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**XXXII.** *Observations on Madding; together with a simple and certain Process for obtaining, with great Beauty and Fixity, that Colour known under the name of the Turkey or Adrianople Red.* By J. M. HAUSSMANN\*.

**I** HAVE already indicated, in the *Annales de Chimie*† and the *Journal de Physique*, that earths and metallic oxides have more or less the property of attracting and retaining the colouring parts of vegetable and animal substances; alumine and the oxide of iron possess it in a greater degree than the oxide of tin; but the attractive force of the latter far surpasses that of the other earths and metallic oxides in regard to the colouring parts of the said substances.

Alumine and metallic oxides do not retain, with the same force of adhesion, the colouring parts of all animal and vegetable substances indiscriminately; that of madder adheres much stronger than those of the other colouring substances, which may be classed in the following order: kermes, cochineal, logwood, yellow India wood, woad, quercitron, Brazil wood, red India wood, yellow berries, &c. The gall-nut, shumac, and other astringent colouring substances, act principally by means of the gallic acid, and, in regard to their degree of fixity, may be placed immediately after madder: the case is not the same with the Prussic acid, which communicates a colour to different metallic oxides, from which it can be separated cold by alkaline leys.

To judge of the fixity of colours arising from animal and vegetable substances, the best method is to employ a ley of oxygenated muriate of potash or soda, with excess of alkaline carbonate. The longer or shorter resistance which the colours make in this ley, will indicate what they will make when acid, alkaline, saponaceous, and other reagents are employed.

In the art of dyeing, and that of cotton-printing, the name of madding is given to that process by which the colouring parts of madder are transferred, by means of water with the aid of heat, to alumine, or to the oxide of iron fixed in any kind of stuff.

\* From the *Annales de Chimie*, No. 122.

† We must here mention, that C. Chaptal, minister of the interior, a good judge in matters of this kind, when he communicated to us these observations, wrote as follows: "C. Haussmann, manufacturer of printed cottons at Laglebach, near Colmar, in the department of the Upper Rhine, well known among those chemists who apply the discoveries of science to improvements in the arts, transmitted to me the annexed memoir. In my opinion it will be of utility to make it known in your Annals, and the author on my request has consented to its being published." *Note of the Editors of the Annales de Chimie.*

The brightness and fixity of the colours obtained from maddering depend not only on the process, but also on the state and purity of the water as well as of the madder. It is therefore absolutely necessary to avoid or to render inactive every acid, alkaline or saline substance that may be contained in the water, or in the madder itself. I have shown that, by adding carbonate of lime, (pounded chalk,) madder which I suspected to contain gallic acid was corrected; but that my friend Charles Bertholdi, professor in the central school of the Upper Rhine, afterwards found that it was sulphuric acid united to magnesia.

The important discovery of this addition of chalk, which I made twenty-five years ago, has given birth to many manufactories, and improved all those established near waters which do not run over or hold in solution this earthy salt, without which it is absolutely impossible to obtain beautiful and fixed madder colours. This chalk since that time has become a new object of commerce; and as the price is very moderate, I have not yet determined the just proportion to be employed: in general, I take one part for four, five, or six, of madder.

In order to obtain the brightest madder colours, it is not sufficient to attend to the quality of the water and of the madder: it is necessary also to observe the degree of the heat of the bath: a low temperature will check the attraction of the colouring parts, and prevent them from being extracted, while one too high will favour the adhesion of the yellow particles of the madder, which obscure and tarnish the shades intended to be produced. The only colour which gains by increasing the heat is black. I have always observed, that on withdrawing the fire from below the boilers, when the hand can no longer be held in the aqueous vehicle which they contain, if the maddering be then continued for two or three hours, the most satisfactory results will be obtained, as the furnace still retains a sufficient quantity of heat to maintain the vehicle at the same temperature, especially when, according to custom, large boilers are employed. Besides, it would be very difficult to fix a determinate degree of heat by the thermometer when the furnaces are large.

