XXVI. Continuation of Mr. Henry's
Considerations relative to the Nature of Wool, Silk, and Cotton, as
Objects of the Art of Dying.

(from p. 133.)

Alum, being a cheap substance, is most commonly used. It consists of vitriolic acid, pure
clay *, or argillaceous earth, and water. According to Bergman, one hundred parts of crys-
tallized alum contain thirty-eight of vitriolic acid, eighteen of clay, and forty-four of water. The
clay is generally supersaturated with acid; this is proved by the phenomena produced on the addi-
tion of mild vegetable fixed alkali. On the first portions of alkali being added, a small portion of
the earth precipitates from those parts of the alum with which the alkali comes in contact; and, as

* The constituent parts of common clay are argillaceous,
mixed with siliceous, earth, in various proportions. Pure ar-
arginaceous earth is only obtainable from alum.
pure clay has an attraction for aerial acid, the effervescence produced is at first small; but presently the remaining free acid, attacking this precipitate, redissolves it, and an effervescence appears, occasioned by the discharge of the aerial acid from the clay. This precipitation, followed by redissolution, and a discharge of gas, continues till the acid be perfectly saturated; the precipitation then goes on regularly, and the earth is no longer dissolved anew, except the alkali be continued to be added after the precipitation is fully accomplished; nor does any effervescence follow when fresh portions of alkali are added.

These are the appearances when mild or aerated vegetable alkali is used; but, if the pure or caustic alkali be employed, the precipitation takes place more slowly; and, if the pure alkali continue to be added after the precipitation is effected, the earth will be redissolved.

This earth has a strong attraction for colouring matter, particularly for such as forms the red and yellow colours; insomuch that, if a solution of alum be poured into water deeply tinged with madder or weld, the earth will quit its acid to
unite with the colouring particles of these substances, and form with them a precipitate or laque; from which it cannot be separated, either by the action of water, or spirit of wine, and is not totally destroyed even by that of fire.

Marine salt of tin, and that formed by *aqua regia*, have for their basis the white earth of that metal, which has also a strong attraction for colouring matter, and is, in some cases, preferred to that of alum. When united to the colouring matter of cochineal, it forms a beautiful pigment, well known by the name of carmine. If the addition of these saline substances, to the coloured liquors, be sufficiently long continued, and under proper circumstances, the whole of the colouring matter will be precipitated, and the water be left colourless *.

Tin is not the only metal which affords bases for colouring substances; lead, bismuth, and zinc, also afford earths, or calces, which attract colouring matter; but the two first have defects which render them less eligible. The calx of zinc may perhaps be usefully employed; but should first be

* Macquer, Dictionnaire de Chymie.
thoroughly purified from the iron which it generally contains.

These all form bases for the more brilliant reds and yellows: for the last, the calx of copper is also employed, having a strong attraction for the colouring matter of weld. Salts containing iron furnish a basis which, with the astringent matter of vegetables, produces a black dye.

When alum is used to supply a basis for the dying of wool, it is the practice to join with it either crude tartar or its purified crystals, in the proportion of five ounces of alum to one of tartar. This last substance we know consists of an alkaline vegetable salt, supersaturated with a peculiar acid, which bears its name. The superabundant vitriolic acid of the alum will decompose a part of the tartar, by attaching itself to the alkali, and thus the quantity of free tartareous acid is increased, which has no properties injurious to the cloth.

In the aluming of silk no tartar is employed; for the silk, in the previous preparation, being impregnated with alkaline or soapy matter, the superabundant acid will be neutralized by it. In
this process, when the tubs have been long used, a very considerable incrustation is formed on their sides; which the dyers, finding no injury from it, suffer to accumulate. Some of the soap used for the scouring adheres to the silk, notwithstanding the washing it undergoes; and the alkali of the soap, uniting with the acid of the alum, some of its earth is precipitated, joins with the detached oil, and forms the incrusting substance; the undecomposed alum, and the vitriolated tartar, perhaps also, in part, entering into the combination *

Cotton requires a still different treatment: as the vitriolic acid is injurious to cotton, and it is necessary that the aluminous solutions should be well dried on it before it be washed, the acid, being concentrated by the evaporation of the water, would corrode the cotton. It is therefore proper to saturate the superabundant acid, previous to the aluming of the cotton; and for this purpose one-sixth or one-eighth of pearl ashes is to be added.

* Macquer, Art de la Teinture de Soie.
But the aluminous liquor used by the printers is prepared in a different manner: to three pounds of alum, dissolved in a gallon of hot water, a pound and half of sugar of lead is added; the mixture is stirred together for a considerable time, and the agitation repeated often, during two or three days; when a few ounces of whiting are to be added gradually, as a strong effervescence ensues. On adding the sugar of lead to the alum, a double elective attraction produces two decompositions, and two new compounds: the vitriolic acid forfakes the earth of alum, to unite with the calx of lead of the facebarum saturni; and this new salt, possessing very little solubility, falls to the bottom of the vessel, in form of a white precipitate. The earth of alum, being left at liberty, and in so minutely divided a state, is attacked, in the act of precipitation, and dissolved by the acetous acid, which, having quitted the lead, is ready to form this new union; and thus a very soluble salt being the product, it remains dissolved in the water, and, when thickened with gum, is applied by means of blocks to the cloth. The piece being afterwards dried in a hot stove,
the vinegar, which, as the cloth dries, becomes highly concentrated, and very volatile, * not having a strong attachment to the aluminous earth, flies off, and leaves the earth upon the cloth ready to receive the colouring matter: and herein consists the advantage of the change of the vitriolic for the aceturous acid.

