Pattern Books:

A textile and paper affair.

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Abstract

This dissertation is an in-depth documentation of James Napier's 1858 dye manual currently located at the Special Collections at the National Library of Scotland, Edinburgh. This project discusses the importance of pattern books as research resources and how interventive conservation may compromise the integrity of the textile patterns for future research. It argues that intervention should be kept to a minimal and only used when extremely necessary in order to preserve the integrity of the textile patterns for future research. This project uses visual analysis and archival research to investigate the textile patterns present in Napier's volume. It concludes that visual analysis is not enough for the complete investigation of these information-rich objects, and also concludes that technical analysis will be required for an in-depth study of this volume.

Acknowledgments

I would like to express my gratitude to every person that contributed in some form to my journey as a textile conservation student in the Centre for Textile Conservation at the University of Glasgow. From the Textile Conservation Foundation that supported me during this past two years, to my parents for always providing me with the best they can in life, making it possible for me to pursue my dream.

I would like to thanks my dissertation supervisors Dr Anita Quye and Professor Frances Lennard, for the constant support during the past 3 months; Julie Wertz for the numerous emails with clarifications on the chemistry of dye recipes; Isobel Griffin and the extremely dedicated team at the National Library of Scotland, Shona Hunter and Ryan Gibson, who were very supportive and accommodative of my visits; and Helen Creasy and Tuula Pardoe for the lovely and informative afternoon at the Scottish Conservation Studio.

And last but not least, my loving *namorido* Christopher, for being always so loving and caring, and for making life so beautiful. Te amo.

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1. Introduction

1.1. What are pattern books (…and other definitions)?

Pattern books can be described as folios that contain, among a variety of materials, textile patterns and technical or personal annotations.[1] Because of the nature of these objects, pattern books are usually collected by libraries and archives, and are therefore cared for by paper or book conservators. Depending on the condition of the object and on the level of complexity of the treatment, conservators may agree that one single specialist can treat the mixed material object: that a textile conservator will treat the paper of a pattern book, or a paper conservator will care for the textile patterns in the object.[2]

The term 'textile pattern' refers to small swatches of fabric from "a usual-sized piece"[3] collected for reference or a "representative sample"[4]. Domestic pattern books were usually assembled by women and used as reference for future designs and ideas for needlework. There are also examples of domestic types created to record the making of clothing garments and the different trimmings used in sewing projects.[5] The commercial type of pattern book was intended to collect, record and catalogue the techniques used in the construction of textiles, ideas for designs and decorations, details of commercial practices like prices and costs, records of exports of products and imports of material, as well as dye recipes and dye

[1] Philip Sykas, "Abundant Images and Scant Text: Reading Textile Pattern Books," in *Textiles and Text: Re-establishing the Links Between Archival and Object-Based Research: Postprints*, ed. Maria Hayward and Elizabeth Kramer, 23-28 (London: Archetype, 2007).
[2] Helen Shenton, "The Conservation of the Heal Textile Sample Books at the Victoria and Albert Museum," in *Paper and Textiles: The Common Ground: Preprints*, ed. Fiona Butterfield and Linda Eaton, 73 (Glasgow: Scottish Society for Conservation and Restoration, 1991).
[3] According to Cambridge Dictionary: A small piece of cloth or paper taken from a usual-sized piece and used to show what it looks like. "Pattern," The Cambridge Dictionary, http://dictionary.cambridge.org/dictionary/english/pattern (accessed July 11, 2017).
[4] According to The Collins Dictionary: A representative sample. "Definition of 'Pattern'," Collins Dictionary, https://www.collinsdictionary.com/dictionary/english/pattern (accessed July 05, 2017).
[5] Sally Tuckett and Stana Nenadic, "Colouring the Nation: A New In-Depth Study of the Turkey red Pattern Books in the National Museums of Scotland," *Textile History*, 43, No. 2 (2012): 161-163.

techniques.[6] [7] This dissertation will focus on the later type, more specifically on the James Napier's 1858 dye manual, which is currently part of the Special Collections at the National Library of Scotland in Edinburgh (shelf number ABS.1.90.181).

This project aims at improving access to James Napier's 1858 dye manual through conservation. In order to achieve this, the volume will be thoroughly investigated with specific focus given to the textile patterns. The analysis carried out will be essentially visual analysis and will make use of magnification (stereo-microscope Leica S8AP0) to allow the collection of high quality images and relevant information. Technical analysis will be limited to testing for the pH of the paper using a Hannah portable pH metre with conductive electrolytic solution (H1 7096O). As a result, an in-depth object record and substantial condition report will be presented. To allow the project to achieve its aim, recommendations for future care and display will also be provided for the object. As the terms 'access' and 'conservation' can have different applications, it is important to clarify the terminology for this research. The word access will be used in the sense of making the object and its contents physically and intellectually available to the public. The term conservation refers to a fundamental step of the conservation process documentation, and to the recommendation of relevant conservation measures.

The process of the documentation of an object is an important step towards its long-term preservation, however, it is quite frequently overlooked. The collecting and recording of information makes it possible for conservation professionals to thoroughly understand the object: its construction and materials, its attribution and provenance, and its current condition and conservation needs. Curators also benefit from a well-documented object, as a well-structured documentation record can greatly facilitate in the interpretation of that object. As Sykas (2001) mentions in *The North West Pattern Book Survey*, the combination of assessment and documentation of collections is extremely important as it: "enables institutions to promote and expand access to their collections while providing sufficient standards of care to ensure long-term preservation."[8]

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[6] Philip Sykas, "The North West Pattern Book Survey," *Textile History*, 32, No. 2 (2001): 156-157.
[7] Tuckett, 162.
[8] Sykas, *The North West Pattern Book Survey*, 156.

1.2. Historic context

In a time of increasing competition, pattern books produced by textile manufacturers were considered highly valuable due to the important and detailed information relating to business practices that they contained. Towards the end of the 19th century, it became common for larger textile companies to buy up and incorporate smaller businesses; pattern books were part of this rearrangement process and would move with the company as part of its assets, adding to their pattern book reference collection. Companies with similar commercial interests would merge together to create associations such as the Bradford Dyers' Association (1898), the Calico Printers' Association (1899) and the Bleachers' Association (1900).[9]

The 20th century saw a decline of the textile industry, this was mainly due to the economic recession caused by two world wars and by fast growing industry in developing countries, which resulted in the large scale closure of textile manufacturing companies in Britain. As a consequence, pattern books had no longer an application or use. The vast majority of them were either incinerated with other paperwork or forgotten in stores, while some were given to museums and archives.[10]

Despite the losses, a considerable number of pattern books were entrusted to public collections. The volumes accumulated quickly in the already busy collection stores of the museums, libraries and archives. Over the years continuing cuts to funding and to staffing experienced by historical institutions made the recording of a large collection impracticable for most of them. The shortage of staff and of resources caused collections of pattern books (many of which were already in a fragile condition) to deteriorate even further in these stores. Their awkward shapes and sizes also contributed to making access and conservation even more difficult. Surveys such as that carried out by Philip Sykas (2001) in *The North West Pattern Book Survey* brought this to the attention of conservation professionals, museums, libraries and archives, who now recognized the importance of these neglected objects and their poor condition in collection stores.

1.3. Significance

[9] Ibid., 157.
[10] Ibid., 157.

Over the past few years there has been an increasing interest in pattern books as research resources. Cross-referencing information collected from pattern books with information collected from object-based investigation or written text evidence (which can lead to the clarification or sometimes to the re-evaluation of dating, provenance and composition of historic objects, for example), provides information that cannot be ignored. The article *Abundant images and scant text: reading textile pattern books* by Dr Philip Sykas (2007) illustrates different methods of application of the information extracted from these volumes, and provides us with a selection of interesting examples. The information gained from the study of these objects not only contributes further in-depth information to the already existent knowledge, but provides new important material and evidence that cannot be acquired in any other way. Dinah Eastop also explored the research potential of pattern books in her publication *Exploring the potential of the Board of Trade Design Register* (2011-12) in which she also acknowledges the challenges that institutions face in maintaining pattern book collections, specifically in relation to how accessible and trackable they are.[11]

Projects like Dye-versity[12], conducted by Dr Anita Quye, have also contributed to reigniting conservation professionals' and researchers' interest in the information held within pattern books, specifically dye-manuals. As previously mentioned, dye manuals contain an enormous amount of valuable information relating to manufacturing and business practices of their time, as well as physical patterns of the actual dyed textiles. A major advantage in the use of these volumes as a resource for research is the possibility of removing (when appropriate) samples from the patterns or applying non-destructive technologies for technical analysis and the investigation of dyes and pigments. The data collected can inform the development of new dyes and pigments, can promote improvement of conservation treatments for fading colours and pigments, and finally, contributes to the understanding of provenance and attribution by cross-referencing information. These types of studies not only highlight the present interest in pattern book collections but also emphasise the relevant implications for

[11] Dinah Eastop, "Exploring the Potential of the Board of Trade Design Register," *Text: For the Study of Textile Art, Design and History*, 39 (2011-12): 52-56.
[12] Dye-versity Flickr for University of Glasgow, https://www.flickr.com/photos/uofglibrary/sets/72157684526474115 (accessed July 11, 2017).

the conservation and preservation of historic objects in general that such research represents.

The dye manual here investigated is an example of a pattern book that allows the application of cross-referencing of written information with object-based investigation, which makes it particularly interesting for the purposes of this project. In this project, the textile patterns present in the volume will be visually investigated, and the information collected from their analysis will be cross-referenced with the information extracted from the receipts that most probably describe the recipes used to dye such textiles. The James Napier dye manual contains 233 recipes for the dyeing of cotton, silk and wool textiles, 26 patterns of dyed cotton, 15 patterns of dyed silk, and 15 patterns of dyed wool. The National Library of Scotland acquired the volume in 1990, and very little information about its life before being part of the Special Collections exists in its records. While the volume contains patterns that are in very good condition, some other textile swatches seem to have degraded far more extensively, which makes one question the accuracy of the dye recipes, or even the idea that the author dyed the textiles patterns himself.

1.4. Literature Review

As mentioned in the introduction to this project, pattern books are objects that combine paper and textile of various qualities, and are usually treated by a paper or book conservator because of the intrinsic nature of the object, but this approach is changing. Recently, the collaboration between conservation departments and the adaptation of techniques borrowed from other conservation disciplines have been very much present in the conservation of mixed media objects like pattern books.[13] An inter-disciplinary approach such as this means that the different elements of the object will receive individual attention, and that they will be treated in accordance to their specific needs.

The literature in the conservation of pattern books in general is fairly limited, so selecting papers for this literature review was quite challenging. The publications selected reflect the trend for an inter-disciplinary approach, where there is collaboration between conservation

[13] Caroline De Stefani, Cordelia Rogerson and Arthur Green, "Evaluating Cross-Disciplinary Working: The Application of Textile Conservation Adhesive Techniques to Book Conservation," *Journal of the Institute of Conservation*, 34, No. 1 (2011): 90-103.

departments and experimentation with techniques borrowed from fellow disciplines. This literature review will compare three publications that record conservation treatments used in the conservation process of pattern books, and two publications that investigate the relation between paper and textile and the treatments that are usually applied to treat them both when combined in the same object (but not necessarily in a pattern book format).

My research has identified a tendency to approach the conservation of pattern books with highly interventive treatments especially in the 1990s. Due to the need for conservation or to provide better access to the paper/pages underneath, the removal of the textile patterns appears throughout the literature. Sheila Landi (2012) describes how, after being removed, the patterns were either wet-cleaned in a non-ionic washing solution or dry-cleaned with (organic) solvents and cotton swabs. Studies like *The Conservation of Various Textile Sample Books* by Gillian Owens, also illustrate this invasive approach. It reports treatments that chose to support fragile samples with adhesive overlays[14] and laid thread couching[15] before re-attaching the samples back on to the (treated) original pages. Less invasive treatments, although less common, were also present in the literature. When it is decided by the conservator(s) not to remove the patterns from the pages, *in situ* treatments are preferred. They can vary from simple surface cleaning with low powered vacuum suction to the use of (organic) solvents and cotton swabs for dry-cleaning.[16] This less interventive approach can be seen in the publication by Helen Shenton (1990) *The Conservation of the Heal Textile Sample Books at the Victoria and Albert Museum*.

The majority of the literature assessed in this review, although fairly descriptive, does not explain the rationale behind the decision making process, thus making it difficult to understand why the application of different approaches to the treatment of similar objects has taken place around the same time (the 1990s). Invasive treatments seem to prioritise the functionality and the aesthetics of the book over its individual features. In three cases assessed for this review, the treatments applied to the books were extremely invasive. While

[14] Gillian Owens, "The Conservation of Various Textile Sample Books." In *Paper and Textiles: The Common Ground*, ed. Fiona Butterfield and Linda Eaton, 83-90, (Glasgow: Scottish Society for Conservation and Restoration, 1991).
[15] Owens, 84.
[16] Shenton, 74.

two case studies chose to "strengthen" the original pages,[17] only one of them describes the type of lamination process applied to the object's pages.[18] The most invasive treatment – from the book and paper point of view – the conservation of *A Lucille Album*, chose to replace all the original pages with new ones. The original degraded pages were stored with the conserved book, and the patterns and trimmings were re-attached to the new pages at the end of the conservation treatment.[19]

Research has shown that the relationship between paper and textile is an ancient one, and can be described as an "unhappy relationship".[20] The difference in physical properties and the format and method used for display seem to be the two main reasons for the most common issues encountered by conservators on works of art on paper lined with textiles for example. The lining of maps with a thin layer of cellulosic textile[21] to improve handling and life-span seems to be as problematic as the case of maps lined with silk.[22] The physical arrangement of the cellulosic fibres in paper is different from that in textiles (cotton and linen, for example). While the fibres in the cellulosic textile yarn are long and purposely organised and spun to form a thread, the fibres in paper are much shorter and randomly arranged in a "felted mass". Due to this difference in position/construction, the two cellulosic products expand and contract in different ways when in contact with humidity. While the result of the expansion of the fibres of the paper causes the sheet to become bigger, the expansion of the fibres of the textile yarn results in the "tightening of the helix". As a result, the two layers (when paper and textiles are put together) expand in different directions causing the object to distort, a process referred to as "planar distortion".[23]

The relationship between paper and silk (protein textile) is also regarded as problematic.[24] As a result of ageing, silk tends to become discoloured and brittle, resulting in splits at fold

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[17] Owens, The Barbara Johnson Album, 84.
[18] Ibid., A French Cotton Pattern Book, 85.
[19] Ibid., A Lucille Album, 85-86.
[20] Allan Donnithorne and Catherine Hicks, "The Problems of Works of Art on Paper with Textile Supports," in *Paper and Textiles: The Common Ground*, ed. Fiona Butterfield and Linda Eaton, 95-100. (Glasgow: Scottish Society for Conservation and Restoration, 1991).
[21] Ibid., 96.
[22] De Stefani, 98.
[23] Donnithorne, 97.
[24] De Stefani, 98.

lines.[25] The conservation of the bound volume of maps discussed by De Stefani, Rogerson and Green in their paper *Evaluating cross-disciplinary working: the application of textile conservation adhesive techniques to book conservation*, demonstrate the consequences of the application of silk as a backing support to maps. Not only was the backing fabric discoloured and brittle, but it also suffered from splits in several areas. All the maps in the binding presented some level of tearing and separation. Adhesive treatments can be a good solution for this type of issue. The use of Klucel G limits the introduction of moisture during the process and is ideal as it avoids the formation of tide lines and further degradation of the paper of the map.[26]

Restoration problems are also encountered in relation to the display systems used for works of art on paper lined with textiles: exposure to airborne pollutants appear to contribute to the inherent incompatibility of the two materials.[27] Exposure to airborne pollutants encourages pH levels to change, turning both paper and textile more acidic, and encouraging degradation processes such as acid hydrolysis.[28] The material chosen to construct an object can also be problematic; unstable and reactive materials are known for triggering degradation.[29] [30] Untreated wood, for example, can release acid vapours, and unstable adhesives can age badly and affect the object structurally, chemically and visually.

Considering the vast potential for pattern books as a research area, it is valid to question the level of intervention applied when conserving these objects. The forceful coexistence between paper and textile found in the pattern book format seems problematic enough. The addition of an extra layer of complication from highly interventive conservation cannot be seen as a positive approach. The application of adhesive overlays over textile patterns, for example, may seem a good solution at the time, however, the ageing of adhesives used in the conservation of textiles and paper is quite often still unknown, as is the interaction between certain pigments found in patterns and organic solvents used for in-situ cleaning of textiles. If

[25] Tímár-Balázsy, 43-48.
[26] De Stefani, 98.
[27] Donnithorne, 97.
[28] Ágnes Tímár-Balázsy and Dinah Eastop. *Chemical Principles of Textile Conservation*. Oxford: Elsevier/Butterworth-Heinemann, 1998, 257-162.
[29] Ibid., 339-342.
[30] Donnithrone, 98.

pattern books are still an unexplored source of information for textile historians and conservation scientists it would be fair to say that the application of interventive treatments should reconsidered as it could compromise evidence for future research.

Whether the priority of the treatment is to preserve the functional features of a pattern book or to conserve the textile patterns it contains, the conservation of these mixed materials objects is not a straightforward challenge. A multi-disciplinary approach seems to be the best approach and the most sensible option. There are no set rules to the types of techniques that could be applied, and borrowing from fellow disciplines can be considered the norm for the successful completion of projects such as those discussed, and for the development of new options for the future. However, the importance of pattern books as resources for future research should also be taken into consideration when proposing conservation treatments. Historical evidence present in the textile patterns should not be damaged or compromised by excessive intervention.

2. Object Record

This section aims at collecting and recording information essential for the understanding of the composition and construction of the object. Such information is relevant for understanding degradation processes and the reasons behind them in the later condition report, and for informing future conservation and preservation.

2.1. Object number:

ABS.1.90.181 (shelf mark at National Library of Scotland – Special Collections)

2.2. Overall description:

James Napier. *A Manual of Dyeing Recipes for General Use*. Second edition. London and Glasgow: Richard Griffin and Company, 1858.

2.3. Dimensions:

158mm height x 110mm width x 11mm depth.

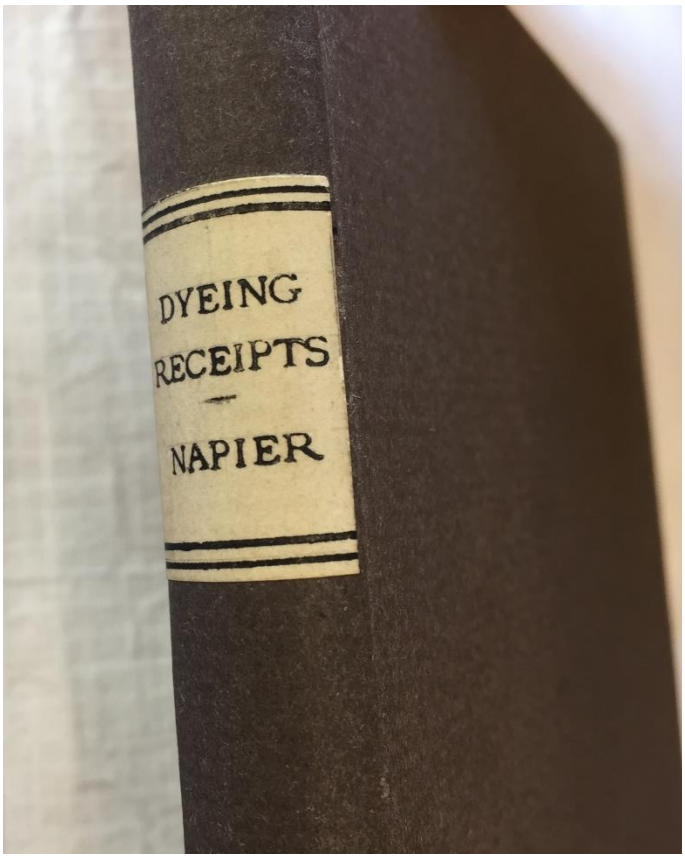


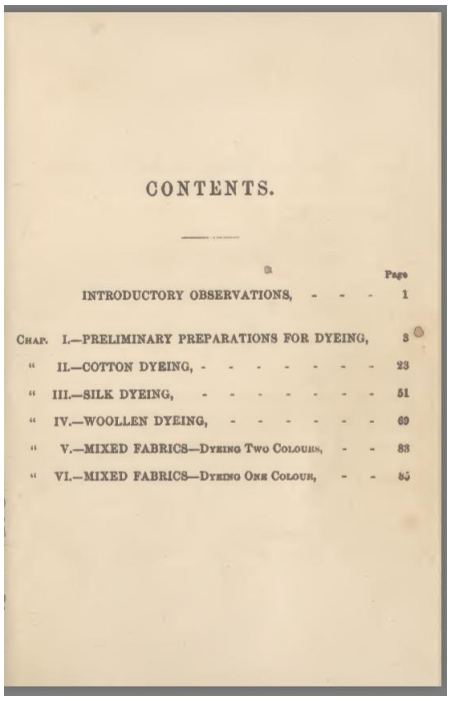
Figure 15- James Napier's dye manual (ABS.1.90.181) - Special Collections – National Library of Scotland. Image courtesy of the National Library of Scotland.

2.4. Detailed description

The James Napier dye manual is a printed book with hard cover boards finished with dark grey material of unidentified quality. The text block has 88 pages with a total of 233 recipes and 56 patterns of dyed fabric. The book is divided in parts as listed below (Fig. 2):

1. Introductory observations.
2. Preliminary preparations for dyeing.
   General instructions for several techniques and steps of the dyeing process. The receipts are numbered from 1 to 69.
3. Cotton dyeing.
   Recipes for dyeing of cotton. The receipts are numbered from 70 to 140 and include a total of 26 patterns of dyed cotton fabric.
4. Silk dyeing.
   Recipes for dyeing of silk. The receipts are numbered from 141 to 186 with a total of 15 patterns of dyed silk.
5. Woolen dyeing.
   Recipes for dyeing of wool. The receipts are numbered from 187 to 224 with a total of 15 patterns of dyed wool.
6. Mixed fabrics – dyeing two colours.
   Recipes for dyeing cotton and wool fabrics in two different colours. Receipts are numbered from 225 to 228. No patterns are present.
7. Mixed fabrics – dyeing one colours.
   Recipes for dyeing cotton and wool fabrics in one colour only. Receipts are numbered from 229 to 233. No patterns are present.

Object shelf mark (Fig. 3) and accession numbers are located on the inside of the front board written by pencil, on both top and bottom edges. It reads “ABS.1 90 181”.



CONTENTS.

Figure 16 - List of content of James Napier dye manual. Image courtesy of the National Library of Scotland.

Figure 17 – Object’s shelf mark on the top right hand-side corner. Image courtesy of the National Library of Scotland.

2.5. Object investigation:

Visual analysis is the first step in the process of documenting an object. It is an important step because understanding the nature of the material that the object is composed of is crucial for the condition assessment and for determining conservation treatments that would make the preservation of the object possible. In the case of the James Napier's dye manual here investigated, visual analysis was key due to the mixed material nature of the object. Mixed material objects are notoriously challenging as their different components present all sorts of limitations and may react differently to interventive and preventive conservation measures. The investigation was carried out in three separate stages: book, patterns and dye recipes. Since this dissertation focuses on the textile aspect of the object, no in depth analysis was carried out for the book and paper elements that make up the dye manual. The textile patterns were individually analysed under magnification (x100) with stereo-microscope Leica S8APO (Fig. 4). Leica application suite for PC was used to allow visualization on the computer screen, which improved visual investigation.[31] The dye recipes were studied individually and

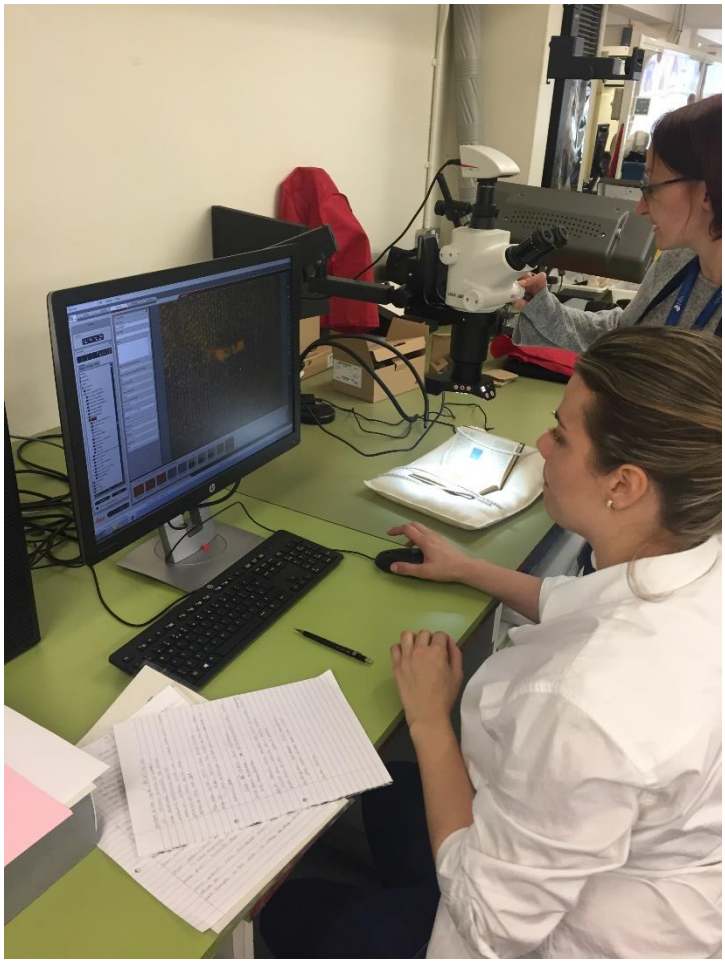


Figure 18 - Visual analysis conducted by the author and conservator Shona Hunter at the National Library of Scotland conservation department. Image courtesy of the National Library of Scotland

[31] Karen Thompson, Margaret Smith and Frances Lennard, "A Literature Review of Analytical Techniques for Materials Characterization of Painted Textiles – Part 1: Categorising Painted Textiles, Sampling and the use of Optical Tools," *Journal of the Institute of Conservation*, 40, No. 1 (2017): 72-73.

their constituents were identified and isolated. They are documented and presented in a table at the end of this section.

2.5.1. Book:

Considering the date of the book, the paper used in its making seems to be machine-made wove paper – possibly a combination of pulp derived from cotton and wood. Up until the mid-19th century, paper was usually made of linen and cotton rags which produced good quality paper due to the long fibres that constructed the raw material. Approaching the mid-19th century, the demand for paper increased and other sources of raw material had to be found. Wood was a readily available resource which promoted the use of wood pulp in the making of paper. Because of its much shorter fibres and the presence of lignin, wood pulp did not produce a high quality, long-lasting paper.[32] [33] The uniformity of the text and the date of the edition suggest the book has been machine printed.[34]

Pencil scribbles are also present on both front and back boards on the inside (Fig. 5). No significance could be attributed to them. The text block has been resized and rebound with the addition of new cover boards as well. Some of the patterns have been cut during resizing and their edges can be seen when the text block is closed. Such interventive actions are believed to have been taken prior to the volume's arrival to the National Library of Scotland Special Collections as their documentation does not mention any of them.

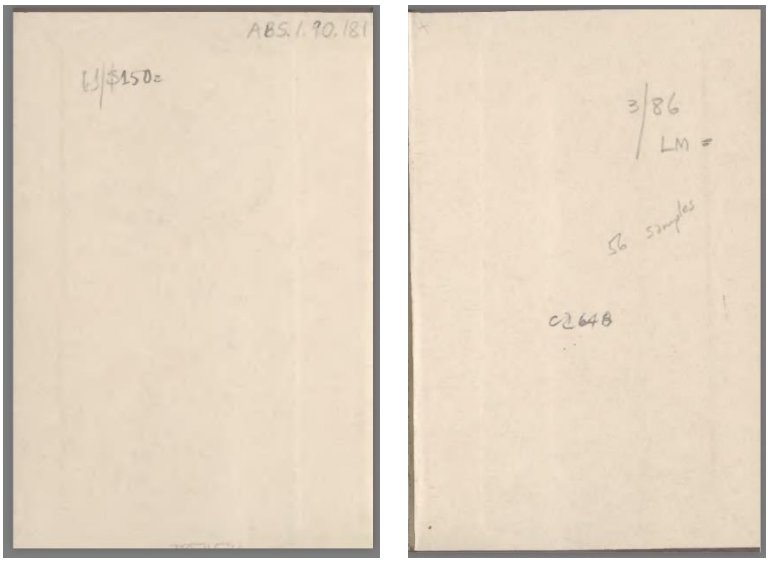


Figure 19 - Inside of front (left) and back (right) cover boards with pencil scribbles. Image courtesy of the National Library of Scotland.

[32] "The Deterioration and Preservation of Paper: Some Essential Facts," Library of Congress, https://www.loc.gov/preservation/care/deterioratebrochure.html (accessed July 06, 2017).
[33] Gerhard Banik and Irene Bruckle. *Paper and Water: A Guide for Conservators* (Oxford: Elsevier/Butterworth-Heinemann, 2011), 220-221
[34] "Discovering literature: romantics and Victorians," The British Library, https://www.bl.uk/romantics-and-victorians/articles/print-culture (accessed July 11, 2017).

