Exploring the colours of the past

in the steps of ancient dyers

Dominique Cardon, Iris Brémaud, Anita Quye, & Jenny Balfour-Paul

Abstract

The purpose of this paper is to present some aspects of the contributions to the history of colours and dyeing technology that can be gained from the comprehensive study of two series of dye books or technical memoirs on dyeing which, for each colour name, do not only give precise descriptions of the colorants and processes used to obtain that particular shade, but actually show what it looks like, by including patterns of dyed fabric. The documents studied were respectively produced in London and in the south of France around the mid-eighteenth century AD.

Figure Captions

FIG. 1 Back of front cover and folio 1 recto of Dye Book 13 in the Crutchley Archive. Photo D. Cardon.

FIG. 2 Diagram of relative importance of different colour names describing patterns in the Crutchley dye books, calculated in relation with a total of 775 dyed patterns whose colour is described by a colour name. Diagram I. Brémaud/D. Cardon.

FIG. 3 Pattern of broadcloth dyed *scharlake*, folio 5 verso of Dye Book 7 in the Crutchley Archive. Photo D. Cardon.

FIG. 4 Pattern of long broadcloth dyed crimson, pattern n° 304 in Pattern Book 3 in the Crutchley Archive. Photo D. Cardon.

FIG. 5 Pattern of long broadcloth dyed *Visner* on 31 March 1731, folio 75 recto of Dye Book 7 in the Crutchley Archive. Photo D. Cardon.

FIG. 6 Patterns of Winchester broadcloth dyed *chieri* (above, recipe in Dutch/Flemish) and *cherreys* (below, recipe in English) on 20 of May 1726, folio 8 recto of Dye Book 13 in the Crutchley Archive. Photo D. Cardon.

FIG. 7 Patterns of long bays dyed buff (above) and flesh (below) in november 1738, Pattern Book 2 in the Crutchley Archive. Photo D. Cardon.

FIG. 8 Pattern of Gloucester cloth dyed yellow in July 1740, Pattern Book 3 in the Crutchley Archive. Photo D. Cardon.

FIG. 9 Pattern of long bay dyed gold in October 1740, Pattern Book 3 in the Crutchley Archive. Photo D. Cardon.

FIG. 10 Patterns of shalloons dyed yolk in March 1740, Pattern Book 3 in the Crutchley Archive. Photo D. Cardon.

FIG. 11 Pattern of long bay dyed pink in June 1741, Pattern Book 3 in the Crutchley Archive. Photo D. Cardon.

FIG. 12 Patterns of long broadcloth dyed rose in April 1741. The bottom pattern shows the final result after a "rousing" bath composed of "hot water and piss". Pattern Book 3 in the Crutchley Archive. Photo D. Cardon.

FIG. 13 Patterns of long bays dyed "peach blossom" in January 1740, Pattern Book 2 in the Crutchley Archive. Photo D. Cardon.

FIG. 14 Patterns of long bays dyed "silver cullor", Pattern Book 2 in the Crutchley Archive. Photo D. Cardon.

FIG. 15 Patterns of "Salsbery broad cloth dyed Orrang Couller" (top), "Pink" (middle), "orira" (bottom), Dye Book 13 in the Crutchley Archive. Photo D. Cardon.

FIG. 16 Patterns of "hair list Drab" cloth dyed "violat" in August 1741. The top patterns "woadded to ye pattern" show the exact degree of the blue ground preceding the "boiling", "graining" and "rousing" processes done at the Crutchleys'. Pattern Book 3 in the Crutchley Archive. Photo D. Cardon.

FIG. 17 Patterns of "Drab cloth" dyed "purple" in July 1741. The top patterns show the exact degree of the blue ground preceding the "boiling", "graining" and "rousing" processes done at the Crutchleys'. Pattern Book 3 in the Crutchley Archive. Photo D. Cardon.

FIG 18 Pattern of "Stop list cloth" dyed "red" in June 1741. Pattern Book 3 in the Crutchley Archive. Photo D. Cardon.

FIG. 19 Measuring the colours of patterns in Paul Gout's *Memoirs* with a portable colorimeter. Photo D. Cardon.

FIG. 20 Pattern of Londrin Second cloth dyed red by Mr Vialat in 1747. Archives départementales de l'Hérault, C/2229. Photo D. Cardon.

FIG. 21 Pattern of Londrin Second cloth dyed red by Mr Dardé in 1747, using bran liquor in the red dye-bath. Archives départementales de l'Hérault, C/2229. Photo D. Cardon.

FIG. 22 Pattern of Londrin Second cloth dyed red in 1753 by Mr Pascal, founder of the Manufacture royale de Montoulieu . Archives départementales de l'Hérault, C/2167. Photo D. Cardon.

FIG. 23 Pattern n° 213 "Stop list cloth" dyed "red" in June 1739. Pattern Book 2 in the Crutchley Archive. Photo D. Cardon.

