raising the colour, it makes no difference whatever.

"When the piece comes from the copperas vat the second time into the lime, it will appear a grass green colour, if there be a proper quantity of lime in the vat. If too little, the piece will appear yellowish, and more lime must be added.

"Take off the pieces quickly after the last dip, and wince them briskly in the water-pit a minute or two at the most. Get them into the sours, and after wincing over twice or thrice, let them lie an hour or two, after which wince again four or five times, and wash well in the wheel. Hot water them, and wheel again before hot souring, which is done in a sour of spec. gravity 1015, heated to 180°. Wince the goods four or five minutes in this, after which wash, hot water, &c. and finish for drying.

"If the goods are kept too long out of the cold sour after the last dip, the oxyd of iron, with which they are coated, oxygenates very rapidly, and the cloth becomes buff or orange. It is with difficulty that the iron is disengaged, and not without long and very strong hot souring.

"The cold sours soon become foul with the loose superfluous indigo, which is detached, and unfits them for light goods, long before the acid is saturated.

"In this case it is economical to add two or three shovels full of fine well-beaten clay, previously mixed up with water; when this is well incorporated with the sours, and suffered to subside, it carries down with it great part of the floating indigo, and renders them fit for use again.

"After every day's work the lime and copperas vats must be refreshed.

"From twenty-five to thirty-five pounds of sifted lime, according to the size of the vat, and the number of pieces that have been passed through it, must be added every night.

"No harm can arise from excess of lime, excepting the unnecessary expense of more than is required, and the accumulation of sediment or mud in the vat, which will soon require removing.

"Ten pounds of copperas are generally added for every piece of callicoe that is dipped. This is suspended at the surface in a wicker basket, and suffered to remain till all is dissolved It is quite unnecessary to rake up the vat, as the fresh additions of copperas will incorporate uniformly without stirring, which, by muddying the vat, may do mischief. Care must be taken to use the hydrometer frequently to correct any deficiency or excess which may arise in the sp. gr. of the solution of sulphat of iron.

"In making new or fresh copperas vats, after having brought them to the standard on the hydrometer, add to every thousand gallons four or five gallons of the lime vat (raked up) and one pound of potash. This is to neutralize the superabundant acid of the copperas.

"The grass green Yorkshire copperas is the best for this purpose, it contains the least free acid; the pale whitish green is the worst, and when such is used it will be proper occasionally to throw into the vat about one pound of potash, and four or five gallons of muddy lime water.

"When daily worked the lime vats should be emptied out, and wholly renewed once a month at least.

"The copperas vats are never wholly emptied, but when the mud accumulates so as to be troublesome and endanger the safety of the work by resting on the lower edge of the piece, it must be taken out with a scoop or shovel proper for the purpose.

"The ground of those goods which show much white will in general be sufficiently clear when finished according to the preceding directions, the white is however greatly improved by a gentle soaping, and one or two days exposure on the grass.

"In general, better work may be produced in the winter months than in summer: in hot weather, the colour is liable to be uneven, patched and meally; the cause of this has not been well ascertained, though, in all probability, it arises from the increased action of the sulphat of iron and lime at an increased temperature: it is not unlikely that weaker copperas vats would be found to act better in summer than strong ones, as the effect of temperature would thereby in some degree be counteracted.

"From the nature of the process of China blue dipping, it must be evident that it must precede any other application of colours to which the cloth is intended to be subjected. If, for instance, reds or yellows are to be introduced, these must follow the operation of dipping; as they would inevitably be ruined by repeated immersions in copperas and lime, or wholly discharged by cold and hot souring."

Of Pencil Colours. These are laid on by young boys and girls with a pencil after the piece is printed.

Blue. I have already given several receipts for pencil blue, which will answer perfectly: I do not, however, think it unnecessary to add the following variation, from my notes on the practice of printing callicoes.

Put two quarts of water into a copper pan; add twenty ounces of good fresh made lime, pounded and sifted, to separate the flinty and unburnt parts: then ten ounces of the best Guatimala indigo, ground as fine as possible, which is essential. Mix the whole together and boil upon a slow fire for half an hour, keeping the mixture stirred all the time. When cold, add eight ounces of red (or yellow) orpiment; boil it then once more for a quarter of an hour, and lastly add two quarts of strong gum water.

I think the above would be improved by the addition of half a pound of pearl ash, but such is the actual process of practice.

Green. Fustic four ounces, green copperas one ounce, logwood liquor one quart, verdigris a quarter of an ounce; boil for an hour; strain it; thicken with starch. Add indigo-pencil-blue till you bring it to the proper shade. This is in fact a chemical colour, not fast; nor is the next, which is of the same description.

Yellow. Dissolve an ounce of turmeric in half a pint of spirits of wine, and add to it a decoction of saffron, a quarter of an ounce in a quart of water, more or less, as the shade of colour requires. Thicken with gum.

Orange. Annatto one pound, pearl ash half a pound, water five quarts; boil them together in a brass pan, keeping them constantly stirring till the boiling commences. Let the liquor stand till it is cold and settled; pour off the clear liquor and thicken it for use.

This is rather a full nankin than an orange: it is at best a fugitive colour, and not fit for good work, as it will not bear more than one washing. Of these pencil colours, none are good but the blue. A green is produced by pencilling over a yellow previously raised with weld or quercitron.

Of Chemical Colours. The printers call those "chemical colours" which are mixed with the mordant previous to either the one or other being applied to the cloth. The pieces therefore are printed at once with the colours of the pattern, and do not require to be afterwards dyed. This mode of printing is more expeditious and cheaper than that by means of dyed or raised colours, but it is very imperfect, from the more fugitive nature of the colours thus laid upon the cloth.

My notes on this part of the subject, are as follows:

Black. Vinegar, four gallons; blue galls, bruised, eight pounds; boil them till the goodness is extracted out of the galls, and they are quite soft; squeeze and strain them. Add to this liquor one pound and a half of green copperas, and one quart of nitrat of iron, or a strong solution of iron in aqua fortis, slowly made, and by a little iron put in at a time.

Another: Galls, four pounds; logwood, one pound; vinegar, one gallon; water, one gallon; green copperas, four ounces; blue copperas, two ounces; iron liquor, one pint; nitrat of iron, one pint.

As the oxyds of lead, mercury, and silver, are apt to turn black, I suggest, that this may be improved by a small portion, six ounces for instance, of sugar of lead, in the first receipt.

Gray. Dilute the blacks, as the strength of your colour requires.

Mud. Water, one gallon; pounded galls, twelve ounces; madder, four ounces; green copperas, four ounces; logwood, four ounces; spirit of salt, two ounces. The galls and logwood should be boiled till the colour is extracted, then strained, and then add the green copperas. Dilute with water according to the required shade.

In my opinion the spirit of salt ought to be superseded, by using a gallon of vinegar instead of a gallon of water.

Emperor's Eye. Boil in a gallon of water for half an hour, two pounds of sumach; and one pound of green copperas, in a bag for a quarter of an hour. Thicken for use.

Stone. Two quarts of vinegar, and two pints of chemical black, boiled together gently for ten minutes.

Drab. Make a strong decoction of sumach, with a small quantity of fustic in it. Take equal parts of this decoction, of vinegar, or rather of tar acid, and of water. Add to them three ounces of green copperas, and half an ounce of sal ammoniac.

Tar acid and pyroligneous acid are the same.

Bancroft's Drab. Sulphat of iron, (green copperas,) one pound; quercitron, three pounds; chalk, four ounces. Or, iron liquor and quercitron. Or, quercitron and nitrat of lead.

Olive. Take strong decoction of quercitron, with a small quantity of yellow berries added to it, one gallon; green copperas, three ounces; blue copperas, two ounces.

Yellowish Green. Red liquor, one pint; iron liquor, one quart: boil six pounds of quercitron, and half a pound of logwood, with four ounces of verdigris, in three gallons of water; strain the decoction and add it to the mixed mordants; thicken for use.

Yellow. Boil, or rather scald two pounds of quercitron, in a gallon of water, during two hours: strain the liquor; make it up a full gallon; add two pounds more of quercitron, and one ounce of powdered galls; boil it again for an hour, and strain it; make it up a full gallon; add to it half a pint of a strong solution of copper in aqua fortis, and a gill of red colour.

Another. Bruise two pounds of yellow berries, called also French berries, Turkey berries, graines d'Avignon: boil them with a quarter of an ounce of saffron in five quarts of water to a gallon, add a gill of strong red liquor, and twice as much nitrat of iron. Thicken.

When the fugitive yellow colour washes away, the nitrat of iron gives a permanent buff, which is raised by the soap in washing.

Green. To the quercitron in the first yellow just above given, add a pound of logwood, two quarts of water, and two ounces of verdigris.

Blue. The pencil blue of indigo already given.

False Blue. Logwood, one pound and a half, boiled in two quarts water and two quarts vinegar; add to it four ounces blue vitriol, and eight ounces verdigris, dissolved in two quarts of hot vinegar.

Saxon Blue is not worth using on printed callicoes.

Salmon. Three gallons of water; wherein boil three pounds of madder, two pounds of sumach, and half a pound of quercitron; strain and add a pint red colour.

Red. Six quarts stale beer, two pounds of brazil wood, one ounce bruised galls, then add two ounces powdered alum, strain the liquor, and when cold add to it four ounces of a solution of tin made in aqua regia, composed of one part aqua fortis, three parts muriatic acid.

This is a poor colour: indeed there is no good red. The following I first introduced in a large way, and I find by an article in Rees' Cyclopædia that it is now common in England; I never knew it used till it was employed for second reds by Baker and Company, under my direction, about the year 1790.

In a large tinned copper vessel make a solution of good brazil wood, by scalding for an hour a pound of brazil to each gallon of water; a quarter of an ounce of pearl ash to each gallon may be added. Strain the liquor through cloth.

Make a solution of tin in aqua regia composed of two-thirds spirit of salt, and one third aqua fortis, taking good care that they contain no iron. Dilute a pint of this solution with a gallon of water, and add it to the brazil decoction in the proportion of about half a gallon of the diluted tin liquor to a gallon of the decoction, or rather add it by degrees till you find no more precipitate produced by the addition. Let off the clear liquor; collect the red sediment, and dry it gradually in the shade, or you may keep it in jars in the form of a moist paste. Dissolve this red sediment in the cold, in a fresh solution of tin, diluted with an equal part of water. Thicken and print with it. The pieces must not be carried up to the stove room, but gently dried in the warm air in the shade, or in a room moderately warm. If the pieces are winced two or three times through whiting or chalk and water, the acid will be less liable to injure the cloth. This red will be more pinky and brighter after one washing in soap and water, and will bear two or three moderate washings.

Purple. Precipitate a decoction of logwood, by a solution of blue vitriol: dissolve the moist sediment either in solution of blue vitriol, or solution of tin in aqua regia, (nitro-muriatic acid,) and print with it, as above.

The following article from Rees' Cyclopædia, though differing in some degree from the processes I have given, is, like the two other articles relating to callicoe printing in that work, drawn up by a master hand. I have before mentioned that the pink reds among the chemical colours, so much praised in this article, were first introduced by myself. I think the principle can be extended to yellows.

"Colour, and Colour-*Making*, *in Callicoe-Printing*. The preparation of colours for callicoe-printing, constitutes one great branch of that beautiful art, and involves in it a series of interesting and important processes. As an art, its operations are more dependant than almost any other, on those minute differences and changes in the constitution of bodies, which it is the business of chemistry to investigate. Hence that liability to error and uncertainty which, in the hands of the ignorant, pervades many of its processes, though conducted according to long established and approved formulæ. Our present volume would scarce suffice for the various receipts in which the art abounds; yet, in the following article, we shall endeavour to lay down general principles, rather than more practical directions; convinced, that by presenting our readers with a clear and concise theory, deduced from such practical illustrations as may be necessary for this purpose, we shall render them a more acceptable service.

"The term *cola*, in callicoe printing, is applied not only to those vegetable, animal, and mineral solutions, which impart their own colour to the cloth on which they are applied, but also improperly to those earthy or metallic solutions, which, possessing little or no tingent properties themselves, yet retain or fix the colours of other substances, when afterwards applied to the cloth. Thus the acetite of alumine, or printer's red liquor, when pure, is almost colourless, and only becomes red by the process of dyeing, as will be explained hereafter. The acetite of iron, or iron liquor, in like manner, when used of a determinate strength, is called *black colour*, and when weaker *purple colour*, though the cloth impregnated with these solutions becomes black or purple, only as being raised, like the other, in the dye-copper.

"1. The colours produced by means of these earthy or metallic solutions (which, in the language of science, are called *mordants*,) form the most valuable and important series, whether considered with regard to the almost infinite variety of shades, or to their solidity and durability. These colours, from the mode in which they are produced, (the mordant being first applied to the cloth, and the colour afterwards raised by dyeing,) are called *dyed colours.*

"2. Sometimes the mordant is previously mixed with a solution of colouring matter, and in that state applied to the cloth, so as to paint or stain it, at one operation, and without the process of dyeing. Thus, another class of colours is produced, many of them possessing great brilliancy indeed, but much inferior to the former in durability. The colours called chemical, by callicoe printers, belong chiefly to this class.

"3. In the third and last class, we may place all those where the colouring matter is simply held in solution by an acid or alkali, and in this state applied to the cloth, without the intervention of any mordant. To one or other of the foregoing classes, may be referred all the colours used in callicoe printing; with the exception, however, of those systems of colours which have been produced by callicoe printers in this country, within a short period, by processes, and upon principles which have hitherto not been made known.

"CLASS I.

"The colours of this, as has been already observed, are produced, by first impregnating the cloth with an earthy or metallic solution, or mordant, and raising the colour afterwards by dyeing. In this article we shall confine ourselves to the preparation of the different mordants, and the enumeration of colours they afford, with different colouring substances. The operations of the dye-house, and the mode of raising the colours in the dye-copper, will be detailed hereafter.

"The two great and most important mordants used in callicoe printing, are those that we have already noticed, *viz.* the solution of iron in acetous acid or vinegar, called iron liquor, and the acetous solution of alumine, or the earth of alum, called red liquor, or red colour, and sometimes yellow liqour.

"With these two solutions, either separately applied, and of various strengths, or mixed together, and in various proportions, an infinite variety of shades of colour are produced. Almost all the hues in nature may be obtained by raising them, and their various combinations, with different colouring substances. From madder, with the acetite of alumine, or red liquor, we obtain various shades of red, from the darkest blood colour to a pink. From weld and quercitron bark, yellows, varying in intensity from a deep orange to a pale straw colour, according to the strength of the mordant employed. From logwood, various shades of violet; from cochineal, Brazil, and Nicaragua wood, pink and crimsons of different hues; and, in short, from almost every different colouring substance, a different shade of colour. With the acetat of iron, or iron liquor, of different strengths, we obtain from madder all the intermediate hues between black and pale purple, or lilac. From weld and bark, olives, browns and drabs, of various hues; from sumach, logwood, galls, and other astringent substances, all the varieties of gray, from the palest shades to the deepest, in which all the minute differences of hue are lost till they approach to black. These various shades are further modified by applying two or more colouring substances to the same mordant, as madder and weld, for example, to the acetite of alumine, which produces orange, light ci namon, nankeen, &c.; and again still further, by mixing the mordants themselves in various proportions, and raising them with either one or more of the different colouring matters. By these means shades, and varieties of colour, may be produced from a few substances only, which baffle description, and for which language has no precise or definite terms.

" The acetite of iron, or iron liquor, is variously prepared. In this country it is chiefly made with the pyroligneous acid, which Fourcroy has proved to be identical with the acetous. Malt acid is preferred by many on account of its being free from volatile oil and resinous matter, with which the other abounds; but the great difference in price, and the facility with which it is obtained, has brought the acid of wood almost into general use. A series of casks filled with scraps and turnings of iron, upon which the acid is poured, is almost the only apparatus necessary for making iron liquor; yet when the consumption is great, or when it is prepared for sale, vats capable of holding several hundred gallons are substituted for casks, and the acid is kept in a state of circulation through the iron by means of pumps. The saturation is much accelerated by this motion, which prevents any deposition on the surface of the iron which might defend it from the action of the acid, and also brings fresh portions of unsaturated acid more frequently in contact with the metal. In a few weeks, sooner or later in proportion to the strength of the acid, the saturation is completed, and the liquor is then removed from the vat into casks for use, and fresh acid poured upon the iron as before. This is an easy and simple mode of making iron liquor, and as it requires but little trouble and attention, is the one most generally in use. The precautions necessary to be observed are, that the acid, if it be the pyroligneous, should not be used too soon after its preparation. It holds much essential oil and resin in solution, part of which separates on being kept a few weeks, and the clear acid may then be drawn off. It may be still further freed from resin by boiling; a portion of essential oil is thus thrown off, and the resin, if held suspended, is precipitated after standing some time. We shall have occasion to recur to this subject again, when we come to treat of the pyroligneous acid, and its formation, under the article *Distillation of Wood.* It is necessary also, that the iron should be perfectly clean and all of it malleable. Cast iron is not soluble in acetous acid. Hoop iron cut into lengths of from eight to ten inches is preferable to any other. It is readily cleaned, and more easily taken out of the vat and returned into it again, than misshapen masses sold under the name of old iron. When malt acid is employed, simple heating and washing is sufficient to free it from any foulness it may have contracted in the vat; but when the pyroligneous acid has been used, it becomes so coated with resin on its upper surface after a second or third solution, as to prolong the period of saturation to twice or thrice its usual length. In this state it must be removed from the vat and heated to redness in an oven, through which there is a current of air. The resin is consumed, and the iron by heating is freed from any remains of carbonaceous matter that may adhere to it, and is again ready for the vat.

" The only objection to this mode of making iron liquor is the time required to saturate the acid, which to those whose consumption is very great, or who manufacture it for sale, is oftentimes of importance. Different processes have therefore been devised to remedy this inconvenience, in many of which the saturation is accelerated by means of heat, which is applied in various ways, as best suits the convenience of the manufacturer; but the most expeditious mode is that of presenting the iron to the acid in a state of oxydation, by which means the solution is effected immediately. Callicoe printers have long been in the habit of using an extemporaneous acetite of iron, formed by mixing together solutions of acetite of lead and sulphat of iron. A very pure acetite of iron may be obtained by this means, but the price of acetite of lead renders this mode too expensive for general use. By forming a solution of lead, however, in pyroligneous acid, and decomposing it with sulphat of iron or copperas, an iron liquor may be obtained sufficiently cheap to render this process advantageous in many cases, though still more expensive than the ordinary mode. A patent was lately taken out for making iron liquor by a process somewhat similar to this, which, however, we understand has not answered the expectation formed of it. A solution of lead in pyroligneous acid is digested on clear metallic iron. The iron becomes oxydated at the expense of the lead and is dissolved, whilst the lead is precipitated in the metallic state, and may again be used for a fresh solution. All these modes are evidently more expensive than the ordinary one of simple solution of metallic iron in pyroligneous acid, and the only consideration with the manufacturer is, whether this extra expense is counterbalanced by the economy of time or not.

"The process adopted some years ago by Mr. Thomson, is perhaps the most expeditious, and next to the common mode, the most economical of any yet in use. It consists in saturating the pyroligneous acid with quicklime, and pouring the clear boiling solution on as much sulphat of iron or copperas as will precipitate the whole of the lime. A cask of iron liquor may be made by this mode in a few hours, and when care has been taken rightly to proportion the ingredients so as to produce complete decomposition, it is inferior to no solution whatever in any of its properties.

"The properties of the acetous solution of iron fit it eminently above all others for the purpose of the callicoe printer, and having detailed its preparation we shall endeavour to point out in what this superiority consists.

"The acetite of iron exists in two states, dependant on the quantity of oxygen combined with the iron. When pure, and recently prepared, it is of a pale greenish hue, but by exposure to air soon becomes tinged with brown. In this state the iron is at its lowest point of oxydation, strongly attractive of oxygen, and if precipitated by an alkali, of a deep green colour. By exposure to the atmosphere, and consequent absorption of air, the solution passes to a deep red brown, and, if concentrated, deposits orange oxyd of iron, and becomes strongly acidulous. With this excess of acid, the solution now becomes permanent; the iron is almost wholly at the maximum of oxydation; and, when precipitated, of a dark red colour.

"The same takes place only in a less degree, and more slowly, with the sulphuric and muriatic solutions of iron. Of a pale greenish hue in their recent state, they gradually attract oxygen from the atmosphere, and become slightly red, deposit red oxyd of iron and pass to a state of acidity, at which the solution becomes permanent, and the oxydation of the iron proceeds no further.

"If the solutions, properly thickened with gum or flour, are applied to cloth, the same change takes place, but with more rapidity, from their diffusion over a thin surface, and more complete exposure to the air. The aqueous and volatile part of the solution speedily evaporates, and as the oxydation goes on, the oxyd of iron is deposited on the cloth, and a portion of acid set free. When this acid is volatile, as is the case with the acetous, and also in a great degree with the muriatic, it is dissipated. The oxydation of the iron then goes on, fresh portions of acid are again liberated and drawn off till the whole of the solution is decomposed, and the oxyd of iron deposited in the cloth. When the acid is not volatile, however, as is the case with the sulphuric, the first portions of acid that are liberated not being drawn off, the oxydation proceeds more slowly till the excess of acid becomes so great as wholly to interrupt it, and great part of the iron in the operation of rincing is again carried off the cloth. Another and more serious inconvenience attending the use of the sulphuric solution is its action on the cloth itself. The disengaged acid being in a state of great concentration acts upon its fibres, weakens, and at last destroys them. The same takes place with the muriatic solution also, for though the excess of acid is slowly dissipated, yet it has sufficient time and concentration to act very powerfully, and is, if possible, still more destructive than the sulphuric, since its action is not confined to the part on which it is applied, but from its volatility extends over the whole surface of the cloth.

"It is necessary, therefore, that the acid should be not only volatile, but harmless in its action on the vegetable fibre, which conditions are more completely fulfilled by the acetous than by any other solution whatever. From the preceding observations on the properties of the acetite of iron, and the changes it undergoes on the surface of the cloth, may readily be deduced the reasons for that exposure to heat and air which callicoe printers have, from long experience, found necessary to goods printed with this solution. By exposure to air iron becomes oxygenated and deposited on the cloth, whilst the heat favours the liberation of the acid, and accelerates the process. From what has gone before it may also be inferred, that the acetite of iron should be used in its recent or *green* state, since in that state the acetous acid is capable of holding a greater quantity of oxyd of iron in so ltion, and that consequently after its saturation and removal from the iron, it should not be too much exposed or agitated in contact with the air. On this account, also, it is wrong to pump the liquor in the vats too much when it approaches the point of saturation, since the oxygenated iron is almost all precipitated, and fresh portions immediately dissolved, so that the liquor might in time be rendered quite thick with precipitated oxyd of iron.