Technical analysis

Test carried out by Shona Hunter (conservator at the National Library of Scotland) indicated that the adhesive used to attach the patterns to the pages is animal glue. A droplet of de-ionised water was applied to the adhesive under the microscope at magnification x0.32. The presence of water caused the dehydrated film to swell but not solubilize completely. To determine the type of animal glue further investigation would be required, such as the use of FTIR microscopy (Fig. 6).[35]

A drop of conductive electrolytic solution (H1 7096O) was applied to two chosen pages for analysis showing the following results: title page recorded pH 4,86 and page 60 recorded pH

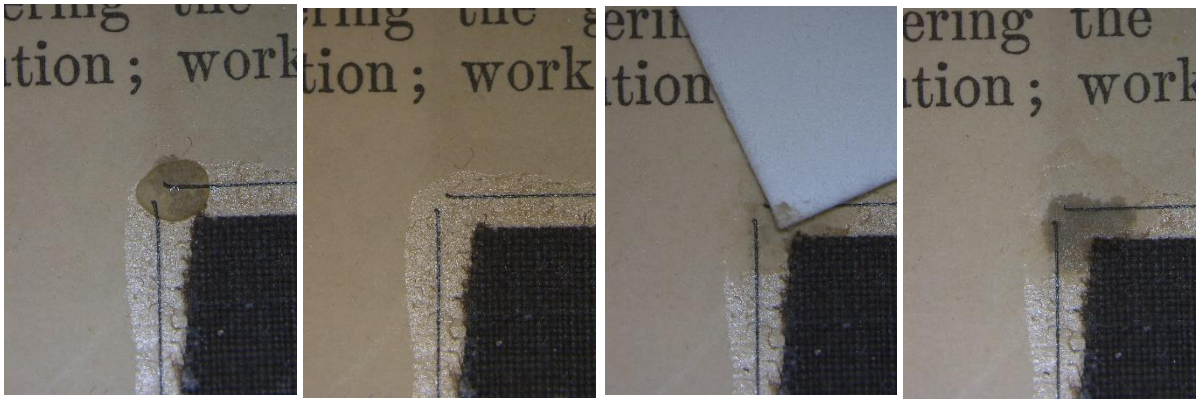


Figure 20 - sequence of images taken during testing of the adhesive conducted by conservator Shona Hunter at the National Library of Scotland. Images run from left to right and show the swelling of the adhesive when in contact with water. Image courtesy of the National Library of Scotland.

4,30. The pH of the text block was measured with the use of Hannah portable pH metre. It is worth noticing that the area for pH testing on page 60 might have influenced the analysis as it was considerably further in on the page, close to the pattern and adhesive. The spot tested on the title page was the bottom right hand-side corner (Fig. 7).

Figure 21 - Testing of pH of title page and page No. 60 at the conservation department. Image courtesy of the National Library of Scotland.

[35] Shona Hunter, email message to author, August 21, 2017.

2.5.2. Patterns:

Within the content of James Napier dye manual are 56 textile patterns that are meant to represent the outcome of some of the dye recipes. Out of the 56 patterns 46% of them are cotton while 27% are silk and the remaining 27% are wool. The textile patterns were all cut to a similar size, approximately 20mm x 20mm (Fig. 8).

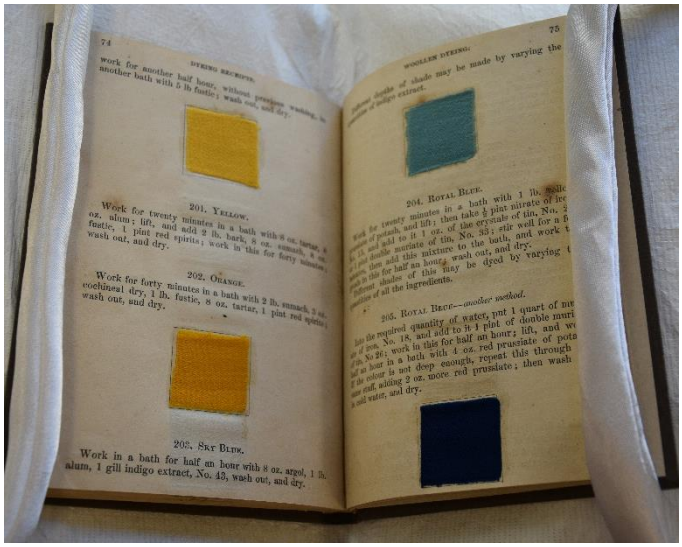


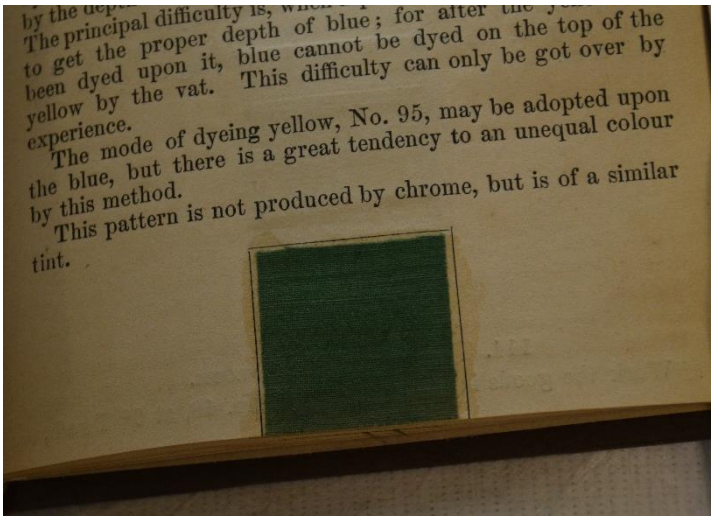
Figure 22 - Overall image of textile patterns in the James Napier dye manual. The patterns measure approximately 20mm x 20mm and are located amongst dye recipes. They are not accompanied by captions or numbers therefore their association to dye recipes had to consider written evidence from the receipts. Image courtesy of the National Library of Scotland.

After careful visual analysis under magnification with stereo-microscope Leica S8APO, the weave of the patterns of cotton and silk have been classified as plain or tabby. The woolen patterns seem to be a twill 2x2. All the patterns present raw edges on all four sides and were glued to the paper with animal glue (as mentioned in section *2.5.1. Book*).

Each of the patterns received a reference number for this project. The reference number is listed on the first column to the right of the pattern image on the table that follows at the end of the *Object Record*. It runs from 1 to 26 C for cotton patterns, 1 to 15 S for silk patterns, and 1 to 15 W for woolen patterns. Reference numbers were necessary as the majority of the patterns could not be linked to one single receipt due to lack of information in the text and absence of captions.

Most patterns are positioned in between two different receipts and therefore could correspond to either top or bottom receipt (Fig. 8). Patterns numbered 16C, 19C, 22C, 10S, 12S, 5W, 7W and 15W could be linked to one single recipe either because the following receipt was for a colour that did not match the pattern or because the text mentioned the connection. Patterns numbered 5S, 7S, 8S, 3W and 12W are very likely to correspond to one

single recipe out of the two options, however, it is not possible to rule out the unlikely recipe completely.


The principal difficulty is, to get the proper depth of blue; for after the yellow has been dyed upon it, blue cannot be dyed on the top of the yellow by the vat. This difficulty can only be got over by experience.

The mode of dyeing yellow, No. 95, may be adopted upon the blue, but there is a great tendency to an unequal colour by this method.

This pattern is not produced by chrome, but is of a similar tint.

Figure 23 - Close up of the dye receipt clarifying that the pattern is not a product of the described recipe. Image courtesy of the National Library of Scotland.

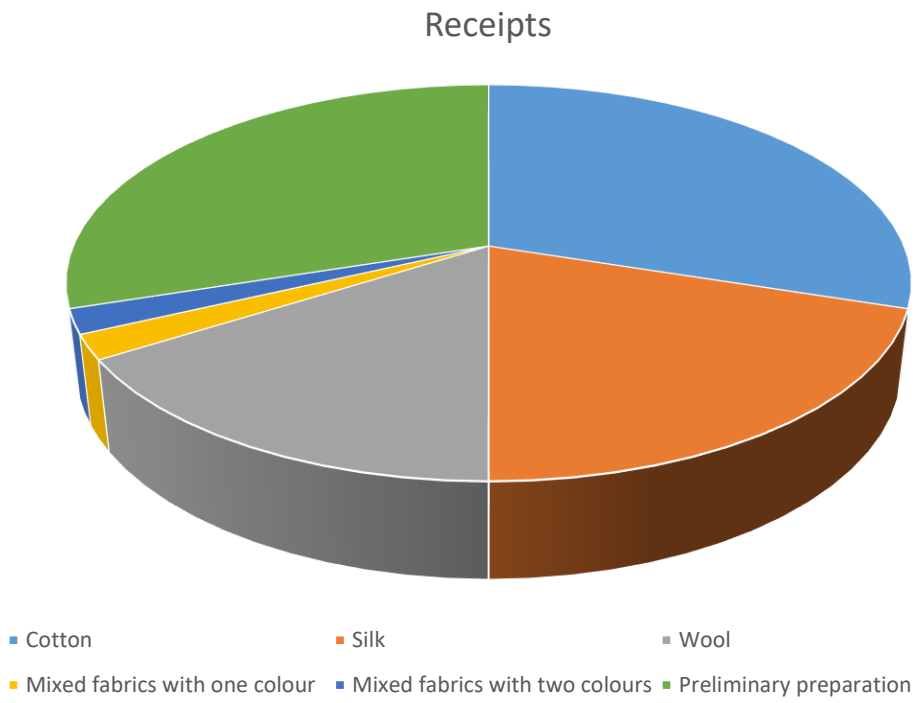
It is not possible to determine whether the patterns found in this volume are a direct result of the dye recipes they relate to or if they are only representations of the results achievable with Napier's dye recipes. On page 39 of the dye manual, Napier writes the following in reference to pattern 16C: "this pattern is not produced by chrome, but is of a similar tint" (Fig. 9). No further reference is made towards the remaining 55 patterns in the volume. By contrast, some authors such as Crookes[36] (1874) and Smith[37] (1880) make clear to the reader whether the patterns in the content of the book are a result of their own dyeing efforts or if they were provided by other sources. Crookes states his appreciation to his collaborators by saying: "The author has also the pleasure of expressing his obligations to Messrs. Brooke, Simpson and Spiller, to Messrs. W. Crum and Co., the late Mr J. Lightfoot, with his successors, Messrs. Grafton and Co., and Messrs. Wood and Wright, for important information furnished, and for patterns of dyed and printed fabrics supplied." On another example, Smith makes the reader aware of his efforts by stating that "the receipts give the mode of dyeing almost every sort of Goods, most of which I have dyed with my own hands, therefore they may be relied upon as genuine and correct".

[36] From the preface of William Crookes' *A Practical Handbook of Dyeing and Calico-Printing with Eleven Page-Plates, Forty-Seven Specimens of Dyed and Printed Fabrics, and Thirty-Eight Woodcuts.* London: Longmans, Green, and Co., 1874.

[37] David Smith*, Practical Dyer's Guide*, Second Edition. Manchester: Palmer and Howe. London: Simpkin, Marshall, & Co. 1880.

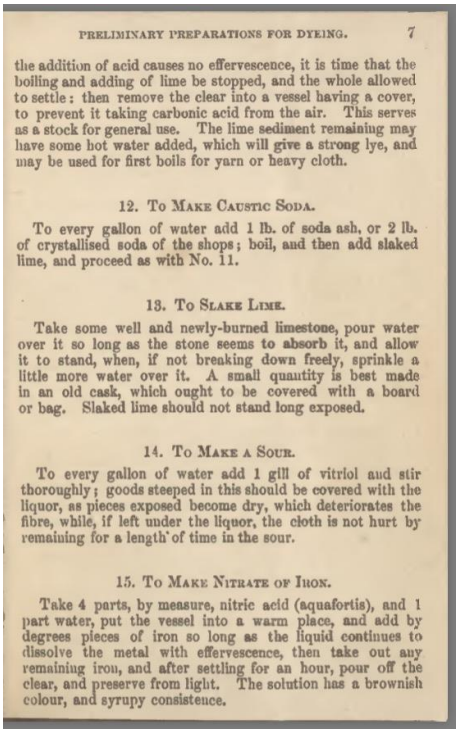
2.5.3. Dye recipes:

James Napier's dye manual provides the reader with 233 recipes using an assortment of mordants, additives and natural dyes. Recipes in the *preliminary preparation* chapter are 30% of the total of recipes (Fig. 10). Recipes for dyeing cotton correspond to a total of 30% while silk has 20% (Fig. 11) and wool 16%. *Mixed fabrics – dyed with two colours* and *mixed fabrics – dyed with one colour* have both 2% of the total recipes each, as seen on the chart below.



The *preliminary preparation* chapter contains 70 recipes that provide guidance on the making of solutions and decoctions to be used as mordants, additives and dyes that will be required as "ingredients" for other recipes that follow in the manual. Out of the 70 recipes, 27 of them are mentioned directly in several of the receipts for cotton, silk and wool in the volume. It is interesting to mention such recipes here, as they might be relevant to the condition report that follows this chapter. The terminology used by the author is also very interesting; names and terms are sometimes inconsistent and may confuse the reader.

Recipes for bleaching both cotton yarn and cloth are given at the beginning as part of the process of preparing the fabric or yarn for the dyeing stage (recipes No. 7[38] and No. 9[39]). Although both recipes use *bleaching liquor*[40] as a base for the bleaching bath, recipe No. 7 has sulphuric acid added to the mixture while No. 9 depends on a sequence of more complex/repetitive steps alongside the addition of *caustic potash* (see recipe No. 11 on the next page), sulphuric acid, *Prussian blue*[41], spent lyes[42], sodium carbonate and *potash. Potash*[43] is the common name for potassium compounds that are in water-soluble form. The most common types of potash used in the dye industry are potassium chloride and potassium hydroxide.



PRELIMINARY PREPARATIONS FOR DYEING. 7

the addition of acid causes no effervescence, it is time that the boiling and adding of lime be stopped, and the whole allowed to settle: then remove the clear into a vessel having a cover, to prevent it taking carbonic acid from the air. This serves as a stock for general use. The lime sediment remaining may have some hot water added, which will give a strong lye, and may be used for first boils for yarn or heavy cloth.

12. To Make Caustic Soda.

To every gallon of water add 1 lb. of soda ash, or 2 lb. of crystallised soda of the shops; boil, and then add slaked lime, and proceed as with No. 11.

13. To Slake Lime.

Take some well and newly-burned limestone, pour water over it so long as the stone seems to absorb it, and allow it to stand, when, if not breaking down freely, sprinkle a little more water over it. A small quantity is best made in an old cask, which ought to be covered with a board or bag. Slaked lime should not stand long exposed.

14. To Make a Sour.

To every gallon of water add 1 gill of vitriol and stir thoroughly; goods steeped in this should be covered with the liquor, as pieces exposed become dry, which deteriorates the fibre, while, if left under the liquor, the cloth is not hurt by remaining for a length of time in the sour.

15. To Make Nitrate of Iron.

Take 4 parts, by measure, nitric acid (aquafortis), and 1 part water, put the vessel into a warm place, and add by degrees pieces of iron so long as the liquid continues to dissolve the metal with effervescence, then take out any remaining iron, and after settling for an hour, pour off the clear, and preserve from light. The solution has a brownish colour, and syrupy consistence.

Figure 24 - Preliminary recipes at the beginning of the dye manual. Image courtesy of National Library of Scotland.

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[38] James Napier, *A Manual of Dyeing Receipts for General Use*. Glasgow: Richard Griffin and Company, 1858, 5.
Bleaching liquor No. 6: bleaching powder and water.
For the bleaching process No. 7: bleaching liquor No. 6 and sulphuric acid (vitriol).
[39] Ibid., 6.
Rot Steep No. 10: cloth is *rotted* in soda or potash or *spent lyes*.
Bleaching process No. 9: sulphuric acid, caustic lye and bleaching liquor No. 6.
[40] Ibid., 5.
Bleaching liquor No. 6. Also called chloride of lime.
David W. A. Sharp, *The Penguin Dictionary of Chemistry*. London: Penguin Books, 2003, 53.
[41] Also called ferric ferrocyanide
"Molecule of the week," American Chemistry Society, https://www.acs.org/content/acs/en/molecule-of-the-week/archive/p/prussian-blue.html (accessed August 22, 2017).
[42] "Spent lye – Definition," Merriam-Webster, https://www.merriam-webster.com/dictionary/spent%20lye (accessed July 30, 2017).
[43] Sharp, 323.

Mordants (from the Latin *mordēre*[44]) are substances usually of inorganic quality that are used to help fix the dyes on to the fibres of the textile.[45] [46] In the *preliminary preparation* part of the book, Napier proposes 11 recipes for the preparation of a variety of mordants such as *caustic potash*, *nitrate of iron*, *acetate of iron*, *sulphate of iron (copperas)*, *proto-chloride of iron(muriate of iron)*, *proto-chloride of tin (crystals of tin)*, *bi-chloride of tin (per-muriate)*, *double muriate of tin*, *plumb tub*, *acetate of alumina (iron liquor)* and *alum solution.*

C*austic potash No. 11*[47], nowadays known as potassium hydroxide[48], is made from *black*[49] *or pearl*[50] *ashes*, *newly slaked lime*[51], *boiling lye*[52] and sulphuric acid.

Nitrate of iron No. 15[53], commonly known as ferric nitrate, is a combination of nitric acid, water and fragments of iron.

Acetate of iron (black iron liquor) No. 16[54] [55], currently known as iron diacetate, is described as a solution of fragments of iron and crude vinegar.

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[44] "Mordant – Definition," Merriam-Webster, https://www.merriam-webster.com/dictionary/mordant (accessed July 16, 2017).

[45] Ibid., 262.

[46] IUPAC, "Compendium of Chemical Terminology," PDF online (2014): 965. http://goldbook.iupac.org/pdf/goldbook.pdf.

[47] Napier, 6.

[48] Sharp, 77.

[49] Black ashes: combination of soda ash, calcium sulfide and un-burnt coal. "Chemistry Chronicles," David M. Kiefer, https://pubs.acs.org/subscribe/archive/tcaw/11/i01/html/01chemchron.html (accessed July 28, 2017).

[50] Pearl ashes is an old fashioned way of referring to a pure form of potassium carbonate extracted from the ashes of plants.
Maurice P. Crosland, *Historical Studies in the Language of Chemistry* (Dover Publications, 2004), 72.

[51] Slaked lime is the traditional name for calcium hydroxide.
Sharp, 363.

[52] Lye is a strong alkaline solution, usually potassium hydroxide, used in the washing and cleansing steps of the dyeing process.
"Lye – Definition," Oxford Dictionaries, https://en.oxforddictionaries.com/definition/lye (accessed July 04, 2017).

[53] Napier, 7-8.

[54] Napier, 8.

[55] Sharp, 218.

S*ulphate of iron (copperas) No. 17*[56] [57], better known as ferrous sulphate, is a mixture of sulphuric acid, water and fragments of iron.

Proto-chloride of iron (muriate of iron) No. 18[58]*,* also called ferrous chloride[59], is a solution of hydrochloric acid, water and fragments of iron.

Proto-chloride of tin (crystals of tin) No. 26[60]*,* also known as tin dichloride[61], is a combination of hydrochloric acid, water and feathered tin.

Bi-chloride of tin (per-muriate) No 27[62], or stannous chloride, is the product of the combination of proto-chloride of tin (crystals of tin), water, hydrochloric acid and nitric acid. The alternative method for *bi-chloride of tin (per-muriate)*[63] uses hydrochloric acid, nitric acid, feathered tin.

Double muriate of tin No. 33[64], or tin dichloride, is made with hydrochloric acid, water and feathered tin – the same as Proto-Chloride of Tin No. 26 but the process of making it does not allow for crystallization to happen.

Plumb tub No. 35[65] is a decoction of logwood with plumb spirits.

A*cetate of alumina (iron liquor) No. 48*[66] [67], or aluminium acetate, contains potassium alum, water, lead acetate, crystalised soda.

Alum solution No. 52[68], or aluminium potassium sulphate, is a solution of alum in water.

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[56] Ibid., 288.
[57] Napier, 8.
[58] Napier, 8.
[59] "Ferrous chloride," PubChem, https://pubchem.ncbi.nlm.nih.gov/compound/ferrous_chloride (accessed August 14, 2017).
[60] Napier, 10.
[61] Sharp, 398.
[62] Napier, 11.
[63] Ibid., 11.
[64]Ibid., 12. Double muriate of tin: hydrochloric acid, water and feathered tin. Same as Crystals of tin or Proto-Chloride of Tin No. 26 but does not crystalise.
[65] Ibid., 12.
[66] Ibid., 16.
[67] Sharp, 17.
[68] Ibid., 18.

Other mordants such as *acetate of lead* (lead acetate), *chrome* (potassium dichromate), *nitrate of lead* (lead nitrate), *yellow prussiate of potash in solution* (cyanoferrates) and *alum* (potassium alum) are also used in some of the dye recipes.

Acids and alkalis are often added to the dye bath to help create an environment that optimizes the adherence of the dyes and pigments onto the textile fibres as well as to improve levelling of colour, and to neutralise the interference of other contaminants that might be present in the water. These are generally called additives. In the *preliminary preparation* part, Napier provides 7 different recipes for the making of a selection of additives such as *red* and *yellow spirits, chemic, softening* and others.

Red spirits No. 29[69] uses hydrochloric acid, nitric acid, water and tin, while *yellow spirits No. 30*[70] has sulphuric acid instead of nitric acid in its composition.
Barwood spirits No. 31[71] is a solution made with hydrochloric acid, nitric acid and feathered tin.
Alum plumb tub No. 36[72] is a solution made with a decoction of logwood mixed with alum. Although usually considered an additive, it is also a pH sensitive colouring solution, also known as aluminium haematoxylin[73], and can be used as a colourant/dye.
Chemic No. 44[74], sometimes also called green copperas[75], is a solution of indigo made into sulphate or extract, water and carbonate soda or calcium carbonate. This modified indigo dye also works as the colourant/dye.
Softening No. 50[76] a combination of common soda and sweet oil is, in the words of the author used "to soften yarns" and likely to neutralise contaminants in the water supply.

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[69] Napier, 11.
Tin was used to finish the dyeing process and to make the colours brighter. Napier says to add it “to good effect” on recipe No. 74
[70] Ibid., 11.
[71] Ibid., 12.
[72] Ibid., 13.
[73] H. S. Freeman and A. T. Peters, Colorants for Non-Textile Applications, (Elsevier, 2000), 401-402.
[74] Napier, 14.
[75] John R. Coxe and Thomas Cooper, *The Emporium of Arts and Sciences, Volume 1* (New York: J. Delaplaine, 1815), 445, https://books.google.co.uk/books?id=5h4AAAAAMAAJ&dq=green+copperas&source=gbs_navlinks_s .
[76] Napier, 17.

Lime water No. 51[77] [78] a mixture of calcium hydroxide (traditionally called new-slaked lime) and water. Other additives identified in the recipes are *muriatic acid* (hydrochloric acid), *sulphate of zinc* (zinc sulphate), *soap*, *vitriol* (sulphuric acid), *chamber lye* (urine)[79] and *cream of tartar* (potassium bitartrate).

The dyes used by James Napier in his dye manual are classified as *natural dyes*. *Natural dyes* are a class of dyes extracted from natural sources such as plants (flowers, wood and roots), insects and minerals. The recipes described below are part of the *preliminary preparation* section and are mentioned in several of the receipts for cotton, silk and wool.

For the making of *annotta No. 39*[80], Napier lists water, *annotta*, pearl of ash and soft soap as ingredients. It is interesting to note here that the term used by Napier *annotta*[81] appears in varied forms across the literature. David Smith in *The English Dyer* calls it *annotto*[82] while Eastaugh et al., call it *annatto*[83] in the *Pigment Compendium.* This documentation will comply to the last format. The dyestuff comes from the seeds of the tropical American native plant of same name, and is extracted through a repetitive method of pressing and soaking the seeds in water.[84]

Catechu No. 40[85] is a combination of water, catechu and sulphate of copper. Although catechu can be extracted from several different species of acacia trees, it is most commonly extracted from the *Senegalia catechu* variety. During the extraction process, the heartwood of the tree is boiled in water and the resulting decoction is evaporated.[86] [87] [88]

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[77] Sharp, 235 and 67.
[78] Napier, 17.
[79] "Chamber lye – Definition," Oxford Dictionaries, https://en.oxforddictionaries.com/definition/us/chamber-lye (accessed July 15, 2017).
[80] Napier, 13.
[81] Napier, 31.
[82] Smith, 250.
[83] Nicholas Eastaugh et al. *The Pigment Compendium: A Dictionary of Historical Pigments.* Oxford; Amsterdam: Elsevier Butterworth-Heinemann, 2004, 14.
[84] Dominic Cardon, *Natural Dyes: Sources, Tradition, Technology and Science*. London: Archetype Publications, 2007, 312-314.
[85] Napier, 13.
[86] "Catechu – Definition," Oxford Dictionaries, https://en.oxforddictionaries.com/definition/catechu (accessed July 22, 2017).
[87] "Brown Dye," Asian Textiles Study, http://www.asiantextilestudies.com/brown.html (accessed August 19, 2017).
[88] Rita J. Adrosko, *Natural Dyes and Home Dyeing* (Courier Corporation, 2012), 40-41.

The making of decoctions[89] [90] in general is explained by Napier in the recipe *decoctions of woods No. 41*[91]*.* The process of pouring boiling water over chips of wood until the water passes clean can be applied to a variety of wood that can produce dyestuff. In this dye manual, the woods used in the form of a decoction are lima-wood, peach-wood, logwood, bark, ebony wood, sumac, quercitron and fustic. The same types of wood are also mentioned differently in several recipes throughout the dye manual, which suggests that the form of application used may be different from a decoction. That is the case of recipe *Cinnamon Brown No. 75* on page 26 where Napier lists the wood ingredients as: "3 ½ lb. of Lima-wood and ½ lb. of logwood" which suggests that the two types of dyestuff are being applied in their solid form.

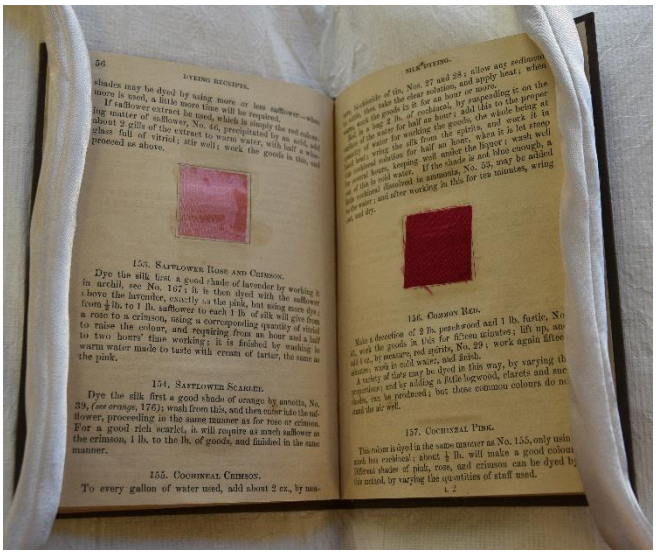

Figure 25 - Overall image of silk receipts with textile patterns. Image courtesy of the National Library of Scotland.

The name sumac, part of the *Anacardiaceae* family, comprehends a large group of plants from the Rhus genus that are a source of both tannins[92] and dyestuff. Different varieties of sumac grow in different parts of the globe and therefore receive different names. The leaves, gals and roots can be used to extract dyestuff and tannins, depending on the type of sumac chosen. Napier does not specify the type of sumac he uses in his recipes.[93]

[89] Smith, 120. The author defines decoction as "pharmaceutical solutions made by boiling a drug (often naturally occurring) with water and filtering."
[90] Napier, 14. The recipe for decoctions given by Napier recommends that the pieces of wood are placed on a coarse cloth and hot water is poured over it until it passes completely clear. The liquid resulting is used for dyeing.
[91] Ibid., 14.
[92] Sharp, 485-486. With similar structures to tannic acids, tannins are used in the textile industry as mordants during the dyeing process.
[93] Cardon, 431-439.

Extracted from the Quercitron oak, this dyestuff of same name is produced from the inner bark of the plant.[94] Napier called it *quercitrou* (see recipe *Spirit brown No. 73*) while Cardon refers to it as *quercitron*, which will be adopted by this study.

The term *fustic* can refer to both old and new fustic, which come from different types of plants. Rich in tannic acid, the dyestuff is extracted from the heartwood of the plant in both cases. Napier does not specify which of the types he uses in his recipes.[95]

Sulphate of indigo No. 42[96] is a simple combination of sulphuric acid with finely grounded indigo. *Indigo extract No. 43*[97] however, uses *sulfate of indigo No. 42* as a base for the recipe but depends on a more laborious combination of other processes, such as dilution and filtering, to produce the final extract. *Indigo* can be extracted from a wide variety of plants from different botanical families[98] and must be dyed through a *vat*[99] process as the actual indigo dye is naturally insoluble and impossible for the textile fibres to absorb. *Blue vat No. 38*[100] is a solution made with indigo, water, copperas (iron sulphate) and slaked lime (calcium hydroxide).

