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,
left any change in the process should produce an
alteration in the result.

A month's work is hardly sufficient to com-
plete 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 follow-
ing ingredients, viz. barilla, oil, galls, sumach,
alum, blood, the gastric juice, madder, soap,
solution of tin in aqua regia, and other sub-
stances.

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 proceed-
ing leads very rarely, and always slowly, to suc-
cessful
cesful 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 formulae 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 batilla.

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

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
In dying Cotton red.

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.

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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 choosing such oil, and such barilla, as will answer his purpose.
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.

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Thirdly,
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 soluion of alum, or of acetate 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 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.