" The preceding ideas are at variance with the general opinion respecting the state in which the acetite of iron should be employed. All the speculative writers, and even many well acquainted with the processes of callicoe printing, recommend the oxygenation of the solution by exposure to air and removal from the iron, as essential to the goodness of the iron liquor. Even Berthollet, in the last edition of his "Elements of the Art of Dyeing," has fallen into the same mistake, the source of which, and the facts which seem to countenance it, we shall point out in a future article.

" It is an object of importance to the callicoe printer to know the precise strength of his iron liquor, and to be able to ascertain this at all times, with little trouble or chance of error. Great mischief and inconvenience often arises from uncertainty in this respect, especially in the pale shades of purple, which are obtained from madder, with diluted acetite of iron. The hydrometer has been objected to, as indicating not merely the quantity of iron in a solution, but also the essential oil, resin and mucilage which these impure solutions often contain. This objection, however, only applies where the same instrument and graduation is employed to ascertain the relative strengths of iron liquors, prepared with different acids, as the pyroligneous which contains much essential oil and resin, and malt acid which abounds in mucilage. In this case the hydrometer may indicate great differences in solutions containing equal quantities of acid and iron, but varying in the quantities of mucilage, oil, or resin. Iron liquor however, prepared constantly by the same process, and from the same acid, varies so little in the relative proportion of its ingredients, that the hydrometer may be used to ascertain its strength in preference to any other mode whatever; provided the necessary precautions are used to correct any error arising from variation of temperature.

" In a work of this kind, not illustrated by actual specimens, and without reference to some particular kind of iron liquor, it is impossible to point out the specific gravities of the different solutions required for producing the various shades we have enumerated. An acetite of iron, of specific gravity 1.047, with madder or logwood, will produce a black, and with weld or sumach an olive, and diluted with six, eight, or ten times its bulk of water, various shades of purple, drabs, or olives, according to the colouring matter employed. A standard solution of iron once obtained, the necessary strength for producing the different varieties of colour is easily ascertained by actual experiment, and to this we must refer our readers.

" When thickened with flour or gum, and tinged with a decoction of logwood or brazil, the better to enable the workman to observe the progress and state of his work, it forms, as we have before observed, the printers' black colour, a purple colour, &c. according to the strength of the solution and the purpose it is intended for. Various ingredients were formerly added to iron liquor, to improve its quality, or vary the hue of colour it produced. Verdigris and copperas were added to the solution intended for black; and sal ammoniac or nitre to the diluted solutions for purple. These are, however, now almost universally laid aside, as being for the most part useless, and often hurtful: the simple acetite of iron being found to answer every purpose of the more complicated and heterogeneous solutions.

" The *acetite of alumine*, or red liquor, is always prepared by the decomposition of alum, by an earthy or metallic salt, since the aluminous earth is not soluble in acetous acid, except in its newly precipitated and minutely divided state. The purest solution, and that which is generally used for the finest and most delicate colours, is produced by decomposing alum with Dutch sugar of lead, generally in the proportion of two parts by weight of the former, to one of the latter. The proportion of the two salts, and also the quantities of each gallon, as used by different callicoe printers, vary yet with little difference in effect. The alum in general predominates so far as completely to saturate the liquor. The printers' aluminous mordant therefore is a compound solution. It is an aceto-sulphat of alumine, consisting of a saturated solution of common alum, and more or less acetite of alumine, according to the quantity of sugar of lead employed. In the neighbourhood of London, the proportions are six pounds of alum, and three pounds of sugar of lead to a gallon of water: when these are completely dissolved, one ounce of Spanish white is added, and the whole briskly stirred till the effervescence has in great measure subsided. In a few hours the solution becomes clear, and forms a standard liquor from which, by greater or less dilution, may be obtained all the various shades of red, yellow, &c. already enumerated. In the above formula the proportion of alum is somewhat too great, a part of it remains undissolved, or immediately recrystallizes and falls to the bottom along with the precipitated lead. This excess of alum is however strongly insisted on by many callicoe printers, as essential to the purity of the mordant, from an idea that the *purest* part of the alum only is taken up in the solution. This fact however may be readily disproved by employing this undissolved or recrystallized alum in the formation of fresh solutions, whose purity will be found in no respect inferior to the former. The purity of the alum and sugar of lead, and especially their being free from iron, is of great importance in the preparation of this mordant, and on this account the Dutch sugar of lead is preferred; but its high price renders it too expensive except for the pale reds of light chintz, and other kinds of work, whose great delicacy in the red tints is required. A substitute for it has been found in the solution of litharge in vinegar, or pyroligneous acid, which is afterwards decomposed by the addition of alum, and the excess of acid neutralized by Spanish white as in the former case. Great part of the acetite of alumine manufactured and sold under the name of red liquor is prepared in this manner. It is in general used for yellows, dark shades of red, and those compound mordants into which the acetite of iron enters, and when its purity is of course of little consequence. The acetite of lime has long been substituted with great advantage by the writer of this article for the solution of lead, and its use is becoming daily more known and extended. When carefully prepared, it is scarce inferior to the best sugar of lead, and the impure solutions answer equally with the best, for the compound mordants before mentioned. The theory of these processes is the same in all. The object being to obtain a solution of alumine or earth of alum in acetous acid. On mixing acetite of lead, and sulphat of alumine together, a change of bases takes place; the sulphuric acid unites with the lead, and falls down in the form of a white heavy precipitate, whilst the earth of alum combines with the acetous acid, and remains in solution. The same takes place with the solution of litharge in pyroligneous acid, which is indeed an impure acetite of lead, and when the acetite of lime is employed instead of lead, the sulphuric acid and lime unite and form an insoluble powder, which subsides, though less quickly than the other, whilst the acetite of alumine remains in solution above; the addition of the Spanish white is necessary to saturate a small excess of acid which exists in the solution. This excess is taken up by the lime, and immediately converted into acetite of alumine, by the decomposition of a fresh portion of alum.

"The acetite of alumine, when pure, is almost colourless. It has a slight acetous smell, and when boiling throws off acetous acid in great abundance, and deposits a portion of alumine. When evaporated it acquires a thick gummy consistence, but does not crystallize, a property which gives it a decided advantage over common alum as a mordant. It unites readily with gum, but when concentrated and holding much alum in solution, forms with flour a watery pulpy kind of paste, which has little adhesion, and from which the fluid soon separates. The sulphuric salts have indeed all a disposition to injure the thickening quality of flour.

"The affinity of cotton for the earth of alum, is so strong as to separate it from its combinations even with the mineral acids. When a solution of common alum properly thickened is applied to cloth, a portion of alumine unites with it, and the acid, which held it in solution, is set free. When this is accumulated to a certain degree, it prevents any further decomposition, and in rincing carries off the greater part of the earth again. When the acid however is volatile, like the acetous, and is dissipated as soon as disengaged, there being no longer any obstacle, the decomposition goes on till the whole of the acid is driven off, and the alumine combined with the cloth. In the infancy of callicoe printing, and before the theory and constitution of the different mordants was properly understood, a variety of substances were added to the solution, some of which are retained to this day. Verdigris, in the proportion of two ounces to a gallon, is recommended by many as tending to exalt the hue of yellows, and may in some cases be useful. Corrosive sublimate has been but lately laid aside, and the nitro-muriat of tin was long thought to give fixity and brilliancy to reds, when used in a small proportion with the aluminous mordant. In general, however, the aceto-sulphat of alumine is found adequate to every purpose of the callicoe printer; we shall not, therefore, perpetuate error by detailing any of those unmeaning mixtures which are still retained by the ignorant and prejudiced. These two mordants, the acetites of iron and alumine, and their various combinations, are those only in general use in callicoe-printing, for producing colours of the first class. This application is so extensive, and at the same time so simple, as to supersede the necessity of any other. The solutions of copper are sometimes used as mordants, but they afford colours of little solidity. The solutions of tin have also been employed, but we shall speak of these and other earthy and metallic solutions which have been used with partial success, when we come to treat of mordants in general.

"CLASS II.

" In this class the colours are produced by combining a solution of colouring matter with some earthy or metallic salt, capable of giving it fixity when applied to the cloth. The mordant and colouring matter are here applied at once, and the cloth is painted, as it were, or stained, with the colour it is intended to retain, and requires, in general, no farther operation than that of rincing, to free it from the paste or gum with which it was thickened.

" The colour of this class possesses, as we have before observed, in general great brilliancy, but wants that solidity and fixity which characterise the colours of the former class. The union of the mordant with the cloth is weakened by its previous combination with the colouring matter, and not being favoured by heat, as in the former case, the triple combination of vegetable fibre, mordant, and colouring matter, wants that solidity which is so necessary to constitute what is called a fast colour.

"Many of these, however, are sufficiently durable to be partially introduced, and intermixed with other colours of greater durability, and some are indispensably necessary, as no better mode has yet been devised of producing them. When the chemist's art shall have discovered means of giving fixity to colours thus topically applied, the art of callicoe printing will have arrived at perfection. Systems of colours may then be combined, which are present incompatible, and the tedious operation of dyeing and bleaching, with their attendant difficulties, be banished from the art. Nor is the hope so chimerical as might at first be imagined; several of the most useful and permanent colours are of this description, as will be shown hereafter.

"We shall content ourselves with describing the leading and most useful colours of this class, giving, at the same time, the theory of their constitution. The mere enumeration of all the varieties that have or may be formed, would be endless and foreign to our purpose.

"*Chemical Black.*

"This is the most useful colour of the class, and one of indispensable necessity in certain combinations of colours, where, for instance, it is mixed with drab, olive, and yellow, raised in the dye-copper with weld, quercitron bark, or any similar colouring matter, and where the presence of any substance, such as logwood or madder, capable of producing a full black, would be ruinous to the other colours. A deep olive, approaching to black, might, indeed be produced, by employing a strong iron liquor, as mordant, and using sumach in the dye-copper; yet as this would bear no comparison in point of intensity with the madder or logwood black, and as the force of the colouring in such course of work greatly depends on contrast, the topical or chemical black, which has all the intensity required, is almost constantly employed. The constitution of this black is pretty nearly the same in all the different formulæ in use. It consists always of a solution of iron combined with a solution of colouring matter generally of an astringent nature. On the right proportion of these two solutions, and on their due specific gravity or strength, depends, in a great measure, the goodness of the black.

"1. If to a decoction of Aleppo galls, in five times their weight of water, made into a paste with flour, a solution of iron in nitrous acid of specific gravity 1.25 be added, in the proportion of one measure of nitrat of iron to eighteen or twenty of the former, a black will be formed fit for almost all the purposes of callicoe printing, and possessing the chief requisites of this colour, namely, tolerable fixity, and a disposition to work well with the block.

"2. In lieu of nitrat of iron, some callicoe printers employ copperas, in the proportion of one pound to a gallon of the decoction of galls. Half the copperas is directed to be dissolved in the gall-liquor before it is thickened with flour; the remaining half, dissolved by heat in as much aqua fortis as will cover it, is added afterwards. This black has tolerable fixity, but does work so well as the preceding.

"3. Copperas dissolved in various proportions of from four to twelve ounces per gallon, will form, with decoction of galls or logwood, blacks of less solidity indeed than the former, yet applicable, nevertheless, in many cases where the others are not.

"The constitution of the two last mentioned blacks differs somewhat from the first. We shall point out this difference, and explain, as concisely as possible, the rationale of the foregoing processes.

"When a solution of iron in nitrous acid is added to a decoction of galls, as in the first example, the solution is decomposed, the iron unites with the gallic acid and tannin principle, whilst the nitrous acid is disengaged. This is proved by the blackness which the solutions assume immediately on being mixed. The disengaged acid, however, shortly re-acts on the new compound, the blackness gradually disappears, and in a few days, if the nitrat of iron has been added in proper quantity, the paste, instead of black, is of a dirty olive green. If the proportion of nitrat of iron be greater than one-eighteenth, this change will be effected sooner; and if so high as one-tenth, the paste, when applied to the cloth, will be a bright orange, like the acetite of iron. By exposure to heat and air, this colour generally deepens, becomes gray, and at last a full black. In this state it is permanent, and adheres powerfully to the cloth. These changes of colour depend on the tannat and gallat of iron in the disengaged nitrous acid, and the evaporation of the acid when exposed to heat and air on the cloth. This solution of the tannat and gallat of iron is indeed an essential requisite in the goodness of the chemical black. If the disengaged acid is not sufficient to effect this, or if it is in too great a state of dilution, the colour has but a feeble adherence to the cloth; it is not presented in a state favourable to its union with it, since the combination into which the iron has entered is insoluble in water. It lies merely on the surface, but does not penetrate its fibres, and yields readily in the various operations to which it is subjected. The chemical black, therefore, of the first example is a solution of the tannat and gallat of iron in nitrous acid.

"The black of the second, but more particularly of the third example, differs from the preceding in the circumstance of the iron in the solution being in a less oxygenated state. We may consider this black in its recent state as a mixed solution of green sulphat of iron, and gallic acid, and tannin principle; for the decomposition of the sulphat is not complete till by exposure to air on the cloth the iron becomes fully oxygenated. When this black is recently applied to the cloth, it is of a pale grayish colour, has little fixity, simple rincing in cold water being sufficient to fetch nearly the whole away. By gradually absorbing oxygen, it becomes deeper, and at last black. The sulphuric acid has no longer any action on it, and is removed in the first operation in which it is immersed in water.

"The decoction of galls used for chemical black is variously prepared. Many callicoe printers infuse the galls cold in casks of vinegar, or pyroligneous acid, suffering them to remain several months, occasionally drawing off the lower part, and returning it on the galls. Others steep them in urine. Both these modes are vicious, particularly the last. Simple boiling in water, till all the soluble matter is extracted, is sufficient, taking care to inclose the galls in a sack, that when soft they may not render the decoction thick.

"*Gray.*

"By diluting the chemical black of the first example with once, twice, thrice, &c. its bulk of water, and thickening the solution with gum, various shades of gray are obtained, which require rincing off in water only, and the deeper shades of which have tolerable permanence.

"The theory of these mixtures is the same as of the black, from whence they are derived. On the addition of water to the olive-green solution, mentioned in the preceding article, the colour instantly becomes deep purple, approaching to black. This is occasioned by the dilution of the free acid, which being no longer able to hold the tannat and gallat of iron in solution, sets part of it at liberty, which instantly regains its colour. For the reason already assigned, this has less adherence to cloth than that in which the solution is more perfect. The addition of a small quantity of nitrous acid effects this. The olive-green colour of the solution is restored, which, by exposure to the air, and consequent evaporation of the acid, disappears, and leaves the tannat and gallat of iron more firmly fixed on the cloth. The complete precipitation of the combination is afterwards effected in the operation of rincing off in water.

"*Yellow.*

"The false or chemical yellows are generally prepared with decoctions of French or Turkey berries, and sometimes with quercitron bark. The latter substance produces pale yellows or straw colour, but does not afford the deep bright orange yellow of the berries. Dr. Bancroft, to whom the public is indebted for the introduction and knowledge of this most useful dyeing drug, indeed, asserts the contrary in his work on "Permanent Colours;" and has given a receipt for the bark-yellow, which has, however, never succeeded in our hands.

"*Berry yellow.* Boil two pounds of good berries, slightly bruised, in a gallon of water during three hours, taking care to replace, from time to time, the evaporated water with liquor obtained from the second boiling of a former quantity of berries. When the liquor is cool, add to it eight ounces of alum, and if it is intended for the block thicken it with flour. If it is meant for those small objects in printed goods, which are generally touched with the pencil, two ounces of sugar of lead should be added with the alum, and the colour thickened with gum dragon. This yellow is generally passed through lime water as the first part of the operation of rincing; by this means the greater part of the earth of alum, which would otherwise have been carried off in the operation, is precipitated on the cloth, and the colour considerably heightened.

" When this operation of liming cannot be performed without injury to some other colour, a greater proportion of sugar of lead should be added. This decomposes the alum, and forms an acetite of alumine, which being more readily decomposed by the colouring matter and the cotton than sulphat of alumine, does not require the assistance of an alkaline solution to precipitate it on the cloth.

" The proportion of berries above directed is for a full yellow; one-fourth or one-third less will form, with the same quantities of salts, yellows of great brightness. Some callicoe printers add a small quantity of nitrat of copper to the yellows intended to be simply rinced off without liming. This heightens the colour, but what is gained in intensity is lost in brightness; for if the solution of copper be added in sufficient quantity to produce any very perceptible effort, it imparts a dulness to the hue which is very detrimental. This is the invariable effect of copper in any shape, whether the acetite, sulphat, or nitrat of copper be employed.

" *Bark-yellow*. For a lemon or straw colour, it will be sufficient to make a decoction of bark by boiling from four to six pounds in as much water as is necessary during two hours, and after evaporating down the decoction to one gallon, add to it two ounces of sugar of lead, and eight ounces of alum. If not limed, the proportion of sugar of lead should be doubled For strong yellows, Dr. Bancroft directs the addition of both nitrat of copper and nitrat of lime in quantities so great, as near seven ounces of the former to a gallon of colour. Experience, however, though it has done justice to the merits of Dr. Bancroft's discovery of the use of quercitron bark, has not verified the expectations he had formed of it as a substitute for the Turkey berries in the topical or chemical yellow.

" The constitution of these colours, whether formed with the sulphat and acetite of alumine, or with the solutions of copper is the same. Alumine, or the earth of alum, and the oxyd of copper, have an affinity both for colouring matter and vegetable fibre. They form the connecting link between these substances, which would otherwise contract a feeble union. When a solution of alum is added to a decoction of berries or of bark, a slight precipitation takes place by the union of a portion of colouring matter with the earth; the greater part however remains suspended or held in solution by the acid of the alum. When applied to the cloth the farther decomposition of the salt is aided by the affinity of this substance for alumine, and, when the acid is volatile, as the acetous for example, by its consequent evaporation. The same takes place with the solutions of copper. The operation of rincing farther aids the precipitation of the colouring matter and alumine, by thus largely diluting with water; and lastly, when the goods are previously passed through the lime tube, the decomposition is complete, the last portions of earth or oxyd are precipitated, and the colour thereby considerably exalted.

"The solutions of tin are capable of forming very bright and beautiful yellows, with decoctions of different yellow colouring substances; but the excess of acid which these solutions necessarily contain, and their powerful action on the cloth, renders their application less general than the preceding. The solution of tin most proper for yellows is the muriatic, and is formed by digesting, in a low heat for several days, the common muriatic acid, or spirits of salt, on fine grain tin. This solution forms, with bark, a pale and lively yellow, and with berries a yellow bordering more on orange. These spirit yellows, however, as they are improperly called, are seldom used except upon dyed grounds, and of this preparation for such purposes we shall treat at large under the head of *Discharged Work.*

"*Blue.*

"The only blue belonging to this class is that produced by combining the colouring matter of logwood with the oxyd of copper. It is but seldom used since the mode of dipping China blue has become generally known; and indeed its want of durability renders it of little value. It may be produced by combining almost any of the solutions of copper with a decoction of logwood.

"1. Boil two pounds of logwood in a gallon of water, and to the decoction, thickened with gum, add eight ounces of sulphat of copper.

"2. To a decoction of logwood as above, add two ounces of sulphat of copper, and two ounces of verdigris.

"Their colours may either be rinced off or limed, as best suits the style of work. The theory of these combinations is the same as the preceding.

"*Green.*

"The chemical or false green is a compound colour, and consists of a mixed decoction of logwood and berries, or bark, and a solution of copper. Though fugitive, its use is in some degree authorized by the impossibility of obtaining a green of greater durability that can be applied in figures with the block. The fast green of the callicoe printers is the product of two operations, and is of course limited in its application, and tedious in its use. The production of a fast green at one operation, or rather by one application to the cloth, either with the pencil, block, or press, is one of the great *desiderata* of callicoe printing.

"1. One pound of logwood and two pounds of berries boiled together during two hours, and strained whilst hot upon two ounces of sulphat of copper, and two ounces of verdigris, and thickened with gum, form a good and lively green, the hue of which may be varied at pleasure by the increase or diminution of the proportion of logwood. To this some callicoe printers add two ounces of common salt, and two ounces of sal enixon or acidulous sulphat of potash.

"2. To one measure of blue of the first example in the preceding article, add two, three, four, &c. measures of a decoction of bark, made by boiling six pounds as before directed for the yellow, and to which, when reduced to one gallon, two ounces of sulphat of copper, and two ounces of verdigris have been added. The tone of the green depending on the relative proportions of blue and yellow, it is, in general, best to keep the two decoctions separate, to be mixed, when wanted, in such proportions as may best suit the purpose required. The theory of these mixtures is the same as of the blue and yellow already described. To the eye of the mere speculative chemist, the addition of common salt and acidulous sulphat of potash in the first example, may appear unnecessary and unmeaning. They indeed affect little, either the hue or fixity of the colour, but experience has proved that this addition facilitates its working with the block, more especially when thickened with gum dragon. The cause of this in the particular instance before us, is perhaps not very clear. The sulphuric salts in general, such as the sulphats of alumine, iron, and copper, are all unfavourable to working, as their solutions, especially when concentrated, neither thicken well with flour nor gum. A saturated solution of copperas cannot be thickened with flour, nor can a strong solution of the aceto-sulphat of alumine, in which the alum is in great excess; even with gum it unites with difficulty. But if to a solution of copperas, which refuses to form a paste with flour, a small portion of nitrat of iron be added, the whole forms a good and substantial paste that works admirably with the block; and half a pound of common salt added to the aceto-sulphat of alumine, has a similar effect. In the instance more particularly before us, the addition of common salt forms a muriat of copper by the decomposition of the sulphat; but this last is in too small a quantity to affect the working of the colour very sensibly. The cause of these effects is to be sought for in the very complicated play of affinities, which exist in such compounds, and which future investigation and discovery may perhaps unfold. The speculative philosopher, who is ignorant of the minute details of an art, that involves in it considerations and difficulties, unsuspected in the laboratory, will hence learn to suspend his judgment in deciding on the merits of a formula, till experience shall have proved the inutility of those ingredients which theory would reject as absurb.