The yellow parts of the madder as well as of other colouring substances are, it is probable, nothing else than the colouring parts themselves combined with oxygen. The product of this combination, by acquiring greater solubility, suffers itself with more difficulty to be taken away by clearing, if the heat has not been properly regulated during the process of dyeing. I have often observed that madder and other colouring

colouring substances, when long exposed to the atmospheric air, do not give colours of the same intensity and the same brightness as before; either because these substances absorb the oxygen of the atmosphere, or that they procure this radical from the water which they attract, or which they naturally contain as a constituent principle, and which is decomposed by a slow and insensible fermentation. The exposure, on the grafts, of cotton or linen dyed a dark madder red, might support the idea of a change to a reddish yellow; for this dark colour becomes clearer but fainter by the exposure, and then assumes a more agreeable shade of crimson. I have shown, in a memoir on indigo, inserted in the *Journal de Physique* for the year 1788, that nitric acid changes this blue fecula into a yellowish substance: a similar change takes place by exposing, on the meadow, the same fecula fixed on any stuff whatever; and the yellow resulting in these two ways is more soluble in warm water than in the same liquid when cold. It however appears that the combination of oxygen is not the only cause of the change of colours, since curtains of any stuff dyed or coloured any shade whatever by vegetable or animal substances, and exposed to the light, lose their colour entirely in the course of time on the side exposed to the solar rays, while the opposite side retains it for a considerable time. If the rays of the sun then give more vigour to living bodies of the animal and vegetable kingdom by disengaging from the latter oxygen gas, it appears that they act with destructive influence on the same bodies deprived of life; by decomposing their constituent principles. In all cases it will be proper to preserve the colouring ingredients in dry places sheltered from the light, which acts upon these bodies perhaps only by decomposing the constituent aqueous part, the oxygen of which may join the carbon to form carbonic acid. Resinous and oily substances should be preserved in the same way. These conjectures prove at least that the action of the sun's rays, or of light, on these bodies, in general presents a vast field for interesting experiments to be undertaken.

If in maddering brighter colours are obtained by carefully regulating the heat, a sacrifice is made at the same time of a small portion of the colouring parts of the madder, which cannot be entirely exhausted except by then increasing the heat to ebullition; but as the colours thus obtained are degraded more or less in the ratio of the quantity of the madder, the gall-nut or shumac used, this method must be employed with caution, and principally for common effects, either in regard to cotton or linen. To avoid as much as possible the loss of madder after the maddering of good arti-  
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cles has been terminated, and before the common ones are put into the boiler, powdered gall-nut or shumac must be added, with a new but small portion of madder: the process must be managed also in such a manner, that the ebullition shall not take place till two hours after.

I several times tried to exhaust the madder by simple ebullition, and without adding any thing else than chalk; but I found that this was unfavourable to all colours, black excepted: it even appeared that the effect of the madder was much less than when the heat was moderately applied, and when the accumulated caloric easily decomposed the colouring substance. It is this tendency to be decomposed, and particularly by fermentation, however little it be moistened or diluted with water, which has hitherto prevented me from obtaining a substantial colour, pretty dark, and sufficiently fixed to be applied on any kind of stuff. I observed also, that if the heat was carried too far the first time, in circumstances when it was proposed to madder a second and third time, it prevented me not only from obtaining bright and agreeable shades, but also of the requisite intensity. The aqueous vehicle of the madder, at too high a temperature, never fails to weaken the adhesive force of the alumine and the oxide of iron to the stuff, and to take from it a portion, which an experienced eye may easily remark on examining the bath.

I shall here repeat, that for common and low-priced articles it is indispensably necessary to employ gall-nuts or shumac, which will save one half and even two thirds of the madder; but the colours obtained are neither so fixed nor so bright. The addition of chalk, however, must not be omitted; otherwise the gallic acid will carry away a portion of the alumine and coloured oxide of iron, which will weaken the shades, and, by tarnishing the stuffs, will also attack the white which may have been preserved in them. Without the addition of gall-nuts or shumac, it seemed to me impossible to exhaust the madder entirely of its colouring parts; which made me presume that their adhesion is favoured by the viscid nature of the tanning principle of these astringent substances, which carry away and combine with themselves the colouring parts. I shall observe also, that gall-nuts as well as shumac lose the property of dyeing black; and acquire, on the other hand, that of dyeing or colouring alumine yellow, oxide of iron olive green, by the addition of chalk, the calcareous base of which unites itself to the gallic acid. Do these yellow and olive-green colours arise from any peculiar substance contained in the gall-nuts and shumac, or are they indebted for their

their origin to the tanning principle? This remains to be examined.