FIG. 24 Patterns n° 214 and 215 "Stop list cloths" dyed "red" in June 1739. Pattern Book 2 in the Crutchley Archive. Photo D. Cardon.

FIG. 25 Patterns n° 225, 226 and 227 cloths dyed "red" in June 1739. Pattern Book 2 in the Crutchley Archive. Photo D. Cardon.

FIG. 26 Mapping of individual colorimetric values of patterns in table 1. Diagram I. Brémaud/D. Cardon.

FIG. 27 Calculation of colour differences between patterns in table 1 and pattern n° 213 in Pattern Book 2 of the Crutchley Archive taken as reference. Diagram I. Brémaud/D. Cardon.

A way out of a conundrum

The colorants that have given their colours to ancient textiles can usually be identified now, thanks to the huge progresses in analytical techniques that have been made in the last fourty years. More exactly, the biological and chemical group they belong to can usually be identified. In some cases, however, the precise biological species used remains difficult or impossible to pinpoint. In cases of colours resulting from the use of several different colorants, this same difficulty may be encountered for each of the components of the final colour. Part of the uncertainty comes from a lack of close correlation between the proportions of colorants indicated by the dye analyses of some ancient textiles and the proportions of colorants present on available references obtained today. This may be due, in part or totally, to differences in the dyeing – including mordanting – processes used.

Such complex context singles out the usefulness of the rather rare historical documents that provide all the necessary clues to understand ancient colours and attempt to reproduce them : this is particularly the case of a number of dye books or technical memoirs on dyeing which, for each colour name, do not only give precise descriptions of the colorants and processes used to obtain that particular shade, but actually show what it looks like, by including patterns of dyed fabric or yarn.

The purpose of this paper is to present some aspects of the contributions to the history of colours and dyeing technology that can be gained from the comprehensive study of two series of such documents, respectively produced in London and in the south of France around the mid-eighteenth century AD.

Sources of colours

The sources

The first series consists of manuscript dye books belonging to the Crutchley Archive, a collection of fifteen family-owned books relating to piece-dyeing of wool fabrics of different types and qualities. They specialized in mordant-dyeing, mostly with red colorants such as madder, cochineal and stick lac but also with exotic dye-woods and some yellow dyestuffs. The preserved dye books in the collection still contain hundreds of dyed textiles with well-preserved colours and detailed dated dyeing instructions covering a near-continuous period from 1722 to 1744, with some earlier entries from 1716. They centre around John Crutchley, an eighteenth-century dyer operating in Southwark, on the southern bank of the Thames, facing the City of London. They are unpublished and still under investigation by our research team, but some reports and results have already been presented[1].

The second series consists of memoirs on dyeing written in Languedoc, in the south of France. The earliest known memoir, dealing with piece-dyeing in the whole range of fast dyes for wool, was produced in the spring of 1744 by Antoine Janot, a master-dyer owner of dyeworks in Saint-Chinian, a town situated some 30 kilometres to the north-west of Béziers, that was an important centre of production of fine wool broadcloths in the 18th century. He completed his first *Memoir* with a second one, written during the summer of the same year, dealing with three more colours particularly fahionable at the time, and with a last memoir focusing on madder-red, in 1747. Janot's three memoirs are now published with colour plates of all the pages with dyed colour patterns, and translations into English are forthcoming[2].

A manuscript including four memoirs on dyeing, two of which are illustrated with patterns of piece-dyed broadcloth, was produced a little later, in 1762 or 1763, by an anonymous author whom research finally allowed to identify as Paul Gout, the director of the Royal Manufacture of broadcloth of Bize, a town close to Saint-Chinian. Gout had earlier been appointed as the

young manager of one of the two Royal Manufactures of broadcloth in Saint-Chinian, situated just next to Antoine Janot's dye works. This had given him many occasions to discuss with Janot and to benefit from his expertise in dyeing, so that Janot's memoirs obviously inspired him, in his turn, to share his own knowledge and the results of the experiences on dyeing he had been pursuing since then. Gout's memoirs and their translation into English are also published with colour plates of all the pages with dyed patterns[3].

Colours and colour names in the sources

Only eight out of the nine dye-books in the Crutchley Archive still contain patterns of dyed textiles corresponding to descriptions of the processes by which their colours have been obtained. However, the name of the colour or nuance of the pattern is not always mentioned. This applies particularly to light shades of pink, mauve and yellow obtained by recycling mordant- or dye-baths already used for prestigious saturated colours using expensive dyestuffs. Another major problem is that some of the Crutchley dye books are in a poor to very bad state of preservation, with dampened pages whose paper has become so fragile that they cannot be consulted, while in other places samples have come loose so that it is unsecure to associate their colour to particular colour names and processes described in the part of the book where they are inserted now. Even in the better preserved dye books, patterns on the outer pages have been stained or discoloured by dampness and mildew (**fig. 1**). These limitations still leave a number of 775 dyed patterns whose colour is described by a colour name and which correspond to a precise description of the whole process by which this colour has been obtained.