"But to return to our subject: there is a wide field open for experiment and discovery in the production of greens, into which logwood does not enter. A callicoe printer near London, celebrated for his ingenuity and invention in colours of this class, has long employed a green which, from its beauty and durability, when compared with the foregoing colours, indicate the presence of indigo as a constituent part. Prussian blue in a minutely divided state, and mixed with bark or berry-yellow, has been employed: but the blue in this case has so little adherence to the cloth, that mere mechanical force, the operation of rincing and washing is sufficient to disengage it. With one or other of these substances, however, it is likely that greens much superior in beauty, and probably also in durability to those generally in use, might, by a series of patient and well conducted experiments, be readily obtained.

"*Pink.*

"The pale, and more delicate shades of red, belonging to this class, are chiefly sought after in callicoe printing. They are employed in giving relief or effect to other admixtures of a more sober cast, and all the skill of the colour-maker is exerted in giving them brilliancy and richness of tint. They are chiefly produced from decoctions of brazil, nicaragua, or peach wood, and cochineal, raised and fixed on the cloth with solutions of tin, rarely with the aluminous mordants, though delicate and lively colours may be produced this way.

"The nitro-muriat of tin is chiefly employed, though the relative proportion of the two acids, and their degree of saturation with tin, varies almost with every callicoe printer. The solution itself, made according to established rule, and with the same properties, varies so considerably at different times, as wholly to alter the nature of its compounds, without any apparent cause of failure. The source of this discordance is to be sought for in the constitution of the solution itself, which from causes that we shall endeavour to explain, is subject to considerable variation.

"First, from the strength or concentration of the acids employed, which are seldom uniform or constant; muriatic acid from the same manufacturer varying often in specific gravity from 1.12 to 1.18, and nitrous acid not less than from 1.15 to 1.23, without reference to the common distinction of single and double aqua fortis.

"When the specific gravity of the acids is neglected, as is but too generally the case, these differences occasion serious inconveniences in the use of solutions, whose properties often depend on the accuracy of their proportions, and on determinate degrees of saturation.

"Secondly, from the impurity of the acids. The muriatic acid of commerce always contains iron and sulphuric acid; if the former exist in any notable proportion, it is unfit for the solution of tin; the presence of the latter is of less importance, though, on the whole, unfavourable to delicate colours. The nitrous acid varies considerably in its purity, being subject to greater or less admixture with the muriatic; the nitre it is made from being seldom free from marine salt. The aqua fortis of commerce is, in fact, an aqua regia. This variation of the proportion of muriatic acid in the nitrous, is of the utmost importance, since the properties of the solution eminently depend upon this. With muriatic acid only, tin forms a colourless and permanent solution, one of whose distinguishing properties is, its strong affinity or attraction for oxygen. With decoction of cochineal, it forms a deep and dull purple-coloured precipitate, which, however, gradually absorbs oxygen, and becomes crimson, especially when exposed on the filter. With decoctions of brazil and peach wood, it affords crimson precipitates, varying in intensity with their saturation with tin. It decomposes all the combinations of iron with colouring matter, deoxygenating the iron which it carries off, leaving the tin in combination with the colouring matter. Thus a madder black becomes a red on the application of muriat of tin. On this property is founded the art of printing on dyed grounds, of which we shall treat hereafter. With nitrous acid, unless very dilute, tin contracts a very feeble union, and is generally precipitated as soon as dissolved, in a state fully saturated with oxygen. The addition of a small quantity of muriatic acid renders this solution more permanent, provided it be not fully saturated with tin, and the addition of larger portions approximates the solution still more to the nature of the former, and renders it capable of supporting a greater degree of saturation. The properties of the solution depend greatly on the proportion of muriatic acid, and consequently of muriat of tin contained in it. When small, the precipitate with cochineal is bright carmine scarlet. It does not decompose the combinations of iron with colouring matter, unless the solution be far from saturation, and this effect is then due to the disengaged acid only.

"The purity of the tin is another requisite which should be carefully attended to. The fine tin of Cornwall, commonly called grain tin, should be employed. If alloyed with lead, it is wholly unfit for these purposes.

"In lieu of muriatic acid, sal ammoniac and common salt are oftentimes employed to form an aqua regia with nitrous acid. The solution differs little from that formed by a mixture of the two acids, the allowance being made by the portion neutralized by the alkali of the neutral salt.

"From this short outline of the history of the substances employed in the formation of the solutions of tin, and of the properties of the solutions themseves, may be deduced such general ideas as will elucidate and explain many anomalous effects in their combinations with different colouring matters, and seem to direct future experiment in the discovery of those minute, but often important, conditions necessary to the formation of particular shades of colour.

"The following examples of spirit reds, as they are improperly called by callicoe printers, will illustrate some of the preceding observations, and may be considered as specimens of the most beautiful and brilliant colours it is possible to form upon cotton.

"1. Prepare an aqua regia by dissolving two ounces of sal ammoniac in one pound of nitrous acid of specific gravity 1.25. To this add two ounces of fine grain tin; decant it carefully off the sediment, and dilute it with one-fourth its weight of pure or distilled water.

"To one gallon of water add one pound of cochineal, ground as fine as flour; boil half an hour; then add two ounces of finely pulverized gum dragon, and two ounces of cream of tartar, and stir till the whole is dissolved. When the liquor is cool, add one measure of the preceding solution of tin, to two of the cochineal liquor, and incorporate well by stirring Apply this with the pencil or block, suffer it to remain in the cloth six or eight hours, then rince off in spring water. This colour will be a bright and beautiful scarlet.

"2. Boil twelve pounds of brazil chips during an hour in as much water as will cover them. Draw off the decoction, and pour on fresh water, and boil as before. Add the two liquors together, and evaporate slowly down to one gallon. To the decoction whilst warm add four ounces of sal ammoniac, and as much gum dragon or senegal as will thicken it for the work required. When cool, add one of the solution of tin before described, to four, six, or eight of the brazil liquor, according to the colour wanted. Suffer it to remain from eighteen to twenty-four hours on the cloth, then rince off in spring water as before. The colour will be a pale and delicate pink. If it is required deeper, the decoction must be made stronger, and used in the proportion of three or four to one of the solution of tin. Nicaragua or peach wood, though not so rich in colouring matter as brazil, yields a colour, however, which is, if possible, more delicate and beautiful. The fine pinks produced by certain houses, which have for years been the envy and admiration of the trade, are afforded by this fine dye-wood.

"These colours require no liming, simple affusion with water being sufficient to precipitate the colouring matter in combination with the tin. The theory of these mixtures is the same as the preceding. They require, however, a greater excess of acid to hold the colouring matter in solution. A decoction of cochineal poured into a saturated solution of tin, occasions an instant precipitate which is not redissolved, and the greater part of which, if applied to cloth, would come off in the operation of rincing. It is sometimes necessary to add a small quantity of muriatic acid to prevent this precipitation, or to correct it when it happens, and sal ammoniac is supposed to have the same effect, probably by engaging the water of the solution.

"With the aluminous salts, the decoction of cochineal and brazil forms colours less brilliant than those we have just described, but which are applicable in cases where the excess of acid in the solutions of tin is attended with inconvenience.

"1. To one gallon of water, add eight ounces of finely ground cochineal, and two ounces of bruised galls; boil half an hour, strain the liquor whilst hot through a fine cloth, upon four ounces of cream of tartar and four ounces of gum, and thicken with gum dragon. This colour requires liming.

"2. Upon six pounds of brazil and two ounces of galls, pour one gallon of water, let them soak some time, then boil two hours, replacing the evaporated liquor with fresh water. Strain through a fine cloth upon four pounds of gum senegal, and add one pint of the acetite of alumine, described in a former part of this article.

"The addition of galls in the two preceding formulæ, is supposed to impart solidity to the colours in some way analogous to the operation of galling in silk and cotton dyeing, of which we shall have occasion to speak hereafter. Their constitution is otherwise the same as the berry and bark yellows, and most others of this class of colours.

"*Purple.*

"1. If the solution of tin directed for the pink in the last article be mixed with six times its bulk of a decoction of logwood, poured whilst hot upon four ounces of sal ammoniac, and two and a half pounds gum senegal, a bright and lively purple will be obtained, the hue of which varies with the strength of the decoction and the proportion of solution of tin employed.

"2. If instead of the solution of tin, the acetite of alumine before alluded to, be used in various proportions of one-sixth, eighth, &c. purples differing in shade and intensity will be formed, applicable in some cases, but possessing less solidity than most of the colours already described.

"The constitution of these compounds is the same as the preceding.

"*Olive.*

"Olives are variously compounded, according to the colour required.

"1. By mixing chemical black in various proportions with berry or bark yellow. The depth and fulness of the olive depends on the quantity of black.

"2. By a decoction of logwood added in greater or less quantity to the bark or berry yellow.

"3. By the addition of copperas or nitrat of iron to decoctions of yellow or astringent colouring matters, such as bark, sumach, berries, weld, &c. each of these produces a different hue, varying from the green olive to a drab or cloth colour. By mixing these decoctions in different proportions, and by varying their strength, and the quantities of copperas or nitrat of iron added to each, a multiplicity of shades may be produced, of which it is impossible to convey any precise or definite ideas.

"These colours may be indifferently thickened with flour or gum, as best suits the work required, but when nitrat of iron is added to solutions containing gum, the instant coagulation that takes place must be counteracted by the addition of a portion of free nitrous acid. This effect arises from the strong action exerted by metallic oxyds, at the maximum of oxydation, on mucilage or gum. When the decoction is very concentrated, and contains sufficient colouring matter to engage the whole of the iron, this effect takes place in a less degree, but with solutions adapted to the production of the foregoing colours, a coagulation invariably takes place, unless counteracted by the presence of a portion of free acid. Of this action of metallic oxyds on the solution of gum we shall further treat under the article *Gum.*

CLASS III.

"In this class, the colouring matter is simply held in solution, by an acid or alkali, and in that state applied to the cloth without the intervention of any mordant.

"The most important of these colours, is the alkaline solution of indigo which forms the topical or

" *Pencil Blue.*

" 1. Prepare a solution of potash, by boiling together seven and a half pounds of quick lime, and fifteen pounds of potash, in ten gallons of water. Decant off the clear liquor, and separate the remainder from the lime by means of the filter. To one gallon of this solution, add one pound of red arsenic, or orpiment, and one pound of fine indigo, both previously ground together in a mill with sufficient water to form a thick paste. Bring them gradually to a boil, stirring carefully all the time, and then withdraw the fire. Thicken the solution with the best gum senegal, and for the pale shades of blue, dilute with one, two, &c. measures of gum-water.

" The quantities and relative proportions of potash, orpiment, and indigo in a gallon of pencil blue vary considerably with different callicoe printers, and within certain limits, it appears, that the accuracy of these proportions is not of great importance. Haussman, an intelligent French printer, employs fifteen pounds of potash, six pounds of orpiment, and eight pounds of indigo, to twelve gallons of water; and Oberkampf, proprietor of the celebrated manufactory of Tony, a still greater proportion of indigo. Some printers add brown sugar, and Bancroft has proposed to substitute this for the orpiment, but without success.

" The solution, when recently made, is a yellowish green, but by exposure to air, becomes gradually deeper, and at last blue. In this state, it is wholly unfit for use, it contracts no union with the cloth, and is detached from it in the first operation of rincing.

" Of the peculiar nature and properties of indigo, we shall have occasion to treat hereafter, under its proper head; at present it will suffice to observe, that it owes its colour and insolubility in alkalies, to a portion of oxygen intimately combined with it. To render it soluble, therefore, it must be deprived of this oxygen, by the action of a substance having a more powerful affinity for it, and the sulphuret of arsenic, or orpiment, is used for this purpose. Sulphat of iron has a strong affinity for oxygen, and is employed in de-oxygenating indigo for certain purposes; but the oxyd of iron not being soluble in alkalies, the solutions of indigo, formed by it, become quickly regenerated by the absorption of oxygen, and cannot even be transferred from one vessel to another. The sulphuret of arsenic, on the contrary, being very soluble in alkalies, presents the double advantage of de-oxygenating the indigo, and of retaining it awhile in that state, till on its application to cloth, it becomes exposed so completely to the action of atmospheric air, as to regain its oxygen, colour, and insolubility, and becomes fixed in its original or blue state.

" The copper coloured pellicles, which forms on the surface of pencil blue, and is renewed immediately on its removal, arises from the absorption of oxygen, which, in spite of the action of the orpiment, is continually taking place. Hence arises that disposition to unevenness, which is the great disadvantage of this blue; the unavoidable exposure to air of small portions of the colour during its application with the pencil, reviving greater or less portions of indigo, and considerably reducing its strength.

" Most callicoe printers boil up the quick lime with the other ingredients, thinking its presence not less necessary than the potash and orpiment; by this means a considerable portion of the solution of indigo is taken up by the sediment, which careful washing does not wholly separate. As the action of the lime is confined merely to the alkali, which it renders caustic, and capable of acting with greater force on the other ingredients; it is certainly much more economical to render the potash caustic before its addition to the indigo. A considerable waste of colour is by this means prevented, and the solution may be thickened the moment the ebullition has ceased without waiting for the deposition, which in the old mode takes place.

" *Orange.*

" The oxyd of iron, when dissolved in acetous acid, forms one of the most useful and important mordants, as we have already shewn in the former part of this article. It is also capable of imparting a very pleasing and permanent colour itself to cotton, when applied in solutions of tolerable strength and purity, and forms the orange, buff, and gold colour of the callicoe printers.

" 1. The solutions of iron in vinegar, strengthened by the addition of copperas may be used, but the purest and brightest gold colours are obtained from copperas and sugar of lead, in the proportion of five pounds of the former, and one pound of the latter, to a gallon of water. When thickened with gum, and employed undiluted, it affords, when limed, a full strong gold colour, and with two, four, six, &c. times its bulk of water, various shades of orange and buff, which resist the action of air, alkalies and soap; and are rather exalted than impaired by frequent washing. The addition of sugar of lead is to increase the strength of the solution. A gallon of water dissolves about four pounds of copperas. The addition of a pound of sugar of lead, enables it to take up another pound nearly, and the strength of the solution may be still further increased by equal additions of the two salts. The operation of liming is a simple precipitation of the oxyd of iron on the cloth, and in cases when this cannot be performed, the proportions of sugar of lead must be increased to nearly that of the copperas. It is only the paler shades of orange, however, which are to be obtained this way. The deep gold colour before named, is not to be procured without the aid of a precipitant. Spanish brown is sometimes added to a solution of iron, and employed in such a case, but it contracts no union with the cloth, and is readily removed by simple washing and beating. When the orange, or gold colour, is thickened with flour, a small portion of nitrat of iron must be added to the paste, for reasons we have assigned on a former occasion.

"2. A beautiful, but fugitive orange, is obtained by boiling half a pound of annotta with one pound of caustic potash in a gallon of water, and thickening the liquor with gum. This colour acts powerfully on the sieves and blocks, which it very soon destroys, and on this account, and also from its want of permanence is seldom used. It may either be simply rinced off, or first passed through water slightly acidulous with sulphuric acid, or what is still better through alum water. This operation is the very reverse of liming, for here the colouring matter to be precipitated, being held in solution by an alkali, an acid must be employed for that purpose. The colour by this means is considerably heightened, and when applied with the pencil, is useful in some cases where the other colours will support the action of alum water without injury.

"Borax, and even spirits of wine, are sometimes added to the alkaline solution of annotta, and are supposed to contribute to its strength and fixity, though on what principle is not easy to discover.

"*Green.*

"The oxyd of copper, dissolved in volatile alkali, affords a pale and delicate green, which is sometimes employed intermixed with other colours. Turnings of copper, or verdigris, which is more generally used, may be digested in a low heat with spirits of sal ammoniac. Care must be taken that the heat be very moderate, and the vessel in which the solution is made, well stopped, the ammoniac will otherwise be driven off, and lost. When the alkali has taken up as much copper as it can dissolve, the solution must be thickened with gum, and applied with the block or pencil. In a few days the ammoniac evaporates and leaves the oxyd of copper on the cloth, which must be rinced to free it from the gum and superfluous colour.

"The blues produced by alternate immersion in copperas and lime, and also in the solution of indigo, by the same substances, properly come under this class of colour, as they are solutions of colouring matter in lime and alkalies. As the processes by which they are applied, differ however very materially from all those that we have been treating of, they claim a separate and distinct notice. For the details of these operations, and the mode of preparing the pastes for bark and pale blue dipping, and the colours for China blue, we must therefore refer our readers to the article *Dipping Blue*."

Of printing by discharging colours already dyed. I have already mentioned the method of producing a pattern by protecting the part intended to be a pattern, by printing a paste or reserve upon it. Thus, one sees frequently not only blue and white, but green and white cloths, and green grounds with yellow patterns. In this case the cloth is dyed blue in the vat, with a reserve or paste on the pattern, which is washed off: the whole cloth is then dyed yellow. Or, the common red colour can be printed on the white pattern when the paste is washed off, and then the whole piece can be dyed yellow, which will permanently strike on the mordanted part only, and then the pattern will be blue and yellow.

Another method is by discharging the colour already dyed, by means of some acid liquor. Thus, if black raised in madder be sprinkled with nitro-muriat of tin, a red colour will be produced in spots where the tin solution falls. In this way, by means of my pink-red with brazil lake dissolved in a nitro-muriat of tin, a good chemical red may be produced on a madder black.

A method of printing spots, or rather producing spots by a discharging liquor on Bandana handkerchiefs previously dyed of a Turkey red, has lately been introduced. A partial account of this process is given under the article "discharging," in the new edition of Rees's Cyclopædia, but as I cannot find the plate of the machinery published as yet, instead of copying the article I shall only refer to it. The principle is to apply a paste of oxymuriat of lime to the spot meant to be discharged, to decompose the oxymuriat by means of sulphuric acid, and to confine the operation by means of a screw press, precisely within the bounds of the pattern. This process might be applied to blues, and supersede paste work; and also to patterns on yellow grounds. In fact, as the invention is new as yet, we cannot foresee all the purposes to which it can be extended. It occurs to me at present, that the following method not hitherto used or suggested, might be employed for the same general purpose:

Let the pattern be stamped out on two corresponding plates of sheet lead of any dimensions. Smear the lead with paste, both the upper and the under plate. Fix the cloth between. Apply force or pressure, if necessary, to keep them together. Inclose them in a box or a room, and throw in oxymuriatic or chlorine gas for a short time. If needful the cloth might be moistened to prevent the corrosive effect of the acid.

In the same way a dyed piece of any colour, might be discharged in patterns, by printing on it a blotch ground in paste work, or reserve, and exposing the open work moistened to oxymuriatic acid. These ideas have never been suggested or practised that I know of; but I am satisfied that they are feasible from the experiments on chlorine gas, which I usually introduce in my chemical lectures before the class.

I proceed now to the brief tract on callicoe printing, by Homassel, republished by Le Grange in 1809. I observe that some of the processes are the same with those employed in England, and I have no doubt from the similarity, that the pastes and reserves were borrowed by the English from the Rouen manufacturers, whose skill has more than once aided the English dyer. As to the other processes (exclusive of those connected with the blue dye) wherever the French differ from the English, I prefer the latter, as more simple, and more scientific: but it is worth while to know the processes of other countries so late as the year above mentioned. The French methods are more complicated and empirical than the modern English. They are not yet aware that acetat of alumine, and acetat of iron, are capable of supplying all that a printer wants for good and fast colours: they have no knowledge in practice, notwithstanding the experiments of Thenard, that sulphat of alumine is decomposed with great difficulty by cloth of whatever description, and can be effectually washed away, and that perfect acetat of alumine fixes on the cloth with much stronger affinity. It is manifest that the theory and practice of printing are not so well understood in France as in England: still, there are observations of practice dispersed through the pages of Homassel, which will repay the perusal of his directions.

I omit Homassel's directions for erecting the apparatus for washing, streaming, &c.; also his method of bleaching the cloths; also his method of mounting the vessels used for the preparation of iron liquor: all this is so much better in the English practice, that I should waste paper by translating it. I presume the directions herein before given on the subject of bleaching and iron liquor, will supersede the necessity of the French artist's directions. The articles relating to bleaching, both in Rees's and Brewster's Encyclopædias, are good, but what I have said on the subject is not superseded by those articles; and being the result of extensive and successful practice under my own eye, I consider as important, brief as it is. The remarks on the method of making acetat and pyrolignat of iron, in the articles from Rees, are well worth attending to.

Fine Red Colour. The reds I prepare (says Homassel) for a hundred quarts of water, can be as well prepared in a small as in a large way, preserving the same proportions.

Take water one hundred quarts (*pintes:* the French pinte is so nearly our wine quart, that they may be taken reciprocally.)

Seventy-five pounds of ground alum.

Two pounds of lead ore, ground and steeped in vinegar. (Mine de plomb.)

Four pounds of arsenic, ground and steeped in vinegar.

Three pounds of common salt, dissolved in water.

Fifteen pounds of sugar of lead, dissolved in water.

One pound of Cyprus vitriol, (blue copperas) dissolved in water.

Two pounds of soda in four quarts of water.

This is the best mordant for weld.

When the sediment of these ingredients has subsided, you may pour off the clear liquor and add fifty quarts of water to the grounds, which being well stirred for four or five days, left to settle, and the clear liquor poured off, will furnish a very good second red.

To enable the printers to see the mordant distinctly, it must be coloured. For this purpose boil a pound of rasped brazil wood in a hundred quarts of water, strain it: dissolve in it seventy-five pounds of alum in powder. Dissolve in a separate vessel twenty pounds sugar of lead in ten quarts of water, and four pounds white arsenic in two quarts of vinegar; a pound of verdigris in a pint of vinegar; two pounds of blue copperas in a quart of vinegar; four pounds of soda in powder; four pounds of whiting or chalk.

When the alum is dissolved, which will be the case in two or three hours, pour in the solution of sugar of lead, stirring it continually; then pour in the arsenic and vinegar, which you must not boil; then the blue vitriol and verdigris. When all is dissolved, add by degrees the soda, then the chalk or whiting, by small quantities at a time. It is important that all the drugs should be dissolved, except the soda, which mixes with the sediment, and is longer in dissolving. The smallest quantity of alum undecomposed will crystallize, and in this state will weaken the mordant, and dispose the colours to run.