Safflower for dyeing cotton No. 45[101] combines safflower with pearl ash (potassium carbonate) and water. Natural from Asia, *safflower* has been used since early antiquity as a dye. Its florets give a yellow dye first (which is usually either used for dyeing or washed away) and a pink/red dye after the safflower matter is combined with sodium carbonate or potassium carbonate.[102] It is interesting to notice that the recipe here discussed is recommended only for the dyeing of cotton. Safflower is also used for dyeing silk, as can be seen on recipes No. 152 and No. 153 in the *silk dyeing* chapter, however a different method must be applied in the preparation of the dye matter. In the recipe *safflower for dyeing silk No. 46*[103] Napier recommends the use of *Safflower for dyeing cotton No. 45* as a base to

[94] Ibid., 199-202.
[95] Ibid., 191-198.
[96] Napier, 14.
[97] Ibid., 14.
[98] Cardon, 337.
[99] Ibid., 339-340.
[100] Napier, 13.
[101] Ibid., 15.
[102] Cardon, 54-59.
[103] Napier, 15.

which sulphuric acid and cotton (whether fabric or yarn is not clarified) are added. The intention is to dye the cotton material deep red. After transferring the cotton into a container with cold water, pearl ash (potassium carbonate) is added and the cotton material stirred and removed. The solution resulting is ready for dyeing silk.

The recipe *to make cochineal liquor or paste No. 53*[104] uses cochineal, ammonia and water to prepare the dye for the dye bath. *Cochineal* are insects native from the Americas that are rich in *carminic acid* – a red pigment. The eggs of the insect just before hatching are the richest in carminic acid, therefore the female full of eggs is the most interesting for harvesting. The cochineal is dried and later crushed into a paste or solution for use.[105] Other dyes and pigments used by Napier in his manual are lac[106], madder[107], archil[108], cudbear[109], lead chromate[110], prussian blue (potassium ferrocyanide/cyanoferrates)[111] and verdigris (copper ethanoate)[112].

2.6. Table of patterns and recipes with names given in the manual and the modern equivalent:

The table below organizes the recipes in relation to each pattern present in the dye manual. To the right of the image of the pattern there is a reference number given to each pattern for the purpose of this documentation. The aim is to facilitate the identification of each of them using this table as a reference. Further to the right is the original page number where the

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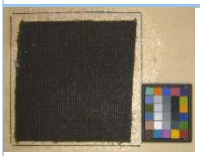
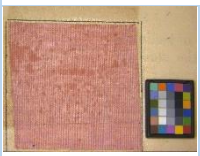
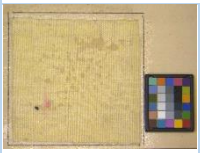
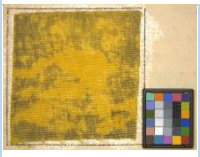
[104] Ibid., 18.
[105] Cardon, 619-624.
[106] Ibid., 656. From insects native to some countries of Asia, lac insects also produce a resin that after purified results in shellac.
[107] Cardon, 107-122. The root of the plant is used to produce a red dye.
[108] Archil is the traditional name for what is known nowadays as orchil. The term orchil comprehends all varieties of lichen that can produce a dark red-violet dye.
"Archil," The Library Index, https://www.libraryindex.com/encyclopedia/pages/covwzjzavp/archil-species-lichens.html (accessed August 11, 2017).
[109] Type of Orchil.
Eastaugh, 283.
"Cudbear," Meriam-Webster, https://www.merriam-webster.com/dictionary/cudbear (accessed August 11, 2017).
[110] The combination of lead acetate with potassium dichromate results in an inorganic pigment insoluble in water called lead chromate.
"Lead Chromate," Pub Chem, https://pubchem.ncbi.nlm.nih.gov/compound/lead_chromate (accessed August 23, 2017).
[111] Sharp, 113.
[112] "Verdigris," Meriam-Webster, https://www.merriam-webster.com/dictionary/verdigris (accessed August 11, 2017).

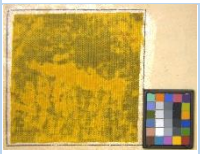
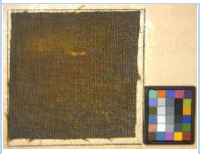
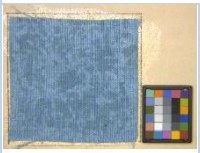
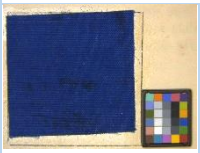
pattern is located in the volume. Next to it there is the recipe that relate to the pattern. There are patterns that have two likely recipes and, in this case, the second possible recipe is located below the first one. The reason for having more than one possible recipe is that the majority of the patterns are not directly connected to any of the recipes by a caption or a reference number. As mentioned earlier in this chapter (section *2.5.2. Patterns*) there are few patterns that seem be connected to one single recipe, therefore they will have only one recipe next to them in the table. The recipes are organized in two columns: the one to the left contains the "ingredients" of the dye bath and calls them the same names used by Napier in the dye manual. The column to the right provides a modern equivalent of the historical names.

Pattern - Cotton	Location of pattern		Possible receipts	Dyes, mordant and additives present in the recipe	
	Ref. No.	**Page No.**		**Terms and names given in the manual**	**Current names**
	1C	25	70. Black	Decoction of sumach Lime-water No. 51 Solution of copperas Decoction of logwood Chamber lye	Sumac Lime-water, No. 51 Ferrous Sulphate Logwood Urine
			71. Jet Black	Decoction of sumach Lime-water No. 51 Solution of copperas Decoction of logwood with fustic Chamber lye	Sumac Lime-water No. 51 Ferrous Sulphate Logwood Fustic Urine
	2C	26	73.Spirit Brown	Decoction of sumach Red spirits No. 29 or yellow spirits No. 30 Quercitrou bark decoction Lima or peach wood decoction Logwood decoction Alum in solution (No. 52)	Sumac Red spirits, No. 29 or Yellow spirits, No. 30 Quercitron Lima or peach wood Logwood Aluminium sulphate
			74. Mordant Brown	Acetate of lead Caustic Potash No. 11 Chrome Sulphate of zinc Muriatic acid Decoction of lima-wood	Lead acetate Potassium hydroxide Potassium dichromate Zinc sulphate Hydrochloric acid Lima-wood

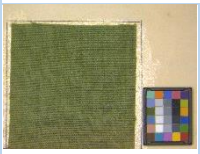
Pattern - Cotton	Location of pattern		Possible receipts	Dyes, mordant and additives present in the recipe	
	Ref. No.	**Page No.**		**Terms and names given in the manual**	**Current names**
				Logwood Alum in solution	Logwood Aluminium sulphate
	3C	27	75.Cinnamon Brown	Decoction of sumach Red spirits, No. 29 or yellow spirits, No. 30 Quercitrou bark decoction Lima-wood Logwood Alum solution	Sumac Red spirits, No. 29 or Yellow spirits, No. 30 Quercitron Lima-wood Logwood Aluminium sulphate
			76.Uvanterine Brown	Acetate of lead Caustic Potash No. 11 Chrome Sulphate of zinc Muriatic acid Lima-wood Fustic Acetate of alumina - (Red liquor), No. 48	Lead acetate Potassium hydroxide Potassium dichromate Zinc sulphate Hydrochloric acid Lima-wood Fustic Aluminium acetate
	4C	28	78. Catechu Brown	Catechu, No. 40 Solution of bi-chromate of potash (chrome)[113] Soap	Catechu Potassium dichromate Soap
			79. Catechu Chocolates	Catechu, No. 40 Solution of bi-chromate of potash (chrome) Soap Decoction of logwood Alum in solution	Catechu Potassium dichromate Soap Logwood Aluminium sulphate
	5C	28	80. Chocolate or French Brown	Decoction of sumach Red spirits, No. 29 or yellow spirits, No. 30 Quercitrou bark decoction Decoction of logwood Red liquor, No. 48.	Sumac Red spirits, No. 29 or yellow spirits, No. 30 Quercitron Logwood Aluminium acetate
			81. Catechu Fawns	Catechu, No. 40 Solution of bi-chromate of potash (chrome)	Catechu Potassium dichromate

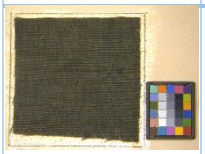
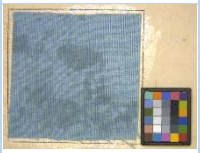
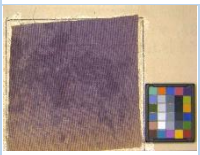
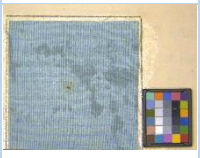
[113] Sharp, 324.

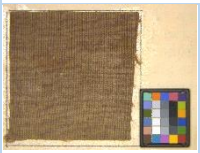
Pattern - Cotton	Location of pattern		Possible receipts	Dyes, mordant and additives present in the recipe	
	Ref. No.	**Page No.**		**Terms and names given in the manual**	**Current names**
	6C	29	82. Catechu Fawns – another method	Catechu, No. 40 Acetate of lead	Catechu Lead acetate
			83. Catechu Fawns – another method	Catechu, No. 40 Copperas solution Soap	Catechu Ferrous sulphate Soap
	7C	30	84. Safflower Pink	Safflower for dyeing cotton, No. 45 Sulphuric acid (vitriol) Cream of tartar in solution	Safflower Sulphuric acid Potassium bitartrate
			85. Rose Colour	Safflower for dyeing cotton, No. 45 Sulphuric acid	Safflower Sulphuric acid
	8C	30	86. Safflower Crimson	Safflower for dyeing cotton, No. 45 Sulphuric acid	Safflower Sulphuric acid
			87. Safflower Red	Annotta, No. 39 Safflower for dyeing cotton, No. 45 Sulphuric acid	Annatto Safflower Sulphuric acid
	9C	31	89. Common Red	Decoction of sumach Red spirits, No. 29 Decoction of lima-wood and fustic	Sumac Red spirits, No. 29 Lima-wood Fustic
			90. Barwood Red	Sumach Sulphuric acid (vitriol) Barwood spirits, No. 31 Barwood	Sumac Sulphuric acid Barwood spirits, No. 31 Barwood
	10C	32	92. Light Straw	Acetate of lead (sugar of lead) Bi-chromate of potash (chrome)	Lead acetate Potassium dichromate
			93. Leghorn	Acetate of lead (sugar of lead) Bi-chromate of potash (chrome) Annotta liquor, No. 39	Lead acetate Potassium dichromate Annatto
	11C	33	94. Lemon Yellow	Acetate of lead (sugar of lead) Bi-chromate of potash	Lead acetate Potassium dichromate

Pattern - Cotton	Location of pattern		Possible receipts	Dyes, mordant and additives present in the recipe	
	Ref. No.	**Page No.**		**Terms and names given in the manual**	**Current names**
			95. Chrome Yellow	Acetate of lead (sugar of lead) Bi-chromate of potash	Lead acetate Potassium dichromate
	12C	34	96. Chrome Amber	Acetate of lead Nitrate of lead Chrome	Lead acetate Lead nitrate Potassium dichromate
			97. Chrome Amber – another method	Acetate of lead Caustic Potash No. 11 Chrome Sulphate of zinc Muriatic acid	Lead acetate Potassium hydroxide Potassium dichromate Sulphate of zinc Hydrochloric acid
	13C	36	103. Chrome Orange – another method	Sugar of lead Lime-water, No. 51 Chrome Softening, No. 50	Lead acetate Lime-water, No. 51 Potassium dichromate Softening, No. 50
			104. Annotta Orange	Annotta solution, no. 39	Annatto
	14C	37	105. Sky Blue	Bleaching No. 7 or No. 9 Nitrate of iron, No. 15 Yellow prussiate of potash in solution Sulphuric acid (vitriol) Alum	Bleaching No. 7 or No. 9 Ferric nitrate Potassium ferrocyanide or Cyanoferrates Sulphuric acid Aluminium sulphate
			106. Napoleon Blue	Bleaching No. 7 or 9 Nitrate of iron, No. 15 Muriatic acid Crystals of tin, No. 26 Double muriate, No. 33 Yellow prussiate of potash Alum	Bleaching No. 7 or 9 Ferric nitrate Hydrochloric acid Tin dichloride Double muriate of tin, No. 33 Potassium ferrocyanide Aluminium sulphate
	15C	38	107. Royal Blue	Iron Muriatic acid Tin crystals Yellow prussiate of potash Sulphuric acid (vitriol)	Iron containing solution[114] Hydrochloric acid Tin dichloride Potassium ferrocyanide Sulphuric acid

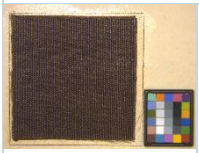
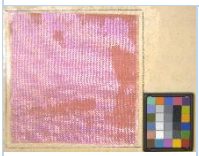
[114] Exact composition unknown from text. The most common iron mordant is iron sulphate Cardon, 39-46.

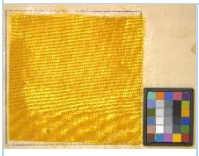
Pattern - Cotton	Location of pattern		Possible receipts	Dyes, mordant and additives present in the recipe	
	Ref. No.	**Page No.**		**Terms and names given in the manual**	**Current names**
			108. Logwood Blue	Blue vat, No. 38 Decoction of sumach Acetate of alumina (red liquor), No. 48 Acetate of iron (iron liquor)(No. 16) Decoction of logwood	Blue vat, No. 38 Sumac Aluminium acetate Iron diacetate Logwood
	16C	39	110. Chrome Green	Blue vat, No. 38 Acetate of lead Caustic potash Chrome	Blue vat, No. 38 Lead acetate Potassium hydroxide Potassium dichromate
	17C	40	113. Bark Green on Cloth	Acetate of alumina (red liquor), No. 48 Decoction of bark Chemic, No. 44	Aluminium acetate Bark Chemic, No. 44
			114. Fustic Green on Cloth	Acetate alumina (red liquor), No. 48 Decoction of fustic Alum in solution Chemic, No. 44	Aluminium acetate Fustic Aluminium sulphate Chemic, No. 44
	18C	41	116. Sage Green	Bleaching No. 7 or No. 9 Nitrate of iron, No. 15 Yellow prussiate of potash in solution Sulphuric acid (vitriol) Alum Decoction of fustic	Bleaching No. 7 or No. 9 Ferric nitrate Potassium ferrocyanide or Cyanoferrates Sulphuric acid Aluminium sulphate Fustic
			117. Olive or Bottle Green	Bleaching No. 7 or No. 9 Nitrate of iron, No. 15 Yellow prussiate of potash in solution Sulphuric acid (vitriol) Alum Acetate of alumina (red liquor), No. 48 Decoction of fustic and sumach Iron liquor, No. 16	Bleaching No. 7 or No. 9 Ferric nitrate Potassium ferrocyanide or Cyanoferrates Sulphuric acid Aluminium sulphate Aluminium acetate Fustic Sumac Iron diacetate

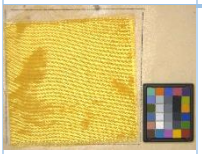
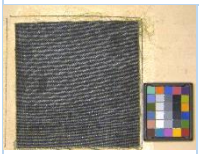
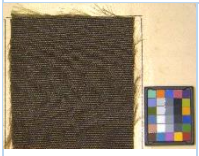
Pattern - Cotton	Location of pattern		Possible receipts	Dyes, mordant and additives present in the recipe	
	Ref. No.	**Page No.**		**Terms and names given in the manual**	**Current names**
	19C	42	119. Olive Green	Bleaching No. 7 or No. 9 Nitrate of iron, No. 15 Yellow prussiate of potash in solution Sulphuric acid (vitriol) Alum Acetate of alumina (red liquor), No. 48 Decoction of bark and logwood	Bleaching No. 7 or No. 9 Ferric nitrate Potassium ferrocyanide or Cyanoferrates Sulphuric acid Aluminium sulphate Aluminium acetate Bark Logwood
	20C	43	120. Puce or Lilac	Red spirits, No. 29 Decoction of logwood Alum	Red spirits, No. 29 Logwood Aluminium sulphate
			121. Puce or Lilac – another method	Acetate of alumina (red liquor), No. 48 Decoction of logwood Alum	Aluminium acetate Logwood Aluminium sulphate
	21C	43	122. Light Purple or Adelaide	Decoction of sumach Spirit plumb, No. 35	Sumac Spirit plumb, No. 35
			123. Light Purple or Adelaide – another method	Decoction of sumach Red spirits, No. 29 Decoction of Logwood	Sumac Red spirits, No. 29 Logwood
	22C	44	124. Purple	Decoction of sumach Red spirits, No. 29 Decoction of Logwood	Sumac Red spirits, No. 29 Logwood
	23C	45	130. Safflower Lavender	Bleaching No. 7 or No. 9 Nitrate of iron, No. 15 Yellow prussiate of potash in solution Sulphuric acid (vitriol) Alum Safflower for dyeing cotton, No. 45 Cream of tartar in solution	Bleaching No. 7 or No. 9 Ferric nitrate Potassium ferrocyanide or Cyanoferrates Sulphuric acid Aluminium sulphate Safflower Potassium bitartrate
			131. Safflower Lavender – another method	Nitrate of iron, No. 15 Yellow prussiate of potash in solution Sulphuric acid (vitriol)	Ferric nitrate Potassium ferrocyanide or Cyanoferrates Sulphuric acid

Pattern - Cotton	Location of pattern		Possible receipts	Dyes, mordant and additives present in the recipe	
	Ref. No.	**Page No.**		**Terms and names given in the manual**	**Current names**
				Alum Safflower for dyeing cotton, No. 45 Cream of tartar in solution	Aluminium sulphate Safflower Potassium bitartrate
	24C	46	132. Iron Buff or Nankeen	Copperas Lime-water, No.51	Ferrous sulphate Lime-water, No. 51
			133. Iron Buff or Nankeen – another method	Nitrate of iron, No.15 Caustic potash, No. 11 Soap	Ferric nitrate Potassium hydroxide Soap
	25C	47	135. Drab	Decoction of sumach Copperas in Solution Decoction of fustic with lima-wood and logwood Alum	Sumac Ferrous sulphate Fustic Lima-wood Logwood Aluminium sulphate
			136. Olive Drab	Sumach Copperas Fustic Alum	Sumac Ferrous sulphate Fustic Aluminium sulphate
	26C	48	138. Stone Colour	Sumach Copperas in solution Alum plumb, No. 36	Sumac Ferrous sulphate Alum plumb, No. 36
			139. Catechu Stone Drab	Catechu, No. 40 Copperas in solution Decoction of logwood Alum	Catechu Ferrous sulphate Logwood Aluminium sulphate

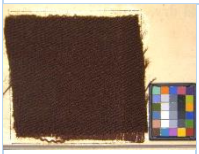
Pattern - Silk	Location of pattern		Possible receipts	Dyes, mordant and additives present in the recipe	
	Ref. No.	**Page No.**		**Terms and names given in the manual**	**Current names**
	1S	52	142. Full Deep Black	Copperas Nitrate of iron, No. 15 Decoction of logwood and fustic	Ferrous sulphate Ferric nitrate Logwood Fustic

Pattern - Silk	Location of pattern		Possible receipts	Dyes, mordant and additives present in the recipe	
	Ref. No.	**Page No.**		**Terms and names given in the manual**	**Current names**
			143. French Black	Copperas Alum Decoction of Logwood Soap	Ferrous sulphate Aluminium sulphate Logwood Soap
	2S	54	146. Brown	Annotta, No. 39 Solution of copperas Decoction of fustic, logwood Archil liquor Alum solution	Annatto Ferrous sulphate Fustic Logwood Archil Aluminium sulphate
			147. Brown	Annotta, No. 39 Decoction of fustic with sumach and peach-wood Copperas in solution Alum	Annatto Fustic Sumac Peach-wood Ferrous sulphate Aluminium sulphate
	3S	55	150. Chocolate Brown	Alum Decoction of peach-wood and logwood	Aluminium sulphate Peach-wood Logwood
			151. Bronze Brown	Decoction of fustic Archil liquor Solution of copperas	Fustic Archil Ferrous sulphate
	4S	56	152. Pink	Safflower Sulphuric acid (vitriol) Cream of tartar	Safflower Sulphuric acid Potassium bitartrate
			153. Safflower Rose and Crimson	White soap Archil liquor Cudbear (Orcein) Safflower Sulphuric acid (vitriol) Cream of tartar	White soap Archil Cudbear (Orcein) Safflower Sulphuric acid Potassium bitartrate
	5S	57	155. Cochineal Crimson	Bi-chloride of tin Nos. 27 and 28 Cochineal	Stannous chloride / Tin (II) chloride Cochineal
Unlikely			156. Common Red	Decoction of peach-wood and fustic Red spirits, No. 29	Peach-wood Fustic Red spirits, No. 29

Pattern - Silk	Location of pattern		Possible receipts	Dyes, mordant and additives present in the recipe	
	Ref. No.	**Page No.**		**Terms and names given in the manual**	**Current names**
	6S	59	162. Sky Blue	Sulphate of indigo, No. 42 Alum solution	Sulphate of indigo, No. 42 Aluminium sulphate
			163. Prussian Blue - Sky	Nitrate of iron, No. 15 Yellow prussiate of potash in solution Sulphuric acid (vitriol) Alum	Ferric nitrate Potassium ferrocyanide or Cyanoferrates Sulphuric acid Aluminium sulphate
	7S	60	164. Royal Blue	Nitrate of iron, No. 15 Muriatic acid Crystals of tin, No. 26 Muriate of tin, No. 33 Yellow prussiate Sulphuric acid (vitriol) Alum	Ferric nitrate Hydrochloric acid Tin dichloride Muriate of tin, No. 33/Tin dichloride Potassium ferrocyanide or Cyanoferrates Sulphuric acid Aluminium sulphate
Unlikely			165. Napoleon Blue	Nitrate of iron, No. 15 Proto-chloride of tin, No. 26 Yellow prussiate Alum Muriatic acid	Ferric nitrate Tin dichloride Potassium ferrocyanide or Cyanoferrates Aluminium sulphate Hydrochloric acid
	8S	61	167. Lavender – another method	White soap Archil liquor Cudbear (Orcein)	White soap Archil = Orchil Cudbear (Orcein)
Unlikely			168. Wine colour, Violet, Lilac, etc.	Plumb liquor, No. 35 Sulphate of indigo, No. 42	Plumb liquor, No. 35 Sulphate of indigo, No. 42
	9S	63	171. Weld, Yellow	Alum solution	Aluminium sulphate
			172. Bark and Fustic Yellow	Alum solution Decoction of bark	Aluminium sulphate Bark

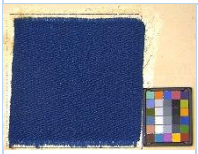
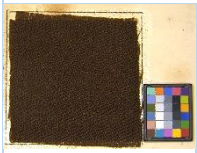
Pattern - Silk	Location of pattern		Possible receipts	Dyes, mordant and additives present in the recipe	
	Ref. No.	**Page No.**		**Terms and names given in the manual**	**Current names**
	10S	64	175. Salmon, Flesh, Nankeen, Buff, etc.	White soap Annotta liquor, No. 39	White soap Annatto
	11S	64	176. Orange	Annotta, No. 39	Annatto
			177. Yellow Drab	Annotta, No 39 Decoction of sumach and fustic Copperas in solution Alum	Annatto Sumac Fustic Ferrous sulphate Aluminium sulphate
	12S	65	179. Slate or Stone Colour	Decoction of sumach, fustic and logwood Solution of copperas	Sumac Fustic Logwood Ferrous sulphate
	13S	66	180. Green	Alum solution Decoction of fustic Indigo extract, No. 43	Aluminium sulphate Fustic Indigo extract, No. 43
			181. Green – another method	Decoction of fustic Alum solution Indigo extract, No. 43.	Fustic Aluminium sulphate Indigo extract, No. 43.
	14S	67	182. Sage Green and Pea Green	Alum solution Ebony wood solution/decoction Indigo extract	Aluminium sulphate Ebony wood Indigo extract
			183. Bottle Green	Alum Copperas Decoction of fustic Indigo extract, No. 43	Aluminium sulphate Ferrous sulphate Fustic Indigo extract, No. 43
	15S	67	185. Olive	Solution of copperas Solution of Alum Decoction of fustic and logwood	Ferrous sulphate Aluminium sulphate Fustic Logwood
			186. Light Olive	Sulphate of indigo, No. 42 Alum solution Decoction fustic	Sulphate of indigo, No. 42 Aluminium sulphate Fustic

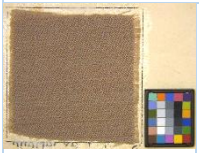
Pattern - Silk	Location of pattern		Possible receipts	Dyes, mordant and additives present in the recipe	
	Ref. No.	**Page No.**		**Terms and names given in the manual**	**Current names**
				Archil liquor	Archil

Pattern - Wool	Location of pattern		Possible receipts	Dyes, mordant and additives present in the recipe	
	Ref. No.	**Page No.**		**Terms and names given in the manual**	**Current names**
	1W	70	188. Black	Camwood Copperas Logwood Chamber lye	Camwood Ferrous sulphate Logwood Chamber lye/Urine
			189. Blue Black	Yellow prussiate of potash Nitrate of iron, No. 15 Crystals of tin, No. 26 Muriate of tin, No. 33 Bichromate potash (chrome) Alum Logwood Barwood Fustic Copperas in solution	Potassium ferrocyanide or Cyanoferrates Ferric nitrate Tin dichloride Muriate of tin, No. 33/Tin dichloride Potassium dichromate Aluminium sulphate Logwood Barwood Fustic Ferrous sulphate
	2W	71	192. Brown	Fustic Madder Peach-wood Logwood Solution of copperas	Fustic Madder Peach-wood Logwood Ferrous sulphate
			193. Brown	Fustic Camwood Logwood Copperas	Fustic Camwood Logwood Ferrous sulphate
	3W	72	194. Crimson	Cochineal paste, No. 53 Dry cochineal Tartar Proto-chloride of tin	Cochineal Dry cochineal Potassium bitartrate Tin dichloride
Unlikely			195. Scarlet	Tartar Dry cochineal Sumach	Potassium bitartrate Dry cochineal Sumac

Pattern - Wool	Location of pattern		Possible receipts	Dyes, mordant and additives present in the recipe	
	Ref. No.	**Page No.**		**Terms and names given in the manual**	**Current names**
				Fustic	Fustic
	4W	73	197. Claret Red	Camwood Copperas Alum Logwood	Camwood Ferrous sulphate Aluminium sulphate Logwood
			198. Lac Scarlet	Tartar Sumach Lac Bi-chloride of tin, No. 27 (per-muriate)	Potassium bitartrate Sumac Lac Stannous chloride/Tin dichloride
	5W	73	199. Pink	Tartar Alum Cochineal paste, No. 53 Red spirits, No. 29	Potassium bitartrate Aluminium sulphate Cochineal Red spirits, No. 29
	6W	74	200. Yellow	Chrome Alum Fustic	Potassium dichromate Aluminium sulphate Fustic
			201. Yellow	Tartar Alum Bark Sumach Fustic Red spirits, No. 29	Potassium bitartrate Aluminium sulphate Bark Sumac Fustic Red spirits, No. 29
	7W	74	202. Orange	Sumach Cochineal dry Fustic Tartar Red spirits, No. 29	Sumac Cochineal Fustic Potassium bitartrate Red spirits, No. 29
	8W	75	203. Sky Blue	Argol[115] Alum Indigo extract, No. 43	Potassium bitartrate Aluminium sulfate Indigo extract, No. 43
			204. Royal Blue	Yellow prussiate of potash Nitrate of iron, No. 15	Potassium ferrocyanide or Cyanoferrates

[115] Sharp, 32.

Pattern - Wool	Location of pattern		Possible receipts	Dyes, mordant and additives present in the recipe	
	Ref. No.	**Page No.**		**Terms and names given in the manual**	**Current names**
				Crystals of tin, No. 26 Double muriate of tin, No. 33	Ferric nitrate Tin dichloride Double muriate of tin, No. 33/Tin dichloride
	9W	75	205. Royal Blue	Muriate of iron, No. 18 Double muriate of tin, No. 26 Red prussiate of potash	Stannous chloride Tin dichloride Potassium ferrocyanide
			206. Pigeon Blue	Chrome (bi-chromate of potash) Alum Tartar Logwood Verdigris	Potassium dichromate Aluminium sulphate Potassium bitartrate Logwood Copper acetate
	10W	76	208. Green	Fustic Argol Alum Indigo extract, No. 43	Fustic Potassium bitartrate Aluminium sulfate Indigo extract, No. 43
			209. Fast Green	Fustic Alum	Fustic Potassium alum
	11W	77	212. Olive	Fustic Logwood Madder Peach-wood Copperas in solution	Fustic Logwood Madder Peach-wood Ferrous sulphate
			213. Olive	Chrome Alum Fustic Camwood Logwood	Potassium dichromate Aluminium sulphate Fustic Camwood Logwood
	12W	78	214. Purple	Chrome Alum Logwood Peach-wood	Potassium dichromate Aluminium sulphate Logwood Peach-wood
Unlikely			215. Wine Colour	Cudbear (Orcein)	Cudbear (Orcein)

Pattern - Wool	Location of pattern		Possible receipts	Dyes, mordant and additives present in the recipe	
	Ref. No.	**Page No.**		**Terms and names given in the manual**	**Current names**
	13W	79	216. Light Violet	Cudbear (Orcein) Logwood Barwood or Camwood Peach-wood Alum in solution	Cudbear (Orcein) Logwood Barwood or Camwood Peach-wood Aluminium sulphate
			217. Puce	Logwood Camwood Cudbear (Orcein) Copperas in solution	Logwood Camwood Cudbear (Orcein) Ferrous sulphate
	14W	80	220. Gray Drab	Bichromate Logwood	Potassium dichromate Logwood
			221. Slate Drab	Peach or lima-wood Logwood Fustic Copperas in solution	Peach or lima-wood Logwood Fustic Ferrous sulphate
	15W	81	222. Slate	Logwood Fustic Alum Copperas	Logwood Fustic Aluminium sulphate Ferrous sulphate

*All images used on this table are a courtesy from the National Library of Scotland.