The quantity of madder to be employed in dyeing ought not only to be proportioned to the extent of the surfaces to be maddered, but also to the concentration of the liquors of the *acetite of alumine and iron*, improperly called mordants; that is to say, to the greater or less quantity of alumine and oxide of iron which these saline liquors, either insulated or mixed together, when they dry on the articles to be dyed, may have left or deposited there by the evaporation of the acetic acid. If the objects to be dyed are not numerous, and, in particular, when bright shades only are to be produced, they may be maddered only once; but when they are numerous, and intended to have dark shades, the maddering must be repeated twice, and even thrice. Three quarters of a pound of madder of a good quality are sufficient for dyeing a piece of white Indian cloth of ten ells in length and three quarters broad, intended to exhibit only a few coloured objects: the quantity of the colouring substance must be increased in the ratio of the mass of alumine and oxide of iron, fixed on a piece of stuff of the above dimensions. It may be extended to 6, 8, 10, and even 12 pounds, for a ground well covered with a lively and very intense colour. Intelligence and practice in the management of a dye-house will not fail to indicate nearly the proper proportions.

Whatever care may be employed in maddering to avoid the adhesion of the yellow parts, the colours obtained will be far from having all the beauty and fixity which they might acquire by clearing, preceded by very long ebullition in exceedingly pure water. This ebullition alone, by the addition of bran, will serve to brighten the colour: more rosy reds will be obtained by employing soap with or without the addition of bran; carbonate of potash or of soda, substituted for bran, will make the reds incline to crimson; but I must observe, that unless the workman chooses to run the risk of making the reds entirely brown, and in such a manner that it will not be possible to restore them, it will be necessary, before soap and alkalies are applied to the stuffs, to expose them to the action of the strongest heat that can be communicated to water. This operation will be attended with success, if as little passage as possible be afforded to the steam, and if the boilers employed be converted into a sort of digesters. The fixity of the colours will be proportioned to the time employed in exposing them to the action of the boiling water. It is needless to observe, that there is no danger

danger of spoiling the colours by soap and alkaline carbonates, when the maddering, instead of being directed with a moderate heat, has been carried to ebullition, as is practised in many dye-houses; but, in this case, the colours obtained are more difficult to be cleared.

As water charged with oxygenated muriatic acid easily carries away the colouring parts of madder, as well as other vegetable and animal substances, by decomposing them; and as acids more concentrated may, in their turn, take from the stuffs the colourless alumine and the oxide of iron, it is impossible for me to adopt the idea of a chemical combination of the colouring parts with alumine and metallic oxides, which, in my opinion, when fixed and coloured on any stuff, form only compound aggregates.

The clearing of objects printed on a white ground requires modifications, which I shall detail on a future occasion, when I find leisure. It will therefore be sufficient at present to state, that after continuing for some time my experiments on the Turkey red, inserted in the *Annales de Chimie* for the year 1792. I at last found a red much more beautiful and durable than that of the Levant, by fixing alumine on cotton, thread, and linen, by an alkaline solution of this earth mixed with linseed oil. The following is the process I employed.

[To be continued.]

### XXXIII. Notices respecting New Books.

*Ausführliche Geschichte der Theoretisch Praktischen Uhrmacherkunst, &c.* A History of Clock- and Watch-making, both Theoretical and Practical, since the earliest Method of dividing the Day to the End of the 18th Century. By I. H. MORIZ POPPE, 1801. 8vo. 564. p. 8.

THE author of this work having published, in 1797, An Essay towards a History of the Origin and Progress of Clock- and Watch-making, consisting of six sheets; it met with such a favourable reception, that he was induced to improve and enlarge it to its present size. He acknowledges the obligations he is under to professors Kastner and Beckmann, who assisted him with their advice and information; and who, on account of their learning and extensive reading, were able to supply him with much useful information. The whole work is divided into ten chapters.

I. *The oldest method of dividing the day, and the invention of sun-dials.*—The period when sun-dials were invented is as  
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