All reds are made much alike, but the receipts here given, have always excelled in beauty and solidity. It is convenient not to use them for three or four days after they are made, in order to insure the complete deposition of all sediment. They are then quite clear, and somewhat like fine veal jelly.

These reds are expensive, and manufacturers who study economy require some that are cheaper.

Another Fine Red. Water, one hundred quarts, or rather decoction of brazil.

Sixty-five pounds alum, managed as before directed.

Fifteen pounds of sugar of lead.

Two pounds of white arsenic, dissolved in vinegar.

Two pounds of Cyprus or blue vitriol, dissolved in vinegar.

One pound of verdigris, dissolved in vinegar.

Three pounds of common salt, dissolved in water.

Six pounds of soda, in powder.

Two pounds of chalk.

Make up this red with the precautions before indicated.

Another. Decoction of brazil, one hundred quarts.

Alum, fifty pounds.

Sugar of lead, twenty pounds.

White arsenic, two pounds.
Sal ammoniac, two pounds.
Blue vitriol, two pounds.
Chalk, four pounds.
Composed as before directed.

Another. Decoction of brazil, one hundred quarts.
Alum, fifty pounds.
Sugar of lead, twenty pounds.
White arsenic, two pounds.
Chalk, four pounds.
Scarlet tin composition, one pound.

If the alum tends to crystallize, increase the arsenic and chalk.

Many printers use the following:
Water, (or brazil decoction,) one hundred quarts.
Alum, fifty pounds.
Sugar of lead, twenty-five pounds.
Blue vitriol, two pounds.
Chalk or whiting, six pounds.

The red colour may be coloured with logwood sometimes, as conveniently as with brazil; and still better with fustic. The colouring matter always disappears, being displaced in the raising with madder or weld.

When the red appears to run, or the alum to crystallize, the colour should not be used. If, as often happens, after the thickening is put in, the alum crystallizes on the surface of the drum, you must stop the work (This always happens from a defect of sugar of lead. *T. C.*) In this case the colours will run when they come to be raised in the dye copper.

If before thickening you find that the alum crystallizes, the composition must be heated, but not to boiling, and stirred till all is dissolved. Then add one half the former quantity of arsenic dissolved in vinegar. A fermentation then takes place, owing to the matters not having perfectly neutralized before, and therefore a complete decomposition could not take place. Then add one-fourth part of the former dose of chalk, in powder, and by degrees, to prolong the effervescence.

As the art of making mordants for reds, demands long practice, you must not serve your apprenticeship upon large quantities, such as an hundred quarts of water: begin with the same proportions of the same drugs in two quarts; and try it on a great scale when you have learnt your business on a small one. (This difficulty is owing to the multitude of the drugs prescribed and the complication of the receipt. No one will fail in making a good red, who will take the substances and proportions I have recommended, to wit, alum, three parts; sugar of lead, four parts; whiting, one-sixteenth of a part. *T. C.*)

Of Second Red. This is in some measure regulated by the method of thickening: if it be thickened with starch, (or paste? amidon) it may be weaker than if it be thickened with gum. A second red made purposely, is better than one made by diluting a strong red; for this red, one third of the drugs used for strong red will suffice. Even this will be too strong, if there be but two reds in the pattern. It is brought forward more advantageously by a third red. The first red is thickened with starch, and is concentrated by the necessary boiling to thicken it. The second red is also concentrated in the same way; the third red thickened with gum, is diluted by the thickening. Some printers may be of opinion that my second and third are too strong. But if they would print a fast green, they must weld the yellows after the first bleaching, and then bleach them again after welding, which altogether will take six weeks on the grass: during this time the reds may be lowered as much as they please. It is very unpleasant to a printer, when he has raised a pattern in fast colours, and bleached the grounds on the grass, to find that the second and third reds are half bleached out.

But if the reds are really too strong, the second red may be thickened with gum in powder, and the third with gum water: then the yellows may be finished with chemical yellow, to which a printer reconciles himself sometimes very easily.

Hence for a second red, where the first is made with seventy-five pounds of alum, take

Water, one hundred quarts.
Alum, twenty-five pounds.
Sugar of lead, five pounds.
Arsenic, twelve ounces.
Cyprus vitriol, twelve ounces.
Verdigris, six ounces.
Common salt, one pound.
Soda, two pounds.
Whiting, one pound.

You must not suppose that this second red is more easily made than the first, although the quantity of water be the same: it requires full as much attention.

Some printers make their second red by putting two parts water to one part first red; but this is apt to make the colour run. (It is impossible this should be the case, if the dilution be made before thickening. *T. C.*) Printers have always their particular mark or number, so that it can be known at once by the master manufacturer, what printer turned out the piece in question. This mark is usually printed with a composition of soot and olive oil, which when the piece has been bleached to clear the ground, appears of a dull faint red, of some value. (This remark is worth noting: I have found, indigo ground with white lead, a very fixed colour. The common bleacher's mark, is nitrat of silver, thickened with gum water, and coloured with lamp black. This is indelible. This red from oil and soot, may suggest some reflections on the use of oil in the Turkey red, says Homassel: which is a remark also worth noting. *T. C.*)

Violet. There are several methods of making violet colour (mordant.) Every printer has his own receipt, depending upon the blue or brown tint, that he wishes to predominate in this colour. The base of violets, is always the same; the varieties are formed, by a little more or less, of blue, of red, or of brown.

The base of all violets is thus made:

Black colour, (Bain de noir.)
Cyprus vitriol, (blue vitriol.)
Saltpetre.
Common salt.
Alum: and sometimes verdigris.

For instance, here are a first and second violet, to be thickened with gum.

Sixteen quarts of black.
Six quarts water.
Eight ounces Cyprus vitriol.
Six ounces saltpetre.
Two ounces alum.

Second Violet.

Six quarts black.
Sixteen quarts water.
Four ounces Cyprus vitriol.
Three ounces saltpetre.
One ounce alum.

Another Violet.

One quart black colour.
Four quarts water.
One ounce saltpetre.
Half an ounce common salt.

By doubling the proportion of black, a brown may be made on this violet, thickening the brown with starch (amidon) and the diluted colour with gum.

The salts should be dissolved in water before they are added to the black.

Another Violet.

One quart black dye for the brown tint.
One quart water.
One ounce sugar of lead.

For the diluted or second violet,

Three quarts water.
One quart black dye.
Half an ounce sugar of lead.

These two violets are thickened with starch (amidon.)

In many printing works, if a printer asks the colourman for a brown, he puts into the pot,

A pint of black.
A pint of water.
A wine glass full of second red.
Half a pound of starch, (amidon,) which is all thickened together over the fire.

In the blacks intended for violets they generally put an ounce of (Cyprus) vitriol to the quart.

Another Violet.

One quart of black.
Three quarts of water.
Two ounces Cyprus vitriol, (blue vitriol.)
Two ounces saltpetre.
One ounce common salt.

This can be deepened of course by increasing the black.

For a second violet diminish the quantity of each of the ingredients.

Red Brown.

One quart first red, (pinte.)
Half a pint black colour, (demi-septier.)

With madder, this is a red inclining to brown: with weld, a brown-green.

Flea Colour with madder.

Three half pints first red.
One half pint black colour.

With weld, this makes the goose dung: these colours are useful for foliage of old trees.

Wood Colour. Raise a violet in madder, then print red colour upon it, and raise it in weld.

Pencil Blue. One pound of indigo in sixteen quarts of water, disoxygenated by liver of sulphur, and thickened with four pounds of powdered gum arabic.

Green Blocked indigo blue; upon which, when washed and dried, print red colour and raise it in weld. This is better in point of colour than when the blue is blocked or pencilled on the yellow, because the causticity of the alkali attacks the yellow and weakens it.

On the thickening of Colours. Colours are thickened with starch (amidon) or with gum. It is hardly possible to fix the proportion of starch to a quart of liquor, on account of the varieties in quality of the starch: sometimes four ounces, sometimes eight are required. Some colours require to be more thickened than others. Reds require so much only as to prevent their running: violets should be thicker, on account of the black, which is apt to run. For the same reason black requires more thickening than any others.

In regular workshops the colours wanted for to-morrow are made to day: each colour ought to have its appropriate vessels.

Some workshops proceed on the principle of economy; some choose to acquire the character of good work. In the first class, starch and gum are seldom employed; they thicken with mill-dust obtained cheaply from the millers.

In thickening, the flour or starch is placed on the fire in a pot, the liquid added by degrees, and stirred till it acquires the proper consistence.

It is better to err on the side of the colours being too thick than too thin: for in the first case the printers can dilute them to their mind, but when too thin, they must be boiled over again in the colour shop, which is often a detriment to the colour: besides the inconvenience of running when the colours are to thin.

If gum be used for thickening in the proportion of four ounces to the quart, the gum in powder is beat up with about half the liquid which it is intended to thicken, and when dissolved, it is gradually diluted by stirring in the other half.

Of the False Colour. This is the glutinous matter used to support the cloth in the tub or drum. It is usually made of ground linseed, boiled to the necessary consistence, and poured hot into the tub, where it is left to cool. The printer who has the command of the table, fixes this after his own manner. This elastic gluten is absolutely necessary to support the cloth of the drum, because if there should be any accidental hole or slit in it, the linseed unites so sparingly with acids and mordants, that they are not spoiled by the accident.

In many shops, instead of linseed, they use the scrapings of printers pots: and throw into the tub indiscriminately all such bottoms and scrapings. This imprudent parsimony occasions faults in the work, when it comes to be maddered.

The false colour in the tub is covered with leather, or waxed cloth, and this again with thick woven cloth, whereon the mordant is smeared with a brush, which the printer takes up by his block.

The tables should be solid, perfectly smooth, level, covered with cloth, kept scrupulously clean, and the block neatly engraved. The mallets should be plugged with lead about the thickness of a finger.

The printing room should be furnished with a stove, not merely for winter but in summer also, especially in damp weather. The fire should be lighted whenever the printers call for it, because in most print shops they are answerable for their work. Beside the stove of the printing shop, there should be a stove-room adjoining or over it, to which the goods are carried when printed, in order to drive off the superfluous acid of the mordant. But the heat should not exceed a blood heat.

No second colour can be printed till the first is perfectly dry: it is particularly necessary to see that the blacks are quite dry, as they are most apt to spread, the rust of the iron having that tendency.

Sometimes over the linseed thickening in the tub, they put cloth dipt in suet in lieu of skin or of oil cloth, a substitute which the printers often prefer.

The blocks must not be kept in a place either too dry, so as to make them fall to pieces, or too moist, to unglue them. If being in one piece they are apt to warp from being too dry, they can be covered with a moist cloth, or warmed over a fire on which water is thrown to raise steam. When the superintendant of the block-cutting shop receives pear-wood planks for the purpose, he should expose them for two months to the sun, near a stream, throwing water on them whenever they become dry.

The master of the works should take care, that when a printer lays aside one block to take another, he does not put by the first till it is perfectly clean, for it spoils them to let the colour dry on.

When a block becomes foul, it can be cleaned with strong sulphuric acid, and then washed in water.

Of Maddering. Coloured callicoes with a black ground, require two madderings: the second requires as much madder as the first.

When there are three reds, the second is printed immediately after the first, but when there are only two, they print and madder the first, before they print the second.

Black grounds require two raisings in madder of a pound and a half each, for a piece of ten ells French or thirteen yards English.

If you have a callicoe black ground, two reds, and two violets, print the deepest violet and the first red, to be raised together, the second red and second violet should be printed afterwards and raised in the second maddering. So that the block which prints the second violets on the white may cover also the black ground; this strengthens the black ground by fresh mordant for the second maddering. But if there be no second violet, then the black may be covered when you print the violet red, except where you have to block in afterwards a chemical yellow. If the black be not strong enough, it may be refreshed by the violet chemically applied without maddering.

In a printing establishment, there should be a copper for dunging, another for maddering, another for welding, another for branning. They should be furnished with grates and fire places; the flue should be divided into two parts, and meet at their exit into the chimney. (The fire places are more convenient on the outside of the room than withinside.) If the boilers be well set, the maddering ought not to occupy more than two hours.

The coppers ought to have a large cock (or rather plug) at the bottom to empty them easily, with winces to turn the pieces in the madder bath. The callicoes should be prepared after mordanting in cow dung, mixed with water, so as to be of a full green colour; wince them in this for half an hour; and then wash them. If they are printed with a colour thickened with gum, they will take a longer time; they should be left exposed to the current of the stream an hour; and then beat, so as to be sure that all the gum is washed out. A fulling mill is often very convenient for this purpose.

The dye copper should be ready filled with clean water to receive the pieces after washing: the madder well broken, should also be at hand; light a fire under the copper or boiler, put in the madder, fasten the ends of the pieces together (about 170 yards in all in England) and wind them evenly on the wince.

By this time the water in the copper with the madder in it will be moderately hot: rake it, so as to distribute the madder evenly. The pieces are winced in the liquor, by one man, while another keeps them sunk in the liquor by means of a stick, till the maddering is over. The madder copper should be so heated that it approaches a boiling heat in an hour and a half, and not sooner. When the madder colour is exhausted, the process is finished, but it is expedient to give the pieces a couple of turns more, which takes about fifteen minutes.

If this maddering be repeated, the goods after being well washed, must be dried, calendered, and reprinted.

When the callicoes have a black ground, you must not forget to put in an ounce or two ounces of nut galls to each piece, and after maddering they should also be passed through a bath of logwood liquor.

The goodness of the work can only be judged of after maddering.

If the grounds are white, the first maddering suffices; but if there be yellows and greens, it must be printed again with colour or mordant. The oxygenated muriatic acid may be made to supersede laying the goods down on the grass. Thus: after washing the maddered goods, boil them in bran and water for a quarter of an hour and then rince them: in a clean tub or cuir, half filled with cold water, put some oxymuriatic acid, prudently: pass the goods through this liquor by wincing them, till they are three quarters white in the ground. Then take them out, wince in a little soft soap and water, and lay them down without washing: it is best done when the weather is fine, that the soap may dry on the pieces. Then wet them on the grass, and in three or four days, the smell of the soft soap will be lost, and the grounds will be bleached.

Before welding, the blue for the greens ought to be blocked on. For this purpose, there should be a tub, three quarters filled with pencil blue: on this put the cloth, single or double as the printer chooses. When the printer has gone the length of the table, he should examine if any parts of the pattern have been missed, in which case, the defects must be pencilled, and then sanded to prevent their spreading.

When the whole piece is printed, it must be soaked in water for two hours to get out all the gum of the pencil blue. Sometimes even, it is needful to rub the places with the hand. If the pieces are washed merely by wincing, this must not be quitted till the gum is surely washed out.

The pieces are then calendered, and printed with red colour according to the strength of the yellow proposed. Wood-colour, is printed on maddered violets to be raised in weld. So, orange colours are printed on reds to be raised yellow, while at the same time the weld copper raises yellow on the whites and green on the blues.

On Green Grounds. For these grounds it is necessary to reserve all the flowers with a paste, that can be washed off in water, but will not separate in the blue vat.

Such a reserve or paste may be thus made:

Sifted pipe clay, one pound.
Gum arabic dissolved in water, two quarts.
Tallow, two ounces.
Wax, one ounce.
Rosin, one ounce.

Boil all together in a sufficient quantity of water to bring them to such a consistence that they will not spread upon the cloth.

This reserve can only be pencilled on, or blocked on with a block well hatted.

When the cottons are dipped, it must be in a vat fresh made and strong, so that the required colour may be soon obtained. Then wash them to get off the paste, dry, calender, and print them with red colour upon the blue, to be raised green by weld. Should any of the reserve still stick on, the heat of the weld bath, and the subsequent washing will detach it.

No more than eight pieces of thirteen yards English are welded at a time, for they must be quickly turned in the liquor.

The copper should admit of and be supplied with forty pounds of weld, which should boil for *two hours*. This long boiling has often been objected to me, inasmuch as the liquor becomes greasy by means of it; this is true, but the weld colour which has not undergone a two hours boiling, is half discharged by bleaching on the grass, while that which has, loses little or nothing.

When the weld has boiled two hours, take it out, enter your eight pieces of ten French ells each (or about thirteen yards English: we enter eight pieces of twenty-eight and a half yards each, though six are better, *T. C.*) well washed previously. They must be winced rapidly for half an hour at the utmost, for weld does its duty very speedily, and the colour is also apt to be redissolved by too long boiling. Then wash the callicoes and bleach them on the grass.

When the goods have been bleached a first time, they will be of a clear white in the grounds in twelve days. If they are for expedition entered into dilute marine acid and water, they must be finished in soft soap and water.

When the welded goods are thus bleached, they must be rinced, dried, calendered and carried to the pencillers, to repair any defects, with pencil blue and chemical yellow.

The reds and second reds may also be pencilled blue for violets, and with pencil yellow for orange. They then go to the print shop to receive the chamois or buffs and drabs; the buffs are usually made of second violet, with no salt, but the mere colour of iron mould. We shall say more on this subject when we come to chemical colours (petit teinte.)

When buffs are to be raised, they are better for staying three or four days before they are washed. But if they are to be dyed, they should be washed as soon as they are dry. When washed and dried, they are glazed (by friction, with a machine that works backward and forward, a polishing stone or glass). They are then calendered and made up for sale.

Of Paste Work, or Reserve Blues. That is, white patterns on a blue ground. They are scoured and prepared in the usual way, then printed with the following paste:

Cyprus vitriol, six ounces, (blue vitriol.)
Alum, two ounces.
Verdigris, two ounces.
Powdered gum arabic, four ounces.

Make a thick paste of pipe clay, with water in which you dissolve two ounces of tallow: stir this mixture into an uniform consistence over the fire. The above mentioned salts are the proportions to be mixed with one pound of ground and sifted pipe clay: they must be dissolved in vinegar, and the whole united by well stirring them together, over the fire. The consistence must be such, that when laid on, it will not spread. The chase, or covering of the linseed mucilage in the drum or tub, is for these pastes usually of leather. The printer ought not to use his common mallet, but give the block a stroke or two with his fist, not too hard.

Reserves are also made for yellows. For this purpose, a quart or two of black colour (bain de noir) is used, in which you dissolve a pound of green copperas. If the black colour be strong, you may put in but half a pound of copperas and as much gum arabic; give it the requisite body with yellow sandy clay, or founders' clay, which the brass-workers use for their castings.

When dipped in the blue vat, it must be often exposed to the air, and stretched, turned, and returned, to prevent its spotting. To make a solid blue, it must be exposed to the air long enough to change the green to a blue, and this a second time. When dyed they must be well washed, and if necessary run through hot water, completely to separate the paste, and then rinced and dried.

In establishments where blues are dyed in the large way, they have square vats of oak, tightly hooped; but they frequently leak; and it is the best part of the liquor that leaks out. More business can be done with two vats lined with lead, than with four wooden ones. I have been in shops where the vats were grooved, tongued, caulked with oakum, and well pitched within and without; in this case to be sure they lost little. In other places they sink their vats in the ground, and ram clay nine inches thick all about them. They would persuade me that these vats lost nothing, but I greatly doubt this; for the caustic alkali will eat small holes even in the wood itself, and find a way of escaping. I know it will penetrate the common glazed pottery.

To dye the goods in the vat, the cloth is stretched on frames by means of copper hooks, suspending them by the selvages, beginning at one end, and finishing at the other. The top bars of the frames run in grooves so that the pieces may be sunk lower at pleasure, and they are stopped by pegs put into the holes at the required depth. The pieces are let down, and raised by means of pullies. The hooks may rust the cloth once or twice, but whenever they once become covered with indigo, they will spot the cloth no more.

Of China Blue or English Blue. (Bleu de Faiance.) In England, and in the great manufactories, where they make a point of carrying the blue dye to perfection, as in those of Jouy, Bercy, and others, they manage their English blue thus.

They grind their indigo, which must be of the finest quality, with one part and a half of green copperas: these ingredients must be ground, either on a marble, or by means of a mill, till they are mutually reduced to the consistence of an oil or a gelly. This union of green copperas with the indigo, serves to give it body and tenacity, so that it does not spread upon the cloth when immersed in the vat.

For a deep blue, they prepare gum water of moderate consistence, neither too thick nor too thin. To make the gum water it is not necessary to reduce the gum to powder, only into small lumps, to avoid the coagulation of the powdered gum.

The union of copperas and indigo with gum water, is not easily effected. For this purpose, they must be well mixed and ground together, and then with a spatula, they must be forced together through a hair sieve. For deep blue, they use equal parts of the indigo and copperas mixture, and of gum water; for a second blue they use five parts of the gum water, and one part of the indigo ground with copperas. The deepest blue is first printed: the next day, and not before, the second blue is printed, which must not be done till the first is perfectly dry. When thus printed two blues, the callicoes must rest for four or five days in this state. By this time, the copperas and indigo will have sunk into the cloth, so that the impression will appear on the opposite side of a rusty colour. Hence I have directed one part and a half of copperas to one of indigo, because the copperas fixes the indigo and prevents its spreading while it is in the vat; and this gives the China blue that solidity which makes it resist the oxymuriatic acid, which does not act strongly on metallic colours.

For a single establishment of China blue, four vats are necessary: for a double course of work six, and for three times as much work as you can get through with four, eight. The potash vat, and vitriolic or sulphuric acid vat, are sufficient for the other six, and make an establishment of three pairs: for independent of the oil of vitriol or sulphuric acid vat, no more than two others are necessary.

In the first vat you put a pound of lime to four gallons of water, and you may put a little more. In the second vat, you put two pounds of green copperas to four gallons of water, or a little more. The copperas vat should never be black, but of a green colour: when it has been worked for some time, it loses its yellow green colour, and if well managed becomes of a fine duck green. The management of this vat consists only in putting in green copperas occasionally, and preventing the top liquor from being mere water. When the vat is much worked, there should be a small quantity of crystals of green copperas kept in the bottom of the vat. The water need not, but can be so saturated with copperas that it will take up no more. When well managed, this vat will keep constantly in order; by degrees a sediment collects from the lime, which is gypsum and falls to the bottom of the vat: the liquor may be drawn off clear, and the sediment emptied occasionally.

In the third or potash vat, you put two pounds of lime to four gallons of water. Formerly a potash ley was added, but that is now disused, although the vat from this circumstance retains the name of the potash vat. At present it is made up with lime alone.

