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 cryſtallized 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 addition 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 argillaceous earth is only obtainable from alum.

pure

pure clay has an attraction for aërial 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 aërial 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 aërated 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

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

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 forſakes the earth of alum, to unite with the calx of lead of the *ſaccharum 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 acetous 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 acetous 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 ſtove, Mr. Charles Taylor has obſerved flaſhes of electric light darting from its ſurface.

waſte

waſte of the *ſaccharum 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 *.

* Macquer, Dictionnaire de Chymie, 2d edit.

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.

The

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 acetous 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 acetous 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

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 premiſe, that all the wooden veſſels employed ſhould be made of deal, or of ſome white wood, free from aſtringent matter; and that the moſt convenient 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 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 from it the groſſer 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 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 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 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.