X. *Obſervations on the Effect of Mordants in dying Cotton red.* By J. A. CHAPTAL.

FROM THE *ANNALES DE CHIMIE.*

IN dying cotton of a fine red colour, by means of madder, it is ſtill the cuſtom, as in certain medical preparations, to adhere ſtrictly to the moſt whimſical and extraordinary preſcriptions, leſt any change in the proceſs ſhould produce an alteration in the reſult.

A month's work is hardly ſufficient to complete all the operations ſuppoſed indiſpenſable for obtaining the fine red colour, called Adrianople or Turkey red. In the proceſs for which are ſucceſſively employed the following ingredients, *viz.* barilla, oil, galls, ſumach, alum, blood, the gaſtric juice, madder, ſoap, ſolution of tin in *aqua regia*, and other ſubſtances.

The true means of ſimplifying this proceſs is not by working at random, and trying, without rules and principles, methods different from thoſe at preſent made uſe of. That mode of proceeding leads very rarely, and always ſlowly, to ſucceſsful

ceſsful reſults. I know but one way of making any progreſs in the arts, namely, by reducing all the operations to ſimple principles; by this means we obtain fixed points, from which we may take our departure, and to which we may refer the reſults of our labours. Chemiſtry is now in a ſufficiently advanced ſtate to furniſh theſe firſt baſes; it is only neceſſary to eſtabliſh them, and they will become, in the hands of the workman, what formulæ are in the head of the mathematician. I ſhall give one example of this, by ſubmitting to chemical principles, the action of the three principal mordants employed in dying cotton red, *viz.* oil, galls, and alum.

It is well known that cotton will not take a permanent red dye from madder, except it has firſt been properly impregnated with oil. The red given to cotton by printing is far from poſſeſſing the ſame degree of fixity, ſince it cannot ſupport the operation of brightening by means of barilla.

This preliminary preparation is given to cotton, by forming (without heat) a ſoapy liquor, by the combination of oil with a weak ſolution of barilla.

This alkaline lixivium is of no uſe but to dilute and divide the oil, ſo as to give the workman the power of applying it, with eaſe, to every part of the cotton, in an equal manner.

I have

I found that potaſh produced the ſame effects as barilla; a circumſtance which is, in my opinion, deſerving of ſome attention, becauſe, in thoſe parts where barilla is ſcarce and dear, its place may be ſupplied by potaſh.

It follows, from this principle, that all kinds of barilla, or of oil, cannot be employed indifferently.

In order that the barilla ſhould be fit for the purpoſe, it is neceſſary that it ſhould be in a cauſtic ſtate, and that it ſhould contain but a ſmall quantity of ſea-ſalt.

It muſt not be rendered cauſtic by quick-lime, becauſe it then gives the colour a brown hue; its cauſticity muſt therefore be produced by calcination.

Barilla which is rendered mild by fixed air, and that which has much ſea-ſalt mixed with it, unite very imperfectly with oil; conſequently, old barilla in an efflorescent ſtate, and the impure barilla of our climate, cannot be uſed in the dye here treated of.

The choice of the oil is as eſſential as that of the barilla.

In order that an oil ſhould be good for this purpoſe, it muſt be capable of uniting very perfectly with the ſolution of barilla, and of continuing permanently in a ſtate of complete combination.

The oil moſt fit for the purpoſes of dying, is not fine oil; on the contrary, it is that which contains a large portion of extractive principle.

The former (fine oil) does not preſerve its ſtate of combination with the barilla: it alſo requires a ſtronger ley; a circumſtance which prevents the dyer from graduating properly his ſubſequent operations.

The other kind of oil makes a combination which is thicker and more durable; it alſo requires but a weak ley, of one or two degrees of ſtrength.

The neceſſity of producing a very intimate and perfect combination of the oil with the barilla, will be readily perceived, by reflecting, that the ley of barilla (as was before mentioned) is only made uſe of for the purpoſe of dividing and diluting the oil, ſo that it may be applied equally to all parts of the cotton. From this principle it follows, that if the oil is not well mixed, the cottons which are dipped in this mordant, will take the oil unequally, and, conſequently, the colour given to them by dying, will not have an uniform appearance.

Hence it is, that the workman conſiders the ſecret of producing an uniform and rich colour, to conſiſt merely in chuſing ſuch oil, and ſuch barilla, as will anſwer his purpoſe.