In some dye shops they add common salt to this vat, but I have tried it, and I find no use or difference whatever produced by this addition. But I have found benefit by adding half a pound of soda to four gallons.

These vats must be prepared three or four days before they are wanted for use, that by stirring, the lime may be fully slacked, and the copperas well dissolved.

The fourth vat, is the sulphuric acid vat; this may be made the same day it is wanted, for it is apt to attract humidity from the atmosphere, and become weaker. Into sixty parts by measure of water, put one part of oil of vitriol, and mix it all well together. The leaden boiler also, should be filled with the same proportions.

The printed callicoes fixed in a frame, are then immersed in the first lime vat for five minutes: raise them and let them drip for three or four minutes: then plunge the frame in the copperas vat for thirty minutes: raise it, let it drip for two minutes: plunge it a second time in the lime vat for twenty or twenty-five minutes: raise it; let it drip for two minutes: plunge it a second time in the copperas vat for thirty minutes; raise it, let it drip for two minutes: plunge it a third time in the lime vat, let it stay twenty minutes; raise it, let it drip two minutes; then a third time in the copperas vat for thirty minutes; let it drip for two minutes.

The callicoes having been thus passed three times into each of the two first vats, the lime vat and the copperas vat, are to be plunged into the third or what is called the potash vat, (although it is in fact a lime vat.) In this vat it should remain one hour; take it out, and let it drip for two or three minutes or more if necessary; then plunge them in the sour vat of sulphuric acid for fifteen minutes. Then carry the frames at once to the river without draining them, and there wash and beat them, till they give out no more blue colour.

When they are thus well rinced, enter them into the leaden boiler a little warm, to take out the iron moulds, and clear the whites perfectly; then carry them to the river to wash, and lay them down on the grass for two nights. The boiler need not be bigger than about ten buckets.

Five minutes before the vats are used they should be stirred up, particularly the lime vats, which should appear like milk: indeed when the frames are let down, they should be moved about occasionally, and not suffered to remain quite still.

If you are not sure that you can depend upon your vats, attach a specimen piece to one of the frames, and examine it before you enter the frames into the vitriol vat. If the pieces have missed taking the colour as you expect, there is no remedy but discharging the colour. If the colour is not quite strong enough, it should rest a little longer time in the potash vat, and be repassed into the copperas vat.

While the cloth stays in the vats, it acquires a dirty green colour, and at the close of the operation it is of a black green, a certain sign that the process has been properly conducted. The vitriol vat makes all this disappear and brings out the proper colour.

When fifty or sixty pieces (of thirteen yards each) have been passed through the two first vats, it frequently happens that the lime vat becomes charged with particles of copperas, which turns the cloth of a buff colour, which can easily be perceived within the first five minutes after a piece is entered. Although this does not influence the solution of the blue, yet as it makes the cloth more difficult to be bleached, a vat so circumstanced must be dispensed with.

The lime vat should also be fed daily with fresh lime, to keep it always of the same strength.

This China or English blue, is a great object with all the callicoe printers, who have, for the most part, been afraid of undertaking it on account of the uncertainty of success, and the expense of the utensils necessary to such an establishment; for which reason I will describe them more particularly, that the expense may be judged of.

(I omit the description, because I consider it as manifestly inferior to the English methods already mentioned.)

Generally a nankin or buff colour is printed on the China blues, which relieves the work very much. The method of managing this, is as follows.

Expose green copperas to the fire till it becomes of a red colour (colcothar), then expose it in a moist place, till it deliquesces; grind this with iron liquor, and use it to colour the gum solution in such proportion as will produce the colour you wish, and print with it. This is in fact the same colour which is called English nankin, and which will continue from its merit to triumph over the inconstancy of fashion.

Of discharging spoiled pieces. The discovery of the oxymuriatic acid has rendered this operation, formerly very difficult, now easy: but as this acid does not act on metallic earths or oxyds, the vitriolic souring in the leaden boiler was deemed indispensable.

But the following is a better method.

Fill a common copper boiler, with the quantity of water necessary to work the cloths in. For every piece of thirteen yards, put in half a pound of gray tartar (white argol) in powder: raise the fire, enter the cloths, and before the liquor boils, all the colours are discharged.

But as the tartar is a vegetable salt, not apt to act prejudicially upon the pieces, you may bring the liquor to a boil, and keep it at that heat for an hour, to dissolve completely the mordant of the madder colours, as well as the other colouring matters that require to be discharged.

When the cloths have boiled an hour, they should be taken out, washed, and well beaten at the river, and then run through a weak bath of oxymuriatic acid, till they are quite cleared; then carry them again to the river and wash them well: they will seldom require to be laid down on the grass, but may be put into work immediately.

If instead of common gray argol or tartar, you employ cream of tartar, the whites will be the better for it, but it is rather dear.

Of the Lesser Dye on Printed Callicoes. Buffs (chamois) are much employed in this course of work.

The printers of fast colours, generally employ only violet colour more or less deep, or black colour, as occasion may require.

A callicoe printed two violets, or violet and black, will exhibit after being washed and ready for the madder copper, two buffs or iron stains, which are occasionally much in fashion.

To raise a buff, dissolve a pound of green copperas in a quart of water; add to it a quart of black colour, to make it deeper: or dissolve in a quart of black colour, a pound of copperas, and if you please, four ounces of sugar of lead.

To raise a yellow buff, dissolve one pound of copperas in two quarts of water, with four ounces sugar of lead: let it remain eight days before you use it. (It may be used in eight minutes. *T. C.*) The older it is, the deeper it is. (I doubt this. *T. C.*)

If you want a lively orange buff, expose copperas to a strong heat on an iron plate or shovel; one pound of copperas thus treated, will give but four ounces of residuum; (this is the common colcothar of vitriol or crocus martis; *T. C.*) leave it on the shovel in a moist place, till it begins to deliquesce and to run; it will be a brown oily kind of liquor, which you may use as you want it.

All buffs are thickened with gum, when they are diluted; but with starch when they are strong. They are fast colours.

Buffs are also made, by rusting iron nails by means of nitrous acid; this acid they mix also with green copperas, but it is a bad and dangerous practice, as it is apt to burn the cloth.

Buffs are also made with annatto, but this is apt to spread and spot, and is not fast.

When you print fast buffs, it is best to thicken with gum.

These colours are usually called English nankins. They stand washing well, but blacken with tea and other astringents.

Of Colours of Application or Chemical Colours.

Of Yellow. Many printers who carry on business largely do not print with a mordant and weld their callicoes, after they have been once printed, maddered, and the whites cleared on the grass; on account of the length of time which this operation takes, especially when a second clearing on the grass is necessary. They say also that a chemical yellow will stand three or four washings, which are as many as are usually required.

In my opinion, however, chemical yellow will not stand three or four washings; one half of it is washed out at the first washing; and if it be not washed by servants who know their business, not only the yellow is washed out in part, but it runs upon the other colours and stains the whites, which spoils the whole appearance of the garment. On the other hand, if the yellows and greens stand as they ought to do, a garment looks respectable even though it should be something worn, for these colours give relief to the others.

Chemical yellow is thus made. Put four pounds of bruised yellow berries into twenty English quarts of water, together with four pounds of quercitron, or else as much rasped fustic; but this last is not near so good as the quercitron. Boil it down to one half, or till you can draw off not more than about eight quarts.

Add to the sediment about twenty quarts more of water and boil it; this last decoction should be set aside to be used for the next quantity of fresh yellow you may want, as it is better than clear water. To each quart of this strong decoction add two ounces of Roman alum. Thicken the yellow with starch: if you have Canary birds in your pattern, thicken with gum.

Of Prussian Blue. Some printers use Prussian blue, (which is so strange a colour for goods intended to be washed that I omit it. *T. C.*)

Of Logwood and Brazil. No good colour can be produced chemically with these drugs, unless the decoction be very strong, nor unless the woods be rasped; it is great waste to use them in chips or shavings.

In a bucket of water, about four gallons, boil two pounds of logwood for an hour. Strain the liquor, and add other two pounds of fresh logwood. Boil down to five quarts. Take care to keep up the boiling heat all the time, otherwise the wood will reimbibe the colour it has given out. The sediment may be boiled over again, and set aside for a fresh quantity.

The brazil wood must be treated like the logwood: nor must you draw more at the utmost than three pints of decoction from a pound of brazil. The sediment boiled over again serves instead of water, for the next quantity of colour you may stand in need of.

For a chemical violet with logwood, add to a quart of the decoction, one ounce of alum and one ounce of saltpetre: thicken either with starch or gum.

To produce a fine light velvety violet, add to four parts by measure of the brazil decoction, one part of logwood decoction, an ounce of powdered alum and as much saltpetre for each quart; thicken with starch. (It is worth while to try the solution of bismuth either in nitric acid or aqua regia. *T. C.*)

For a *red* as a companion to the *violet*, one quart brazil decoction, one ounce alum, one ounce saltpetre: thicken with starch.

For a deep logwood *blue*, take one quart decoction of logwood, half an ounce blue vitriol, half an ounce of powdered alum, two drops of oil of vitriol; thicken with starch. For a *second blue*, thicken this with gum water.

Of Green. To make a green, take three parts of the chemical yellow liquor alumed as before directed, one part of logwood decoction, and the eighth of an ounce of blue vitriol, thickened with starch.

Of Black. Two pounds logwood, as much sumach, a quarter of a pound of blue galls well bruised; boil in four gallons of water, till it is reduced one half: then put in a quart of vinegar, and continue the boiling; then add an ounce of sal ammoniac, and reduce the liquor by boiling to one gallon: then add two ounces of blue vitriol; when dissolved, draw off the clear liquor, and thicken with starch.

Another Black. Boil from four to five pounds of oak saw-dust in a common bucket (about four gallons) of water: when boiled for an hour or two, strain the liquor, and boil in it two pounds of rasped logwood; after about an hour, put in a quart of vinegar, and an ounce of sal ammoniac. Boil down to one gallon; add two ounces of powdered blue vitriol: strain and thicken with starch.

When these colours are to be washed after printing, let them soak first in water for four hours, then wash them.

If they should be nankin or buff dimities, the colours should be thickened with gum: in which case, they should soak for six hours before they are finally washed, otherwise the colours will be apt to stain the whites. Nor should these colours be soaked or washed till two days after they are printed.

Chemical White. This is printed on gauzes, muslins, and lawns. Take some old worn rags of these substances: bleach them as white as possible, finishing in a sulphuric acid souring, and then wash scrupulously. When quite dry, grind them to powder in a new snuff mill: sift them through a covered sieve. It is this fine dust that is used for the impression.

Cover the printing table with a cloth tightly stretched, or with pasted paper. Fix some ledges of wood to the edges of the table, that may rise about an inch above the level of the table: cover the table evenly with the sifted dust above described, four or six lines (above a quarter of an inch) thick: upon this dust, as on a carpet, the gauze or muslin is stretched, which is then printed simply with gum water: this gum water soaks through, and causes the dust to stick to the printed gauze on the opposite or under side. This impression perfectly resembles embroidery.

This process may be improved not only by producing patterns in colours, but by fixing those coloured dusts on the gauze or muslin by means of a varnish that will not wash out. Thus, take

Spirit of turpentine (oil of turpentine) one pound.

Of Venice or Chio turpentine, one pound.

Of sandarach, one ounce.

Of mastic, in drops or tears, one ounce.

Dissolve the mastic and sandarach in the oil of turpentine, and thicken it with the turpentine in substance, to the degree necessary for printing. This varnish should be rather dilute than otherwise. When once dry, nothing but caustic potash will wash it out. To clean the blocks, they must be soaked in oil, and then washed with hot caustic alkali.

When an impression is to be made in many colours, there must be as many tables prepared in the same way, and covered with powder of linen or cotton of the required colours.

When this impression is well made, it very naturally represents an embroidery of many colours.

One may thus print in gold and silver, by using ground gold and silver leaf.

On Striped, or Jasper Printing. This is done without engraved blocks.

You must have several figured tools of various sizes—flies and stars cut out in milled lead—very thin boards, some straight, some notched, serrated or jagged regularly at the edge, of different patterns, to make such lines and stripes as you see fit.

You must have a square racquet of ten inches or a foot long, of which the meshes should not be more than three or four lines square, of fine brass wire.

You must provide also brushes and colours.

The colours employed, are, solution of annatto, buff colour, black, brazil red, and logwood violets and blues.

All these colours must be thickened with two ounces of gum arabic or senegal to the quart: each colour must have its own brush.

The method of using these materials, is as follows.

Suppose you wish to print two front pieces of waistcoat pattern, in rays or stripes of goose dung green. You place upon the patterns small strips of wood to preserve the whites. Take the racket in the left hand, and a brush in the right: dip the brush in the annatto colour, shake it three or four times over the pot of colour, that a very small quantity may remain on the brush. Pass the brush over the racket, at about the height of a foot from the waistcoat pattern, moving the racket here and there as the circumstance requires; the colour should fall in a very fine and gentle rain.

If the brush be not shaken when you take it out of the colour pot, the colour will fall on the cloth in thick drops, which would spoil the pattern.

When the waistcoat piece is covered with annatto colour, evenly in those places which are not covered with the slips of wood, then take the black colour, and sprinkle it over the annatto in the same manner as above directed. The union of these two will make the goose green.

It is not necessary that this jasper colour should be as thick as if it were intended for printing. When the goose green is thus produced, take up the wooden strips, and the white will appear in all its freshness.

This kind of work is not washed; it is sent out immediately in the state thus described.

Another example will suffice to illustrate this kind of work.

Suppose you wished to colour a piece with goose dung green stripes, white flowers, with an orange or aurora colour bee.

Place the pattern of cloth on the table: cover the white with your strips of wood, kept firm by leaden or iron weights. Then at equal distances upon that part which is to be sprinkled goose green, place your flowers in lead upon the white, then on the flower, a bee or a star. Sprinkle with logwood violet. Then take up your leaden flowers and bees. Fix your bees on the white flowers, and then sprinkle with annatto colour with the precautions before prescribed.

When the annatto is perfectly mixed, and the goose green appears even, take up your leaden figures, and strips of wood, and if the work be well done, you will have stripes of goose green, interspersed with bees of an orange colour (from the annatto) and violet and white flowers.

Dimities are also thus printed in stripes, and with borders, by means of Prussian blue, and logwood violet.

If this kind of work is to be printed, it must be so before it is sprinkled; and the printed impression must be well washed, and the piece calendered and dried. You may sprinkle afterwards in buff, taking care that your strips of wood are well pressed down. It is evident that great varieties of patterns may be thus produced.

The lead patterns may be cut out with a pen knife or scissars, or stamped; and may be placed on the cloth one after another; and in this way, the patterns may be varied, and pieces printed quickly and at small expense.

On the Business of a Scourer. (Teinturier—Degraisseur.) This is a business extremely useful to the economy of dress, and of the furniture of a house. (A scourer must be a dyer. *T. C.*)

Without this art, either the consumption of articles would double, or what would rather be the result, the luxury of furniture would decrease one half. For the object of the scourer, is to give an appearance of freshness to the articles sent to him.

The scourer takes away the spots produced by grease and by colouring matters, on lace, gauze, linen, muslin, &c.; such as the spots of ink, iron mould, tallow and such like. He does so likewise on cloth and silk, but this is often to be effected by such means as will answer a very temporary purpose only.

The scourer cleans, re-dyes, and turns out as new, the old garments sent to him, whether of cloth, cotton, linen, gauzes, or silk; but in this art as in many others, the means that will answer in skilful hands, will only spoil the articles, if used by the unskilful.

First then, all the essential oils have the property of dissolving oily and fatty matters.

Oil of oranges, lemons, bergamotte, rosemary, take out greasy stains, but they are too expensive for use in the large way.

Private persons may use these oils, and effect their purposes for the same price that they give to a scourer; and they will be freed from the smell of oil of turpentine, which the scourers commonly employ; and even this is no trifling matter.

But the proper substance for the purpose is oil of lavender.

The merchants who deal in this oil, disguise by mixture the genuine oil of lavender, so as to change the very smell of it.

The true oil of lavender possesses the quality of extracting grease without the aid of oil of turpentine, which however has the same property, but with a very unpleasant smell.

If a callicoe spotted with oil, should be cleaned, and the spots are not taken out of it, they will reappear even after washing. All spots should be taken away in the first instance, especially if it is to be dyed over again.

Ox-gall is usually employed for this purpose: or where the cloth will bear it, caustic alkali, which forms a soap with the grease; the cloth can then be washed.

When oil of turpentine is made use of for the purpose of detaching grease spots, you dip a piece of spunge or of cotton into the oil of turpentine and rub the spot till it disappears. But it is expedient to cover the part so rubbed, with some kind of powder, as pounce or ground plaster, or pipe clay, otherwise there would remain a border with the oil of turpentine, which does not always take place with oil of lavender. Spots of paint can be rubbed out in the same manner.

For white garments, use ground plaster; for colours use some fat earth, pipe clay, or ashes.

A scourer should take care not to drive the spot into the substance of the cloth, for after some days it will appear again more extended. Such is the case of many persons who have a drop of wax from a wax candle upon their clothes; they attempt to take it out with a coal in a silver spoon held over some blotting paper. The spot will seem to disappear, but in a day or two it will reappear with a more extended border, and there is more difficulty in eradicating it then, than at first.

To take out spots of wax, you must employ spirit of wine, or very strong brandy. When you put this on, the wax will be reduced to a kind of powder or dust. No powder is necessary to be used with the spirit of wine. (Spirit of wine cold, will not dissolve more than an ounce of wax at the utmost to the quart. Oil of turpentine, especially when warm, dissolves wax much more easily. *T. C.*)

When the fronts of waistcoats of silk embroidered are to be cleaned, they must be treated with oil of turpentine, and then dusted over with ground plaster, if the ground of the pattern be white; or with some fat or aluminous earth in powder, if they be coloured. When quite dry, they may be shaken and brushed, and then they will appear almost as new. But if these fronts of vests are of satin, it is best to rub them in cold soap and water three or four times, and wash them well in very clear water till quite clean, and dry them quickly. But you must not employ in this washing more than ten minutes at the utmost; they must in fact be dry in that time: otherwise the colours of the embroidery will be apt to run upon each other. Hence for this operation, it is best to choose dry and fine weather, and much care must be taken in the process.

When it happens that the embroidery runs, for want of taking the necessary precautions, there is no remedy but to wash out the colours that have thus run, by hot soap and water. This will weaken the other colours to be sure, but this is better than to have the garment spoiled.

After washing in soap, it should be rinced out in hard water: if the water be not hard, a drop or two of vitriolic acid will make it so.

Vests of dimity with gold and silver spots or figures, may be cleaned in the same way, first with soap, and then rinced out in hard water. This is more necessary where there is gold embroidery on the waiscoat; because this is usually worked on a ground of annatto, which soap will alter: in this case, a drop or two of the acid of vitriol is necessary to the rincing. The operation should be finished in less than ten minutes.

All embroidered goods that have been scoured, require to be glazed, or to run through rollers or regularly calendered. Calendering gives life to gold and silver embroidery.

Embroidered muslin of any kind, is passed over hot iron, while somewhat damp. This is the boasted English mode of finishing. (I do not think Homassel perfectly understands the process of English finishing. He may either mean that the goods are passed over a red hot iron to burn off the pile in the progress of bleaching; or that in the finishing, they are run through two pair of polished iron rollers, hollow, and furnished inside with hot irons; which is the finishing for muslins and muslinets. They are a little damp, and slightly starched and blued. *T. C.*)

Embroidered casimirs are also cleansed by means of soap, of which you need not be sparing. When once spotted or stained, you must wash them with soap, till they acquire an uniform colour.

To scour a cloth coat, you must begin by beating it well with a small stick to get out all the dust. Then the spots will appear more plainly. Then mark all the spots with soap, not missing one. The soap will disappear with the spot. Then mix ox-gall with water, wherewith brush over the whole coat, so as to moisten it, in the direction of the pile of the cloth. When thus moistened, stretch the cloth backward and forward, to get out all the creases, and dry it on a half hoop (demicerceau.) When dry, it should have the lustre of new cloth; give it a brushing to soften it, and that is all it will need.

Old scarlet dresses are also thus cleaned. Frequently there are black spots and iron stains, which can be taken out by rubbing the place with a slice of lemon, or with lemon rind containing a little of the acid juice.

When the cloth is dry, put lemon juice on the spots; if after the second application they do not disappear, rub the place with the yellow juice of the rind, and leave it on for two or three days, then card or teazle it, and the spot will disappear. But if the cloth is almost new, clean it with lemon juice with as much pains as you would with ox-gall. (Whether an acid be proper or not, depends on the nature of the colour. *T. C.*)

As to grease spots which lemon juice will not act upon, apply the essential oil of lemons. (I do not see why oil of turpentine will not do. I shall give my process presently. *T. C.*)

When the spots are made by the dropping of a tallow candle, apply the ox-gall, but with management. First, by means of a knitting needle, introduce some ox-gall into the middle of the spot; by degrees you may separate from the cloth the tallow and the ox-gall too, by the assistance of the needle. But this requires patience.

When the spot is taken out, the place is moistened with lemon juice. (I cannot tell why: nor why lemon juice is prescribed whatever the colour may be. It is an unnecessary application after the tallow is out. *T. C.*) If the spot is crimsoned, (rosèe) cover it with lemon peel, or moisten it with lemon juice, in which some salt of sorrel is dissolved. If at the end of your trials, the scarlet is made too yellow, it can be crimsoned again with a little white soap and water, applied with a linen rag. (A very weak acid will suffice to bring the rose colour to a scarlet. Undiluted lemon juice is too strong. *T. C.*)

The yolk of egg also, dissolves the scarlet and destroys the crimson of the spots.

A habit, a cloak, a riding coat of scarlet which has met with some unpleasant accident, as falling in the mud, or some such thing, should be washed or fulled with ox-gall to get rid of these dirty stains. Then prepare a warm bath of water acidulated with a very small quantity of oil of vitriol, into which the cloth must be plunged, and be worked about in it, till it acquires an even colour. Then stretch it out, but do not wring it: when half dry lay the pile with a clothes-brush. Stretch it again, and dry it gradually.

Tallow spots, spots from a stove pipe, are taken out with salt of sorrell. (It will not take out tallow spots. *T. C.*) When the tallow is taken out, and the cloth cleansed with ox-gall and water, wash it and work it prudently so as not to attack the colour.