That the Crutchleys specialized in mordant-dyeing with red dyestuffs, is manifest both from the actual colours of the samples and from the colour names by which they are described, overwhelmingly representing the section of the colour spectrum ranging from orange red to

purple (**fig. 2**). The most common colour is scarlet, also mentioned as *scharlake*, *scharlaken*, or *scarlatt* in the earlier dye books, two of which are entirely written in Dutch/Flemish while two others have recipes in Dutch/Flemish on one page, with the corresponding English tranlation on the facing page. This reveals that the Crutchleys employed one or possibly several Flemish or Dutch master-dyer(s) at the beginning of their business. All together, the patterns described as *scharlake*/*scharlaken* (36 patterns), *scarlatt* (77 patterns) or scarlet (180 patterns) amount to 37.8 % of the number of patterns described by a colour name (**fig. 3**). The next most frequent colour is the crimson group, mentioned as *carmosijn* in the recipes in Dutch/Flemish. Besides standard crimson (40 samples) and *carmosijn* (19 samples) several nuances of crimson are distinguished, according to saturation – "deep" crimson or *carmosijn* (14 samples), "bright crimson" (3 samples) – lightness (3 samples of "light" crimson or *carmosijn*), hue (1 sample of "scarlet crimson") or process (3 samples of "mock crimson" from non-fast "out of grain" ingredients). All together, the crimson/*carmosijn* group amounts to 83 samples, i.e. 10.7 % of the total number of patterns described by a colour name (**fig. 4**). Two more shades of purplish reds are often produced at the Crutchleys' dyeworks: firstly, the group of 49 patterns of the "wine" or "vine" colour, variously mentioned as *wiens*, *wyn*, *visne* or *visner* (**fig. 5**) and *wijn* in the recipes in Dutch/Flemish, which includes 3 patterns of "deep wine", amounting together to 6.7 % of all patterns considered for this study; and a smaller group of 20 patterns of "cherry" (**fig. 6**), including 4 "light cherry" and 2 "deep cherry", amounting to a proportion of 2.6 % of all patterns. The third most common colour mentioned after scarlet and crimson, however, is "buff" (**fig. 7**), represented by 73 patterns, i.e. 9.4 % of the total. Including a wide range of feebly saturated light yellows, it illustrates the importance attached by the Crutchleys to optimising the use of costly ingredients through recycling, since buff patterns usually correspond to processes reusing yellow-coloured mordant baths commonly used for scarlet-dyeing. This also applies to a few patterns described as "yellow"

(**fig. 8**) (2 patterns i.e. 0.25 % of total), "gold" (**fig. 9**) (3 patterns, i.e. 0.4 %) or "yolk" (**fig. 10**) (6 patterns, i.e. 0.8 %). The Crutchleys also offered a range of gradually less and less saturated light red to pale pink shades. The most common is "pink" (**fig. 11**) (66 patterns) including "full pink" (3 patterns) and "deep pink" (1 pattern) amounting to 8.5 % of total. "Flesh", a very pale pink, is also a popular colour, with 52 patterns (including one of "full flesh"), amounting to 6.7 % of total. "Rose" (**fig. 12**), slightly more purplish than "pink", is illustrated by 22 patterns amounting to 2.8 % of all patterns and is also declined as "deep" or "light" rose (1 pattern of each). The "blossom" group illustrated by 18 patterns (i.e. 2.3 % of total) includes 4 patterns of "peach blossom" (**fig. 13**), 2 of "light blossom" and one of "rosemary blossom". With a little addition of a non fast blue colorant, such as logwood, blossom pink turns to a greyish mauve poetically called "silver" (**fig. 14**) for 2 patterns, representing 0.25 % of all patterns. "Aurora" 18 patterns or 2.5 % of total) and "orange" (13 patterns i.e. 1.7 %) are less saturated lighter colours obtained in the same way as scarlet, only with smaller quantities of ingredients (**fig. 15**). "Violat" (**fig. 16**) (21 patterns i.e. 2.7 % f total) and "purple" (**fig. 17**) (6 patterns i.e. 0.8 %) were only done on high quality broadcloth and only the red-dyeing second step of the process took place at the Crutchleys, after the fast blue grounds necessary for the two shades had been given by the woad-and-indigo dyers on the northern bank of the river, "at London".

Lastly, 24 patterns (3.1 %) are described as "red" (18 patterns), *root* (1 pattern) or *craproot* (5 patterns) (**fig. 18**). It clearly appears to be a name reserved to a vivid red obtained purely from madder.

The Crutchleys' palette is therefore described with 18 colour names and a few adjectives allowing to subdivide some colours into nuances, mostly according to lightness or saturation.