3. Condition Report

While the *object record* focuses in recording as much information as possible about the material and construction of the object, the *condition report* aims at collecting information on the object's current condition. The information collected serves to inform present and future conservation.

3.1. Book

The volume studied in this project, James Napier - *A Manual of Dyeing Receipts for General Use*, is overall in good condition, except for a few of the textile patterns that are discoloured, faded and show signs of degradation of the pigments/dyes.

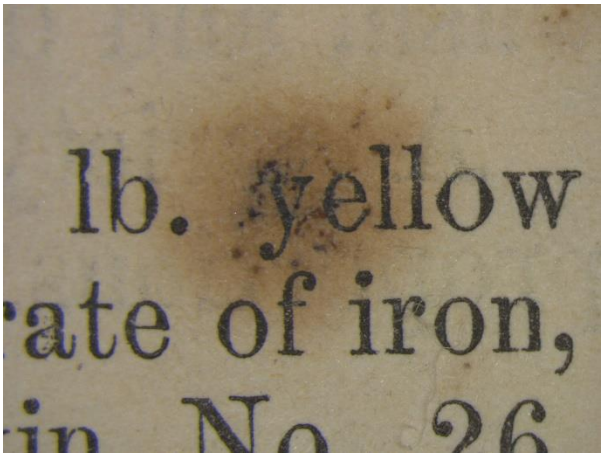


Figure 26 - Close up image of foxing on page 75 of the dye manual. Image courtesy of the National Library of Scotland.

3.1.1. Soiling (Particulate/Ingrained)

The volume was visually inspected for the presence of soiling, both particulate and ingrained. Stereo-microscope Leica S8APO was used during investigation.

The object did not present particulate nor ingrained soiling of considerable levels.

3.1.2. Discolouration and staining

The volume was visually inspected for noticeable alteration in the colouration of the pages. Overall mild yellow discolouration could be noted throughout the volume.

Stains of rusty aspect could be seen scattered throughout the volume. They vary in size, dimension and intensity. These stains will be referred to as *foxing*[116] (Fig. 12).

Some pages also have been splattered with what seems to be dyestuff.

[116] See *Considerations* section for explanation on *foxing*.

3.1.3. Creasing and folds

Creases and folds were not identified during visual investigation.

3.1.4. Structural Damage:

The volume has clearly been re-sized and re-bound at some point in its history. As no information about the re-sizing exists in the documentation of the volume with the National Library of Scotland, it is very likely that it happened before the volume was acquired by the institution. The cutting of the text block to a smaller size caused the loss of material of certain patterns. Textile patterns 8C, 16C, 21C, 23C, 15S, and 9W were cut during re-sizing and are now exposed at the edge of the text block (Fig. 13). Original cover boards are missing. The current cover boards are very likely to have been added to the volume at the time of the re-sizing.

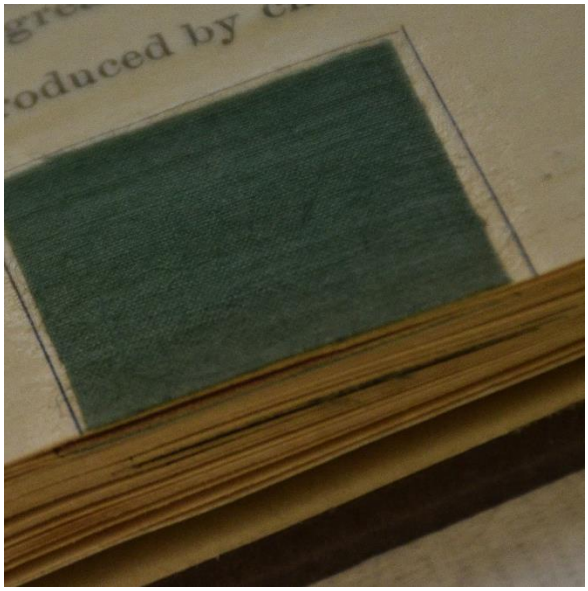
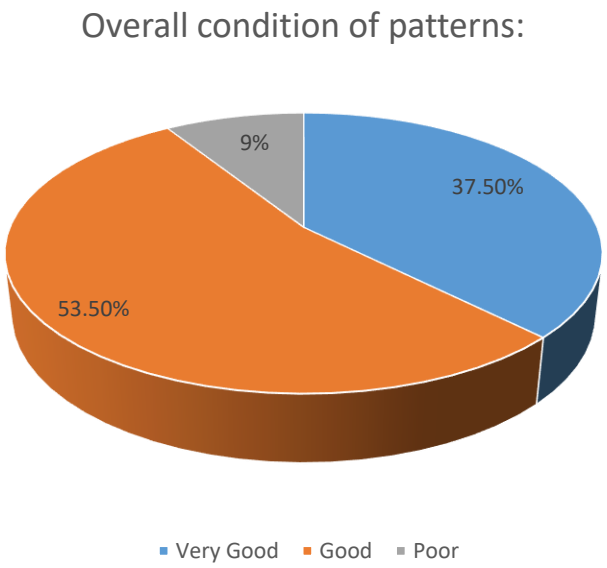


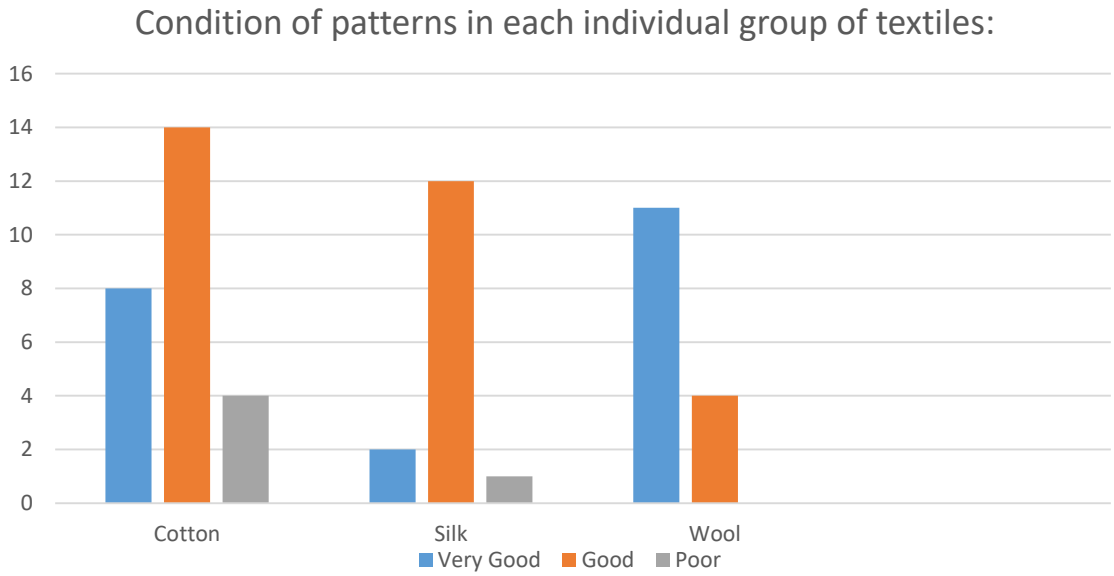
Figure 27 - Detail image of the edge of some of the patterns exposed at the end of the text block. Image courtesy of the National Library of Scotland.

3.2. Patterns:

The 56 textile patterns analysed for this dissertation are in overall good condition. As the chart illustrates below, the majority of 53.5% can be considered as in *good* condition while an impressive 37.5% has been categorized as *very good* condition during visual analysis. A small percentage, only 9%, shows significant visual alteration. These isolated cases will be discussed in detail in the appropriate sub-section.



In the group of wool patterns, 11 out of 15 patterns have been considered in *very good* condition and a minority of 4 patterns has their condition labeled as *good*. The vast majority of silk patterns, 12 out of 15, are in *good* condition, while 2 have been assessed as *very good* and only 1 as *poor*. Cotton patterns are not only the most numerous ones, but also is the category with the highest number of patterns in *poor* condition: 4 in total. It has 14 patterns in *good* condition and 8 in *very good* condition. See the graph below:



3.2.1. Soiling (Particulate/Ingrained)

After careful visual analysis, it has been concluded that the majority of the textile patterns do not present any significant level of soiling, neither particulate nor ingrained. Pattern 23C is only exception to the rule. The presence of a small dark mark soiling can be seen in the centre of the square of fabric (Fig. 14).

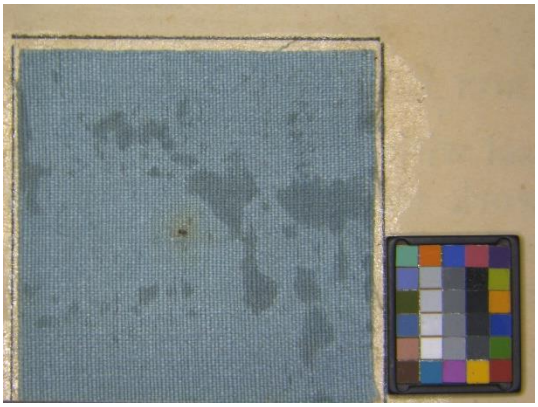


Figure 28 - Pattern 23C and the small mark of soiling/foxing identified in its centre. Image courtesy of the National Library of Scotland.

3.2.2. Discolouration and staining

Several cotton patterns present dark discolouration of varying intensity. The staining ranges from subtle, like pattern 4C (Fig. 15), to severe as in the pattern No. 14C (Fig. 16). The patterns that appear discoloured are 4C, 5C, 6C, 7C, 8C, 9C, 10C, 14C, 15C, 16C, 17C, 20C, 22C, 23C and 24C. Some silk patterns also present uneven dark discolouration. Patterns 4S, 6S, 9S, 10S, 13S and 14S were more extensively discoloured than patterns 5S, 6S, 8S, 11S and 12S, which are more subtly damaged. Wool patterns do not show any signs of dark discolouration.

Figure 15 – Pattern 4C with subtle darkening due to embedding of the adhesive. Image courtesy of the National Library of Scotland.

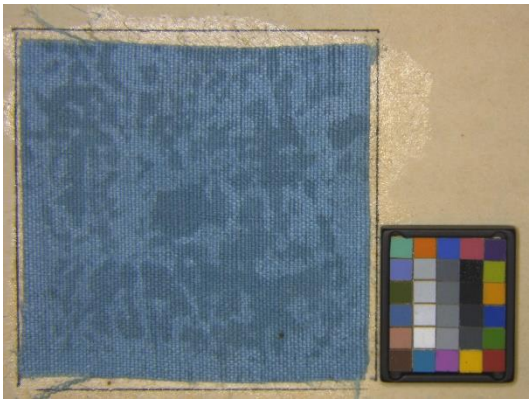


Figure 16 – Pattern 14C with severe darkening due to embedding of the adhesive. Image courtesy of the National Library of Scotland.

Patterns of cotton 11C, 12C and 13C present unusual visual alterations in comparison to the already mentioned patterns above, and will be discussed separately in the *considerations* section. Numbers 11C (Fig.17) and 12C (Fig. 18), both originally shades of yellow, show extensive dark discolouration of different quality to the darkening observed on the other patterns previously. Pattern number 13C (Fig. 19) shows a dark grey substrate with orange fibres stuck to its surface. A “rusty” coloured stain can be seen in the middle of the pattern.

Pattern 10C presents two small marks towards the bottom left hand-side corner. The smallest mark is black and the slightly bigger mark is pink.

Pattern 21C presents intense fading of the colour along the bottom edge (Fig. 23).

Transference of colour

Several patterns in the dye manual transferred colour on to the page opposite (Fig. 20). Out of the total number of 56 patterns, 20% were marked as *intense transference of colour*, 48% with *moderate transference* and 32% with *no transference* at all. Within the 20% of the patterns marked with intense colour transfer, the majority of them were of cotton 55%, while 25% were silk and 20% wool. In the moderate colour transfer group, cotton represents 33% of the patterns while wool has the majority with 41% and silk represents only 26% of the total. The group of patterns that did not transfer any colour at all is the one with the most contrast amongst the materials: cotton patterns represent 61% of the patterns while silk has 28% of them. Woolen patterns are only 11% in this category.

Note: The degree of transference of colour has been categorized: 1 – indicating intense colour transfer, 2 – indicating moderate transference of colour, and 3 – for the patterns that did not transfer colour at all. See graph below:

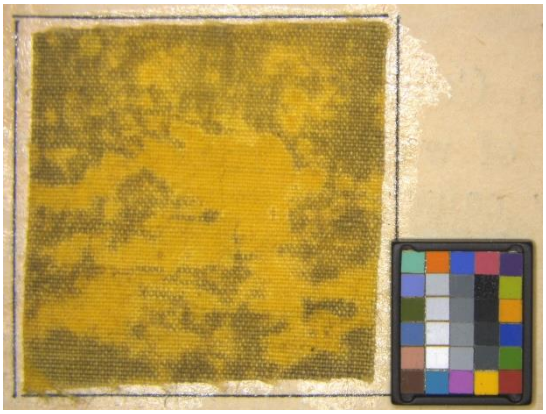


Figure 17 - Pattern 11C showing dark, greenish discolouration. Image courtesy of the National Library of Scotland.

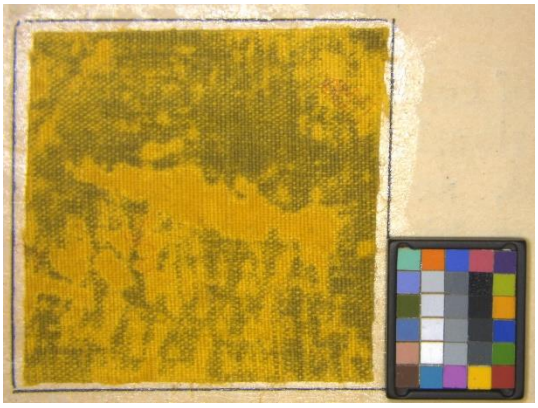


Figure 18 - Pattern 12C showing dark/greenish discolouration. Image courtesy of the National Library of Scotland.

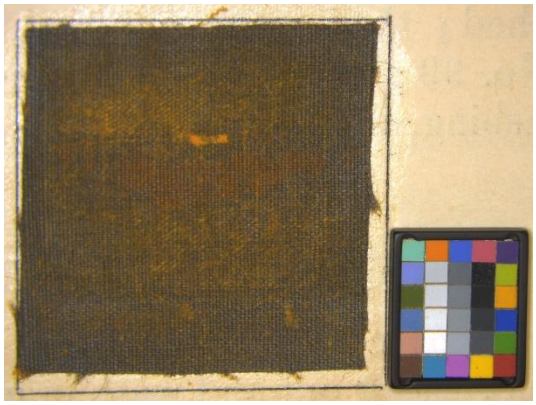
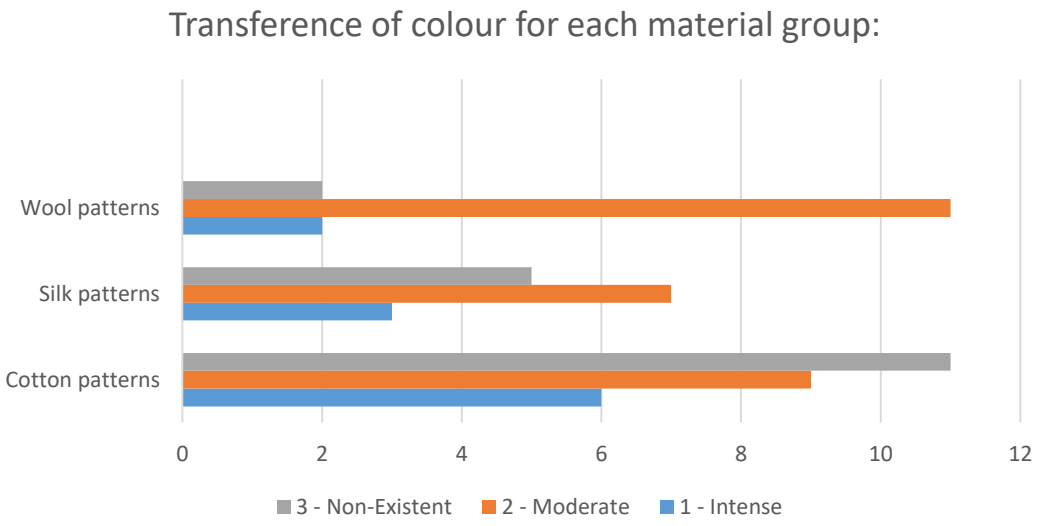
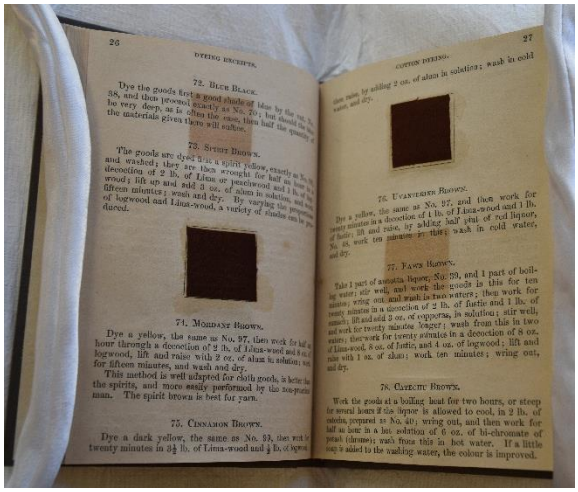


Figure 19 - Pattern 13C showing orange fibres stuck to the dark grey substrate. Image courtesy of the National Library of Scotland.





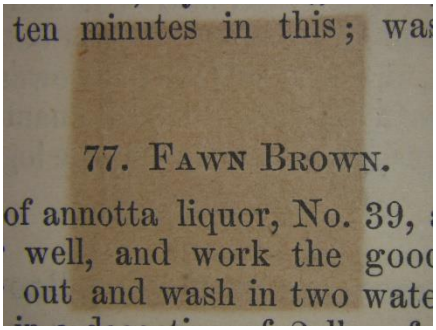


Figure 20 - Overall image of transference of colour in the dye manual (left) and detail image of the transfer of colour onto recipe No. 77 (right). Image courtesy of the National Library of Scotland.

3.2.3. Creasing and folds

Creasing and folds were not identified during visual analysis of the patterns.

3.2.4. Structural damage

No relevant structural damage has been identified on any of the textile patterns.

4. Considerations

This section is intended to discuss the possible reasons for the current condition of certain textile patterns. Very often there might be more than one causes to a particular degradation process or damage identified in the condition report. That said, this section will not explore the degradation that can be potentially caused by certain components of the dye recipes, but focuses on the degradation happening to certain patterns specifically.

It is important to remind the reader that most of the analysis carried out in this investigation has been of a visual type only. No technical analysis has been conducted on the textile patterns during this project. Therefore, the discussion will be essentially hypothetical, and will rely on existent literature for substantiation.

Note: Testing of the adhesive and of the pH of the paper were conducted by the National Library of Scotland, and were the only two methods of technical analysis carried out for this project.

4.1. Paper

The technical analysis mentioned on pages 9 and 10 of the *Object Record* chapter under the section *2.5.1. Book*, described the measuring of the pH of two random pages of the James Napier dye manual. The testing was carried out to help understand the current condition of the volume. Considering that the pH scale runs from 0 to 14, 0 being the most acidic and 14 the most alkaline, the results of the testing can be regarded as good as they were closer to neutral 7 than to either of the extremes. The title page read pH 4,86 and page 60 read pH 4,30 during testing. The current level of acidity of the paper and the mild discolouration of the pages suggest that the volume has been kept in storage protected from light and in good environmental conditions.

Acidity is directly connected to the ageing of paper. The most acidic the paper, the more rapid the ageing process happens. The acidity of the paper changes over time due to the

influence of external pollutants or because of the breakdown of internal components.[117] As the paper ages, either due to internal or external factors, its colouration starts to change in consequence of the building up of degradation products.[118] Discolouration of aged paper is usually connected to exposure to light, however, the pages inside of a closed book can also become yellow over the years depending on its composition. In the case of the James Napier dye manual, the possible cause for the yellow discolouration of its pages could be found within its own material. Wood pulp paper, very common after the second half of the 19th century, is particularly prone to discolouration.[119] The degradation is more intense if the paper is exposed to light, but keeping the volume closed and away from it would not prevent processes such as acid-catalised hydrolysis and oxidation from occurring.[120] In this case, the inherent quality/nature of the material used to make the object will probably be most responsible for its own degradation.

The stains present in several pages of the volume here discussed are likely a consequence of particulate soiling of metallic nature that deposited on the surface of the pages during use of the dye manual and became ingrained over time. These stains can be referred to as *foxing*. Foxing is the name given to ageing related spots and dark-brown marks that appear usually on historic paper, but can also be seen of other objects such as historic textiles. There are two main known sources for foxing: metal contamination and biological growth. The contamination with particles of metals may happen during the making of the paper or through airborne dust. The oxidation of the fine particles present in the paper creates the rusty appearance of the stain. The second type of stain could be the result of a fungal growth in the sizing of the paper. The contamination in this case is also airborne.[121]

Colorful stains were also identified throughout the pages of the dye manual. They are irregular in size and shape and are visually similar stains caused by watercolour paint. They could possibly be a consequence of accidental spillage of dyes or ink during handling.

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[117] Michael Seery, "Paper Conservation," Royal Society of Chemistry, https://eic.rsc.org/feature/paper-conservation/2020204.article (accessed August 03, 2017).
[118] Banik, 222-223 and 244.
[119] Ibid., 220.
[120] Ibid., 243-244.
[121] Soyeon Choi, "Foxing on Paper: A Literature Review," *Journal of the American Institute for Conservation*, 46, No. 2 (2007): 138-141.

4.2. Patterns

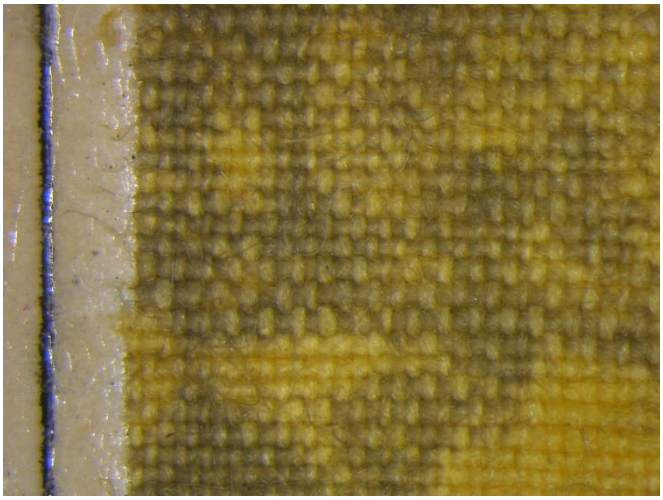

Figure 21 - Degradation of pigment lead chromate on pattern 12C. Image courtesy of the National Library of Scotland.

The nature of the small dark mark on pattern 23C has not been confirmed. However, visual analysis suggests that it could be ingrained soiling containing metal particles given its "rusty" aspect.[122] The mark here discussed is visually similar to the marks identified as foxing that have been seen on the paper and were described in the subsection above. The absence of particulate soiling inside the volume suggests that the book has been kept closed for most of its life, which prevented airborne pollutants from depositing on the pages.

The adhesive was generously applied to the paper to secure the swatches of fabric. Evidence of its excessive application can be seen on the edges of the outlined squares marking were the fabric should be inserted. The excessive adhesive would still have been wet at the time of the application of the textile pattern, and embedded the fibres. The drying of the adhesive caused the fibres to darken. Although sometimes visually disturbing, the dark marks do not seem to compromise the integrity of the textile fibres. In fact, there are two examples of patterns that have had their original colours "preserved" by the adhesive. On patterns 11C and 12C, the adhesive seems to have encapsulated the original pigment and preserved it from ageing. The pigment used in both patterns according to the recipes[123] that correspond to each of the swatches is *lead chromate*[124]. Lead chromate is notorious for darkening when exposed to light, and for becoming green as a consequence of the oxidation of the chrome

[122] Tímár-Balázsy, 158.

[123] Recipe 94. *Lemon Yellow* and 95. *Chrome Yellow* correspond to pattern 11C, and 96. *Chrome Amber* and 97. *Chrome Amber – another method* corresponds to pattern 12C.

[124] Sharp, 232.

component.[125] [126] [127] The degradation seen on both patterns matches the visual aspect of degraded lead chromate pigment (Fig. 21).

Figure 22 - Detail image of pattern 13C. Orange fibres can be seen stuck to the dark grey substrate. Image courtesy of the National Library of Scotland.

Interestingly, the volume has never been put out on display at the National Library of Scotland and it is considered a *low demand* volume, which means it is not frequently requested for consultation in the reading room.[128] With this in mind, it would be reasonable to consider that the patterns on pages 33 and 34 might have been exposed to light at some point before it became part of the library collection. The presence of lead acetate in the composition of the pigment also poses a health and safety risk to whoever gets in contact with it.[129] Conservation scientists, as well as conservators and visitors that request access to the volume, would be in a more vulnerable position as the close and repetitive contact necessary during study and investigation could intensify exposure. The wearing of protective personal equipment is highly recommended, as well as carrying out the investigation in a well-ventilated room or under fume extractors.[130]

Pattern 13C still remains somewhat of a mystery regarding its current condition (Fig. 22). What can be observed is a substrate of dark grey colour that has fibres of bright orange

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[125] Eastaugh, 225.

[126] Letizia Monico et al, "Degradation Process of Lead Chromate in Paintings by Vincent van Gogh Studied by Means of Synchrotron X-ray Spectromicroscopy and Related Methods. 2. Original Paint Layer Samples," Analytical Chemistry – American Chemistry Society: ACS Publications, 2010. file:///M:/ac1025122_part2%20(1).pdf.

[127] "Van Gogh's Fading Colours Inspire Scientific Inquiry," Chemical & Engineering News, http://cen.acs.org/articles/94/i5/Van-Goghs-Fading-Colors-Inspire.html (accessed August 27, 2017).

[128] Isobel Griffin, phone call to author, August 28, 2017.

[129] "Lead Poisoning: Historical Aspects of a Paradigmatic 'Occupational and Environmental Disease'," US National Library of Medicine National Institutes of Health, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3430923/ (accessed August 27, 2017).

[130] "Safety Data Sheet," Fisher Scientific, https://beta-static.fishersci.com/content/dam/fishersci/en_US/documents/programs/education/regulatory-documents/sds/chemicals/chemicals-l/S25378.pdf (accessed August 11, 2017).

colour randomly attached to its surface. The orange fibres look almost as if they had been glued to the grey substrate and then removed later on. Visual analysis is not enough to determine what is happening to this pattern and future research would be suggested.

The ink marks seen on pattern 10C appear to be accidental. The black mark could possibly be black ink due to the fact that the stain is very localized and defined, whereas the pink mark seems to be of an aqueous quality due to the way that the pink colour has been absorbed and expands out to the other fibres that surround it.

The only pattern to present considerable fading of colour is pattern 21C on page 43 of the volume (Fig. 23). The dye recipe for this pattern lists sumac, a tannin rich dye, as one of the ingredients of the recipe. Tannins are highly acidic materials and promote the degradation of cellulose in the vegetable fibres,[131] in this case cotton, making the fibres susceptible to other forms of degradation. Considering that the fading is happening from along the bottom edge upwards, and that this edge of the pattern is located near the edge of the text block, the proximity of the pattern to the edge of the text block maybe be the reason for the fading. The proximity of the pattern to the edge of the text block exposes the already fragile textile pattern to the damaging effects of airborne pollutants[132] and light[133].

Figure 23 - Detail image of fading of colour on pattern 21C. Image courtesy of the National Library of Scotland.

Transference of colour from the patterns onto the paper is very common in this volume. A table was created to organize the patterns according to the intensity of the transfer of colour, as mentioned at the end of the object record and illustrated by graph number x, and can be seen at the end of this dissertation as appendix 4. The recipes were studied and their composition

[131] John S. Mills and Raymond White. *The Organic Chemistry of Museum Objects* (London: Routledge, 2011), 127-128.

[132] Tímár-Balázsy, 157-159.

[133] John Shore, *Cellulosics Dyeing* (Bradford: Society of Dyers and Colourists, 1995), 38-41. Tímár-Balázsy, 88-92.

was investigated. Although there seems to be a tendency for the brown, dark brown and black patterns to transfer colour with higher intensity to the opposite page, there was not possible to connect the transference of colour to a particular ingredient (or, specifically, from the dye recipes). It is possible that the excess of dye transferred to the page opposite due to the proximity of the pages when the book was closed. The acidity of the paper might have also encouraged the dyes to transfer.