When the scourers have taken out a spot and the colour with it, they are in the habit of renewing the colour by means of crayons of the same colour, which they procure at the colour shops. This suffices for the moment, but no longer.

But the colours may be renewed by more sure means. Thus for browns, the Lyons sorrell mixed with a very little water, and applied with a pencil, brings out the browns, on silks as well as on cloth.

For the green and yellow colours, resort to the chemical greens and yellows of the callicoe printer.

To raise the yellow, damaged in a green, cover the spot with fresh wood ashes; cover the ashes with paper, and pass backward and forward over the paper, a common sad iron heated. All alkalies bring out or deepen yellows.

Fast blues do not change; but if they do in a small degree, they can be renewed by the logwood blue made with blue vitriol.

All the fine reds, such as scarlets, crimsons, rose colours, nut colours, which have been altered and yellowed by salt of sorrel, are renewed by fresh wood ashes. They must be used sparingly, lest they deepen the colour too much. (A weak solution of potash is much better. *T. C.*)

Gray colours are also restored by ashes, (rather by a very weak solution of any alkali, *T. C.*) but they must be retouched with caution and dexterity, with a pencil dipt in logwood liquor.

There are taylors who at the same time profess to be scourers. They are dextrous in taking out the piece where a spot appears, and substituting neatly another piece from some corner of the same garment. Any person who is skilled in the use of silk and a needle may do the same.

Salt of sorrell also takes out the spots of ink in cloth. But it requires a little practice to know how to manage it. (I have taken ink spots and iron moulds out of the finest muslins thus: have ready some spirit of salt, (muriatic acid) in a wine glass: hold the spotted muslin on the finger of your left hand; dip your finger of the right hand into the spirit of salt undiluted, and moisten by dabbing it, the spot to be taken out; in about half a minute, the spot will appear discharged; then wash it immediately in plenty of water, so as to wash out all remains of acid. If the spot be not entirely eradicated, dry the cloth and repeat the operation. If your spirit of salt be strong and good, it will succeed without injuring the finest muslin materially. But if you attempt it with diluted spirit of salt, you will certainly rot the place. *T. C.*)

Spots of pitch, tar, varnish, oil paint, can be taken out with fresh butter. (Better with oil of turpentine. *T. C.*) When the spots are effaced and nothing but the butter remains, this can be taken out by the common methods of getting rid of grease spots. For instance, suppose a spot of pitch was found on a blue coat, and that by means of butter the pitch had been dissolved and rubbed away; you may take out the butter stain by scraping on it pipe clay, fuller's earth, French chalk, or soap stone, at several times, till all the grease be soaked up. In this case it will not be necessary to wet the whole coat with ox-gall and water, as you must do, if you cannot use any of these fat earths.

Talc, or soap stone, or pipe clay, or fuller's earth, will answer very well to take out spots in cloth dyed of any fast colour; but on scarlets, these earths produce a blackish stain very hard to be effaced. They must be treated with much care with lemon juice or salt of sorrell.

On green cloth, these earths enfeeble the yellow, which is brought out again by alkalies.

They also take the blue out of Amiens gray, and leave only the ground. But this can be remedied, by putting a little Spanish white on the place moistened with some dilute Saxon blue: or the spot can be crayoned; for the Amiens gray is not much faster than the crayon colour. In Saxon blues and greens, these earths enfeeble the colour: but the same means can be employed to renew the tint.

In Paris muds, and gray colours dyed upon the same principle, these earths may be used to advantage.

You may also full with fuller's earth or pipe clay all old cloths intended to be dyed over again. But they must be well washed and beaten at the river, to get out all the clay. (Terre gras.)

To take iron moulds out of lace and lawn, proceed thus:

In soaping to cleanse them, heat a sad-iron, or any clean iron plate. Upon this iron plate so heated, lay a piece of clean cloth moistened with clean water, so that a steam may arise; hold the spot over this steam; then with your finger dipt in salt of sorrel, dab the spot till the rust or stain disappears. Then proceed to soap and wash it. (I presume he means it must be first washed and rinced; and then exposed to the steam with the salt of sorrel, and not with the soap upon it. *T. C.*)

Rumpled, creased and fretted velvets, are also brought even by the steam arising from wet cloth on hot iron or copper: the pile can be delicately raised, and evenly laid by a brush, while the cloth is thus under the operation of steaming.

Laces and lawns spotted with ink, can also be cleaned by means of fresh green sorrel. The sorrel stains them green; but this colour quickly washes out.

The oxymuriatic acid would answer the purpose still better, but it is not yet well known among the scourers.

Callicoes are scoured in the following manner.

Wash or full them well four times in soap and water, washing them between with clear water; this should not occupy a long time, but be done quickly, else you will wash out all the colours. After the third or fourth washings, wash or rince them out in hard water, and dry them as quickly as possible. Glaze or calender them: if you glaze them use white wax for the light colours, and yellow wax for the darker ones; just enough to make the glass ball run smoothly, and no more. Many scourers are not content with this, but starch the cloths till they are stiff; then they sprinkle them evenly; then wax and glaze them, till the callicoes are stiff and brittle enough to tear very easily.

I would here offer an observation for the use of callicoe printers. It is not necessary that a callicoe should go to a scourer to wear it out. It undergoes wear and tear enough from the bleaching to the printing. It is this wear and tear at the scourer's, that makes the printers say, a colour is fast enough if it will stand scouring twice.

Callicoes of fast colour, are well cleaned with oxgall, which ought to be chosen clear, for some is much more so than others. (I do not see any necessity to send callicoes to a scourer: the fast colours will stand four or five washings, and that is as much as the cloth will stand. If spotted, the means indicated in this section will answer to take out the spots. *T. C.*)

Silk stockings are cleaned by washing in two or three suds, soap and waters. When cleaned from dirt, boil them the last time in soap and water with a little powder blue. Wring them out of this boiling, and then expose them to brimstone. In coming out of the brimstone stoving, put them on legs, and covering them with clean cloth, rub them with a tampon (a ball of cloth) to give them lustre, or else with a smooth ball of glass to glaze them. Then take them off the wooden legs, stretch them, and fold them up.

To give them the water hue, put one of two stockings on one leg, and put the other upon it, turning it inside out, so that they shall tally with each other, the grain of the silk in both lying the same way: then with a polished wooden ball or glazer, rub them backward and forward till they become, as it is called, watered.

If the clocks of silk stockings are coloured, they are best cleaned with ox-gall, green, clear, and limpid; they should not be sulphured.

To whiten gauzes without fraying them, they should be put into a bag of white linen or cotton: prepare three suds or soap baths (soap and water); dip the bag in the first; beat it between the hands, and when the soap and water is dirty, do the same with the second and third portion of soap and water: then rince the bag in very clear water; then in clear hard water with a few drops of Saxon blue in it. Others wash the gauzes in two soap baths, then boil them in a third with a little powder blue, for near an hour; then they press out all the soap suds, and dry the gauzes and expose them to sulphur. They then stiffen them with a solution of gum tragacanth filtered through fine linen.

After this cleaning and blueing, have ready a frame on which you stretch some clean white linen: to this linen tightly stretched, keeping all the threads perfectly even, pin your gauze, using the same precautions with that also, so that there are no creases or waving and irregular threads: then slightly moisten the gauze with a sponge dipped in a weak solution of filtered gum tragacanth; only take care that it does not stick to the cloth, to which it is pinned. (You can pass a clean ivory paper cutter between the gauze and the cloth. *T. C.*) When dry, take off the gauze and make it up. The gauze may be gummed before you pin it to the cloth.

When you wish to stiffen the gauze very much (platier le gaze) dissolve some starch in water wherein you have previously dissolved some gum tragacanth. The thicker the composition the stronger the gauze. You may in this way make large pieces, by fixing a chase (chassis) of two or three ells long on a tressel. Attach the gauze by pinning the selvages, and when stiffened, dry it by passing over it a warming pan or a frying pan containing some hot coals. When one set of gauzes thus treated is finished, begin another and so on.

When a person is used to this method of getting up gauze, it can be done still quicker by an oar (une rame) and the work is better. But when the operation is performed on the entire piece of gauze, which is usually woven with *unbleached* silk, before you finish the gauze as here directed, you must wash it with soap and water to get out the gum.

Silk stuffs most easily cleaned are satins, India taffetas, and damasks. Pekins and Italian taffetas may also be cleaned, but are never so well fulled, or re-dyed. They should be cleaned dry, with essential oils, while the others may be washed even without any fraying; only detach the grease spots first with essential oil.

Silk stuffs without colours, are sufficiently cleaned by washing in three separate suds or baths of soap and water; or the last may be employed for boiling the stuffs in it. When dry they are stiffened, with a weak solution of the whitest gum tragacanth.

Brown silks can be cleaned with ox-gall; so also can stuffs of delicate colours and the lighter articles of silk, such as taffetas: when well cleaned and stiffened, they look as good as new.

The thicker furniture silks, damasks and such like, should be cleaned with a soft brush before they are fulled (washed.) They must be well rinced out of the soap and water, except those parts that are destined to be brimstoned, which should always take place before rincing. These more substantial silks, are never stiffened but by the rollers or the calender.

The calenders know how to water the silks intended to be so treated. All silk stuffs intended to be dyed over again, should be well cleaned, and then undergo a boiling in soap and water; for soap is friendly to silk, and the boiling gives a lustre which the silk would not otherwise possess. But before dyeing, the soap must be well washed out.

When silk goods are dyed, and have for that purpose been previously alumed, all the alum must be scrupulously washed out, otherwise it would counteract the operation of stiffening and finishing; the gum and the alum would unite, and produce a muddiness of appearance. Hence after dyeing, they should be boiled in hot water.

Silks re-dyed, are stiffened either stretched upon cloth on a frame or (*à la rame;* I do not understand this) by a solution of tragacanth.

Many scourers use Flanders glue for all kinds of stiffening, but the lustre is not so good as that of tragacanth; nor is there any economy in it, for gum tragacanth goes much farther. (I cannot conceive how Flanders glue can answer, for it is hardly equal to the best English glue. A glue from the cuttings of white kid gloves may answer. *T. C.*)

Fish glue is also used (that is icthyocolla or isinglass, *T. C.*) but this is much more expensive, and can only be afforded for Italian gauzes, and ribbands. They mix also spermaceti with isinglass, to give a fine pearly white. (This is a bad practice, it attracts the dust so readily: nor indeed will it dissolve in, though it will mix with fish glue. It ought not to be employed. *T. C.*)

All these gums and glues should be strained through lawn.

When ribbands have to be dyed, they must be cleaned like gauzes in two or three fresh suds of white soap, in a bag, to prevent their being frayed. (In pressing out the soap and water, it must be done gently, or the gauzes and ribbands will be burst, torn, or frayed. *T. C.*) The ribband dyers clean them usually by hand, and then scrape them with a knife, *et les vaclent ensuite au couteau:* that is, I presume, draw them under a dull knife with a smooth edge gently pressed upon the ribband, to press out and scrape off all the soap and water, and smooth the surface. *T. C.*)

To bleach or to dye ribbands, follow the directions already given as to other silk goods.

The colour most in use for dyed ribbands, are roses, laylocks, delicate blues and greens, and all the varieties produced by archil.

Blues are dyed by Saxon blue, that is, a solution of indigo in oil of vitriol. For greens, turmeric is added to this blue; yellows are dyed with turmeric in spirit of wine; rose colours or pinks, with carthamus or safflower.

You find among the colour shops, rose pink in cups or in liquid, expressly for the purpose of dyeing ribbands.

Orange is produced by annatto. The other colours are dyed on ribbands as they are dyed on silk: for which see the section on silk dyeing. When the ribbands are dyed, they must like silks be well pressed to get rid of all moisture; for which purpose they must be passed through rollers of hard wood, close set by a screw: this squeezes out all the water and prepares them for the finishing. Dry them: stiffen them with gum, then pass them through cylinders, the one of polished iron the other of paper. This is the best method: but every ribband dyer does not possess cylinders of any kind. In this case, when the ribbands are dry after stiffening, they are sprinkled with water, and wrapped in clean linen to make them imbibe the moisture evenly; then they receive their gloss by a hot iron in the following manner: the table is covered with a smooth old cloth; the end of the ribband is placed on this cloth, and pressed with the hot iron; a person takes hold of the short end of the ribband, and draws it under the hot iron so pressing upon the ribband in its passage. This manœuvre is better done by two persons, but can be managed by one if necessary.

If instead of thus drawing the ribband under the hot iron, you pass the hot iron over the ribband, the gloss will be much inferior, and the marks of the iron will be visible on the ribband.

Ribbands can also be printed by blocks adapted to their size, on the principles of chemical printing, and printing *en jaspe*, or by sprinkling. For these articles are seldom wanted to be washed.

To dye over again old silk garments, take care first to clean them perfectly, and then rince the soap well out of them. They can then be dyed on the principles of silk dyeing. In the same way woollen garments can be cleaned and re-dyed on the principles of woollen dyeing: but before they are dried after dyeing, the knap should be laid with teazle or cards; and then when dry they should be pressed. An old cloth coat well cleaned, dyed, and finished, may be made almost as good in appearance as a new one.

Leather gloves and garments are cleaned by washing in a ley of potash weak but warm: then, in two separate soap suds, and dried upon the last without rincing. The last must be weak. They must be dried speedily, turning and stretching them in all directions.

M. Chaptal's directions for cleaning Woollen and other cloths: from the Bulletin des Sciences.

The art of cleaning cloth presupposes first, a knowledge of the various substances liable to occasion spots upon them; secondly, a knowledge of the substances to which we must have recourse in order to remove the spots produced upon the cloth; thirdly, a knowledge of the manner in which the colours of the cloths will be affected by the re-agents meant to be employed for the removal of the spots; fourthly, a knowledge of the manner in which the cloths themselves will be affected by the substances proposed to be employed; fifthly, we should know how to restore the colour of the cloth, when rendered faint by the process of taking out the spots.

Of the substances which occasion spots upon cloths, some are easily known by their appearance, for instance, grease of every kind: others produce more complicated effects, such are acids, alkalies, perspiration, fruit, urine.

The effect of acids upon blacks, purples, blues (except indigo blue and Prussian blue) and some other colours, and upon all those shades of colour which are produced by means of iron, archil, and astringent substances, is to turn them red. They render yellows more pale, except the yellow of annatto, which they turn to an orange (or a salmon colour. *T. C*)

Alkalies turn scarlet, and the reds produced by brazil or logwood, to a violet colour: they turn green upon woollens to a yellow (that is when the blue is a Saxon blue, and not an indigo blue, *T. C.*) and they give a reddish cast (not red, but brown, *T. C.*) to the yellow produced by annatto.

The effect of perspiration is the same nearly as that of alkalies. (Owing to the ammoniacal salts contained in perspirable matter, as in urine. *T. C.*)

Spots that are produced upon cloths by simple substances, are easily removed by well known means.

Greasy substances are removed by alkalies, by yolk of egg, or by fat earths; (that is, pipe clay, fullers' earth, loams or earths containing much clay, which greedily absorbs moisture of whatever kind, when the clay is dry. *T. C.*) Oxyds of iron are removed by nitric or by oxalic acid. Spots occasioned by acids are removed by alkalies and vice versa. (I advise the reader to follow Homassel on these points. *T. C.*)

Spots caused by fruit upon white cloth are removed by sulphureous acid, or what is still better, by oxymuriatic acid. (Put a silver or pewter plate over a tea pot so that it can be heated by the steam; lay the spot on the hot metal, and moisten it with lemon juice. If you stain your table-cloth with red wine, pour white wine on it; or water; or sprinkle it with salt; to get it finally out hold it over steam, moistening it with lemon juice: or, moisten it with oxymuriatic acid. *T. C.*)

But when the spots are of a complicated nature, various means must be tried successively. Thus to remove a spot occasioned by the coomb of carriage wheels, we must first dissolve the alkali by some of the means above mentioned, and then take away the oxyd of iron by oxalic acid. (The reader will certainly fail if he follows Chaptal. There is no alkali in the coomb of carriage wheels: cart grease is made by boiling tar in animal fat; the friction intermixes with it minute particles of metallic iron abraded from the axle-tree. Carriages of pleasure, are oiled or greased, and this oil or grease is coloured by abraded iron. Warm oil of turpentine is the proper application. *T. C.*)

The colours of the cloths are often injured by the re-agents made use of. In order to restore them, we must thoroughly understand the art of a dyer, and know how to modify the means according to the circumstances. This is sometimes difficult, because it is necessary to produce a colour similar to that of the rest of the cloth, and to apply that colour to a particular part only. Sometimes also the mordant which fixed the colour, or the basis which heightened it, has also been destroyed and must be restored. It is evident that in this case, the means to be employed to restore the colour, must depend upon the nature of the colour, and the means employed to produce it; for it is well known the same colour can be produced by several ingredients different from each other.

Thus when after having made use of an alkali to remove an acid spot upon brown, violet, or blue cloth, &c. there remains a yellow spot, the original colour is again produced by means of a solution of tin. (I do not know that it is so. *T. C.*) A solution of sulphat of iron restores the colour to those brown cloths that have been dyed with galls. Acids give to yellow cloths which have been rendered dull or brown by alkalies, their original brightness. When black cloths dyed with logwood have any reddish spots occasioned by acids, alkalies turn such spots to a yellow colour, and a little of the astringent principle turns them black again. A solution of one part of indigo in four parts of sulphuric acid, properly diluted in water, may be successfully applyed to restore a faded blue colour on wool or cotton. Red or scarlet colours may be restored by means of cochineal, and a solution of muriat of tin. (With a fourth part nitric acid. *T. C.*)

The choice of re-agents is not a matter of indifference: vegetable acids are generally preferred to mineral ones. The sulphureous acid however, may be used for stains made by fruit; it does not injure blue upon silk, or the colours produced by astringents, nor does it affect yellow upon cotton. (It affects them all, but less than the sulphuric acid. The best form of sulphureous acid, is to burn a match under the spot. Where this cannot be done, and be limited to the place, which in general it can be by smearing the stuff next the boundaries of the spot with paste, make your sulphureous acid by adding sugar to oil of vitriol. *T. C.*)

The volatile alkali of hartshorn or ammonia, succeeds better than the fixed alkali of soda or pearl ash, in removing spots produced by acids. It is usually made use of in the form of vapour, and acts quickly, seldom injuring the colour of the cloth. (Place a vial containing salt of hartshorn or spirit of sal ammoniac, in a tin can containing boiling water: take out the cork, and lay the stain on the mouth of the vial. *T. C.*)

The means of removing grease are well known; namely alkalies, fullers' earth (pipe clay, soap stone, *T. C.*) essential oils dissolved in alcohol, a sufficient degree of heat to render the grease volatile. (This will make it spread. Proceed thus: take away mechanically by means of a knife all the grease you can: then cover the spot with pipe clay, fullers' earth, or scraped soap stone, or French chalk. Press a piece of blotting paper on it and below it; hold a hot iron over it, till part of the grease is absorbed by these substances. With a fine rag rub out the rest by means of warm oil of turpentine. *T. C.*)

Spots of ink, or any other stains occasioned by the yellow oxyd of iron, (iron moulds), may be removed by oxalic acid (salt of sorrel, or lemon juice, *T. C.*) the colour may be restored by alkalies, or by a solution of muriat of tin. (I doubt this. *T. C.*) Such spots may also be taken away by oxymuriatic acid, when they are upon white cloth, or upon paper. (The practice of the bleachers in taking out iron moulds I have already given in my remarks on Homassel.

The effect of alkalies and that of perspiration is the same: their spots may be removed by acids, or even by a dilute solution of muriat of tin.

When the spots are owing to various unknown causes, we must have recourse to compositions possessing various powers, of which the following may be considered as one of the most efficacious. Dissolve some white soap in alcohol; mix with this solution, four or five yolks of eggs; add gradually some spirit of turpentine, and then stir into the mixture such a quantity of fuller's earth, as will suffice to make it up into balls. Rub the spots, previously well wetted with water, with these balls; after which the cloth is to be well rubbed and washed. By these means, all kinds of spots except those occasioned by ink or some other solution of iron, will be removed.

The washing of the cloth takes off its gloss, and leaves a dull spot disagreeable to the eye. The gloss may be restored by passing in a proper direction over the washed part of the cloth, a brush wetted with a very dilute solution of gum water; then laying on the part a sheet of paper, a piece of cloth, and a considerable weight, which are to remain there till the cloth is quite dry.

Such are the directions of Chaptal, which however savour more of theory than experience; but many things are worth attention in them. Homassel is more to be depended on. Some person obtained a premium in London a few years ago, for cleaning cloths with the expressed juice of potatoes. *T. C.*)

APPENDIX.

On the Colours produced on Woollen, by means of various plants. From D'Ambourney, of Rouen.

THIS gentleman instituted a set of experiments to ascertain what permanent colours could be produced by means of plants, chiefly those in common use, and easily procured. They appear to be made with considerable care, and were deemed of such importance as to be published by order of the French government, under the administrationship of M. Calonne, in 1786.

I have already intimated my opinion, that a few drugs in common use and well known, whether of foreign or domestic growth, would better answer the purpose of a dyer, than a multiplicity of dye stuffs whose virtues were not ascertained with equal precision, and which produced no better effect at the same price than the drugs in use. The more chemical knowledge extends, the more will the Materia Tinctoria, like the Materia Medica, be reduced in number and in price.

But these observations ought not to extend to the experiments of the laboratory, the true source of future improvement in the art of dyeing. The experiments and perseverance of Dr. Bancroft has sent into every dye house, and every printing shop in Europe, without any exception, an article so common in the American woods, that it was never noticed here, though a chemist could hardly pass by a tanner's establishment without being struck with the colour of the skins. I mean the quercitron, or bark of the common American black oak. This drug has nearly superseded weld and fustic, both in the woollen and the cotton dye; in so much, that I may venture to say, not one-fiftieth part of those drugs are now used in England, France, and Germany, that were used thirty years ago.

The experiments of D'Ambourney on the birch, the Lombardy poplar, and the black alder in particular; the use of walnut peel, and of soot on the continent of Europe, so little employed in England and this country, promise improvements in dyeing by means of common and cheap articles, by no means to be slighted or overlooked.

Homassel, or Bouillon Le Grange for him, have republished the kind of abridgment of D'Ambourney's experiments, which D'Ambourney himself inserted at the end of his book: this presents a general idea only of what vegetables may be employed in dyeing, but does not afford information sufficiently accurate for a dyer to follow at once. I shall republish this abridgment with the English names of the plants, not so much for the use of the dyer as of the experimentalist; and to open a door to a kind of knowledge, which our own country is better calculated to afford than any other, and to an employment for leisure hours, in a very high degree amusing, interesting, and instructive.