It

It follows, alſo, from theſe principles, that there ſhould be an exceſs of oil, and not merely as much as is requiſite for the ſaturation of the barilla; for, in the latter caſe, ſome of the oil would quit the cotton, when it was waſhed, and the colour would remain dry.

When the cotton is properly impregnated with oil, it is made to undergo the operation of *galling*. In this operation, galls produce ſeveral advantages. Firſt, the acid they contain decompoſes the ſoapy liquor with which the cotton is impregnated, and fixes the oil upon it. Secondly, the animal nature of the galls gives the cotton a diſpoſition to receive the colouring principle. Thirdly, the aſtringent principle unites to the oil, and forms with it a compound which grows black as it dries, which is almoſt inſoluble in water, and which has a very ſtrong affinity with the colouring principle of the madder.

This laſt combination may be obtained, and an opportunity given of inveſtigating its properties, by mixing a decoction of galls with a ſolution of ſoap.

From the above principles it follows, Firſt, that other aſtringents, in whatever proportion they are employed, cannot be uſed inſtead of galls. Secondly, that the decoction of galls ſhould be made uſe of as hot as poſſible, in order that the decompoſition may be ſudden and complete.

Thirdly, that the galled cotton ſhould be dried quickly, to prevent its turning black, which would diminiſh the brightneſs of the red colour meant to be given to it. Fourthly, that dry weather ſhould be choſen for the proceſs of galling, becauſe wet weather tends to give the aſtringent principle a black colour, and alſo retards the drying. Fifthly, that the cotton ſhould be preſſed with the greateſt care, in order that the decompoſition, about to be produced, may take place equally at every part of its ſurface. Sixthly, that there ſhould be a fixed proportion obſerved, in the quantity of galls and ſoap made uſe of. If the galls predominate, the colour is apt to be black; if the ſoap is in exceſs, that portion of the oil which is not combined with the aſtringent principle becomes uſeleſs, as it is carried off when the ſtuff is waſhed: the colour alſo is more faint.

The third mordant employed in dying cotton red, is alum. This ſubſtance has not only the property of brightening the red colour produced by madder, but it alſo contributes, by its decompoſition, and the fixity of its earth, to give ſolidity to the colour.

In order to judge of the effects produced by alum, in dying cotton red, it is only neceſſary to mix a decoction of galls with a ſolution of alum. The mixture immediately becomes turbid, and a greyiſh

greyiſh precipitate is formed, which, when dried, is inſoluble in water, and in alkalies.

Every circumſtance that happens in this experiment, may be obſerved in the operation of aluming, for the purpoſe of dying. The cotton, when galled, and dipped in a ſolution of alum, or of acetite of alumine, changes its colour, and inſtantly becomes grey. No precipitate appears in the bath, becauſe the precipitation takes place in the ſubſtance of the cotton, in which the products of that operation remain fixed. It muſt, however, be obſerved, that if the ſolution of alum, into which the galled cotton is dipped, is too hot, a certain portion of the galls eſcapes from the cotton, and then the decompoſition of the alum takes place in the bath itſelf; this neceſſarily diminiſhes the proportion of the mordant, and thereby renders the colour leſs rich.

Here then is a combination of three principles, (oil, the aſtringent principle, and the earth of alum,) which ſerves as a mordant in dying red with madder. When theſe principles are uſed ſeparately, they produce neither the ſame fixity, nor the ſame brilliancy in the colour.

This mordant is, undoubtedly, the moſt complicated of any known in the art of dying, and it preſents to the chemiſt a ſpecies of combination very intereſting to inveſtigate.

It

It is from the exactneſs of this combination, and from the ſkill of the artiſt in making it, that a beautiful colour is to be expected. But, although it may be poſſible, by taking experience for our guide, to conduct ourſelves properly through the labyrinth of theſe numerous combinations, it is very difficult to render them more ſimple and perfect. It is only by reaſoning upon the operations, and calculating the principle and reſult of each of them, that we can be complete maſters of our proceſſes, can correct the errors of them, and can obtain conſtant reſults. Without doing ſo, the practice of the moſt experienced artiſt, offers only a diſcouraging alternation of ſucceſſes and failures. It was my view, in the analyſis I have here given of the operation of dying red with madder, (the moſt complicate of all ſuch operations,) to give an example of the aſſiſtance chemiſtry can afford to the arts, when it enlightens them by its principles. And I am convinced that the moſt ignorant workman will find, in this ſhort explanation, the principles of his work, and the rules by which he ought to conduct himſelf.