5. Recommendations

The mixed composition of the object represents a major challenge in conservation terms. The presence of cellulosic material such as cotton and wood pulp, paired with the presence of proteinaceous components such as silk and wool, suggest that the proposition of preventive conservation measures will have to take all the different needs of the different materials into consideration. Providing different materials with the required conservation care (without disturbing a different material in close proximity) can be a challenging task. Each of the listed materials have different properties and therefore different limitations to exposure to temperature, relative humidity and exposure to light. Some might be more sensitive than others.

The current good condition of the volume itself, and of the majority of the textile patterns within its contents, reflect the successful application of the National Library of Scotland's storage and display guidelines.[134] With the long-term preservation of the James Napier manual in mind, and the safe guarding of its potential as a research resource for future study, a selection of preservation and conservation measures from a textile conservation point of view are suggested below.

5.1. Preventive Conservation

Preventive conservation is generally known as a collection of measures that aim at adjusting the environment in which an object is placed in order to slow or even stop the ageing and degradation of the material that compose the object.[135] Developing new methods for access that help preserve the object is also very important.[136] This study proposes that the historic

[134] The National Library of Scotland storage guidelines specify that the temperature of storage areas should remain between 15-20 °C and that the Relative Humidity should be maintained around 40-60%. It also specifies that fluctuations in the environment should not surpass 10% for RH and 5 °C for temperature within any 24h period.
Shona Hunter, email message to author, August 21, 2017. See appendix 5 for National Library of Scotland guidelines.

[135] Charlie Constain, "Framework for Preservation of Museum Collections," in *Preventive Conservation in Museums*, ed. Chris Caple, 23-38 (London: Routledge, 2011).

[136] Anne French, "Achieving Access Through Collection Care, Conservation and Display," in *Textile Conservation: Advances in Practice*, ed. Frances Lennard and Patricia Ewer, 19-25 (London: Elsevier/ Butterworth-Heinemann, 2010).

information provided regarding the recipes can serve as a substitute for the actual handling of the volume in some cases. Historians and conservation scientists, or researchers in general, that need access to the volume to investigate the content of dye recipes can have access to the contents of the book through both digital copy[137] of the manual and through the detailed description of the recipes and its ingredients in the table in the object record section, and appendix 1 provided in this documentation. The idea is to provide new methods of access to improve access at the same time as preserving the actual volume.

5.1.1. Storage

The hygroscopic nature of textiles means they have a tendency to readily react to fluctuation to RH (relative humidity) levels by swelling and expanding if humidity increases or shrinking and distorting of the RH reduces. It is more important to maintain relative humidity stability (to avoid excessive swelling and desiccation of the material) than achieving optimal RH level for mixed material objects. In the case of James Napier dye manual, it is also important to consider that changes in RH fluctuation can promote changes to the dyes and the adhesive used to attach the patterns to the pages. Fugitive dyes would be prone to migrate if RH reaches beyond 65%, and could stain the paper. Animal glue swells in the presence of water and high RH could also damage the adhesion resulting in the detachment of the patterns. If high RH causes damage and can contribute to the fading of many dyes[138], low RH promotes dehydration of textile fibres below 50%. Considering that optimal RH for paper is recommended to be around 50%, the guidelines implemented by the National Library of Scotland (which recommend RH to be maintained between 40-60%) should be satisfactory for the preservation of the textile patterns in the James Napier dye manual.[139] [140]

I would recommend, in addition to the National Library of Scotland storage guidelines, the use of acid-free tissue to interleave the pages that have textile patterns on them. This measure would not only minimize the contact between paper and textile, but also act as

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[137] The digitization of the volume is currently in progress at the National Library of Scotland and should be made available in the near future.
[138] Tim Padfield and Sheila Landi, "The Light-Fastness of the Natural Dyes," *Studies in Conservation*, 11, No. 4 (1966): 191.
[139] Caroline Rendell, "Textiles," in *The National Trust Manual of Housekeeping* (London: National Trust, 2011), 404-419.
[140] David Erhardt and Marion Mecklenburg, "Relative Humidity Re-Examined," *in Preventive Conservation in Museums*, ed. Chris Caple, 339-354 (London: Routledge, 2011).

a method for monitoring changes to the stability of the patterns. The acid-free tissue would absorb degradation materials and become discoloured as the degradation happens. As the acid-free tissue would only be added between pages that contain textile patterns, this measure should not add considerable bulk to the structure of the dye manual. If preferred, spider web tissue could be used as an alternative to acid-free tissue.

5.1.2. Display

Considering the potential of the James Napier dye manual as a resource for future research and study, I would recommend that access to the volume is restricted to the reading room for the purpose of archival research. Natural dyes are notorious for fading when exposed to light[141] and further investigation on the light-fastness of the patterns should be carried out in the event of the volume being considered for display. It is important to avoid exposing patterns that can be particularly sensitive to light such as the ones dyed with fustic, lead chromate and annatto.[142] An example of the effect of light on dyes and pigments can be seen on patterns 11C and 12C which were dyed with lead chromate, or chrome yellow, and now present extensive dark, greenish discolouration.

5.2. Interventive Conservation

It is recommended that pattern 23C be accessed for potential surface cleaning using low powered vacuum suction. The reddish, brown stain seen on the pattern is very likely caused by the presence of particles of metal in the airborne soiling that deposited on the surface of the textile swatch. Although surface cleaning will not stop the oxidation that is already in progress nor revert the staining caused by the process, it would help in reducing future damage to the textile and paper.

5.3. Further Research

This research set out to investigate and visually analyze the James Napier dye manual in order to produce a substantial piece of documentation that will inform its preservation and future study. Given the nature and limitations of this study, several aspects of the composition and degradation of the textiles patterns within the volume were not explored. A

[141] Tímár-Balázsy, 88-92.
[142] Padfield, 182-191.

variety of analytical investigation techniques *are* suggested here in order to improve future understanding and documentation of several of the patterns, and the conservation issues that relate to them.

Although the likely composition of the pigments used on patterns 11C and 12C has been identified (through written evidence collected from the receipts that relate to the patterns), further investigation would be useful for determining their composition with greater accuracy. Analytical techniques such as X-Ray Fluorescence Spectrometry (XRF),[143] which is used extensively in the identification of pigments in paintings, could be a good option as sampling is not necessary for the process. The object is placed underneath an X-ray beam that produces a reading of the material. This information is then compared to a database of materials for interpretation. Fiber Optics Reflectance Spectroscopy is another possible alternative in the identification of these pigments.[144]

The same analytical techniques mentioned above could be used in the identification of the dyes or pigments used on the dark grey substrate of pattern 13C. In addition, light microscopy could help in the sampling of the orange fibres, and would help determine the quality of the material and whether the orange fibres belong to the substrate or not.

Further investigation regarding the instability of the dyes of certain patterns and the consequent transference of colour to the facing page within the book is also recommended (see appendix 1 for patterns that transferred colour). In-depth study of the ingredients of the recipes combined with techniques like micro-fading spectrometry[145] would help clarify the type of interaction between paper and textile in those cases.

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[143] Annemie Adriaens, "Non-Destructive Analysis and Testing for Museum Objects: An Overview of 5 Years of Research," *Spectrochimica Acta* Part B, 60 (2005): 1504.
[144] Cultural heritage Science Open Source, http://chsopensource.org/2013/11/25/fors-fiber-optics-reflectance-spectroscopy/ (accessed August 3, 2017).
[145] Julio M. del Hoyo-Melendez and Marion F. Mecklenburg, "Micro-fading Spectrometry: A Tool for Real-Time Assessment of the Light-Fastness of Dye/Textile Systems," *Fibres and Polymers*, 13, No. 8 (2012): 1079-1080.

6. Conclusion

The research potential of pattern books is an underexplored field that has only recently begun to receive the attention of conservation scientists and historians. In order to protect the rich content of these objects it is necessary to rethink the interventive approach conservation usually has towards pattern books. Highly interventive treatments may compromise the swatches potential for future investigation, and the application of advanced techniques of analysis such as: X-Ray Fluorescence Spectrometry, Fiber Optics Reflectance Spectroscopy and micro-fading spectrometry – to mention but a few.

The aim of this project was to thoroughly document the James Napier dye manual, 1858 2nd edition, currently part of the Special Collections at the National Library of Scotland. With in-depth documentation, this research intended to raise the volume's scientific investigation profile while simultaneously suggesting conservation measures to promote access *to* and the preservation *of* the volume. Although the volume can be classified as in good condition, a small number of patterns present considerable degradation issues that were addressed in this research, and that should not be overlooked. This research project did not undertake any form of technical analysis to the textile patterns themselves; conservation issues highlighted in the considerations section are the result of visual analysis and archival research only. Possible reasons for the identified degradation processes are given – but cannot be argued to be ultimately correct. Further investigation is necessary in order to collect more in-depth information, and to confirm or disprove the suggested reasons behind the visual alteration of certain fabric swatches. Further research would also help clarify the degradation issues highlighted in this study, but that are not explored here due to its limited nature.

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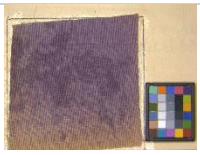
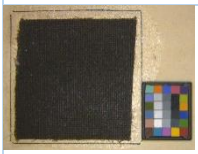
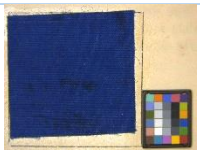
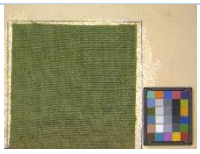
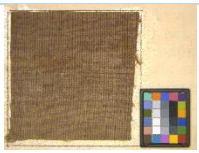
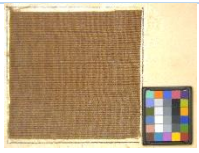
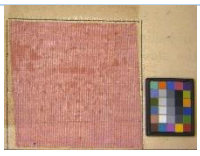
Colour transfer table

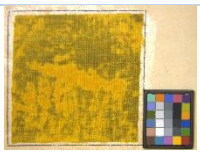
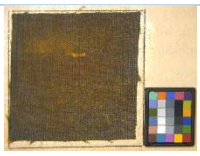
Pattern - Cotton	Location of pattern		Colour transfer	Possible receipts			
	Ref. No.	Page No.	1-intense 2-medium 3-none		Dyes	*Mordants*	Additives
	2C	26	1	73.Spirit Brown	Lima or peach wood Logwood Quercitron Sumac	*Aluminium sulphate*	**Red spirits, No. 29 or Yellow spirits, No. 30**
				74. Mordant Brown	Lima-wood Logwood	*Aluminium sulphate* *Lead acetate* *Potassium dichromate* *Potassium hydroxide*	**Hydrochloric acid** **Zinc sulphate**
	3C	27	1	75.Cinnamon Brown	Lima-wood Logwood Quercitron Sumac	*Aluminium sulphate*	**Red spirits, No. 29 or Yellow spirits, No. 30**
				76.Uvanterine Brown	Lima-wood Fustic	*Aluminium sulphate* *Lead acetate* *Potassium dichromate* *Potassium hydroxide*	**Hydrochloric acid** **Zinc sulphate**
	4C	28	1	78. Catechu Brown	Catechu	*Potassium dichromate*	**Soap**
				79. Catechu Chocolates	Catechu Logwood	*Aluminium sulphate* *Potassium dichromate*	**Soap**
	5C	28	1	80. Chocolate or French Brown	Logwood Quercitron Sumac	*Aluminium sulphate*	**Red spirits, No. 29 or yellow spirits, No. 30**
				81. Catechu Fawns	Catechu	*Potassium dichromate*	-
	21C	43	1	122. Light Purple or Adelaide	Sumac	*Spirit plumb, No. 35*	-
				123. Light Purple or Adelaide – another method	Logwood Sumac	-	**Red spirits, No. 29**

Pattern - Cotton	Location of pattern		Colour transfer	Possible receipts			
	Ref. No.	**Page No.**	**1-intense 2-medium 3-none**		**Dyes**	***Mordants***	Additives
	22C	44	1	124. Purple	Logwood Sumac	-	**Red spirits, No. 29**
	1C	25	2	70. Black	Logwood Sumac	*Ferrous sulphate*	**Lime-water, No. 51**[146] **Urine**
				71. Jet Black	Fustic Logwood Sumac	*Ferrous sulphate*	**Lime-water No. 51** **Urine**
	6C	29	2	82. Catechu Fawns – another method	Catechu	*Lead acetate*	**-**
				83. Catechu Fawns – another method	Catechu	*Ferrous sulphate*	**Soap**
	9C	31	2	89. Common Red	Fustic Lima-wood Sumac	-	**Red spirits, No. 29**
				90. Barwood Red	Barwood Sumac	-	**Barwood spirits, No. 31** **Sulphuric acid**
	15C	38	2	107. Royal Blue	-	*Iron* *Tin dichloride* *Potassium ferrocyanide*[147]	**Hydrochloric acid** **Sulphuric acid**
				108. Logwood Blue	Blue vat, No. 38 Logwood Sumac	*Aluminium sulphate* *Iron diacetate*	**-**
	16C	39	2	110. Chrome Green	Blue vat, No. 38	*Lead acetate* *Potassium hydroxide* *Potassium dichromate*	**-**

[146] David W. A. Sharp, The Penguin Dictionary of Chemistry, pg 235 and 67.

[147] Pigment, not dye.

Pattern - Cotton	Location of pattern		Colour transfer	Possible receipts			
	Ref. No.	**Page No.**	**1-intense 2-medium 3-none**		**Dyes**	***Mordants***	Additives
	17C	40	2	113. Bark Green on Cloth	Bark	*Aluminium acetate*	**Chemic, No. 44**
				114. Fustic Green on Cloth	Fustic	*Aluminium acetate* *Aluminium sulphate*	**Chemic, No. 44**
	24C	46	2	132. Iron Buff or Nankeen	-	*Ferrous sulphate*	**Lime-water, No. 51**
				133. Iron Buff or Nankeen – another method	-	*Ferric nitrate* *Potassium hydroxide*	**Soap**
	25C	47	2	135. Drab	Fustic Lima-wood Logwood Sumac	*Aluminium sulphate* *Ferrous sulphate*	**-**
				136. Olive Drab	Fustic Sumac	*Aluminium sulphate* *Ferrous sulphate*	**-**
	26C	48	2	138. Stone Colour	Sumac	*Ferrous sulphate*	**Alum plumb, No. 36**
				139. Catechu Stone Drab	Catechu Logwood	*Aluminium sulphate* *Ferrous sulphate*	**-**
	7C	30	3	84. Safflower Pink	Safflower	-	**Potassium bitartrate** **Sulphuric acid**
				85. Rose Colour	Safflower	-	**Sulphuric acid**
	8C	30	3	86. Safflower Crimson	Safflower	-	**Sulphuric acid**
				87. Safflower Red	Annatto Safflower	-	**Sulphuric acid**

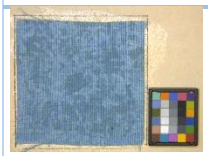
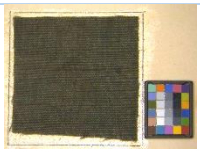
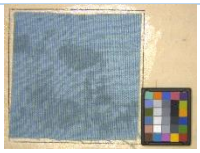
Pattern - Cotton	Location of pattern		Colour transfer	Possible receipts			
	Ref. No.	**Page No.**	**1-intense 2-medium 3-none**		**Dyes**	***Mordants***	Additives
	10C	32	3	92. Light Straw	-[148]	*Lead acetate Potassium dichromate*	-
				93. Leghorn	Annatto	*Lead acetate Potassium dichromate*	-
	11C	33	3	94. Lemon Yellow	-[149]	*Lead acetate Potassium dichromate*	-
				95. Chrome Yellow	-	*Lead acetate Potassium dichromate*	-
	12C	34	3	96. Chrome Amber	-	*Lead acetate Lead nitrate Potassium dichromate*	-
				97. Chrome Amber – another method	-	*Lead acetate Potassium dichromate Potassium hydroxide*	**Hydrochloric acid Zinc sulphate**
	13C	36	3	103. Chrome Orange – another method	-[150]	*Lead acetate Potassium dichromate*	**Lime-water, No. 51 Softening, No. 50**[151]
				104. Annotta Orange	Annatto	-	-

[148] The combination of lead acetate with potassium dichromate results in an inorganic pigment insoluble in water called lead chromate. The pigment therefore is unlikely to be removed from the fibre by mechanical action such as wet cleaning or abrasion. Explore degradation of lead chromate… sensitive to light. Pigment compendium page 225

[149] The combination of lead acetate with potassium dichromate results in an inorganic pigment insoluble in water called lead chromate. The pigment therefore is unlikely to be removed from the fibre by mechanical action such as wet cleaning or abrasion. Explore degradation of lead chromate… sensitive to light. Pigment compendium page 225

[150] Chrome orange is an inorganic pigment consisted of lead chromate and lead oxide.

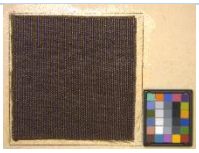
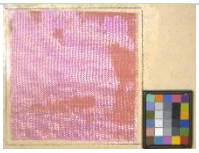
[151] Softening agents are used to neutralise contaminates in the water supply.

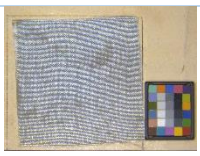
Pattern - Cotton	Location of pattern		Colour transfer	Possible receipts			
	Ref. No.	**Page No.**	**1-intense 2-medium 3-none**		**Dyes**	***Mordants***	Additives
	14C	37	3	105. Sky Blue	-[152]	*Aluminium sulphate* *Ferric nitrate* *Potassium ferrocyanide or Cyanoferrates (Prussian Blue)*	**Sulphuric acid Bleaching No. 7 or No. 9**
				106. Napoleon Blue	-	*Aluminium sulphate* *Double muriate of tin, No. 33* *Ferric nitrate* *Tin dichloride* *Potassium ferrocyanide*[153]	**Hydrochloric acid Bleaching No. 7 or No. 9**
	18C	41	3	116. Sage Green	Fustic	*Aluminium sulphate* *Ferric nitrate* *Potassium ferrocyanide or Cyanoferrates*	**Sulphuric acid Bleaching No. 7 or No. 9**
				117. Olive or Bottle Green	Fustic Sumac	*Aluminium acetate* *Aluminium sulphate* *Ferric nitrate* *Iron diacetate* *Potassium ferrocyanide or Cyanoferrates*	**Sulphuric acid Bleaching No. 7 or No. 9**
	19C	42	3	119. Olive Green	Bark Logwood	*Aluminium acetate* *Aluminium sulphate* *Ferric nitrate* *Potassium ferrocyanide or Cyanoferrates*	**Sulphuric acid Bleaching No. 7 or No. 9**
	20C	43	3	120. Puce or Lilac	Logwood	*Aluminium sulphate*	**Red spirits, No. 29**
				121. Puce or Lilac – another method	Logwood	*Aluminium acetate* *Aluminium sulphate*	-
	23C	45	3	130. Safflower Lavender	Safflower	*Aluminium sulphate* *Ferric nitrate* *Potassium ferrocyanide or Cyanoferrates*	**Potassium bitartrate** **Sulphuric acid Bleaching No. 7 or No. 9**

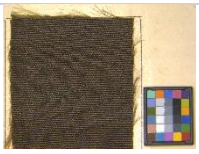
[152] The product of the reaction between ferric nitrate and potassium ferrocyanide is ferric ferrocyanide, a blue pigment called Prussian blue. Therefore, the colour of the pattern comes from the product of the reaction, not from an organic dye.

[153] Pigment, not dye.

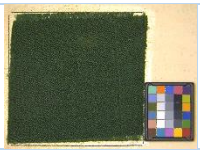
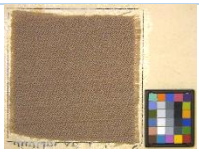
Pattern - Cotton	Location of pattern		Colour transfer	Possible receipts			
	Ref. No.	**Page No.**	**1-intense 2-medium 3-none**		**Dyes**	***Mordants***	Additives
				131. Safflower Lavender – another method	Safflower	*Aluminium sulphate* *Ferric nitrate* *Potassium ferrocyanide or Cyanoferrates*	**Sulphuric acid** **Potassium bitartrate**

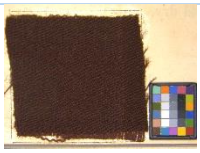
Pattern - Silk	Location of pattern		Colour transfer	Possible receipts			
	Ref. No.	**Page No.**	**1-intense 2-medium 3-none**		**Dyes**	*Mordants*	**Additives**
	1S	52	1	142. Full Deep Black	Fustic Logwood	*Ferric nitrate* *Ferrous sulphate*	-
				143. French Black	Logwood	*Aluminium sulphate* *Ferrous sulphate*	**Soap**
	2S	54	1	146. Brown	Annatto Archil Fustic Logwood	*Aluminium sulphate* *Ferrous sulphate*	-
				147. Brown	Annatto Fustic Peach-wood Sumac	*Aluminium sulphate* *Ferrous sulphate*	-
	3S	55	1	150. Chocolate Brown	Logwood Peach-wood	*Aluminium sulphate*	-
				151. Bronze Brown	Archil Fustic	*Ferrous sulphate*	-
	4S	56	2	152. Pink	Safflower	-	**Potassium bitartrate** **Sulphuric acid**
				153. Safflower Rose and Crimson	Archil Cudbear (Orcein) Safflower	-	**Sulphuric acid** **Potassium bitartrate** **White soap**
	5S	57	2	155. Cochineal Crimson	Cochineal	*Stannous chloride / Tin (II) chloride*	-
unlikely				156. Common Red	Fustic Peach-wood	-	**Red spirits, No. 29**

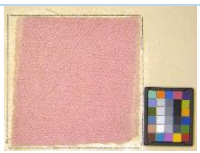
Pattern - Silk	Location of pattern		Colour transfer	Possible receipts			
	Ref. No.	Page No.	1-intense 2-medium 3-none		Dyes	*Mordants*	Additives
	6S	59	2	162. Sky Blue	Sulphate of indigo, No. 42	*Aluminium sulphate*	-
				163. Prussian Blue - Sky	-	*Aluminium sulphate* *Ferric nitrate* *Potassium ferrocyanide or Cyanoferrates*	**Sulphuric acid**
	8S	61	2	167. Lavender – another method	Archil Cudbear (Orcein)	-	**White soap**
unlikely				168. Wine colour, Violet, Lilac, etc.	Sulphate of indigo, No. 42	*Plumb liquor, No. 35*	-
	9S	63	2	171. Weld, Yellow	-	*Aluminium sulphate*	-
				172. Bark and Fustic Yellow	Bark	*Aluminium sulphate*	-
	10S	64	2	175. Salmon, Flesh, Nankeen, Buff, etc.	Annatto	-	**White soap**
	11S	64	2	176. Orange	Annatto	-	-
				177. Yellow Drab	Annatto Fustic Sumac	*Aluminium sulphate* *Ferrous sulphate*	-
	7S	60	3	164. Royal Blue	-	*Aluminium sulphate* *Ferric nitrate* *Muriate of tin, No. 33/Tin dichloride* *Potassium ferrocyanide or Cyanoferrates* *Tin dichloride*	**Hydrochloric acid** **Sulphuric acid**
unlikely				165. Napoleon Blue	-	*Aluminium sulphate* *Ferric nitrate* *Potassium ferrocyanide or Cyanoferrates* *Tin dichloride*	**Hydrochloric acid**

Pattern - Silk	Location of pattern		Colour transfer	Possible receipts			
	Ref. No.	**Page No.**	**1-intense 2-medium 3-none**		**Dyes**	*Mordants*	**Additives**
	12S	65	3	179. Slate or Stone Colour	Fustic Logwood Sumac	*Ferrous sulphate*	-
	13S	66	3	180. Green	Fustic Indigo extract, No. 43	*Aluminium sulphate*	-
				181. Green – another method	Fustic Indigo extract, No. 43	*Aluminium sulphate*	-
	14S	67	3	182. Sage Green and Pea Green	Ebony wood Indigo extract	*Aluminium sulphate*	-
				183. Bottle Green	Fustic Indigo extract, No. 43	*Aluminium sulphate* *Ferrous sulphate*	-
	15S	67	3	185. Olive	Fustic Logwood	*Aluminium sulphate* *Ferrous sulphate*	-
				186. Light Olive	Archil Fustic Sulphate of indigo, No. 42	*Aluminium sulphate*	-

Pattern - Wool	Location of pattern		Colour transfer	Possible receipts			
	Ref. No.	**Page No.**	**1-intense 2-medium 3-none**		**Dyes**	***Mordants***	Additives
	4W	73	1	197. Claret Red	Camwood Logwood	*Aluminium sulphate* *Ferrous sulphate*	-
				198. Lac Scarlet	Lac Sumac	*Stannous chloride/Tin dichloride*	**Potassium bitartrate**
	9W	75	1-2	205. Royal Blue	-	*Potassium ferrocyanide* *Stannous chloride* *Tin dichloride*	-
				206. Pigeon Blue	Copper ethanoate	*Aluminium sulphate*	**Potassium bitartrate**

Pattern - Wool	Location of pattern		Colour transfer	Possible receipts			
	Ref. No.	Page No.	1-intense 2-medium 3-none		**Dyes**	***Mordants***	Additives
					Logwood	*Potassium dichromate*	
	10W	76	2	208. Green	Fustic Indigo extract, No. 43	*Aluminium sulphate*	**Potassium bitartrate**
				209. Fast Green	Fustic	*Potassium alum*	-
	11W	77	2	212. Olive	Fustic Logwood Madder Peach-wood	*Ferrous sulphate*	-
				213. Olive	Camwood Fustic Logwood	*Aluminium sulphate* *Potassium dichromate*	-
	12W	78	2	214. Purple	Logwood Peach-wood	*Potassium dichromate* *Aluminium sulphate*	-
Pattern 12W looks more like this 215 than 214.				215. Wine Colour	Cudbear (Orcein)	-	-
	13W	79	2	216. Light Violet	Barwood Cudbear (Orcein) Logwood Peach-wood	*Aluminium sulphate*	-
				217. Puce	Camwood Cudbear (Orcein) Logwood	*Ferrous sulphate*	-
	14W	80	2	220. Gray Drab	Logwood	*Potassium dichromate*	-
				221. Slate Drab	Fustic Logwood Peach or lima-wood	*Ferrous sulphate*	-
	15W	81	2	222. Slate	Fustic Logwood	*Aluminium sulphate* *Ferrous sulphate*	-

Pattern - Wool	Location of pattern		Colour transfer	Possible receipts			
	Ref. No.	Page No.	1-intense 2-medium 3-none		Dyes	*Mordants*	Additives
	6W	74	2	200. Yellow	Fustic	*Aluminium sulphate* *Potassium dichromate*	-
				201. Yellow	Bark Fustic Sumac	*Aluminium sulphate*	**Potassium bitartrate** **Red spirits, No. 29**
	7W	74	2	202. Orange	Cochineal Fustic Sumac	-	**Potassium bitartrate** **Red spirits, No. 29**
	1W	70	2	188. Black	Camwood Logwood	*Ferrous sulphate*	**Chamber lye/Urine**
				189. Blue Black	Barwood Fustic Logwood	*Aluminium sulphate* *Ferric nitrate* *Ferrous sulphate* *Muriate of tin, No. 33/Tin dichloride* *Potassium alum* *Potassium dichromate* *Potassium ferrocyanide or Cyanoferrates* *Tin dichloride*	-
	2W	71	2	192. Brown	Fustic Logwood Madder Peach-wood	*Ferrous sulphate*	-
				193. Brown	Camwood Fustic Logwood	*Ferrous sulphate*	-
	8W	75	2-3	203. Sky Blue	Indigo extract, No. 43	*Aluminium sulphate*	**Potassium bitartrate**
				204. Royal Blue	-	*Double muriate of tin, No. 33/Tin dichloride* *Ferric nitrate* *Potassium ferrocyanide or Cyanoferrates* *Tin dichloride*	-

Pattern - Wool	Location of pattern		Colour transfer	Possible receipts			
	Ref. No.	**Page No.**	**1-intense 2-medium 3-none**		**Dyes**	***Mordants***	Additives
	3W	72	3	194. Crimson	Cochineal Dry cochineal	*Tin dichloride*	**Potassium bitartrate**
unlikely				195. Scarlet	Dry cochineal Fustic Sumac	-	**Potassium bitartrate**
	5W	73	3	199. Pink	Cochineal	*Aluminium sulphate*	**Potassium bitartrate** **Red spirits, No. 29**