In Antoine Janot's first *Memoir,* processes to obtain 65 different colours in the fast mode of dyeing (*en bon teint*) are described. However, only 59 patterns of dyed fine wool broadcloth

now figure in the manuscript, partly because some of the colours were not illustrated by a sample, from the start, and partly because a few samples got detached from the place where they were stuck and have been lost. His second *Memoir* describes processes for three colours then in high demand : crimson (*cramoisi*), wine soup (*soupe au vin*) and celadon green (*vert céladon*). Janot was not satisfied with the processes currently used by most dyers and proposes recipes to obtain these colours in the fast mode of dyeing. The memoir is illustrated with 5 patterns, two of them representing the degrees of light woad-and-indigo blue he has used as grounds for the wine soup and celadon green colours, respectively. His last *Memoir,* proposing an optimised process for dyeing red with madder, is illustrated with 2 colour samples because at the end, 1 sample of celadon green has been added by Janot.

Here is the list of all Janot's colours illustrated by a pattern of dyed wool broadcloth, in the order in which they appear in his *Memoirs*: raven's wing (*aile de courbeau*), Turkish blue (*bleu turquin*), King's blue (*bleu de Roy*), celestial blue (*bleu céleste*), azure blue (*bleu d'azur*), sky blue (*bleu de ciel*), dainty blue (*bleu mignon*), off-white blue (*bleu deblanchy*), grass green (*vert d'herbe*), emerald (*émeraude*), parrot green (*vert perroquet*), light *festequet* green (*vert clair festequet*), pistachio green (*vert pistache*), yellow green (vert jaune), yellow (jaune), lemon yellow (*jaune citr*on), sulphur yellow (*jaune souffré*), straw yellow *(jeaune paille*), golden yellow (jeaune doré), yellow wax (*cire jeaune*), cinnamon (*canelle*), hazelnut (*noizette*), dead leaf (*feuille morte*), coffee (*caffé*), musk (musc), tobacco (*tabac*), olive green (*vert d'olive*), rotten olive green (*vert d'olive pourry*), dry olive green (*vert d'olive* seiche), madder red (rouge de garance), saddened red (rouge bruny), King's colour (couleur de Roy), crimson purple (*pourpre cramoizy*), crimson amaranth (*amarante cramoizy*), crimson violet (*viollet cramoizy*), mauve, lilac (*lilla*), quince blossom (*fleur de coin*), linen grey (*gris de lin*), sour cherry (*agriotte*), plum grey (gris de prune), chamois (*chamoix*), iron grey (*gris de fer*), mole grey (*gris de taupe*), bezoar grey (*gris de blezouard*), beaver grey (*gris castor*), prince

grey (*gris de prince*), crimson (*cramoizy*), scarlet (*écarlatte*), flame scarlet (*écarlatte feu*), cherry (*cerize*), rose, jujube, spiny lobster (*langoutte*), orange, mimosa (*cassie*), daffodil (*jonquille*), cabbage green (*vert de chou*); winesoup (*soupeavin*) with its corresponding blue ground of off-white blue (*bleu deblanchy*), celadon green (*vert seladon*) again with its corresponding blue ground of off-white blue (*bleu deblanchy*), madder red (*rouge de garance*).

Paul Gout's second *Memoir* includes 108 patterns of the same fine wool broadcloth as in Antoine Janot's *Memoirs*, all dyed in different colours illustrating corresponding dye recipes. His fourth *Memoir* includes 59 more patterns, some corresponding to alternative processes for colours already presented in the second *Memoir*, others to new colours or nuances.

Here is the list of all Gout's colours illustrated by a pattern of dyed wool broadcloth, in the order in which they appear in his *Memoirs*.

In the second *Memoir*: Persian blue (*bleu pers*), Turkish blue (*bleu turquin*), King's blue (*bleu de Roy*), tanned blue (*bleu tanné*), azure bleu (*bleu d'azur*), celestial blue (*bleu céleste*), dainty blue (*bleu mignon*), milky blue (*bleu de lait*), off-white blue (*bleu déblanchi*), scarlet (*écarlate*), flame colour (*couleur de f*eu), pomegranate blossom (*fleur de grenade*), jujube, spiny lobster (langouste), orange, pale orange or apricot (*orange pâle* or *abricot*), gold (*couleur d'or*), mimosa blossom (*cassie*), daffodil (*jonquille*), chamois, doe (*biche*), coffee with milk (*café au lait*) milk chocolate (*chocolat au lait*), crimson (*cramoisi*), wine soup (*soupevin*), vetch blossom (*vessina*), sour cherry (*griotte*), cherry (*cerise*), rose, flesh (*chair*), pale flesh (*chair pâle*), purple (*pourpre*), violet, lilac (*lilas*), dove breast (*gorge de pigeon*), mauve, linen grey (*gris de lin*), peach blossom (*fleur de pêcher*), madder red (rouge de *garanc*e), crimson madder (*garance cramoisillé*), saddened red (*rouge bruni*), King's colour (*couleur de Roy*), King's colour without saddening (*couleur de Roy sans bruniture*), golden Moor (Maure doré), golden cinnamon (*cannelle doré*), reddish cinnamon (*cannelle*