The mordants employed by D'Ambourney were not well calculated for the dyer's work shop: they were the following:

1. Bismuth dissolved in single aqua fortis: of this solution one part, with brine of common salt, two parts, and tartar in powder, one part, was used to woollen sixteen parts by weight. Water, as much as necessary.

2. A solution of tin made by dissolving four ounces of sal ammoniac and nine ounces of grain tin in four pounds of single aqua fortis. Five pounds and one ounce of this solution, with an equal quantity of tartar, and twice the quantity of brine, formed the mordant for sixty pounds weight of cloth.

3. A solution of tin in aqua fortis and common salt.

4 and 5. Another solution of tin with less tin: both hot and cold.

6. A solution of tin with a small quantity of gold, in aqua regia.

7. Tin dissolved in strong muriatic acid only.

8. Tin dissolved in nitro-muriatic acid; nitrous acid, one part; muriatic acid, one part; tin, one-eighth of a part.

9. Tin dissolved in various proportions in nitro-muriatic acid, wherein the muriatic was one-third of the nitrous.

10. Solution of nitrat of copper.

11. Muriatic solution of iron.

12. Solution of three pounds of red argol or tartar in boiling water, and nine pounds of alum, for sixty pounds of cloth.

It is evident that the experiments are less valuable, in proportion as you employ new, unusual, and expensive mordants: so that M. D'Ambourney's experiments do not bear upon practice so much as they might do.

I have had a good deal of experience in this kind of experiment myself, and I feel myself therefore entitled to offer to others who would pursue the same very entertaining employment of leisure hours, the following advice.

The object is, not so much to procure brilliant colours, as permanent colours: by permanent colours meaning always such as will stand the three tests of air, soap, and acids.

The substances to be dyed may be confined to woollen and cotton. The mordants ought to be the mordants in common use. I have a very high opinion of nitrat, and nitro-muriat of bismuth; and also of nitrat of iron; but I fear, the necessary attention to economy will confine their utility to brilliant colours, and very high priced goods. They ought to be the subjects of a separate set of comparative experiments.

For experiments on Woollen, take well scoured, clean, white flannel as the subject to be dyed. Boil it in clean snow or rain water for half an hour. Take it out, wring it, dry it. Water of calcareous soils will modify the effect of the colouring substances employed; not so the water of mountainous and siliceous soils. Of such flannel, take any quantity of a given weight, as one, two, three, or four pounds.

1. Let it soak in the common boiling hot mordant of alum three ounces and a half, to finely-powdered tartar one ounce and a half, for each pound of cloth. It may remain covered up for twelve hours. Then take it out, wring it moderately, rince it in cold water moderately, and dry it not perfectly, but so as to be slightly damp, and keep it in an under-ground room. Tartar in proportion of *one-third* of the alum I consider as too small, in the proportion of *one-half*, rather too much; that is, as a general rule. Alum without the tartar, crystallizes too readily, gives the cloth a harshness to the touch, and though the colours are equally full in most cases, they are not equally bright. I do not believe that any decided decomposition of the alum takes place without the intervention of the cloth; and perhaps too, not without the further intervention of colouring matter. But these facts have not yet been chemically ascertained; and every chemist knows the obscurity that yet hangs about the operation of common tar-

tar in the silvering of brass and copper, and the tinning of brass wire for pins.

2. Mordant for woollens. To a pound of aqua fortis, add a pound of pure clean rain water, and two ounces of sal ammoniac. In this mixture, slowly dissolve two ounces of grain tin, then add one ounce of powdered white tartar. When you dye with the woods or plants, first let the cloth stay for fifteen minutes in this solution diluted, using it in the proportion of one-fifth or one-sixth part the weight of the cloth. Then having soaked it in this solution and dried it moderately, enter it into a hot decoction of the plant, and when it has taken up as full a colour as it will, take it out of the decoction, rince it well in cold water, soak it again in the mordant and dye it again. Then wash it well and dry it, as a specimen of the colour with the tin mordant.

3. From some experiments I have made, I believe the tin mordant may be as usefully prepared in the following as in any other way, but it is not the actual dyer's practice; which the preceding method approaches as far as may be: except that I have directed the usual dose of tartar to be put to the mordant instead of putting it to the dye stuff, as in the scarlet dye.

Make an aqua regia thus. Muriatic acid, from iron, three parts; nitric acid, one part. Dissolve slowly as much tin as it will take up, pour it off clear, and then add muriatic acid in like proportion to the amount of one-sixth in quantity of the solution, so that there shall be an excess of acid. Of this, when diluted with an equal quantity of water, employ one part by weight to six or eight parts of cloth.

But the second process being the process of practice, I should upon the whole prefer it. We sadly want a judicious set of experiments on mordants. Indeed no man but a dyer by practice and a good chemist into the bargain, can even guess at the multitude of desiderata in the art of dyeing; and how little we know about it as yet.

These, with iron and copper, will be mordants enough for woollen. The pieces of flannel used for these experiments should be not more than six inches square, cut off *after* the cloth has been mordanted with alum and tartar, but divided *before* the tin mordant is used. The weight of each piece may be ascertained by weighing the whole piece first.

4. Dissolve four ounces of green copperas in a pint of water,

and add two ounces of finely powdered tartar. Stir them till dissolved; this will be the utmost proportion for one pound of cloth.

Mordant the cloth with this in all proportions, (noting them) and mix it also occasionally with the alum and tartar mordant, wherever you want saddened colours, as is done in practice for olives and drabs.

5. Make a similar mordant, using blue instead of green copperas.

Secondly. Mordants for Cotton.

1. Take a given weight of callicoe well bleached. Immerse it for six hours in water acidulated with sulphuric acid; to wit, one part oil of vitriol to fifty parts water. Take it out, wash it perfectly and scrupulously. This is necessary to dissolve any alkaline or earthy mordant which the cloth in bleaching is apt to imbibe. The callicoe printer never dispenses with this.

2. Make a mordant merely of alum: using four ounces of alum to one pound of callicoe, and soak your callicoe in this mordant boiling hot, for six hours. Keep it in a damp place.

3. Make a mordant of acetat of alum, as in common practice, though it be not perfect: but for these experiments common practice is the best foundation to build upon: thus,

Take one part by weight of alum finely powdered; dissolve it in as much hot water as is necessary, and no more; that is five pints of water and half a pint of vinegar to one pound of alum. Then add to it three-fourths of a part of sugar of lead: stir them well, let them settle, pour off the clear liquor after the sediment has settled for a day: add to each pint of the clear liquor four ounces of gum arabic, bruised into a coarse powder; keep stirring it occasionally until dissolved.

Divide your callicoe so cleared by an acid, into pieces of four or six inches square. In the middle of each piece print a figure or make a spot with your thickened acetat of alumine. Let it dry. Then let it soak for half an hour in a liquor composed of one part by measure of fresh cow dung to four parts boiling water. Then take out the piece: rince it: dry it: lay it by for use, to be dyed in the decoction of the proposed vegetable. Boil it, or rather keep it in a full scalding heat of the decoction for an hour. Then boil it in bran and water, and bleach it in the air for a day.

4. Make a mordant of iron in the acetous acid thus: dissolve in four parts by weight of hot water one part of green copperas; add more water if necessary when cold, to keep it in solution. To

this solution add an equal weight of sugar of lead. Let the sediment subside, thicken the clear liquor with gum arabic, and use it on the callicoe in the same manner as you use the acetat of alumine. This will be the same with the common iron liquor.

You may mix these two mordants at your pleasure, so as to produce browns, purples, and chocolates, with reds; and olives, drabs, &c. with yellows. So, you may use for mordanting the whole piece of callicoe, sulphat of iron (green copperas) either mixed or unmixed with common alum-solution: for the colours are thus greatly varied with the same drug, or colouring material.

These mordants might be increased in number, and varied; but then the experiments would become too complicated, and would vary too much from the usual and approved practice.

I have stated in the beginning of this work, that the quantity and brilliancy of the colouring matter of a dye drug might be ascertained by a solution of acetat of alumine or muriat of tin generally speaking. I prefer the former, particularly for cotton: but the muriat or nitro-muriat of tin is very useful for colours to be applied to woollen.

Make a filtered decoction of the vegetable to be tried: drop into it a solution of acetat of alumine not thickened with gum, and a little diluted. Or, a saturated solution of nitro-muriat of tin, wherein the muriatic is in the proportion of three parts, and the nitric acid of one.

The quantity and colour of the colouring matter may be thus ascertained.

Such a course of experiments with the woods, herbs, fruits and flowers of our own country, would be a very valuable and interesting work: that ought indeed to be a national work, but that is not to be expected.

I have already mentioned that the birch tree, and the Lombardy poplar, promise useful and permanent colours, and deserve to be the subject of many experiments not yet made, particularly in the back country, for which these experiments seem peculiarly calculated.

Table and Classification of Colours procured from Indigenous Plants.

According to the experiments of D'Ambourney.

Homassel, or Bouillon Le Grange, have omitted the Linnæan names of the vegetables, which I have supplied from D'Ambourney's original work. I cannot always answer for the English names, though I believe there are very few mistakes; but as I have added the Linnæan ones, there can be no difficulty to a botanist.

Aurora.

Golden-yellow aurora, from the stalks and fresh leaves of *Bidens tripartita*, the trifid water hemp agrimony: not so bright from the dry plant.

Tarnished, from the yew tree. *Taxus baccata.*

Brilliant, with nitro-muriat of tin and alum in the decoction of the same.

From the dry flowers of furze, *Ulex Europæa*, with a little madder.

Cinnamon-aurora, from the young shoots of the Lombardy poplar, *Populus Pyramidalis*, with one forty-eighth of madder.

From the roots of a wild apple-tree.

Aurora-capuchine, from the Virginia sumach, *Rhus Virginiana*, Stags-horns. Quere, if this be also the *Rhus typhinum?* This required two baths.

The capuchin tinge increased by a small quantity of madder.

From the dry straw of buckwheat, *Polygonum fagopyrum*, with a nitro-muriat of tin.

Rich and brilliant with nitro-muriat of tin and gold from the dried straw of buckwheat, the fruit of the berries of the black berry-bearing alder, *Rhamnus frangula*, and a little madder.

Blue.

The blue vat, Saxon blue, and logwood blue as usual.

Logwood blue, made more solid by the bark of the birch tree, *Betula alba*, with the nitro-muriat of tin.

Bluish gray, from the common black elder berries, *Sambucus nigra.*

Handsome blue, but fugitive, from the same berries and sulphat of copper.

Browns.

Rappie snuff brown: fresh alder, *Betula alnus.*

Olive brown, from the shoots of *Agnus castus.*

Deep brown, from the stalks and leaves of *Leonurus cardiaca*, mother wort.

The most beautiful and solid colour from fresh walnut peel.

Puce-brown, from the fresh bark of the black walnut, *Juglans nigra.*

Same from the shoots of the marsh elder, or Guelder rose while in sap, *Viburnum opulus.*

Gray-olive, deep brown, from the stalks and leaves of *Parietaria*, Pellitory of the wall.

Caca-Dauphin, or Bright Fawn Colour.

Bright greenish, from common heath, *Erica vulgaris*, and buckwheat straw, both dry, with nitro-muriat of tin.

Light fawn, from buckwheat straw dried: beautiful with solution of tin and gold.

Olive fawn, from dry buckwheat straw and dried berries of the *Rhamnus frangula.*

Avanturin-fawn, from the same, with bismuth mordant.

Cinnamon.

From the shoots of the rose-acacia, *Robinia hispida*, with bismuth.

From the shoots of the apricot tree.

From the stem and roots of the bilberry or whortle-berry, *Vaccinium myrtillus.*

From the branches of the broad-leaved trumpet flower, *Bignonia Catalpa.*

Rich, from a half spent bath of logwood and sumach with tin and gold solution.

Light nankin, from the fresh wood of the common horn beam, *Carpinus Betulus*, barked.

Yellowish, (very good) from the Cyprus, *Cupressus foliis acaciæ deciduis: Virginia:* mixed with the dry shoots of the horn beam.

From the roots of the *Fragaria vesca*, or strawberry.

Reddish, brilliant, in a fresh bath or decoction of madder with bismuth.

Deep, from the common broom, *Spartium scoparium.*

Reddish, from the shoots of the *Grevia occidentalis*, elm-leaved, with purple flowers.

Mordorè, cinnamon, from the bark of the common beech, *Fagus sylvatica*, with nitro-muriat of tin.

Nankin, from the green stalks of the hop, *Lupulus.*

Mordorè, from the roots of yew, *Taxus baccata*, and birch bark.

Rich colour, from the dried flowers of furze and a little madder.

Mordorè, from the shoots of the Portugal laurel.

From the fresh roots of *Convolvulus sepium*, great bindweed.

Light rose-coloured cinnamon from the branches of *Prunus Mahaleb*, perfumed cherry.

Same, from the branches of the sallow or black willow, *Salix Caprœa*, with bismuth.

Yellowish, from the shoots without leaves of the larch, *Pinus Larix*, with bismuth mordant. Same, from the wood of the wild cherry tree.

Delicate, from the bark of the Dutch medlar, *Mespilus Germanica*, with bismuth.

From the shoots of the five-leaved bladder nut, *Staphylea Pinnata.*

Reddish, from the barks of the elm and birch.

Light, from the shoots of the peach tree.

Golden, from the ripe fruit of the wake robin, *Arum maculatum.*

From the branches of a three year old pear tree.

Rose coloured, from the shoots of *Syringa*, *Philadelphus Coronarius.*

Carmelite.

From a mixture of shoots of alder, a little madder, dry berries of the black alder, and shoots of Lombardy poplar.

From a half spent bath or decoction of balsamine, *Impatiens Balsamina*, then in the decoction of black alder berries.

From wine of the black alder berry with a little madder.

Light from dry hay, which is improved greatly by a little madder.

From the stalks of lavender.

Rich from the shoots of scarlet flowering chesnut, *Esculus octandra Pavia*, with dried black berries.

From shoots of buckthorn, *Rhamnus catharticus*, and then in madder.

From dried wheat straw, a little sumach, and solution of iron.

From the Italian or Lombardy poplar, dried berries of black alder, madder, and solution of iron.

Light and brilliant from buck-wheat straw, dried black alder berries, Lombardy poplar, and madder, with bismuth mordant.

At once from buck-wheat bran, dried black alder berries and Lombardy poplar.

From chimney soot (which in France is generally wood soot) madder, dried black alder berries, and poplar.

From red clover and a little madder.

The ivy leaved speedwell, *Veronica hederifolia*, furnishes a very good ground for carmelites.

Citron or Lemon Yellow.

From the young branches of the acacia. *Robinia Caragagna seu Sibirica.*

Greenish, from the *Aristolochia clematitis*, Birthwort.

From the shoots of the *Daphne mezereum*, red mezereon.

From the branches and leaves of *Guilandina Dioica*, Canada Bonduc.

Brilliant, from the common heath, *Erica vulgaris*, with tin mordant.

Brimstone, from the green leaves of myrrh, *Scandix odorata*.

Light citron, from the meadow saffron, *Colchicum autumnale*.

From the *Coronilla glauca*, seven-leaved Colutea.

From the shoots of Cyprus.

Brilliant, from the counter poison, *Asclepias Vincetoxicum*.

From the shoots of the hairy broom, *Genista pilosa*.

From the dyers' broom, *Genista tinctoria*.

From the musk Geranium, *Geranium moschatum*.

From the common knapweed, *Centaurea nigra*.

From the swamp golden rod, *Senecio paludosus*.

From the common yellow jessamin of the woods, *Jasminum fruticans*.

From the *Tagetes patula*, (Oillet d'Inde) African marigold?

From the shoots of the olive, *Olea Europæa*.

From the larger nettle, *Urtica dioica;* common nettle.

From the *Scandix pecten veneris*, a species of cicely.

From the black Virginia poplar, *Populus Balsamifera*, Tacamahac, white poplar, *populus alba*, aspen tree, *populus tremula*,	Solid colours on wool mordanted with bismuth, and after being dyed run through tin solution. The older wood gives sadder colours but solid.

From larkspur, *Delphinium Ajacis multiplex.*

From the green leaves of pitch pine, *Pinus maritima.*

From the common red pepper, Guinea pepper, *Capsicum annuum:* (while green.)

From the leaves of the potatoe.

From the double white meadow sweet, *Spiræa ulmaria.*

From the China aster, *Aster Sinensis.*

From the green stalks of rue, *Ruta graveolens.*

From buckwheat, *Polygonum fagopyrum*, twining bindweed, *polygonum convolvulus*, on wool with tin mordant.

From African ragwort, *Othonna Cheirifolia.*

From the fresh stalks of Canada (common) golden rod, *Solidago Canadensis.*

From the leaves of the same.

Crimson.

Venetian scarlet, from brazil wood on woollen, grounded with birch bark, after being mordanted with tin solution.

More intense, from the same, using only a stronger dose of brazil wood of Fernambouca, called amaranthine brazil wood.

Less brilliant, when the colour was fixed by the shoots of the birch tree instead of the bark.

Light crimson, by birch bark and wood of St. Martha (Nicaragua.)

Same in a half spent bath of the same.

Same with varied proportions.

Rose red, nearly crimson from a decoction of birch bark, brazilletto, and alum.

Less brilliant, from brazilletto and alum without birch bark.

More lively and solid by brazilletto, birch bark, alum and cream of tartar, in two successive baths.

Same in the same bath half spent.

From Angola wood (Cam wood, the most lively of the woods, *T. C.*) birch bark and alum in the same bath or decoction.

Yellow.

Two dippings in a decoction of the shoots of large leaved privet, *Rhamnus alaternus.*

Jonquil yellow from the straight leaved privet, *Alaternus folio minore.*

From the shoots in leaf of the American arbor vitæ, *Thuya occidentalis.*

Jonquil yellow, from the shoots of *Calycanthus floridus*, Carolina alspice foliis internis longioribus.

From two baths of the old wood of acacia.

July-flower yellow, from the bark of the alder: and from the leaves of artichoke.

Bright yellow, from the shoots of *Ceanothus Americanus*, New Jersey tea ree.

Olive yellow, from two baths of Canada bonduc, *Guilandina Dioica.*

July-flower yellow, from the flowers of balsamine.

Dull yellow, from the green shoots of birch.

Bright yellow, from the unripe berry of black alder.

July-flower yellow, from the common heath with tin mordant.

Same with the addition of black alder berries ripe, and dried.

Dull capuchin yellow, from the ripe berries of bryony.

Chamoy yellow, from beech-mast.

Apricot yellow, from alpine chervil, or honeysuckle, *Lonicera.*

Golden yellow, from the male dogwood, *Cornus mas.*

From turmeric, altered by soap.

From the trefoil cytisus.

From fumitory, fresh and dry.

From fustic made solid by birch bark with tin mordant.

From dry weld; better from green weld.

From hairy broom, *Genista pilosa.*

From *Genista tinctoria*, dyers' broom.

Intense olive yellow, from herb Robert, *Geranium Robertianum.*

Jonquil yellow, from furze fresh: and dry.

From the bark of horse chesnut.

Apricot yellow from the bark of black willow, *Salix Capræa.*

Olive yellow, from the fresh stalks of buckthorn.

Good yellow, from the Italian aster, starwort, *Aster Amellus.*

Delicate, from the bark of elm, dried black alder berries and buckwheat straw with tin mordant.

From the shoots of yellow osier, *Salix Vitellina.*

Greenish yellow, from fermented pansy, hearts' ease, *Viola tricolor.*

From the larger pusicaria, *Polygonum orientale.*

From the bark and also from the shoots of the Italian poplar, particularly from the fresh shoots with tin mordant.

Another shade with the same and dried berries of black alder. This ingredient is economical and renders other colours solid.

Jonquil yellow, with the black Virginia poplar, tin mordant.

From the fresh plants of common field basil, *Clinopodium vulgare.*

From the bark of pitch pine.

From the shoots of the Indian date plum, Placqueminier, *Diospyros Lotus.*

From the bark of the plane tree.

From the roots of wild apple.

From the fresh China aster.

From the Virginia sumach or stagshorn (*Rhus Virginiana.*)

From the fresh flowers of African marygold, *Tagetes erecta.*

From the plants nearly dry of common saw-wort. *Serratula.*

From wild sage.

From the white willow, *Salix alba.*

From thyme.

From the roots of tormentil.

From the fresh plants of yellow trefoil.

From the common golden rod, *Solidago*, *Virga aurea.*

Wine Lees.

Wool mordanted with a precipitate of alum and tin becomes a deep brown-red in a decoction of bran of sorgho.

Maron. Chesnut.

From the Carolina alspice, *Calycanthus floridus.*

From the bark of common maple.

Deep, from brazil, archil and madder.

From dry hay with madder.

From madder with bismuth mordant.

From beech bark.

From horse chesnut bark, scarlet flowering chesnut, *Esculus octandra.*

Reddish from Italian or Lombardy poplar and madder.

From the dry wood of the apple tree.

From the bran of sorgho, son de sorgho. Millet?

Merd'orè. Goose dung.

From the shoots of the snow drop tree, *Chiananthus Virginiana.*

From the bark of alder.

From the *Aristolochia clematitis*, birthwort.

From the restharrow, *Ononis arvensis.*

From the common southernwood, *Artemisia.*

From the *Cucubalus Behen*, bottle campion.

From the cow wheat, *Melampyrum nemorosum.*

Brilliant, from the black alder berry, with mordant of blue copperas.

Yellowish from terragon, *Artemisia Dracunculus.*

From the *Euphorbia Cyparissas*, a species of spurge.

From the leaves of the fig tree.

From the narrow leaved all-heal, *Galeopsis Ladanum.*

From the cotton weed, *Filago Impia.* Quere cudweed?

From the *Gnafolium silvaticum*, wood everlasting.

From the common red rosebay, *Nerion Oleander.*

From the *Leonurus marubiastrum.* Quere, whether horehound or motherwort?

From ground ivy, *Glecoma Hederacea.*

From black horehound, *Manubium nigrum.*

After long boiling from common field basil, *Clinopodium vulgare.*

From marsh horehound, with small leaves, *Lycopus palustris glaber.*

From the Siberian plum, *Prunus Sibirica.*

From wild sage.