Cotton patterns

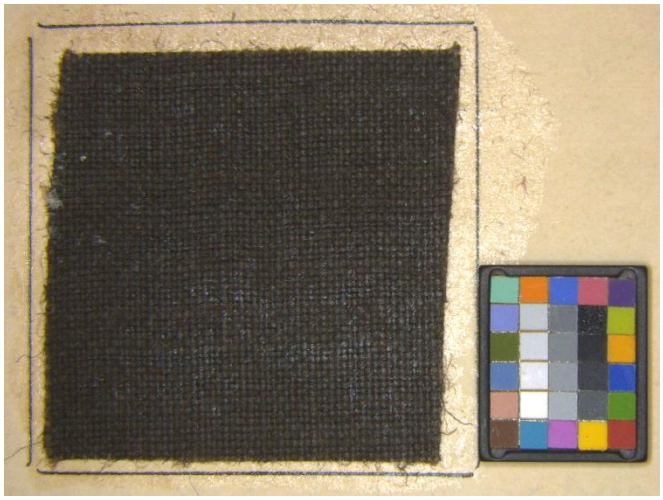


Figure 29 - 1C

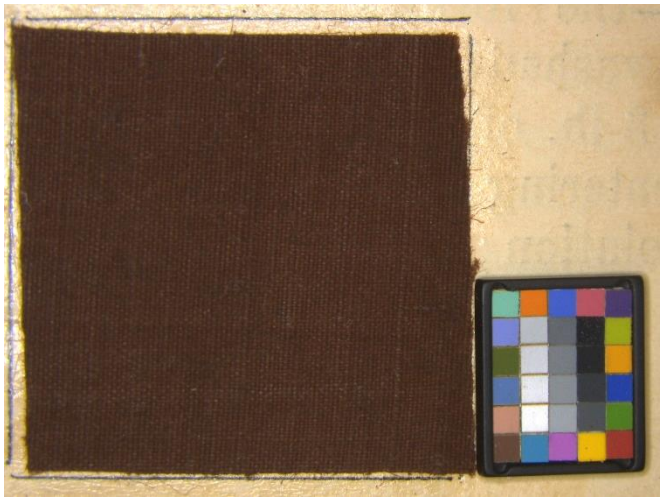


Figure 30 - 2C

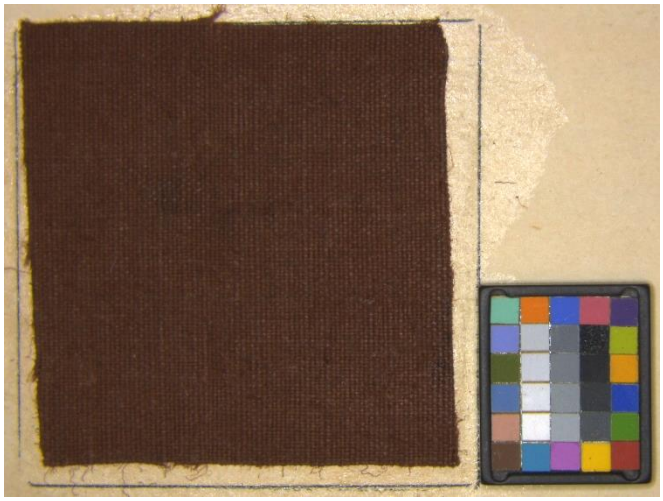


Figure 31 - 3C

Figure 32 - 4C

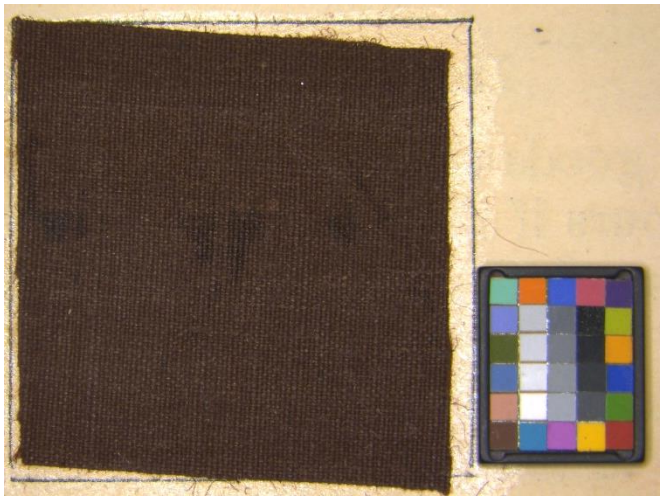


Figure 33 - 5C

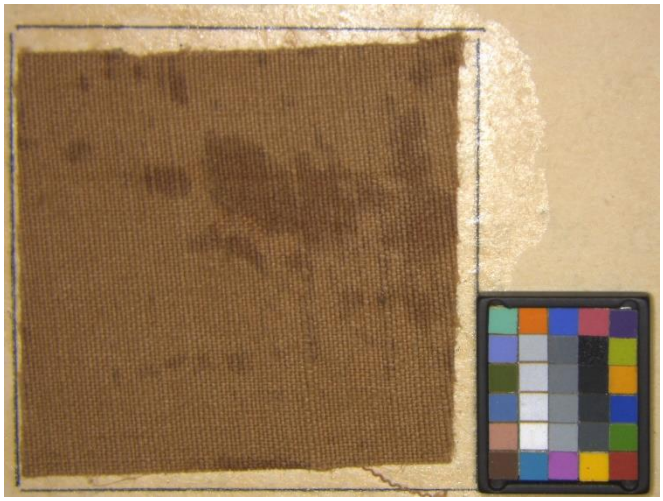


Figure 34 - 6C

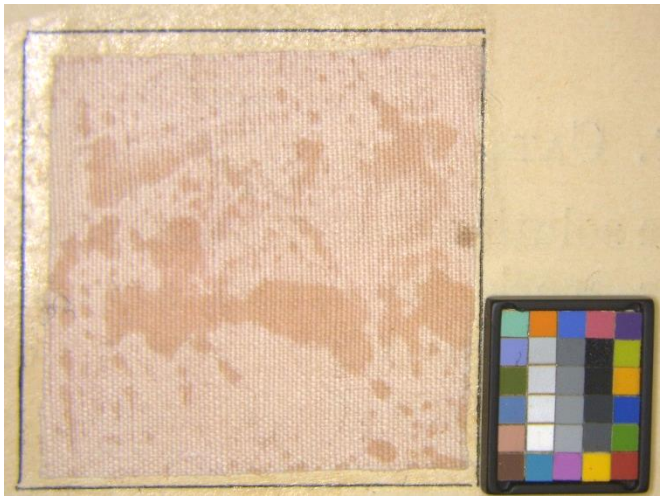


Figure 35 - 7C

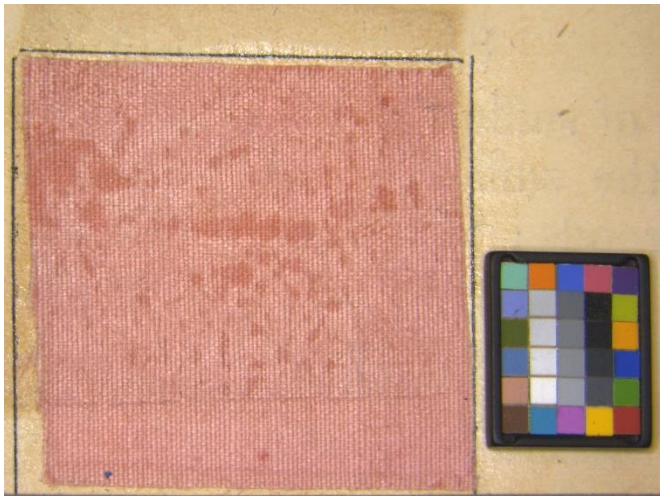


Figure 36 - 8C

Figure 37 - 9C

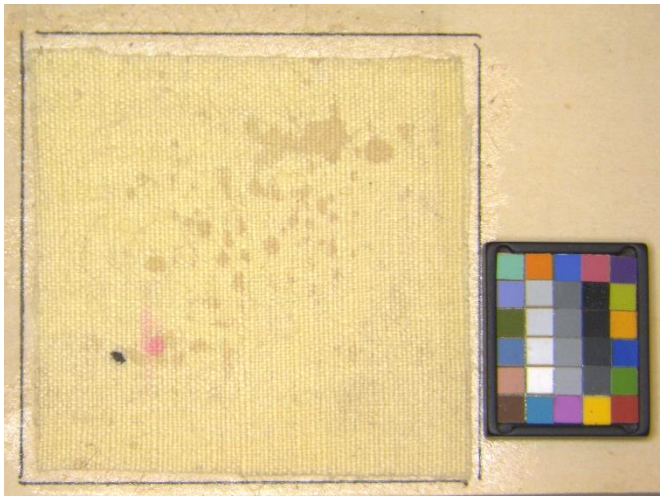


Figure 38 - 10C

Figure 39 - 11C

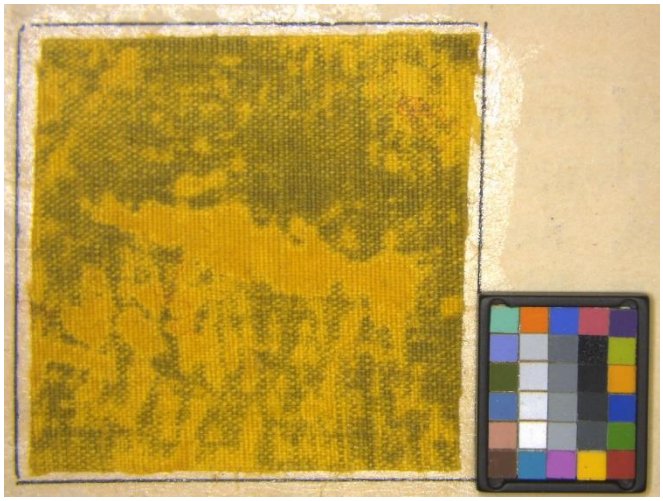


Figure 40 - 12C

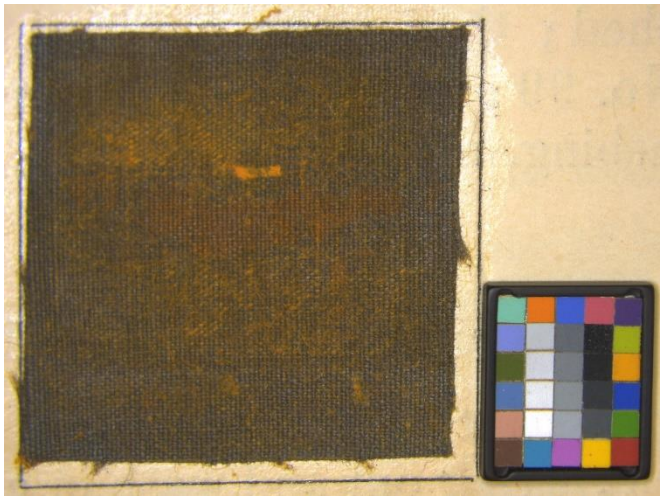


Figure 41 - 13C

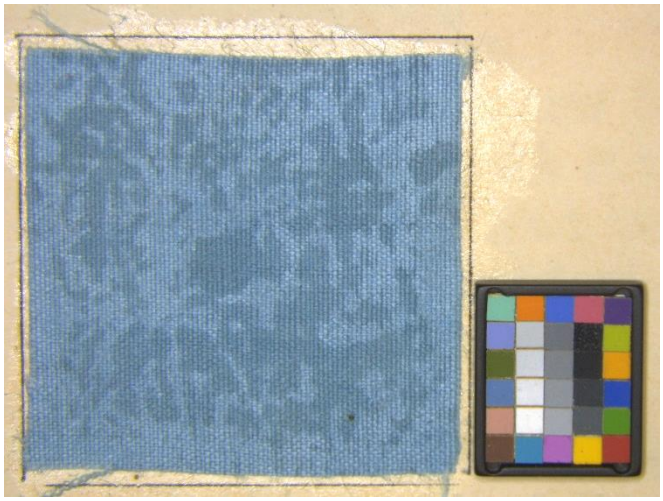


Figure 42 - 14C

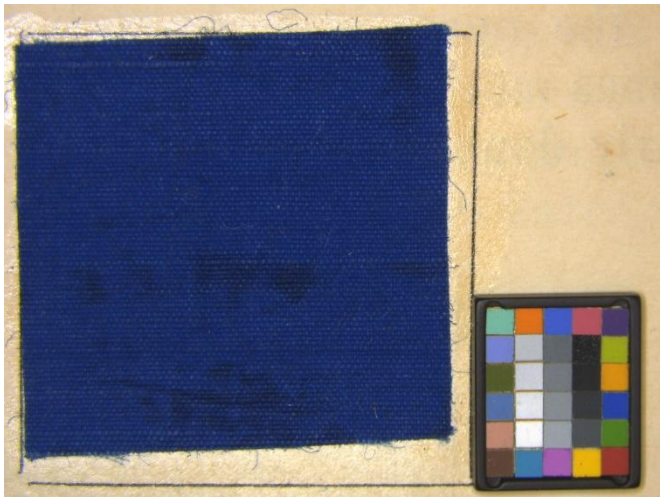


Figure 43 - 15C

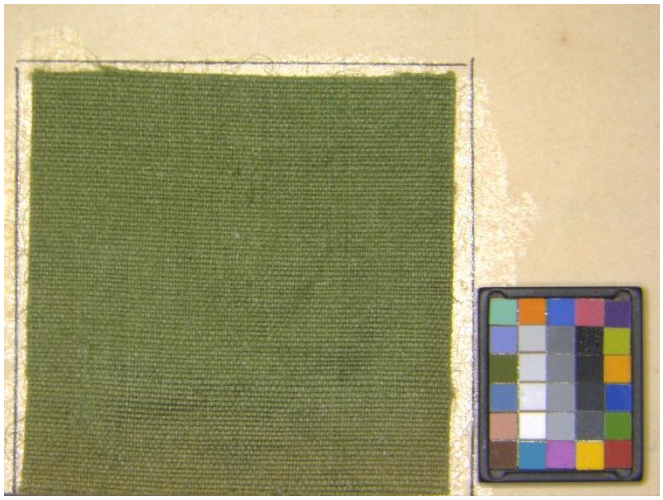


Figure 44 - 16C

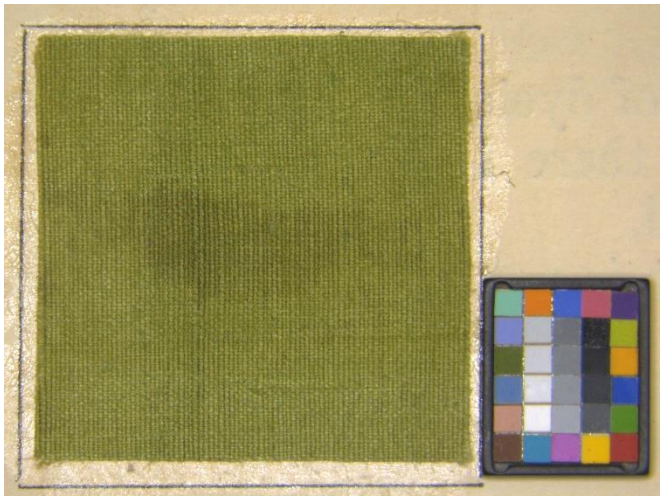


Figure 45 - 17C

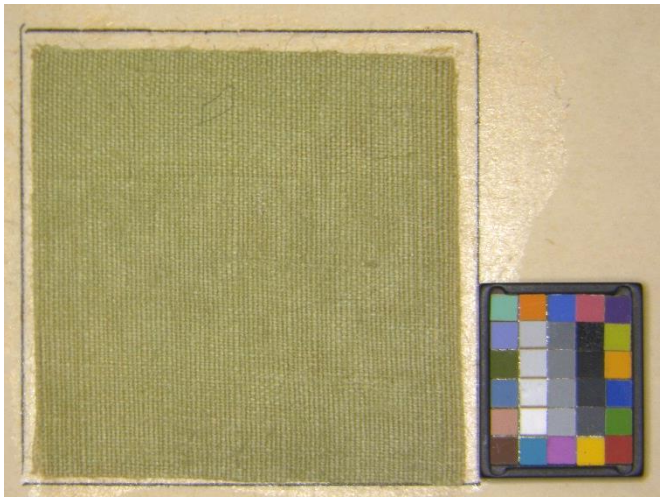


Figure 46 - 18C

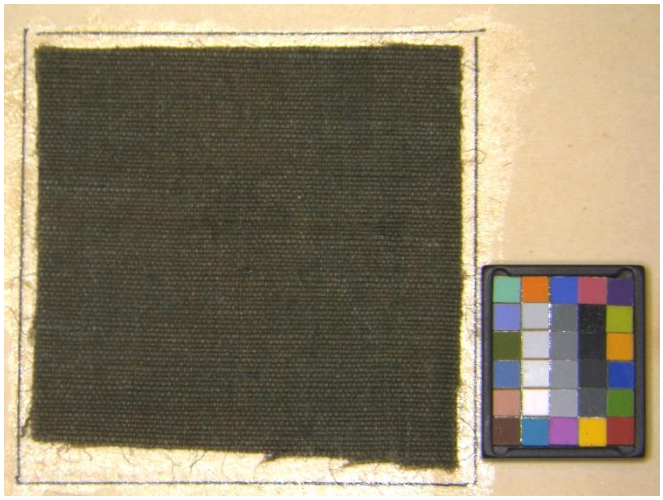


Figure 47 - 19C

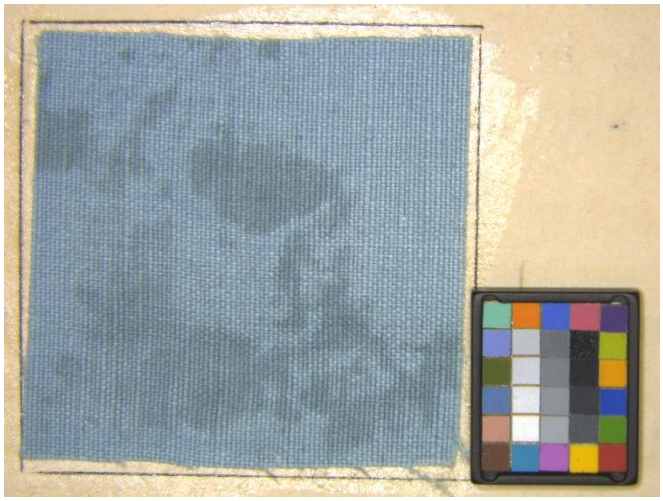


Figure 48 - 20C

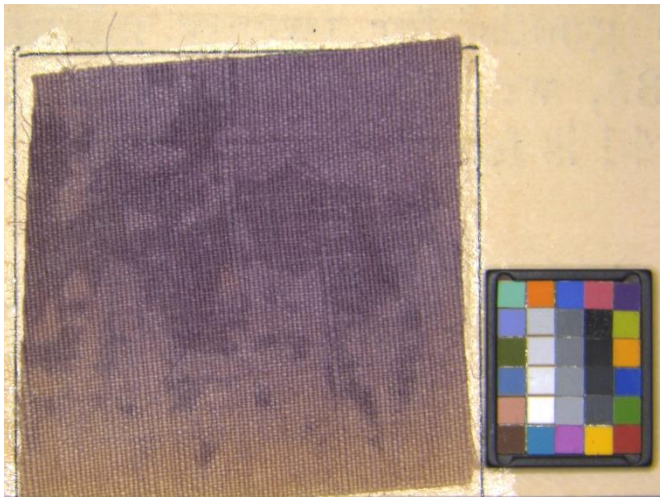


Figure 49 - 21C

Figure 50 - 22C

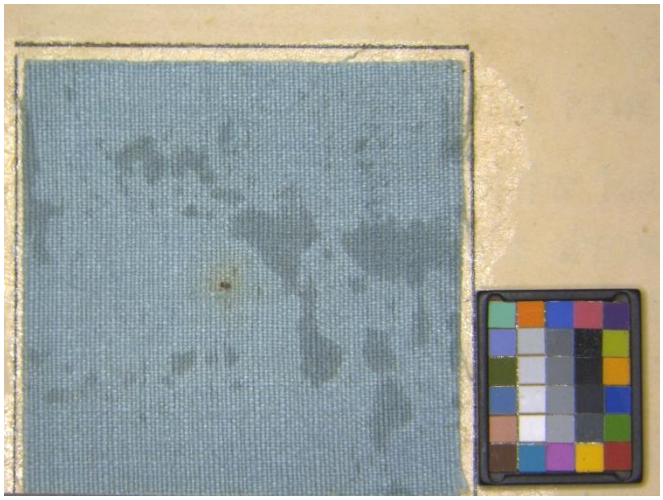


Figure 51 - 23C

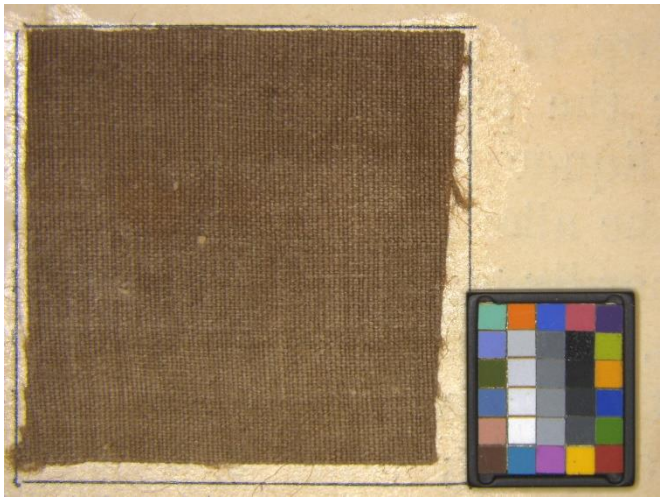


Figure 52 - 24C

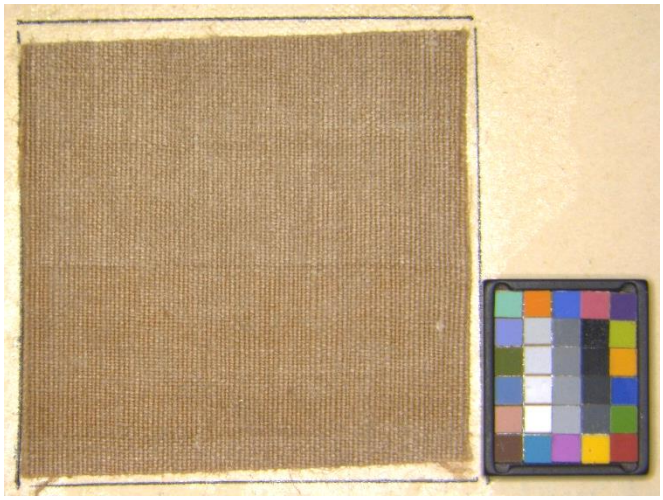


Figure 53 - 25C

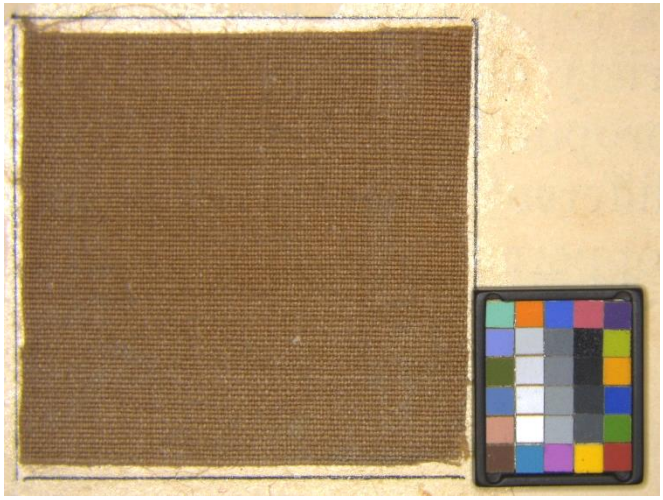


Figure 54 - 26C

Note: All images are a courtesy from the National Library of Scotland.