rougeâtre), burnt cinnamon (*cannelle brûlé*), golden wax (*cire doré*), lemon, yellow (*jaune*), golden yellow (*jaune doré*), tanned yellow (*jaune tanné*), dead leaf (*feuille morte*), *festiqui*, black green (*vert noir*), dark green (*vert brun*), duck green (*vert de canard*), full grass green (*vert d'herbe rempli*), grass green (*vert d'herbe*), emerald (*émeraude*), parrott (*perroque*t), light green (*vert clair*), gay green (*vert gay*), nascent green (*vert naissant*), pistachio green (*vert pistache*), apple green (*vert pomme*), cabbage green (*vert de chou*), sea green (*vert de mer*), celadon green (*vert céladon*), dark olive (*olive brun*), rotten olive (*olive pourrie*), olive, green olive (*olive verte*), dry olive (*olive sèche*), Saxon blue (*bleu de Prusse*), apple-green (*vert de pomme*), Saxon apple-green (*vert de pomme Saxe*), Saxon off-white blue (*bleu déblanchi Saxe*), brown (*marron*), reddish brown (*marron rougeâtre*), full clove (*girofle rempli*), plum (*prune*), greyish plum (*prune grisâtre*), hazelnut (*noisette*), reddish hazelnut (*noisette rougeâtre*), soft hazelnut (*noisette doux*), doe hazelnut (*noisette biche*), dark hazelnut (*noisette foncé*), greenish hazelnut (*noisette verdâtre*), tobacco (*tabac*), dark tobacco (*tabac brun*), Spanish tobacco (*tabac d'Espagne*), greenish tobacco (*tabac verdâtre*), coffee (*café*), black (*noir*), mole (*taupe*), slate (*ardoise*), lead grey (*gris de plomb*), rat grey (*gris de rat*), darker rat grey (*gris de rat plus foncé*), reddish rat grey (*gris de rat rougeâtre*), agate, light agate (*agathe clair*), rat on hazelnut (*rat sur noisette*), beaver grey (*gris de castor*), pearl grey (*gris de perle*), silver grey (*gris d'argent*).

In the fourth *Memoir* : scarlet (*écarlate*), grass green (*vert d'herbe*), crimson (*cramoisi*), agate, flame colour (*couleur de feu*), winesoup (*soupevin*), royal winesoup (*soupevin royal*), superior winesoup (*soupevin supérieur*), royal amaranth (*amaranthe royal*), vetch blossom (vessinat), madder red (*rouge de garance*), bronze green (*vert bronzé*), spiny lobster (*langouste*), greenish coffee (*café verdâtre*), orange, Saxon green (*vert de Saxe*), Saxon celadon (*céladon Saxe*), bright daffodil (*jonquille vif*), gunpowder of the English (*poudre à canon des Anglais*), rose, lilac (*lilas*), light dove breast (*gorge de pigeon clair*), Saxon apple

green (*vert de pomme Saxe*), golden Moor (*Maure doré*), chestnut brown (*marron*), gold colour (*couleur d'or*), mimosa blossom (*cassie*), grass green (*vert d'herbe*), yellow (*jaune*), English doe (*biche anglais*), caper green (*vert de câpre*), English purple (*pourpre anglais*), English violet (*violet anglais*), lemon (*limon*), golden yellow (*jaune doré*), golden wax (*cire doré*), cinnamon (*cannelle*), festiqui, mole (*taupe*), slate (*ardoise*), saddened red (*rouge bruni*), King's colour (*couleur de Roy*), reddish hazelnut (*noisette rougeâtre*), ash grey (*gris cendré*), jujube, Saxon blue (*bleu de Prusse*), Saxon off-white blue (*bleu déblanchi Saxe*), bishop violet (*violet d'évêque*), dark grass (*herbe foncé*), dark green (*vert brun*), wine soup (*soupevin*), amaranth, violet purple (*pourpre violet*), dark purple (*pourpre foncé*), cherry (*cerise*), nascent green without woad (*vert naissant sans pastel*), chamois.

Beyond their poetical, evocative power, these lists must also be read as a technical language. They show that 14 colour names literally correspond, in the English and Dutch/Flemish recipes of the Crutchley books and in the recipes in French of the two Languedocian dyers: firstly, red, a colour name synonym with madder red for all dyers. In the two ranges of orangey or purplish reds obtained from insect dyes, most names for the different degrees are also common in these sources: scarlet, orange, gold and yellow in the range of colours deriving from the mordanting and dyeing processes for scarlet ; violet, purple, wine/winesoup, crimson, cherry, rose, blossom, flesh and silver in the range of purple to mauve.

Such correspondances obviously offer precious oportunities for precisely comparing the dyeing technology and coloristic expertise of broadcloth dyers in two of the most important regions of production of the major branch of textile industry in Europe at the time.