From stalks and leaves of rue.

From the shoots of *Rhus coriaria*, true sumach.

Rich colour from the shoots of the *Sambucus racemosa*, or scarlet berried alder.

Mordorè.

From the straight leaved privet, *Rhamnus alaternus;* three dippings.

Light, from the shoots of alder with a little madder.

From the bark and shoots of *Cratægus oxiacantha*, haw-thorn or white thorn.

From the shoots of Christ's thorn, *Algalon*, *Paliurus aculeatus rhamnus.*

From cinquefoil, *Potentilla anserina*, the leaves.

Mordorè chesnut, from the whole plant.

Almost purple, from the shoots and bark of the birch tree with archil, which is fixed thereby.

From dried black alder berries and a little madder.

Beautiful from the shoots of the flowering Virginia hornbeam, *Carpinus Virginiana florescens.*

From dried hay with madder; the decoction somewhat acidulated.

Rich, from the common broom, *Spartium scoparium*, with bismuth.

Better still, with a mordant of tin.

From the shoots of the common or cherry laurel, *Prunus lauro-cerasus.*

Light colour from Luzerne (*medica*) and madder.

From the bark of horse chesnut, *Æsculus hypocastanum.*

From a half spent bath of *Salix caprœa*, black willow.

From the dried shoots of buck thorn, *Rhamnus catharticus.*

From the bark of elm.

From the shoots of yellow osier, *Salix Vitellina.*

From the Italian poplar, with a little madder in the bath when nearly spent; the cloth mordanted with blue copperas.

From Italian poplar, brazil of Fernambouca, and dried black alder berries.

From the bark of pitch pine.

From the fresh bark of Geneva pine, Scotch pine, *Pinus sylvestris.*

From the coloured heart of the wood of the cultivated plum, *Prunus domestica*, hedge plum or white bullace?

From the fresh shoots of *Pyracantha.*

From the ripe berries of the bramble, *Rubus fruticosus.* (Common blackberry.)

Musk.

From the half spent decoction of the large leaved privet.

From the *Thuya Canadensis*, American arbor vitæ.

From the *Thuya Sinensis*, Chinese arbor vitæ.

From a third dipping in decoction of Carolina alspice, *Calycanthus floridus.*

From the shoots of the poison tree *Rhus toxicodendron.*

From the wood of the *Acacia*, in strong dose.

From the flowers of *althæa frutex*, *Hybiscus Syriacus.*

From the branches of *Cratægus torminalis*, wild service.

From the ripe stalks of agrimony.

From the shells of the apricot kernel.

Musk-cinnamon, from the shoots of bilberry, *Vaccinium myrtillus.*

From the common bladder sena, *Colutea arborescens.*

Chesnut musk, from the flowers of *Balsamine*, with blue copperas.

Golden, from roots of common avens, *Geum urbanum.*

From betony.

From roots of bistort.

From wood of red mezereon, *Daphne mezereon.*

From the shoots of black birch, *Betula nigra.*

From the fine-leaved heath, *Erica cinerea.*

From the roots of asarabacca, *Azuram Europæum.*

From the lesser Indian cress, *Tropæolum minus.*

From black currants.

From chesnut bark.

From comfrey, *Symphytum officinale.*

From the dogwood of New Holland, and of Virginia.

From common cyprus.

From the *Dierilla acadiensis.*

From the fruit of the sloe or black thorn, *Prunus sylvestris.*

From Dutch or hemp agrimony, *Eupatorium cannabinum.*

Rich, from the green shoots of Venice sumach, *Rhus cotinus.*

Light, from the nettle hemp, *Galeopsis tetrahit.*

From a weak bath of *Genista pilosa.*

From the large flowering geranium, bloody crane's bill, *Geranium sanguineum.* Also from *Geranium Robertianum.*

Beautiful, from the dwarf cistus, *Cistus helyanthemum.*

From hawk weed, *Hieracium majus.*

From the shoots of the beech.

From rag wort, *Senecio jacobæa*, and from *Senecio palustris*, or marsh golden rod.

From elecampane, *Inula dysenterica.*

From wild lettuce.

From the broad-leaved sweet bay tree, *Laurus nobilis.*

From the young leafy branches of *Liriodendron tulipfera*, tulip tree.

From yellow toad's flax, *Antirrhinum linaria.*

From the leafy shoots of liquid amber.

From the shoots of the smaller bind weed, *Convolvulus arvensis.*

From the roots of *Lysimachia vulgaris*, loose strife.

From the young leafy branches of horse chesnut, *Æsculus hypocastanum.*

Richer colour, from the scarlet flowering chesnut, *Æsculus octandra pavia.*

From the wood and bark of *Salix capræa*, black willow.

From the leafy shoots of the larch tree, *Pinus Larix.*

From the stalks and leaves of water mint, *Mentha aquatica.*

From *Mercurialis annua.*

From the fresh plants of the greater snap dragon, *Antirrhinum majus.*

From the shoots of sweet gale, *Myrica gale.*

From the dry roots of the common nut, (walnut) *Juglans regia.*

From the thick bark of the walnut tree.

From black walnut bark, and from the shoots and leaves, fresh and dry.

From the red fruits of the Guelder rose, *Viburnum opulus.*

From the stalks of common marjoram, *Origanum.*

From the roots of sorrel, *Rumex acetosella.*

From the roots of garden patience, *Rumex patientia.*

——————— bloody dock, *Rumex sanguineus.*

From the Virginian silk, *Periploca græca.*

From spignel, pasil de montagne, *Athamanta libanotis.*

From the barked wood of the Italian poplar.

Beautiful, from fresh pimpernel.

From the shoots of the Indian date plum, *Diospiros lotus.*

From the bark of the plane tree, and from the wood and bark.

From the flowers of piony.

From the mark or pressed fruit of the pear.

From the *Campanula* or bell flower, *Pyramidalis.*

From the double white meadow sweet, *Spiræa ulmaria.*

From the yellow *Ranunculus.*

From the stalks of rosemary.

From a weak decoction of *Tagetus erecta*, African marigold.

From the shoots of the yellow Austrian rose, *Rosa lutea.*

From Spanish sain foin, *Hedasyrum coronarium.*

From the leafy shoots of purple spiked willow herb, *Lythrum salicarlia.*

From the tops of the *Pinus abies*, or fir tree.

From the fresh stalks of buckwheat.

From the stalks of climbing bindweed, *Polygonum scandens.*

From the twining bindweed, *Polygonum convolvulus.*

From the fresh plant of knotty fig wort, *Scrophularia nodosa.*

From the sun flower.

From the dry flowers of the common black elder, and from its berries, fermented and unfermented.

From the dried uncured leaves of tobacco: and from the green leaves.

From the stalks of tansy.

Light musk, from the *Thlaspi aranse*, penny-cross, a kind of shepherd's purse.

From the bark of the roots of tormentil.

From the common native golden rod.

From vervain, *Verbena.*

From vine cuttings.

From the ripe berries of *Sambucus ebulus:* and from the same dried.

Nankin.

From the shoots of the Judas tree, *Circis siliquastrum*

——————— rose acacia.

——————— Italia azedarach, *Melia azedarach.*

——————— Dutch medlar, *Mespilus inermis.*

From the leafy stalks of agrimony.

From the New Jersey tea tree, apalachine, *Ceanothus Americanus.*

From birch bark.

From ripe cherries.

From the cherries of Zara.

From Dutch or hemp agrimony, *Eupatorium Cannabinum.*

From red gooseberries.

From the flowers of the queen's bean, haricot a la reine, (kidney bean with red flower?) *Phaseolus coccineus.*

From the hairy trefoil, *Lotus hirsutus, or hemorrhoidalis.*

From the European nettle tree, *Celtis australis.*

From the wood of an orange tree.

From the kernel of peaches.

From the bark of all the poplars.

From the barked wood of the Scotch pine, *Pinus sysvestris.*

From the shoots of the double cinnamon rose, *Rosa Cinnamomea.*

From the barked wood of the willow.

From the shoots of the mountain ash, *Sorbus occuparia.*

From the Guelder rose, *Spircea opulifolia.*

Hazle-nut Colour (Noisette.)

From the shoots of button wood, *Cephalanthus occidentalis.*

From the bilberry or whortle-berry, *Vaccinium myrthyllus.*

From common avens, *Geum urbanum.*

From the catalpa.

From the dry white birch, *Betula alba.*

From fresh common heath, *Erica vulgaris.*

From the evergreen box tree, *Buxus sempervirens.*

From the cones of the pitch pine, *Pinus maritima.*

From the red bark of the roots of the male dogwood or cornelian cherry.

Cornus mas, reddish hazle colour.

From the barked wood of the same.

From the mixture of laburnum and ptælea.

From the roots of the black thorn or sloe, *Prunus sylvestris.*

Hazle-nankin, from the wood of the common maple, *Acer campestre.*

From dry hay, and madder acidulated.

From the bark of the spindle tree, *Eronymus Europæus.*

From the wood of the juniper.

From the shoots of the red currant tree, *Ribes rubrum.*

From the dry wood of the yew.

From the fresh barked wood of the sallow or black willow, *Salix Capræa.*

From the wood of the laurustinus, *Viburnumtinus.*

From the wood of the buckthorn, *Rhamnus catharticus.*

From the shoots of the Persian or narrow-leaved wild olive, *Eleagnus angustifolia.*

From the barked wood of the elm.

From the flowers of the common purple orpine, *Sedum telephium.*

From the black poppy, *Papaver nigrum.*

From the wood of all the poplars.

From the leaves of pitch pine, *Pinus sylvestris.*

From dried plums, and from the black grape.

From the shoots of sea buck thorn, *Hippophae Rhamnoides*

From the African rag wort, *Othonna cheirifolia.*

From the green barked lime tree, *Tilia Europæa.*

From the roots of tormentil.

Olive.

From the stalks of wormwood, *Artemisia absynthium.*

From the fresh stalks of the silk plant, swallow-wort, *Asclepias Syriaca*, or *Apocynum*, Syrian dog's bane.

From cow wheat, *Milampyrum nemorosum.*

From the green shoots of the black alder, *Rhamnus frangula*, with green vitriol: and from the roots of the same plant.

Green olive, from the ripe plants of *Bromus tectorum*, broom grass.

From common self heal, *Prunella vulgaris.*

From the poplar with logwood.

From the scabious leaved centaury, or common knap weed, *Centaurea scabiosa.*

From the toadstool, *Boletus viscidus.*

From the Germander, *Teucrium chamædris.*

From the flowers of meadow saffron, *Colchicum autumnale.*

From the branches of common hazle, *Corglus avellana.*

From the hairy evergreen laburnum or trefoil tree, *Cytisus hirsutus.*

From the dried husks of the common bean, *Vicia faba.*

From a weak bath of green weld, *Reseda luteola.*

——————— *Geranium moschatum.*

From winter cresses, or rocket, *Erisimum barbarea.*

From common knap weed, *Centaurea nigra.*

From the ripe stalks of drop wort, *Ænanthe pimpinelloides.*

From the ripe berries of ground ivy.

From mercurialis, French mercury, fermented.

From the bark of the branches of the walnut, *Juglans regia.*

From the roots of water patience, *Rumex aquatica*, particularly with solution of iron.

From the leaves of black poppy, *Papaver nigrum.*

From pansy, or heart's ease, *Viola tricolor*, fermented and unfermented.

From fresh shoots of the poplar, with nine grains of logwood More intense by doubling the logwood.

From the poplar, redyed in wine of the berries of *Rhamnus frangula*, and in the dried berries of the same.

Ombre, or Brownish Yellow: ground for Carmelite.

From two dippings in the straight-leaved privet, *Alaternus.*

From the shoots of the southernwood, *Artemisia absynthium.*

From the shoots of the common alder, *Betula alnus.*

From the twigs of *Celastrus scandens*, climbing staff tree.

From the lesser centaury.

From the scabious leaved centaury.

From the roots of celandine, *Chelidonium majus.*

From virgin's bower, *Clematis vitalba.*

From the three leaved cytisus.

From the dog rose, *Rosa canina.*

From the shoots of scorpion sena, *Coronilla emerus.*

From fennel, *Anethum fœniculum.*

From Spanish broom, *Spartium junceum.*

From the bear's-foot hellebore, *Helleborus fœtidus.*

From the cotton weed, *Filago arvensis.*

From the *Erysimum officinale*, sauce alone? Hedge mustard?

From the wood of the ivy, *Hedera helix.*

From the dry wood of the laylock or lilac, *Syringa vulgaris.*

From the leafy stalks of common loose-strife, *Lysimachia vulgaris.*

From the melilot, *Melilotus officinalis; trifolium.* (The seeds of this plant ground and mixed with curd, give the colour and the flavour to the shap-zugar, or sapsago cheese, as I know. *T. C.*)

From the half spent decoction of the olive tree.

From the wood of the black mulberry, *Morus nigra.*

From the shoots of the orange tree, and the skin (ecorce) of ripe oranges.

From the stalks and leaves of the *Palma Christi.*

From *Scandix pecten veneris.*

From the pansy: and the pansy of Rouen, *Viola Rothomagensis.*

From the white meadow sweet, *Spiræa ulmaria.*

From the bramble roots, *Rubus fruticosus*, black-berry.

From savory, *Satureia hortensis.*

From the evergreen golden rod, *Solidago semper virens.*

From the shoots of the common black elder, *Sambucus nigra.*

From soot.

From the shoots of the red bark tamarisk, *Tamarix gallica.*

From the feathered columbine, *Thalictrum Aquilegi folium.*
From the small yellow trefoil, *Trifolium luteum flore lupuli.*
From fresh red clover, *Trifolium rubens pratense.*
From the Canada golden rod, *Solidago.*
From the ivy-leaved speedwell, *Veronica hederifolia.*
Better from the same with bismuth.

Purple.

From brazil wood fixed by birch bark, with tin mordant.

Plum.

From the fresh and dry berries of the black alder, *Rhamnus frangula.*

From birch bark and logwood.

From bran of millet, sorgho.

Ronce d'Artois, Artois Bramble.

From the stalks and leaves of stinking orach, *Chenopodium vulvaria.*

From the plant balsamine.

From a weak bath of fermented berries of black alder: also from the dried berries.

From the plant of stinking chamomile, *Anthemis cotula.*

From myrrh, (sweet scented myrrh) *Scandix odorata.*

From the leaves of the large oblong citron, *Citrus medica.*

From the lesser hemlock or fool's parsley, *Othusa cynapium.*

From spinach, *Spinacea oleracea.*

From spurge, *Euphorbia palustris.*

From the leafy stalks of tythy malle, *Euphorbia cyperisasis,* Euphorbia tythy malloides, Curassao-myrtle spurge.

From the weak decoction of green weld.

From the yellow everlasting pea, *Lathyrus aphaca.*

From the bark of the European nettle tree, *Celtis australis.*

From shoots of poplar, with dried berries of black alder.

From wild germander, *Veronica chamædris.*

Rose.

From the purple kidney bean. Haricots d'espagne. *Phaseolus purpureus.*

——— spotted kidney bean, *Phaseolus rufus variegatus.*

From wild germander, *Veronica chamædris.*

From the roots of the greater bindweed, *Convolvulus sepium.*

From the archil of the Canaries reddened by acids.

Red.

From the roots of the red ladies bed straw, *Gallium verum.*

From the Portugal cross, *Cruciata, Lusitanica, latifolia, glabra, flore, albo.*

The two preceding equal to madder.

Chesnut red, from madder and sumach.

Purple red with madder, after mordanting with bismuth and galling.

Scarlet red from fine madder: rose red from the same, with mordant containing one-eighth of tin.

More fiery from Cyprus, Smyrna, or Lizari madder.

From the flowers of *Glaucium.*

Several other varieties of red from madder with different mordants.

Ventre de crapaud, (toad's belly). Ground for Carmelite.

From the branches of the varnish tree, *Rhus vernix.*

From the goat's rue-leaved vetch, *Astragalus galegi formis.* Milk vetch?

From bastard or wild indigo, *Amorpha fruticosa.*

From shepherd's purse, *Thlaspi, Bursa pastoris.*

From flea bean, *Conyza squanosa.*

From the shoots and leaves of holly, *Ilex aquifolium.*

From the wood of furze, (jonc marin) *Ulex Europæa.*

From white horehound, *Manubium vulgare.*

From the basil called *Thymus acinos.*

From savory, *Satureia hortensis.*

Ventre de Biche, (literally Doe's belly) Tan Colour.

From the wood of *Althæa.*

From the bark of young oak.

From Alpine ebony, *Cytisus laburnum.*

From the bark of common broom, *Spartium scoparium.*

From the shoots of the three-thorned acacia, *Gleditsia triacanthos.*

From common lettuce, *Lactuca sativa.*

From the shoots of sophora.

Green.

From the ripe, and from the fermented berries of black alder.
From the bark of the common ash, *Fraxinus excelsior.*
From Italian poplar on a blue ground, mordanted with bismuth.
From the flowers of the violet.

Vigogna, (colour of Vigogna wool.)

From the shoots of the Siberian acacia.
From the dry shoots of the elder.
From the leaves of artichoke.
From rest harrow, *Ononis arvensis.*
From wild angelica, *Angelica sylvestris.*
From tuberose crowfoot, *Ranunculus bulbosus.*
From common bladder sena, *Colutea arborescens.*
From flowers of balsamine.
From the water parsnip, *Sium latifolium.*
From *Gallium verum*, lady's bedstraw.
From the round leaved bell flower, *Campanula rotundifolia.*
From the sea holly with pinnated cut leaves, *Eryngium campestre.*
From the blue berried upright honeysuckle, *Lonicera cærulea.*
From the common hedge honeysuckle, *Lonicera periclimenum.*
From the pasque flower, *Anemone pulsatilla.*
From the seven leaved colutea, *Coronilla glauca.*
From the branches of the fig tree, *Ficus carica.*
From the rose flowering raspberry, *Rubus odoratus.*
From the barked wood of the common ash, *Fraxinus excelsior.*
From the heart of the common broom, *Spartium scoparium.*
From the yellow everlasting pea, *Lathyrus aphaca.*
From the *Valantia aparine.*
From the thorny hedge gooseberry. *Uva crispa.*
From the dwarf cistus, *Cistus helianthemum.*
From catmint, *Nepeta cataria.*
From the stalks of knee-holly or butcher's broom, *Ruscus aculeatus.*
From the shoots of white jessamin, *Jasminum officinale.*
From sow-thistle, *Sonchus oleraceus.*
From *Sonchus maximus plumerii*, Japonese thistle.
From wild lettuce, *Lactuca scariola.*
From common lettuce, *Lactuca sativa,* with tin mordant.

From the young branches of the laylock or lilac.
From the hay of Luzerne, *Medica.*
From the *Lychen prunasti.*
From the lesser snap dragon, *Antirrhinum Orontium.*
From sweet myrtle, *Myrica gale.*
From Dutch medlar, *Mespilus Germanica.*
From the shoots of buckthorn, *Rhamnus catharticus.*
From the dried shells of walnuts, *Juglans regia.*
From elm bark with tin.
From the French willow, narrow leaves, red flowers, *Epilobium angustifolium.*
From the dry straw of wheat.
From the stalks of parsnip, *Pastinacea sativa.*
From the vines of the *Vinca major*, Periwinkle.
From all the poplars.
From bark of the plane tree.
From China aster, *Aster Sinensis.*
From knot grass, *Polygonum aviculare.*
From green sain foin, *Hedasyrum onobrychis.*
From scorzonera.
From the flowers, &c. of common elder, *Sambucus nigra.*
From the bark of sycamore.
From the stalks of *Thalictrum.*
From the shoots of common lime tree, *Tilia Europæa.*
From the roots of upright tormentil, *Tormentilla erecta.*
From common privet, *Ligustrum vulgare.*
From the shoots of the wayfaring tree, *Viburnum lantana.*
From viper's bugloss, *Echium vulgare.*

Violet.

From logwood fixed by birch bark, with bismuth mordant, of various shades: and also with tin mordant.
From the skins of the fruit of *Uva crispa.*

dicines, with an Appendix containing a Dispensatory for Private Practitioners and Families. Revised and adapted to the climate of the United States by Dr. S. P. Griffitts, late Professor of Materia Medica in the University of Pennsylvania, $3 00

Cambon's Letters and Conversations of certain Young Ladies, 1 00

Evenings at Home, or the Juvenile Budget opened, 6 volumes printed and bound in 2 vols. 12mo. 2 00

History of America, containing a General Description of the Country; of the Natives, and their Customs and Manners; the discovery of America by Columbus; the Conquests of Mexico and Peru; the British Colonies; and the Revolution, terminating in the Independence of the United States; with 2 maps, 12mo. 1 00

Hurdis's Poems, containing the Village Curate, Tears of Affection, The Bouquet, and Adriana, or the first of June, 12mo. 1 00

Helme's Instructive Rambles in London and the Villages adjacent, designed to amuse the Mind and improve the Understanding of Youth, with a handsome frontispiece, 12mo. 1 00

More's (Hannah) Strictures on the Modern System of Female Education, with a View of the Principles and Conduct of Women of Rank and Fortune. 2 volumes handsomely printed, 12mo. 1 75

Purves's Observations on Dr. Priestley's Doctrines of Philosophical Necessity and Materialism, with Observations on Socinian Arguments, 12mo. 1 00

Raffald's (Mrs.) Experienced English Housekeeper, for the use of Ladies, Housekeepers, Cooks, &c. written purely from practice; consisting of nearly nine hundred Original Receipts in Cookery of all kinds; Confectionary, Pickling and Preserving, Distilling, Brewing, &c. with plates, 12mo. 1 00

Thomson's Seasons and Castle of Indolence, with the Author's Life, and Aiken's Essay on the Seasons, 12mo. 1 00

The same book, calf gilt, 1 50

The same, with plates by Lawson, the most beautiful that ever were engraved, calf gilt, 3 00

Tour from Gibraltar to Tangier, Sallee, Mogadore, Santa Cruz, and Tarudant; thence over Mount Atlas to Morocco, including a particular account of the Royal Harem, by Lempriere, 12mo. 1 00

The same, calf gilt, 1 50

Tour through Zealand, containing a Historical Account of the Battle of Copenhagen, 12mo. 0 50

World Unmasked, or the Philosopher the Greatest Cheat, 12mo. 1 00

Also, a variety of MEDICAL BOOKS.