Silk patterns

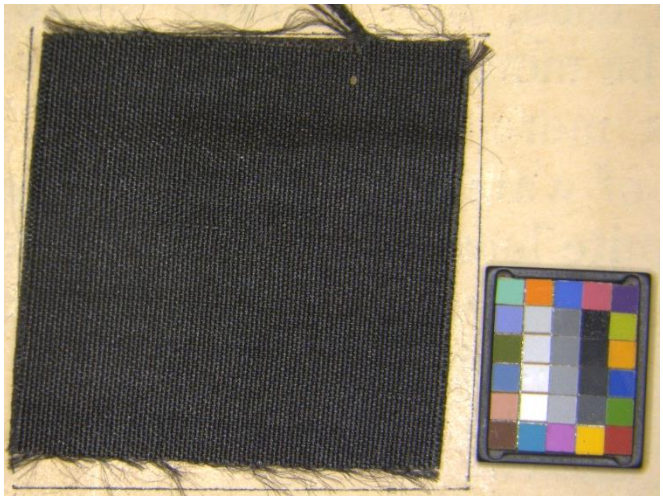


Figure 55 - 1S

Figure 56 - 2S

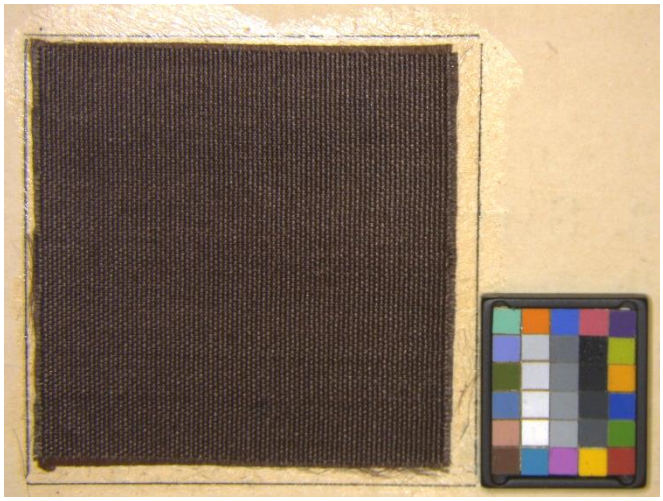


Figure 57 - 3S

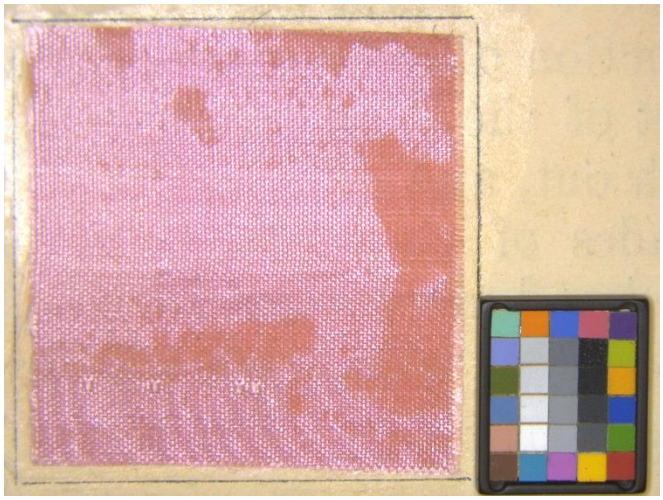


Figure 58 - 4S

Figure 59 - 5S

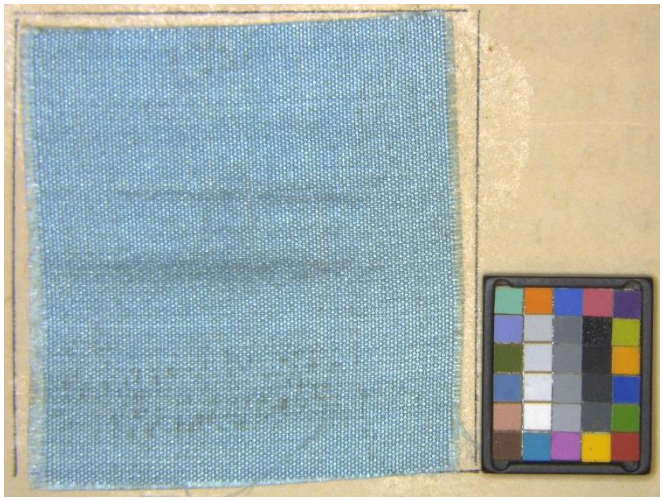


Figure 60 - 6S

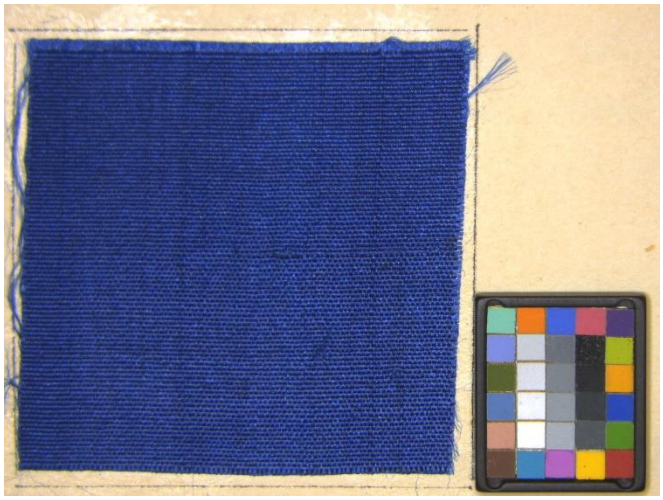


Figure 61 - 7S

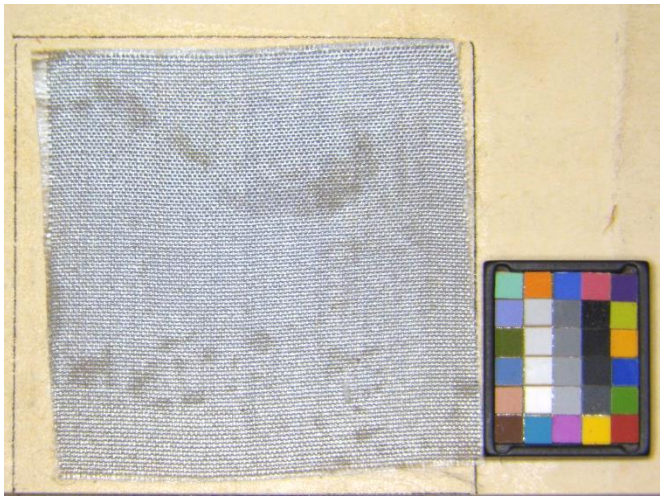


Figure 62 - 8S

Figure 63 - 9S

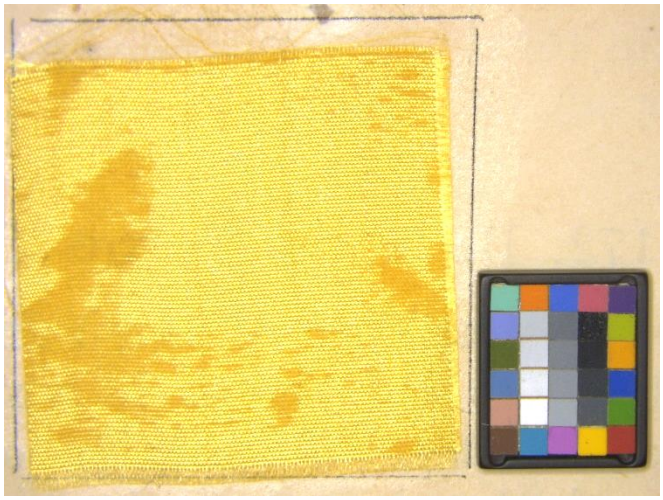


Figure 64 - 10S

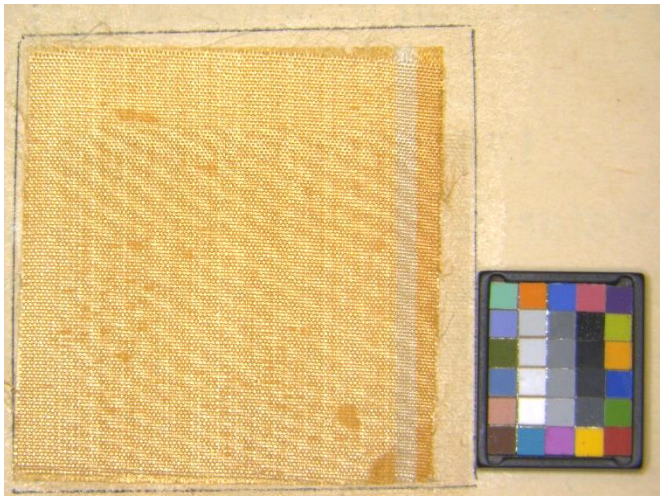


Figure 65 - 11S

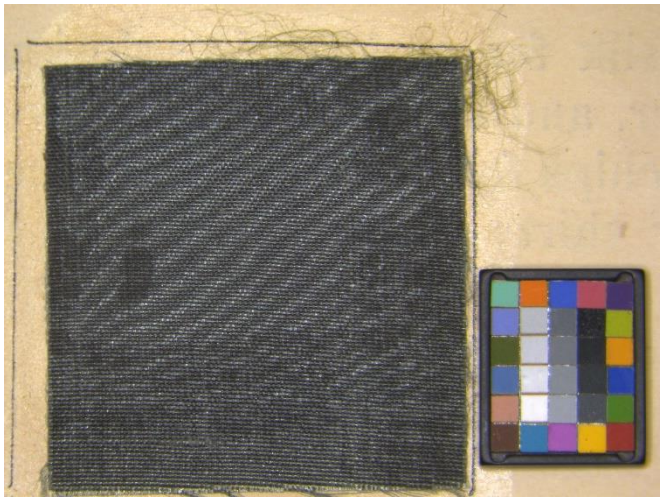


Figure 66 - 12S

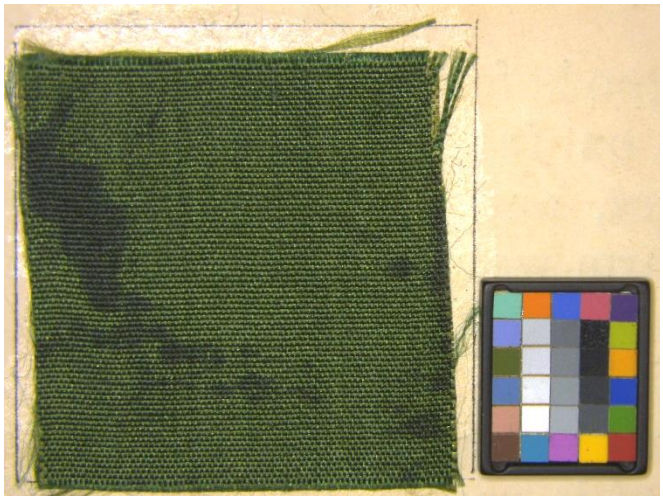


Figure 67 - 13S

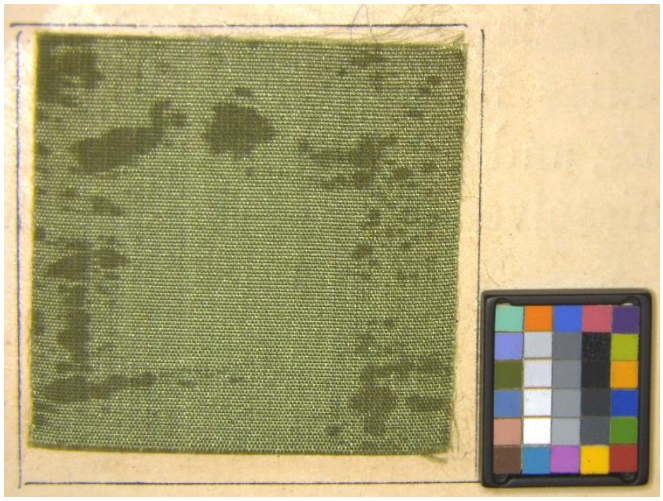


Figure 68 - 14S

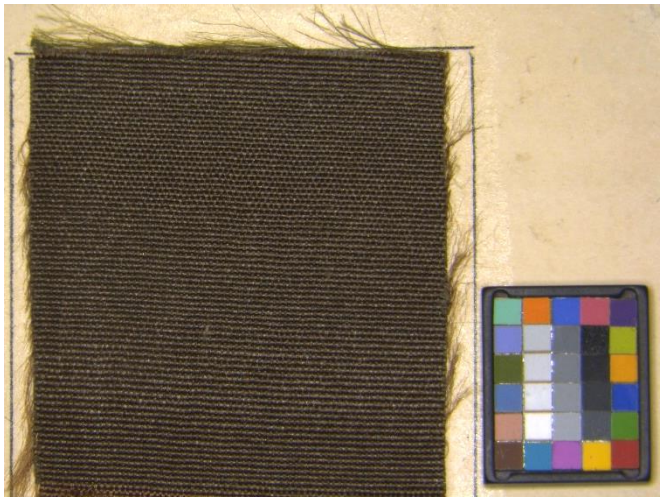


Figure 69 - 15S

Note: All images are a courtesy from the National Library of Scotland.

Wool patterns

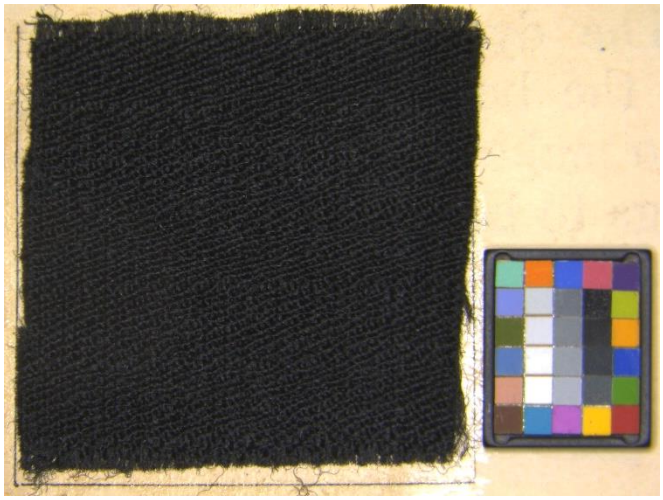


Figure 70 - 1W

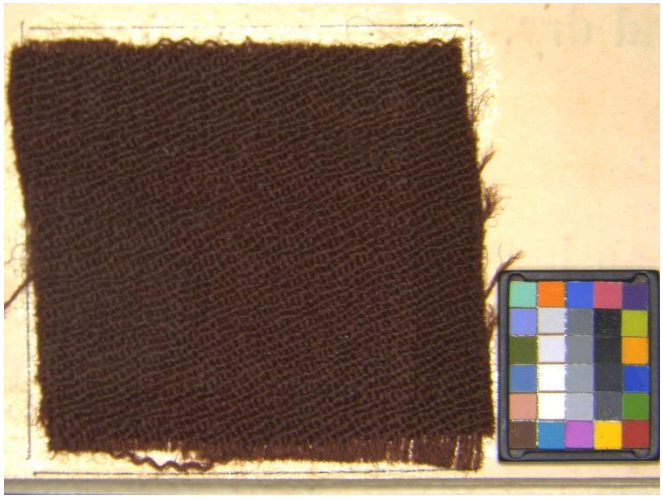


Figure 71 - 2W

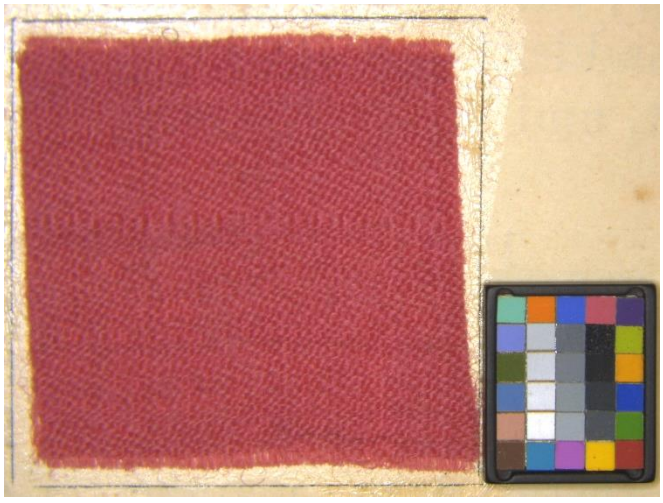


Figure 72 - 3W

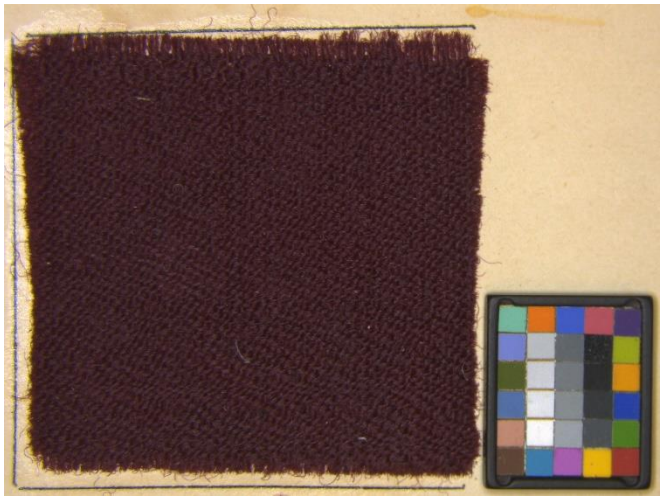


Figure 73 - 4W

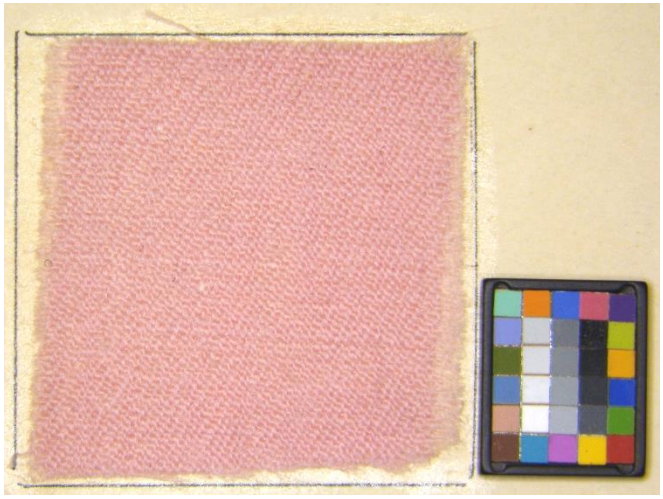


Figure 74 - 5W

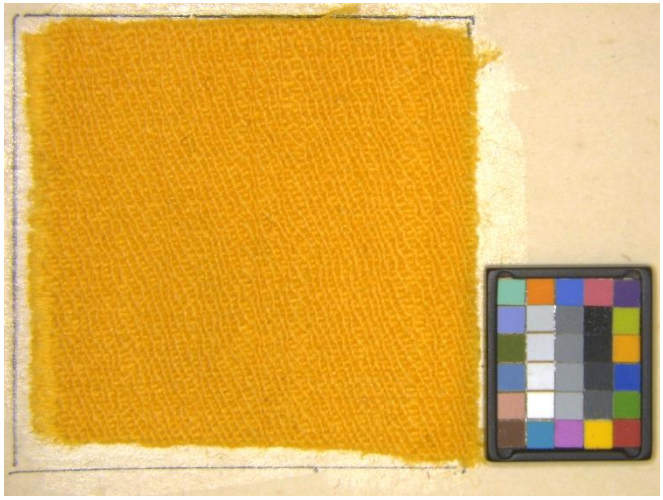


Figure 75 - 6W

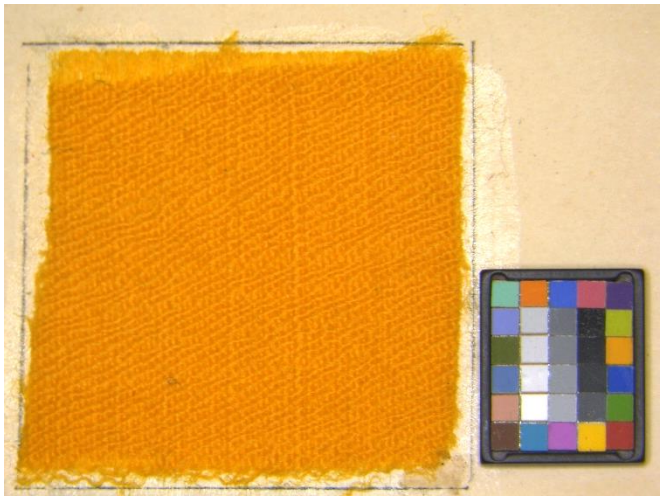


Figure 76 - 7W

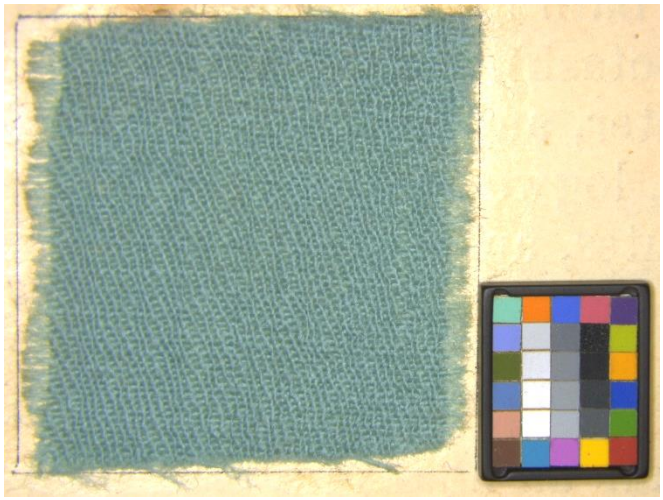


Figure 77 - 8W

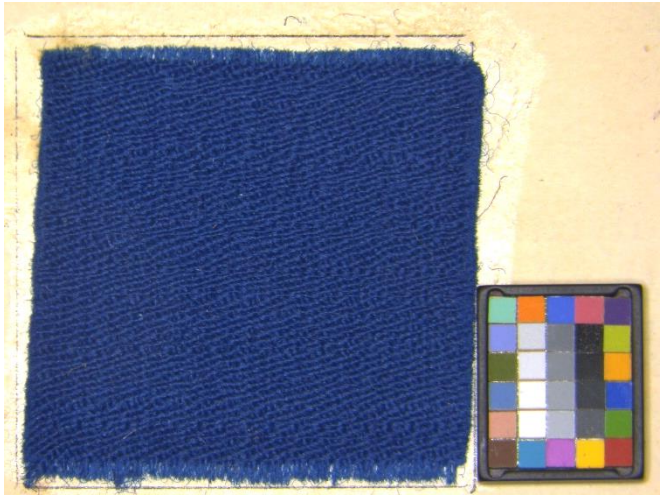


Figure 78 - 9W

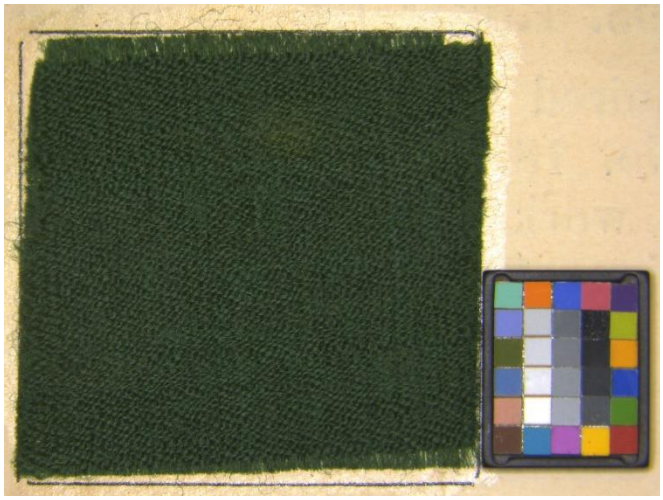


Figure 79 - 10W

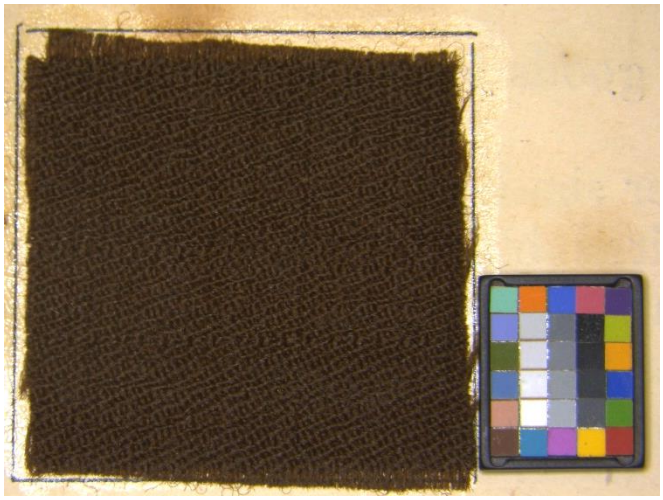


Figure 80 - 11W

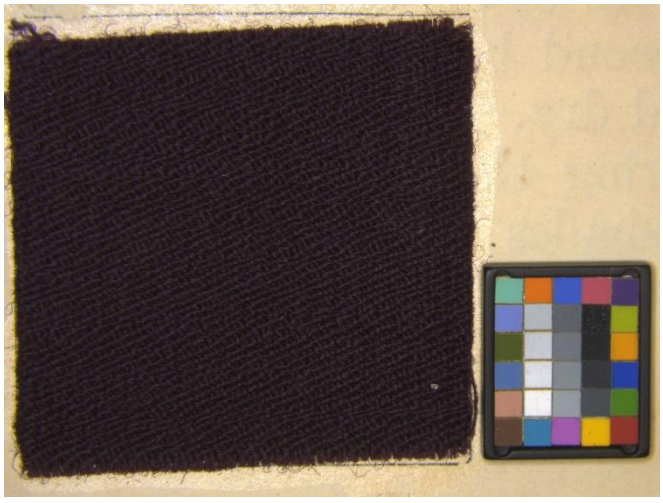


Figure 81 - 12W

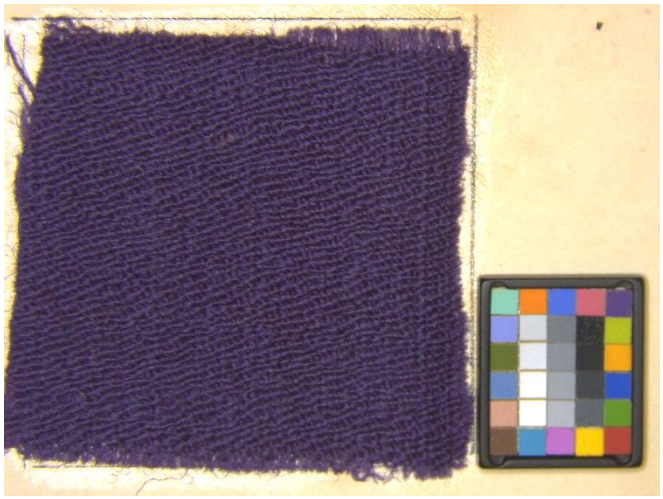


Figure 82 - 13W

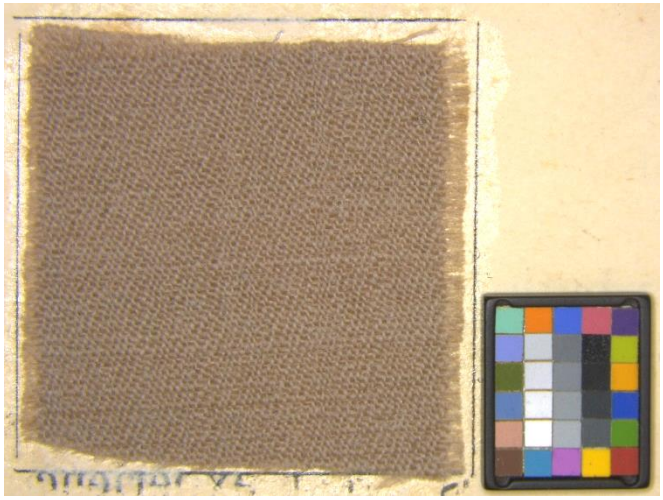


Figure 83 - 14W

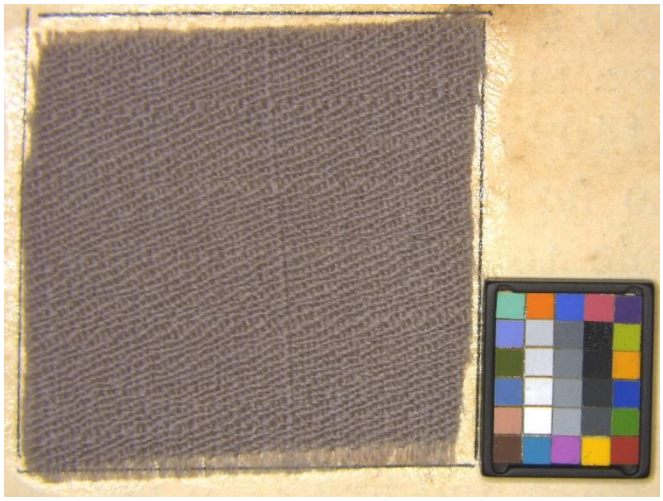


Figure 84 - 15W

Note: All images are a courtesy from the National Library of Scotland.

National Library of Scotland guidelines

National Library of Scotland Collections Environment Guidelines for Integrated Pest Management (IPM)

1. Introduction

These guidelines have been drafted with reference to standards for collections care such as BS 4971:2017, PAS 198:2012 and BS ISO 18934:2011, and various other publications such as the Preservation Advisory Centre's guidance leaflet on pests[154] and other useful literature[155].

Pests include insects such as furniture beetles, clothes moths and booklice, which eat many of the organic materials found in library collections, and vermin such as rats, mice and pigeons, which shred paper and textiles to build their nests and stain collection material with their droppings.

The Collections Care and Estates teams work together to deliver the Library's Integrated Pest Management (IPM) programme. However, a successful IPM strategy requires the involvement of everyone who works for and uses the library, because everyone should practice the good housekeeping required to avoid pest infestations and the vigilance required to spot problems early on. The Collections Care team should ensure that there is adequate awareness about pests by organising regular training sessions for staff who work with collections, and issuing regular reminders and updates.

IPM should be a standard item on the agenda for the meetings between the Estates and Collections Care teams which happen roughly once every six months.

The species and breeding patterns of insect pests in the UK are constantly evolving, and the Collections Care team must use the conservation literature and professional networks to keep abreast of new threats to the Library's collections.

2. Monitoring pest activity

Insects

Insect traps may be sticky blunder traps which catch all varieties of insect, or pheromone traps which are targeted to attract one particular type of insect. The Library's approach is to:

- use sticky traps in areas where no insect problem is known about, and pheromone traps (where they are available) if a problem with a particular type of insect is being investigated;
- deploy traps at a low level throughout areas where collections are stored and used, and deploy more traps in areas where insect activity is suspected;
- check traps twice a year, once in the spring, when most insects are at their most active, and once in the autumn, although additional checks may be made in areas where insect activity is suspected or ongoing;
- record the location of traps on building plans;
- use the various printed and electronic resources available to identify the insects caught on traps or found elsewhere in the Library, if necessary seeking specialist advice, and record the results on spreadsheets;
- analyse this data to understand the nature and severity of any pest problems, and to determine when action to eradicate pest infestations is necessary.

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[154]Pinniger, D., *Pests*, guidance leaflet written for the Preservation Advisory Centre, London, The British Library, 2012

[155]Florian, M.E., *Heritage Eaters: insects and fungi in heritage collections*, London, James and James Ltd., 1997
Insect pests in historic houses, poster accessed on 1 August 2017 at

Additionally, sightings of insects by any staff member should be reported to the Collections Care team, with an insect specimen provided for identification wherever possible. If someone finds evidence of insects in a collection item, they should alert the Collections Care team by using the alarm button on the conservation database.

Vermin
Sightings of vermin or nest-making materials or droppings should be logged on the Estates helpdesk by the person who found them. Additionally, Collections Care staff should be contacted immediately if there is any damage to collections. Estates staff monitor the helpdesk, and if there are several sightings in one particular area, Collections Care and Estates staff should discuss whether action is necessary to tackle the problem.

Relatively inaccessible areas of the buildings, such as voids, should be checked regularly by Estates staff or by Facilities Management staff acting under the instruction of Estates staff, to ensure that they are free from vermin, particularly pigeons.

3. Preventing pest infestations
Pest infestations can be avoided by keeping pests out of the building, by removing food sources from inside buildings wherever possible, by keeping the temperature and relative humidity (RH) at appropriate levels and by keeping buildings clean and well maintained.

- Wherever possible acquisitions of historic collections should be checked for signs of pest infestation before they are brought into the Library, and if there is a significant likelihood of infestation a conservator should be involved in the check.
- When new acquisitions of historic collections arrive at the Library they should be taken to a quarantine area first if an infestation is known about or suspected from the preliminary check, or considered likely because of where the acquisition was stored previously. The rooms currently used as quarantine areas are the disaster/quarantine room on level 4 CB for small volumes of material and the project room on level 3 CB for larger volumes of material, although this material must be kept well away from other collections.
- Any signs of old pest infestation in new acquisitions should be cleaned away to make new problems easy to spot. If a new acquisition is suspected to contain live pests, it must be treated in addition to being cleaned.
- The likelihood of pest infestations occurring can be minimised by keeping food consumption well away from areas where collections are stored and worked on; these areas are listed in the *Responsibilities for staff working with collections* document, which is kept with the other HR induction documents. Food storage in workspaces should only be temporary, and should be in suitable vermin-proof containers. Staff should be reminded regularly of these rules, and cleaning staff should report any concerns to Collections Care staff. Staff should also be encouraged to keep designated food consumption areas clean and tidy. Additionally, food waste should not be placed in ordinary bins and waste from the cafe should be stored in the agreed areas only.
- The likelihood of pest infestations occurring can also be minimised with regular and thorough programmes of cleaning, particularly in areas where food is stored, prepared and consumed. Cleaning programmes should periodically tackle areas which are difficult to access, such as under floors, behind cupboards and underneath collection shelving.
- Different insect pests have different preferences regarding temperature and RH, but on the whole insects are less likely to thrive if the environment is cool and dry. Care should therefore be taken to ensure that there are not localised areas of high humidity in storage areas.

- Building maintenance programmes should ensure that measures to prevent vermin entering the building (such as netting to keep pigeons out of voids) is maintained and effective.

4. Dealing with pest infestations

Insects

- If an insect infestation is discovered in an area where collections are stored or worked on, a thorough search must be undertaken to see if the source of the infestation can be found. The source could be collection material, food waste or something else such as dead vermin. If the source can be identified it should be removed.
- The area where the infestation was found must be cleaned thoroughly, and any infested non-collection material (such as packaging) should be disposed of.
- Any infested collection material should be taken away and treated, usually by freezing. Freezing using the Library's freezers should be undertaken for seven days to be guaranteed to be effective. However, freezing does not provide any protection against potential re-infestation, so it is important that the material is returned to a pest-free environment.
- There may be situations where a high number of insects are being caught on traps but the source of the infestation cannot be found, and it is not feasible to freeze all the collection material in an area. In these situations the use of a permethrin-based spray, powder or smoke bomb may be considered as a last resort, but this should only be undertaken by a competent pest control contractor, with a method statement to minimise the risk to the collections and to avoid setting the fire alarm or fire suppression system off accidentally.
- The pest monitoring programme should pay particular attention to areas where there has been an insect infestation in the past.