Characterising colours, comparing the comparable

How can one objectively and precisely assess the actual chromatic correspondances or differences between patterns described by the same colour names?

Answering this question is but one of the objectives of a more general research currently pursued by the authors: the aim is to collect a databank of the chromatic characteristics of as many dyed textile patterns preserved in historical documents as possible, in order to provide a sound basis to follow the evolutions of colour names, map the chromatic spaces the different names correspond to, and try to relate such informations on colour terminology and chromatic content with the evolution of dyeing technologies during the era of pre-synthetic dyes.

For the present study, the first step has consisted in performing colorimetric measurements of all the dyed textile patterns in the sources discussed (**fig. 19**) - taking into account the limitations already mentioned about the present state of preservation of the Crutchley archive. The results are expressed in the most widely used international system of specification for surface colours and particularly, for the colours of textiles : the CIELAB (L*a*b*) chromatic space, proposed in 1976 by the *Commission Internationale de l'Eclairage* (International Commission on Illumination). Specification of the colour of each sample is also expressed in the complementary CIE LCH system.

To allow a pertinent comparison of the chromatic characteristics of patterns illustrating similar colour names in the different sources, the type and quality of the fabrics being dyed also have to be taken into account. The same quality of fine wool broadcloth, known as Londrin Second, was used for the patterns in the *Memoirs* of the two Languedocian dyers. It was the best-selling quality and the third finest in the range of fine broadcloths that were especially produced for exportation via Marseilles to the different ports of the Levant. Its technical specifications have been described and compared with those of some English and Dutch rival products in a former publication[4]. By contrast, the Crutchleys' dye works catered for a wider diversity of clients bringing many different types and lengths of wool fabrics to

be dyed, from worsteds and new draperies such as shalloons and bays, to a range of different good quality broadcloths, including the one called “drab”, also a best-seller in the Levant. For the following colour comparisons, therefore, only patterns dyed on broadcloth have been selected in the Crutchleys’ dye books.

For the chromatic specification of the patterns, chromaticity coordinates are expressed, as mentioned above, according to the two complementary systems CIE L*a*b*, and CIE L*C*h°.

In these systems, colour is defined by three co-ordinates:

1) Lightness or L* on the axis of greys (from black, corresponding to L* = 0, to white, corresponding to L* = 100) ;

2) on the a* axis, green (negative values of a*) is opposed to red (positive values of a*) ;

3) along the b* axis, blue (negative values of b*) is opposed to yellow (positive values of b*).

The same system can be expressed in terms of Chromaticity, C* and hue angle, h° : C* describes the chromaticity or colourfulness, based on a given level on the axis of greys (C* = 0 = no saturation ; C* = 100 = maximum saturation) ; h° defines hue in a circular way (0° = magenta red; 90° = yellow ; 180° = green ; 270° = blue ; 359° = nearly magenta red).

Material and methods

All the patterns have been measured in the same conditions. Measurements were performed in rooms protected from direct sunlight, using the same portable colorimeter Datacolor® microflash. Data were integrated at between 400 and 710nm (at 10nm intervals), with a diffuse illumination geometry, a 45°/0° measuring head, specular reflectance being excluded. The colorimetric data corresponding to the CIELab and CIELCh systems were obtained according to the CIE 10° standard observer, using standard illuminant D65, corresponding to day light and commonly used for textiles. The observed surface corresponded to 59mm²

(8,7mm diameter aperture). Whenever the size of the pattern permitted, each pattern was measured at two to three different points. The values presented here correspond to the average calculated from the data obtained from the successive measurements.

Just red

Within the scope of this paper, it is evident that it is not possible to present detailed comparisons for all the 14 colours that have been found to be given the same name by the Crutchleys and the Languedocian dyers. Since the Crutchleys were specialized in red-dyeing, it seems appropriate, as a case study, to choose an emblematic red dye in which they were expert: madder red.

This dye being most commonly done by them on fine broadcloths, it makes comparisons with patterns of Languedocian Londrin Second cloth dyed into madder red fairly pertinent. Because of the importance of this dye/colour, many patterns of madder red have been preserved in the Archives of the ancient province of Languedoc, which permits to extend comparisons to the reds produced by five different Languedocian dyers (table 1).

The processes by which Janot's and Gout's reds were obtained are precisely described in their memoirs and since the standard weight of a piece of Londrin Second cloth had been prescribed by a royal regulation, it is possible to calculate the proportions of ingredients used in their recipes (table 2). By contrast, though the processes are also very precisely described in the Crutchleys' dye books, it is unfortunately very seldom possible to use the quantitative data mentioned to calculate proportions in relation with the dry weight of fabric to be dyed. This is because, even in the rather rare cases in which the type and quality of broadcloth are specified, the weight of the pieces cannot be precisely known since it was not submitted to

regulation. It must have been relatively uniform for each category, so that the Crutchleys did not feel the need to write it down repeatedly.