Thus we see that the printer's liquor for the red and yellow colours is not, as those artists generally imagine, a mixture of alum and sugar of lead, but merely an acetated argill, or aluminous earth, combined with vinegar. The addition of whiting is intended only to neutralize the superabundant acid, and would perhaps be better made to the alum, before the mixture of the sugar of lead; for, as that acid immediately precipitates some of the lead, without furnishing the aceturous acid with aluminous earth in return, a

* The vinegar, by its union to the calx of lead, seems to have acquired some new properties; for, on separating it from the lead, by distillation, it always contains some portion of ether. When the cloth has become dry in the hot fledge, Mr. Charles Taylor has observed flashes of electric light darting from its surface.
waste of the *fuscobarum saturni* is the consequence, which might be prevented by the mode now recommended.

The solutions of tin, and of the other white metals, should be as perfectly saturated as possible; otherwise, not only the superabundant acid will injure the cloth, but the calx will not so readily precipitate, to form the white basis. In the dying of wool the solution of tin is mixed with the decoction of cochineal, and falls, in the form of carmine, on the cloth; but silk has in vain been attempted to be dyed scarlet in this mode. M. Macquer has however accomplished this *desideratum*, by first fully impregnating the silk with the solution, before he proceeded to the dying. By this means M. Macquer declares that he has produced scarlet, though not equal to that dyed on wool, yet sufficiently beautiful, and superior to the scarlet formed by a mixture of safflower and arnatto. And, he adds, that an eminent manufacturer at Lyons had succeeded in dying great variety of colours on silk, by applying the tin basis after the same manner *

If a scarlet could be dyed without the use of nitrous acid, the tin basis might be employed for this purpose on cotton; but that acid being requisite for the production of this beautiful colour, and being highly corrosive to cotton, this basis is prevented from being applied to that substance. But, if this metallic earth has any preference to alum, for other colours on cotton, it might be procured united to acetous acid, by a process which I have lately discovered, somewhat similar to that for making the printer's liquor; viz. by adding to a solution of tin, in marine acid, a solution of sugar of lead. The marine acid will unite with the lead, and precipitate as plumbum corneum, and the vegetable acid will unite with the tin, with which it could not easily be saturated by any other mode; for, the acetous acid has very little power to dissolve tin in its metallic form.

The cupreous basis may be obtained from blue vitriol, and from verdegris, or acetated copper. It is seldom used by itself, but generally in conjunction with alum.

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The martial basis, where wool and silk is concerned, is obtained from green vitriol or copperas; but this basis is best procured, for cotton, from a solution of iron in acetic acid, or even, as it should seem, in the astringent principle: for, a solution of iron is used by the dyers of cotton, with great success, which is formed by stratifying old iron with alder bark, and digesting them in water.

It may also be worthy of remark, that cotton, having but a weak attraction for colouring matter, requires that it should be presented under every advantage; and the Dijon Academicians having proved that the mineral acids are destructive of the astringent principle, in which the colouring matter of those substances requiring a basis seems to reside, this property, added to others, may be a reason for their rejection, and for the preference given to the acetic acid.

Having thus given an account of the various preparations that are generally used for wool, silk, and cotton, and of the basis applied for the reception of the colouring matter, let us next take a view of the particular preparatory operations.

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practised in the process for dying the Adrianople or Turkey red, on cotton; and to these also add a detail of the process itself. It is proper to pre-
mise, that all the wooden vessels employed should be made of deal, or of some white wood, free from astringent matter; and that the most con-
venient quantity for operating on, in proportion to the ingredients used in the several operations, is sixty-six pounds of cotton.

From sixty pounds of Alicant barilla, a ley is drawn, by means of soft water, amounting to sixty gallons; and then, by pouring on of fresh water, a second ley is formed, measuring forty gallons; after this, a third ley is also ex-
tracted 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-fieve, to sepa-
rate from it the grocer parts.

These preparatory measures being taken, the first operation consists in adding nine pounds of Gallipoli
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 a stove, but the former is to be preferred 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
containing four gallons of the second barilla liquor, and adding this mixture to six gallons of the first barilla liquor, and four gallons of 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 it must also be after the subsequent operations; and these are to be conducted in the same manner, with respect to the manipulations, as 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 liquor, dung liquor, and first barilla liquor, four gallons each. After this operation, the
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 processes.

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 three 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
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-two 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 dying.

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The galling forms the ninth operation. Sixteen pounds of galls, or, if the blue galls be used, a somewhat smaller portion, 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 it 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 skains. After this it is to be dried, either wholly or in part, in the open air; if it cannot be thus completed, as rain would, in this state, and especially as the cotton approaches to dryness, be highly prejudicial, the drying must be finished in a stove. The liquor which has been wrung out is to be added to the remaining half in the copper.

TO BE CONCLUDED IN OUR NEXT.

XXVII.