Vermin

- In areas where there have been several sightings of vermin, the situation should be discussed with the cleaning staff to see if there is a housekeeping issue, and any such issues should be addressed. The Estates team should organise for the Library's pest control contractor to put down extra poison in the area.
- Any non-collection material which has been damaged by vermin activity should be thrown away or sterilised. Any collection material which has been damaged should be treated through the Conservation Unit's minor repairs programme.
- Relevant staff, particularly security and cleaning staff, should be made aware of the problem and asked to be vigilant for signs of ongoing activity.

National Library of Scotland Collections Environment Guidelines for Light

1. Introduction

Library collections must be exposed to light in order to be consulted and displayed, but exposure to light inevitably causes organic materials to deteriorate, and the damage is cumulative and irreversible. The aim of these guidelines is to facilitate access to the collections while controlling their light exposure as far as is feasibly possible, in order to ensure that they have a displayable lifetime of at least 500 years and are accessible for considerably longer.

These guidelines specify the Library's approach to lighting for collections in storage, collections being consulted by library users and staff and collection on display, either within the library or while on loan to other organisations.

2. Collections in storage

Collections must be stored in darkness, with lighting for collections retrieval and other activities such as surveying and auditing switched on only for the periods when it is required. The ultra-violet (UV) component of the lighting in collections storage areas should be negligible, meaning equal to or less than 10 µWatts/lumen. Where possible items of higher value and significance (typically class 1 and class 2 items)[156] should be stored in boxes, which protect them from light altogether when they are in storage.

3. Collections being consulted by Library users and staff

It is recognised that some popular items may receive considerable exposure to light when they are consulted in the Library's reading rooms or by Library staff, or are used in workshops and seminars. However, it would be impractical to keep records of this light exposure, and it is hoped that for items with numerous pages or folios, the light exposure received by each individual page when the item is read is fairly low.

Despite the lack of record-keeping, the light exposure on collections during consultation must be controlled by keeping lighting at around 400-500 lux of ambient light, or 300 lux of ambient light with additional task-lighting for those who require it. Electric lighting must have a negligible UV component, and UV filtration film must be applied to windows to block out the UV component of daylight.

4. Collections being displayed

4.1 Using colour change to define the displayable lifetime of collections

[156] The definitions for the various classes of items are given in the Library's Collections Security Matrix.

The monitoring and control of lighting for collections on display is more achievable than for collections being consulted, and is arguably more worthwhile because the chosen pages or folios are displayed continuously for the period of the exhibition.

The following guidelines for collections on display have been created with the aim of allowing the components of the Library's collections which are susceptible to colour change to undergo no more than 10 *perceptible changes* over a period of 500 years, equating to an acceptable dose of 0.2 *perceptible changes* every 10 years. This approach has already been adopted by many museums, including the Victoria and Albert Museum[157] and the National Museum of Australia[158], and a *perceptible change* has been defined by the V&A to be equivalent to a colour difference (ΔE) of 1.5 CIEDE2000 units.

Museums which aim for 10 *perceptible changes* over 500 years have defined this period as being the target 'lifetime' of their collections. From a museum perspective, an item which has undergone 10 *perceptible changes* may well be considered unsuitable for further display, and hence found to have reached the end of its useful 'life'. The same may be true for works of art on paper held within the Library. However, the majority of the Library's collections consist of text on a plain background, and even after the text has visibly faded, the item may well still be displayable, and visitors are likely to view the fading simply as evidence of the age of the item. Furthermore, even with faded text, an item will be of interest to researchers for as long as the text is at least partially legible. Hence if a rate of colour change equivalent to 0.2 *perceptible changes* every 10 years is permitted at the Library, most of the collections will have a 'displayable' lifetime of considerably more than 500 years, and a 'usable' lifetime that is longer still.

It is recognised that most items in the Library will already have had some light exposure, and that some may have had a lot. Since it is generally not possible to know about an item's previous light exposure history, it is standard practice by museums, galleries and libraries to implement a lighting programme where all items start with a full quota of light exposure still available. Having said that, if an item is visibly faded there is always the option to set special conditions for it.

These guidelines are based primarily on data relating to the colour changes undergone by photographic materials, media used to create text and images, and materials such as cloth and leather used to make bound volumes. This is because this data is relatively easy to come by. However, it is recognised that paper may also undergo colour changes upon exposure to light, and that all organic materials (e.g. paper, cloth, parchment, leather) are weakened by exposure to light, resulting in a loss of strength and flexibility which may be just as important as colour change in

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[157] Ashley-Smith, J., Derbyshire, A. and Pretzel, B., 'The continuing development of a practical lighting policy for works of art on paper and other object types at the Victoria and Albert Museum', *Proceedings of the 13th Triennial Meeting of the ICOM Committee for Conservation*, *Rio de Janiero*, *22-27 September 2002*, ed. R. Vontobel, James & James, London (2002), pp. 3-8.

[158] Ford, B. and Smith, N., 'The development of a significance-based lighting framework at the National Museum of Australia', *AICCM Bulletin,* Vol. 32, 2011, pp.80-86.

causing an item to become unusable. These guidelines may be reviewed and updated as more data about other types of light damage becomes available.

4.2 Record-keeping for display programmes

In order for these lighting guidelines to be implemented, good records must be kept for individual items, down to page/folio level where appropriate, so that for each exhibition the exact details of the items displayed, the length of exposure and the average light intensity are known.

4.3 Light exposure of items on display in the Library and at borrowing institutions

- Items on display in the Library's exhibition galleries receive approximately 61 hours of light per week (providing that the practice of turning the lights off when the galleries are closed is continued). Items on loan to borrowing institutions will generally receive around 60 hours of light per week. Items on display in the Library's front hall receive approximately 66 per hours of light per week (if case covers are used so that items are only exposed to light when the Library is open to the public) or 112 hours of light per week (if no case covers are used, since the front hall is lit for approximately 16 hours per day).
- It is assumed that the UV component of the light which items are exposed to when in the Library's exhibition galleries or in borrowing institutions is negligible.
- Library front hall displays should be located close to the entrance to the building, and kept away from the stairs up to the reading room where the light levels are at their highest, unless the duration of the display is a week or less. The light levels on items in the front hall vary from around 80-250 lux depending on the location, and the representative value is therefore taken as 250 lux. It is assumed that items are only displayed in cases with UV filtration, as is the case for the Library's current stock.

4.4 Approach for setting display programmes

- Table 2 gives a suggested approach to setting display programmes for items over a 10 year period. It is suggested that programmes for all items are set using the same 10 year cycle, and that the first cycle should be considered to have begun in January 2014, which is the date from which good records are available.
- In general 'borrowing' time from future 10 year periods in order to put an item on display for longer now should be avoided, because it may create difficulties for our successors if the future allocation for an item has already been 'used up'. However, there may be rare circumstances when borrowing time from the future can be justified e.g. if an item is heavily in demand over a few years because of an anniversary and is then unlikely to be required for the next few years.
- For each category of item, a programme for each 10 year period has been suggested, to allow the items to feature in some long-term exhibitions (3-6 months) in the Library's exhibition galleries or on loans to other institutions, and in some shorter exhibitions in the Library's front hall. There can be some trading between these types of exhibitions, providing that the total dose of light does not exceed the maximum permissible during the 10 year period.
- It is suggested that 'extremely sensitive' items are not displayed in the front hall, because these displays would use up their permissible dose of light very quickly. However, there may be occasions when a display for a few hours can be justified.

- The suggested display programmes take into account the Library's 'Security guidelines for displaying collection items in the front hall', which recommend that class 1 items are not displayed in the front hall, and that class 2 items are usually only displayed for brief events with a dedicated security presence, although longer displays of class 2 items may sometimes be sanctioned at the discretion of the appropriate curatorial division's manager.

4.5 Placing material into categories of sensitivity

The placing of different types of material into different categories of sensitivity (less sensitive, moderately sensitive, very sensitive and extremely sensitive) has been done with reference to the approach taken by other cultural organisations, and using the results of research undertaken on some representative items from the Library's collections with a Microfader[159], in 2013. It is recognised that there will always be items that are more or less light-sensitive than would be expected, but it is not practical to test everything with the Microfader. However, there may be situations where it is considered appropriate to test an individual item in order to determine its sensitivity, rather than assuming that it will behave in the way that would be predicted for that type of item. For example:

- Many black handwriting inks and coloured inks are less sensitive than BW2.5, so if an increase in light exposure is required for a particular item, testing might show this to be acceptable.
- Highly significant or valuable items which have been classified as 'less sensitive' should be tested if they are being proposed for a display lasting 2 or more years.

Table 1. Approximate light dose to cause a 'perceptible change' of the ISO Blue Wool standards

ISO Blue wool equivalent	1	2	3	4
Dose required for 1 perceptible change (Mlux h)[160]	0.3	1	3	10
Dose required for 0.2 perceptible changes (Mlux h)	0.06	0.2	0.6	2

Table 2. Categorisation of library material according to light sensitivity

ISO Blue wool equivalent	Below BW1.5	BW1.5 – BW2.5	BW2.5 – BW4	Above BW4
Category	Extremely sensitive	Highly sensitive	Moderately sensitive	Less sensitive

[159] A Microfader is a piece of non-destructive analytical equipment which artificially ages a very small sample of an artefact using a very intense xenon light. The result gives an indication of the light sensitivity of the artefact, which is usually stated in terms of its ISO 'blue wool equivalent'.

[160] Michalski, S., 'Agent of deterioration: Light, Ultraviolet and Infrared', online information from the Government of Canada website (accessed online at http://canada.pch.gc.ca/eng/1444925073140, 30 January 2016).

Typical types of material	Early photographs (pre-1870) Colour photographs Coloured typewriter ink Coloured printed letterheads Felt tip pens	Blue prints and cyanotypes All handwriting inks, black and coloured, including iron gall ink Works of art on paper that are coloured Wood pulp papers Coloured papers excluding black/grey Textiles Leather	Black and white photographs from post-1870 Wood	Black typewriter ink or black printed ink on good quality paper Works of art on paper that are black and white and on good quality paper Black/grey paper
Maximum dose permissible in 10 years (Mlux hours)	0.06	0.2	0.6	2
Permissible time period and light level in the exhibition galleries during a 10 year period	6 months at 40 lux (main exhibitions) or 3 months at 80 lux (Treasures displays)	1 year at 50 lux (main exhibitions) or 6 months at 100 lux (Treasures displays)	3 years at 50 lux (main exhibitions) or 18 months at 100 lux (Treasures displays)	Permanent display at 50 lux, or up to 100 lux if not on permanent display. Shorter periods may be specified for items of high significance
Permissible time period and light level in the front hall with case covers during a 10 year period	Front hall display not recommended	3 months at up to 250 lux	8 months at up to 250 lux	2 years at up to 250 lux
Permissible time period and light level in the front hall without case covers during a 10 year period	Front hall display not recommended	2 months at up to 250 lux	4 months at up to 250 lux	1 year at up to 250 lux
Suggested programme during a 10 year period	Allow up to 6 months at 40 lux in Library main exhibitions, or 3 months at up to 80 lux in Library Treasures displays, or the equivalent exposure for external loans, and do not display in the front hall	Class 1 and 2 items: allow up to 9 months at 50 lux in Library main exhibitions, or up to 6 months at up to 80 lux in Li brary Treasures displays, or the equivalent exposure for external loans, and occasional very brief front hall displays. Class 3, 4 and 5 items: allow up to 6 months at 50 lux in Library exhibitions, or up to 4 months at up to 80 lux in Li brary Treasures displays, or the equivalent exposure for external loans, and up to 6 weeks in front hall	Class 1 and 2 items: allow up to 2 years at 50 lux in Library main exhibitions, or up to 2 years at up to 100 lux in Li brary Treasures displays, or the equivalent exposure for external loans, and occasional very brief front hall displays Class 3, 4 and 5 items: allow up to 1 year at 50 lux in Library main exhibitions, or up to 6 months at up to 80 lux in Li brary Treasures displays, or the equivalent	Class 1 and 2 items: allow up to 2 years at up to 100 lux in Library main exhibitions or Treasures displays, or the equivalent exposure for external loans, and occasional very brief front hall displays Class 3,4 and 5 items: allow up to 2 years at up to 100 lux in Library main exhibitions or Treasures displays, or the equivalent exposure for external loans, and up to 6 months in front hall displays with case

		displays with case covers, or up to 4 weeks in front hall displays without case covers	exposure for external loans, and up to 8 weeks in front hall displays with case covers, or up to 4 weeks in front hall displays without case covers	covers preferred but not mandatory

National Library of Scotland Collections Environment Guidelines for Mould

1. Introduction

These guidelines have been drafted with reference to standards for collections care such as BS 4971:2017, PAS 198:2012 and BS ISO 18934:2011, and various other publications such as the Preservation Advisory Centre's guidance leaflet on mould[161] and other useful literature[162]. Mould growth is largely a result of the incorrect temperature and relative humidity (RH), and mould growth should therefore be avoided if the Library's Collections Environment Policy is followed, with appropriate reference to the Library's **Collections Environment Guidelines for Temperature and RH**.

Mould is the common name given to the visible growth of fungi on dead material. The fungi secretes enzymes into the foodstuff and absorbs the resulting solution, thus breaking down the foodstuff both physically and biochemically. Mould growth causes paper to become weak, fragmentary and stained, and this damage is irreversible.

Mould spores are minute and ubiquitous in the air. They can remain dormant for long periods of time, but when the conditions are right they will germinate. The necessary conditions are:

- temperatures of 10-35 °C, with optima above 20 C;
- RH greater than 65%;
- suitable organic foodstuffs.

In general mould growth is more likely in areas with dark conditions and a lack of air movement.

The germinating spores produce hair-like hyphae, which penetrate into the material and grow on the surface of the object. A mass of hyphae is known as a mycelium. While the conditions are right, the hyphae will feed and grow, and the mould is active. If the RH drops, the mould will dry out and become inactive or dormant, but it is still viable should the RH rise again. Mould is only killed by anoxic environments, or temperatures above 50 °C or various fungicides, including ethanol.

The Collections Care and Estates teams should work together to prevent mould growth and tackle any outbreaks of mould that occur. However, it is also extremely helpful if other staff who work with the collections are able to spot and flag up potential mould. The Collections Care team should ensure that there is adequate awareness about mould by organising regular training sessions for staff who work with collections.

2. Monitoring mould

- All staff, and particularly those who work with the collections, should be vigilant for signs of mould growth.
- If someone finds possible mould on a collection item, they should alert the Collections Care team by using the alarm button on the conservation database or by telling them directly.
- If someone finds mould on the internal building fabric they should alert the Estates team, who should contact the Collections Care team if the mould is in an area where collections are stored or used.

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[161]Child, R.E., *Mould*, guidance leaflet written for the Preservation Advisory Centre, London, The British Library, 2004 (revised 2011)

[162]Florian, M.E., *Heritage Eaters: insects and fungi in heritage collections*, London, James and James Ltd., 1997
Florian, M.E., *Fungal Facts: Solving Fungal Problems in Heritage Collections*, London, Archetype Publications, 2002
Guild, S. and Macdonald, M., *Mould prevention and collection recovery*, Ottawa, Canadian Conservation Institute, 2004

3. Preventing mould growth

Mould growth can be prevented by avoiding bringing mouldy collections into the Library, and by ensuring that the conditions inside the library will not allow mould spores to germinate or dormant mould to be reactivated.

To avoid bringing mouldy collections into the Library and allowing the mould spores to spread:

- Acquisitions of historic collections should be checked for signs of mould before they are brought into the Library, and if there is a significant likelihood of mould a conservator should be involved in the check.
- When new acquisitions of historic collections arrive at the Library they should be taken to a quarantine area first if they are known to have mould, or if this is considered likely because of where the acquisition was stored previously, or if they are damp. The rooms currently used as quarantine areas are the disaster/quarantine room on level 4 CB for small volumes of material and the project room on level 3 CB for larger volumes of material, although this material must be kept well away from other collections.
- Mould on collection items (either incoming collections or items already in the collection) must be removed to prevent the spores from spreading and contaminating other items. Additionally, damp collections must be thoroughly dried out before being put in storage areas, to avoid mould growth occurring on them.

To provide an environment where mould spores will not germinate and mould will not grow:

- The building should be watertight and any water ingress or internal flooding must be dealt with promptly and effectively, and followed-up with close monitoring of the building fabric and collections which were affected.
- Collection material should be kept off the floor and not put against outside walls, and should be stored so as to allow air circulation around it.
- The temperature and RH should be as specified in the Library's **Collections Environment Guidelines for Temperature and RH**, and environmental monitoring strategies must endeavour to identify localised areas of high RH.

4. Dealing with mould in the building or on the collections

Mould in the building

- Mould in the building will always be connected to dampness, in the form of water ingress/flooding or high RH. The source of the dampness must be identified and addressed to prevent further problems.
- Any portable non-collection material which has suffered mould growth (e.g. carpet, packaging) should be discarded if possible.
- The building fabric and any portable material which is being kept (e.g. floor tiles) should be dried out using a combination of dehumidification and fans to circulate the air. Additional heating should generally not be introduced because of its potential to accelerate mould growth, although the introduction of low level heating in very cool areas is acceptable.
- Once the mould has been dried out, it should be cleaned off using a dry brush or cloth and a vacuum cleaner with a HEPA filter to retain the fungal spores and mycelium fragments. The building fabric should then be treated with ethanol or a biocide, to kill the mould spores. Appropriate PPE should be worn while this is undertaken.
- The area should be monitored for signs of mould growth recurring.
- Any collections in the area should be checked and treated if necessary.

Mould on the collections

- If mould is found on collection items, they must be isolated from the surrounding collections immediately. If curatorial advice is needed before collections can be treated, small amounts

of material can be bagged and placed in the fume cupboard in the conservation workshop, and larger amounts of material should be put into skips and placed in the CB quarantine room. Curatorial advice is needed for all Manuscript and Archive items (in case they are deposits) and for other items if their status is not clear. The owners of deposits need to be contacted before deposited items are cleaned.

- Collection items should be dried out, cleaned and sterilised if necessary following the procedures given in **Method Statement number 11, Safe cleaning of mould material**, which is kept on RIVO. This document also describes the health and safety protocols and gives advice on the extent to which it is appropriate for volunteers and Library staff outside the Collections Care team to work on mouldy collections.
- Storage enclosures and other packing materials which have been in contact with mouldy collection material should be discarded and replaced.
- If the mould growth may have occurred because of a problem with the environment within the Library, this should be addressed.

National Library of Scotland Collections Environment Guidelines for Pollutants

1. Introduction

These guidelines have been drafted with reference to various publications about pollutants in museums, libraries and archives[163]. The relevant standards are BS 4971:2017, PAS 198:2012 and BS ISO 18934:2011, although they do not specify acceptable values for levels of pollutants.

Pollutants may affect many types of library collections, causing acid hydrolysis and oxidation of paper and other organic based materials; blackening of pigments due to sulphide formation; and corrosion of metal components, such as metal fixings on book bindings. Dust particles cause damage through several mechanisms, for example: coloured particles cause soiling, abrasive particles scratch surfaces and cut into fibrous materials and organic particles provide a food source for mould and pests.

The pollutants of most concern to the Library are:

- Nitrous oxides and sulphur dioxide, which come mainly from external sources; nitrous oxides are present in motor vehicle emissions, and sulphur dioxide is generated by fossil fuel combustion;
- Volatile Organic Compunds (VOCs) such as formaldehyde, acetic acid and formic acid, which come mainly from internal sources such as wood, paints and varnishes, adhesives, foams, cardboard and fibreboard;
- Ozone, which is formed from the reaction of nitrous oxides with VOCs, and hence comes mainly from external sources;
- Dust, which consists of particles of organic and inorganic origin such as soil, soot, textile fibres, vegetal and insect fragments, skin cells and hair, plaster and stone, and which comes from both external and internal sources.

Some collection materials are themselves sources of pollutants. For example, paper and board made from low quality wood pulp may emit VOCs, and acetate films degrade to produce acetic acid.

2. Acceptable values for levels of pollutants

There is not a standard for acceptable levels of pollutants in a library, archive or museum environment, and the Library has therefore referred to a range of publications to specify its acceptable levels. They are:

- Sulphur dioxide ≤10 µg/m^3
- Nitrous oxide ≤10 µg/m^3
- VOCs: no acceptable level is specified (which is fairly standard practice in libraries, archives and museums, because measuring the levels of VOCs is expensive, and the levels are generally low except potentially in display cases, if unsuitable materials are used)
- Ozone: ≤2 µg/m^3

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[163]Blades, N., Oreszcyn, T., Bordass, B. and Cassar, M., *Guidelines on Pollution Control in Museum Buildings,* London, Museums Association, 2000

Blades, N., 'Measuring pollution in the museum environment', V&A Conservation Journal, Issue 14, January 1995

Camfill, *Molecular filtration preserves artefacts*, information brochure accessed on 1 August 2017 at https://www.camfil.com/FileArchive/Product%20Detailed%20Info/Literature%20(US)/Molecular_Filtration_Preserves_Artifacts.pdf

Grzywacz, C.M., *Monitoring for Gaseous Pollutants in Museum Environments*, Los Angeles, The Getty Conservation Institute, 2006, accessed on 1 August 2017 at https://www.getty.edu/conservation/publications_resources/pdf_publications/pdf/monitoring.pdf

- Dust: no acceptable level is specified; the amount of dust deposited on the collections and storage furniture is assessed qualitatively, and action is taken if the amount of dust is considered unacceptable

3. Monitoring Pollutants

The levels of nitrous oxides are measured annually using diffusion tubes and if the level in any area is above 10 $\mu g/m^3$, the relevant carbon filter in the air handling system is replaced.

The Library does not currently measure the levels of sulphur dioxide, because with the move away from burning fossil fuels, previous monitoring has shown that if carbon filters are changed as the levels of nitrous oxides become unacceptable, the levels of sulphur dioxide remain comfortably below 10 $\mu g/m^3$.

The Library does not currently measure the levels of ozone, because the standard monitoring method (diffusion tubes and ion chromatography) has a detection limit of around 5 $\mu g/m^3$, and so the information produced is not very useful. When the ozone levels were checked in 2014 on a one-off basis, they were found to be below the detection limit of the monitoring equipment (i.e. below 5 $\mu g/m^3$) and hence not a major cause of concern.

The Library does not currently measure the concentration of dust particles in the air or the amount of dust deposited on the collections and storage furniture, although a range of techniques are available for dust monitoring, some of which are fairly low cost and could be trialled in the future. However, the amount of deposited dust is assessed qualitatively during periodic checks undertaken by cleaning staff, Conservation Unit staff and Collections Support Services staff, and cleaning of the furniture and/or the collections is then scheduled if the amount of dust is considered unacceptable.

4. Preventing damage from occurring

The Library uses a range of strategies to safeguard the collections against damage caused by pollutants:

- the internal generation of pollutants is minimised through a range of strategies including using metal rather than wooden shelving in collections storage areas; restricting the use of materials in display cases to those which have been tested and approved by other organisations[164]; using low VOC-emitting paints where feasible and favouring hard flooring over carpet in collections storage areas;
- windows in collections storage areas are kept closed to minimise the ingress of externally generated pollutants;
- there are regular programmes of cleaning to remove deposited dust from the floors, furniture and collection items;
- there are carbon filters in the air handling system which absorb gaseous and particulate pollutants, and these filters are changed when they are no longer effective, using the results of the nitrous oxides monitoring to determine when this point is reached. This approach is more cost-efficient than changing all the filters on a fixed cycle whether they are exhausted or not;
- there is a programme of boxing to protect collection items from dust, and a long-term aspiration for all of the Library's collections to be boxed.

[164] Large organisations such as the British Museum and National Museums Scotland undertake testing of materials for use in display cases and make the results available.

National Library of Scotland Collections Environment Guidelines for Temperature and RH

1. Introduction

These guidelines have been drafted with reference to BS 4971:2017, PAS 198:2012, BS ISO 18934:2011 and research undertaken by the Image Permanence Institute and the International Federation of Film Archives.

2. Monitoring temperature and relative humidity (RH)

Temperature and RH in the George IV Bridge, Causewayside and Kirkintilloch buildings are usually monitored through the Building Management Systems (BMS), using sensors with a high degree of accuracy. If monitoring in additional locations is required on a long-term basis, it is preferable that this should be done by adding additional sensors to the BMS, for monitoring only rather than control. The BMS sensors should be calibrated once a year, and a record of this should be kept.

Monitoring on a short-term basis or in places where it would be difficult to install BMS sensors, such as exhibition cases, may be done using dataloggers, which are downloaded manually or wirelessly. These should be calibrated annually where this is possible. Additionally, basic hygrometers which simply give spot readings without recording data, may be used in areas where it is helpful for staff to be able to check the conditions quickly, such as in work areas.

3. Target temperature and RH for paper-based collections

3.1 Storage areas

In storage areas the temperature should remain between 15-20 °C and the RH should remain between 40-60%. Environmental fluctuations should not exceed 10% for RH or 5 °C for temperature within any 24 hour period.

3.2 Reading rooms

In the reading rooms the temperature should remain between 15-25 °C and the RH should remain between 40-65%. Parchment, vellum and fragile photographic materials should not be issued if the conditions are outside these parameters. Environmental fluctuations should not exceed 10% for RH or 5 °C for temperature within any 24 hour period.

3.3 Exhibition spaces

For exhibitions within National Library of Scoltand and collection items on loan externally, the temperature should remain between 15-20 °C, but with occasional periods of up to 25 °C permissible, and the RH should remain between 40-60%, but with occasional periods of up to 65% permissible. Environmental fluctuations should not exceed 10% for RH or 5 °C for temperature within any 24 hour period.

3.4 Short-term displays and events within or outside National Library of Scotland (item on display in National Library of Scotland or away from National Library of Scotland for up to 7 days)

For short-term events, which may be held in spaces within National Library of Scotland which do not have tight environmental control, or in external venues where it is difficult to control the environment, the target conditions are:

- For most items, temperature between 15-25 °C and RH between 35-65%;
- For vellum and parchment, temperature between 15-25 °C and RH between 40-65%.

4. Target temperature and RH for photographic collections

Most photographic collections are currently stored alongside the paper-based collections, but a cool photographic store has now been created in the George IV Bridge building, and the target conditions in this store are temperature of 15 °C (±1.5 °C) and RH of 40% (±2%).

5. Target temperature and RH for magnetic media
This includes audio cassette tapes and reel-to-reel tapes, videos, LTO tape, floppy discs and computer hard drives (standard spinning disc type).

In cool storage areas (currently Vault 2 Kirkintilloch), set-points for the temperature and RH should be agreed so that the temperature is between 8-16 °C and the RH is between 30-50%, with environmental fluctuations not exceeding 5% for RH or 3 °C for temperature within any 24 hour period.

6. Target temperature and RH for film
In cold long-term storage areas (currently Vault 1 Kirkintilloch), set-points for the temperature and RH should be agreed so that the temperature is between 0-8 °C and the RH is between 30-50%, with environmental fluctuations not exceeding 5% for RH or 3 °C for temperature within any 24 hour period.

In short-term storage areas (dirty and clean vaults in Hillington, and then Kelvinhall from summer 2016) the currently agreed set-points aim for temperature between 16-18 °C and RH between 45-55%. However, in short-term storage areas for film with vinegar syndrome or fungus contamination (vinegar vault and fungus vault), the requirements are relaxed to temperature below 20 °C and RH below 60% RH, since additional air changes are required.

7. Target temperature and RH for audio collections
Gramophone discs (acetate, shellac and vinyl)and wax cylinders
Gramophone discs and wax cylinders should ideally be stored in moderately cool conditions, as for magnetic media. However, for short term storage they may be kept in the same conditions as the paper-based collections, with temperature between 15-20 °C and RH between 40-60%, and environmental fluctuations not exceeding 10% for RH or 5 °C for temperature within any 24 hour period.

8. Target temperature and RH for optical discs
Optical discs include CDs, DVDs and Blu-ray Discs. They should ideally be stored in moderately cool conditions, as for magnetic media. However, for short term storage they may be kept in the same conditions as the paper-based collections, with temperature between 15-20 °C and RH between 40-60%, and environmental fluctuations not exceeding 10% for RH or 5 °C for temperature within any 24 hour period.

9. Target temperature and RH for hardware
Old hardware such as video recorders, audio tape recorders and computers is stored to allow the transfer of material from obsolete formats to modern formats, and for spare parts. It is anticipated that this area of the Library's collections will grow in the future. It should be kept in the same conditions as the paper-based collections, with temperature between 15-20 °C and RH between 40-60%, and environmental fluctuations not exceeding 10% for RH or 5 °C for temperature within any 24 hour period.

10. Target temperature and RH in work areas for all collections
In areas where collections are consulted and worked on, such as the conservation workshop, digitisation workrooms and curatorial offices, the temperature should remain between 15-25 °C and the RH should remain between 40-65%, and environmental fluctuations should not exceed 10% for RH or 5 °C for temperature within any 24 hour period. Parchment, vellum and fragile photographic materials should not be worked upon if the conditions are outside these parameters.