Their dye books not being published, we here provide transcriptions of the processes corresponding to the patterns used for comparisons in table 1.

Let us first offer a sampling of what the entries actually read like:

Pattern Book 2, folio 73:

"*N° 213 June 1739 for Mr Bosanquett*

Boyl.^{g} 5 Stop list Clo., after a Boyl.^{g} of red bays

35 lb argol 30 lb allom 1 pint Spirits

2 hours boyl

Boyl.^{g} 5 D^{o} after a Boyl.^{g} of red Lo: bays

35 lb argol 30 lb allom 1 pint Sp.^{ts}

2 hours boyl

Madd.^{d} y^{e} above 10 Clo.a pretty good heat w.th 13 ½ lb Umbro & 1 ½ lb gamean p Cloth.

folio 74

N° 214 June 1739 for Mr Forster

1st. Boyl.^{g} 5 Stop list Clo. red – Viz.

30 lb argol 30 allom 3 q^{ts} Sp.^{ts} 7 pales br: Liq^{r}

1 ½ hour boyl

N° 215 2^{d}. Boyl.^{g} 5 D^{o} … D^{o} – Viz.

25 lb argol 25 lb allom 3 q^{ts} Sp.^{ts} -

1 ½ hour boyl

Madd.^{d} y^{e} above 10 Clo. w.th 14 lb Umbro & 1 lb Gam.^{n} p Cloth"

Now, here follows the transcription of the same entries and of the entries corresponding to patterns 4-6 in table 1, in present day spelling and with abbreviations developed :

folio 73 (fig. 20)

"N° 213 June 1739 for Mr Bosanquett

Boiling 5 Stop list cloths, after a boiling of red bays

35 lb of argol, 30 lb of alum, 1 pint of spirits

boil for 2 hours

Boiling 5 dito after a boiling of red Long bays

35 lb of argol, 30 lb of alum, 1 pint of spirits

boil for 2 hours

Maddered the above 10 cloths at a pretty good heat with 13 ½ lb Umbro & 1 ½ lb gamean per cloth.

folio 74 (fig. 21)

N° 214 June 1739 for Mr Forster

1st. Boiling 5 Stop list cloths red – Viz.

30 lb of argol, 30 lb of alum, 3 quarts of spirits, 7 pails of bran liquor

boil for 1 ½ hour

N° 215 2d. Boiling 5 dito … dito – Viz.

25 lb of argol, 25 lb of alum, 3 quarts spirits -

boil for 1 ½ hour

Maddered the above 10 cloths with 14 lb of Umbro and 1 lb of Gamean per cloth"

folio 75 (fig. 22)

N° 225 June 1739 for Mr Nettelton

1st. Boiling 4 cloths red – Viz.

24 lb of argol, 24 lb of alum, 3 quarts of spirits, 7 pails of bran liquor

boil for 1 ½ hour

N° 226 2d. Boiling 4 dito … dito – Viz.

20 lb of argol, 20 lb of alum, 3 quarts of spirits

boil for 1 ½ hour

N° 227 3d. Boiling 4 ½ dito … dito – Viz.

23 lb of argol, 23 lb of alum, 3 quarts of spirits

boil for 1 ½ hour

Maddered the above 12 ½ cloths at a moderate heat with 14 ½ lb Umbro per piece & 10 lb Gamean."

All the clue elements are thus routinely recorded. Only the weight of the cloths is missing and although it is precised that patterns n° 213-215 have been cut from pieces of a quality of

broadcloth identified as ”five stop list”, it does not help because the standard dimensions and weight of that type of cloth are unfortunately not known.

The mordanting process is described first, for different lots of cloths that will then be dyed together in the same red dye-bath. This first operation is called « boiling » (*bouillon* in French) because it involves turning the pieces for a long period of time through a bath maintained at boiling temperature, to absorb the mordants. Three mordanting agents figure in all the recipes of “boiling”: argol, i.e. crude tartar from wine barrels ; alum, of quality and provenance not specified ; and “spirits”, the name given to the new tin mordant originally adopted to obtain a scarlet colour with American cochineal. Used in the form of a yellow liquor, “spirits” are obtained by dissolving granulated tin in nitric acid (*aqua fortis*) diluted with water and ammonia. This mordant is usually prepared at the dye works, shortly before being used. A fourth ingredient, bran liquor, is only added in the boiling processes for n° 214 and n° 225. It is obtained by letting a decoction of wheat bran go sour (it is called “*eaux sûres*” by French dyers who, however, do not use this preparation in their mordant baths for madder red). Antoine Janot instead puts wheat bran which has the function of precipitating any impurities that might alter the river water he uses.

This is not the only difference between the Crutchleys and the Laguedocian dyers, concerning the mordanting processes. The most remarkable one lies in the proportions of tartar used in relation with alum: while the Languedocian dyers use between 12 and 16% less tartar than alum, the Crutchleys’ dyers systematically use at least as much tartar as alum. Also, neither Janot nor Gout use any “spirits” (which they call *composition*) in their mordant baths for madder reds. Gout comments that “other dyers put 1 pound tin liquor for scarlet. This acid gives a much brighter effect, but it makes it more difficult to get a uniform colour”[5].

They also differ in the way they compose their red dye-baths, even though the main ingredient is the same. The name the Crutchleys give it, “Umbro”, comes from Dutch/Flemish

onberoofde, which is unstripped madder, the *garance non robée* of Languedocian dyers. It was the second best quality of madder, obtained after a first pounding of the dried roots at the mill had eliminated the remaining earth and all the thin roots. The name of the other quality of madder used at the Crutchleys', *"Gamean"*, comes from Dutch/Flemish *gemeen,* common. It is the equivalent of the *garance commune* of French dyers. Years later, William Partridge, discussing the different qualities of madder in his own *Practical Treatise on Dying* published in 1823, describes "gamene" as the third grade of madder, just above the lowest, and he confirms that "the umbro and gamene are mostly used in England"[6]. None of the Languedocian dyers mention using common madder for reds, however, but only for various shades of browns or in the setting of woad-and-indigo vats[7]. By contrast, they add other ingredients that may affect the pH of their madder dye-baths and/or help the colorants uptake, such as tartar, bran liquor, gall nut or ammonia.

All in all, it transpires that the way the Crutchleys prepare to obtain just the right red consists of finely adjusting the composition and pH of the mordant baths, and then only playing on different proportions of two slightly different qualities of madder in the red dye-baths. While the Languedocian dyers' strategy was to try and adjust the colour right through the whole process, including in the dye-baths. It would be extremely interesting to analyze all these patterns by HPLC or UHPLC in order to check whether all these subtle variations in the nature and proportions of ingredients are reflected in the proportions of the differents components of madder fixed on the cloths by the different processes. Taking even minute samples for such analyses is a difficult decision to take, however, given the small sizes of the patterns. An alternative solution might be to try and replicate these recipes as exactly as possible (not forgetting the importance of the differences in the waters used) and analyze the resulting patterns.

What must already be stressed at this stage is that, combining the results of this technological analysis of the processes with the chromatic data of the resulting patterns, one gets to realize with amazement that the Crutchleys and their Languedocian colleagues managed to reach closely similar results (fig. and). While they were working with completely different water resources and dyeing with one of the most complex natural colorants, their expertise at playing with proportions of ingredients, pH, temperatures and times of baths was focusing on obtaining what this study proves to be a common vision of true, madder, red. Fig. shows similar dispersions within the group of patterns from the Crutchley archive and the group of patterns from the Languedocian dyers: both groups completely overlap for ligthness and chroma (fig. , left). The only slight difference is that the hue angles of the Cruchleys' patterns are very slightly higher, that is more orangey, than those of the Languedocian dyers (fig. , right). Maybe the result of their systematically adding "spirits" in the mordant baths? However, calculating the colour differences between all samples and sample n° 213 of Pattern Book 2 of the Crutchleys taken as reference, is revealing. Using the Colour Difference formula CIEDE 2000 (of improved accuracy), it appears that within each group, differences never reach a value of 2; and moreover, that the two groups differ remarkably little: Janot's pattern of madder red in his *Mémoire sur les rouges de garance* (pattern 3') is closer to the red of pattern n° 213 than is pattern n° 215 in the same Pattern Book 2 of the Crutchleys. All patterns are well below the value of 2, which, in the CIEDE 2000 system, is the level presently fixed as the maximum acceptable difference for two lots of coloured objects in the industry. For a majority of samples in the two groups, the difference in relation with the reference pattern is inferior to 1. It is important to stress that below this value of 1 in this system, colour differences are not perceived by the human eye.

Reviving the colours of the past for a greener world

This case study of the colour red, as seen and prepared by English and French dyers, does not only reveal their impressive virtuosity as colorists, their amazing sensitivity to the slightest nuances and variations in lightness, chroma and hue that could be induced by their subtle playing with a few ingredients and the proportions in which they were implemented. Their ability to provide clients week after week, year after year, with the beautiful madder red they wanted, also implies a deep intuition - that could also be defined as an empiric understanding - of the complex chemical reactions that were at work in their huge brass and tin vessels. The routine achievement of a precise chromatic effect evidenced by this example should serve as an encouragement for today's designers, colorists and dyers, at the present time of rising environmental consciousness, increasing demand for natural dyes and revival of the production and uses of natural colorants. Not only high standards of beauty and quality can be obtained using natural dyes, but also high levels of reproducibility.

End notes

[1] Quye 2014, 2016 ; Quye et al. forthcoming.
[2] Cardon 2019; *id*., forthcoming.
[3] Cardon 2013, 2016.
[4] Cardon 2016, pp. 26-39.
[5] *Ibid*. p. 59.
[6] Partridge 1973, p. 108.
[7] Cardon 2019, pp. 59-60.

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