society of dyers and colourists

Cloth Hall Court,
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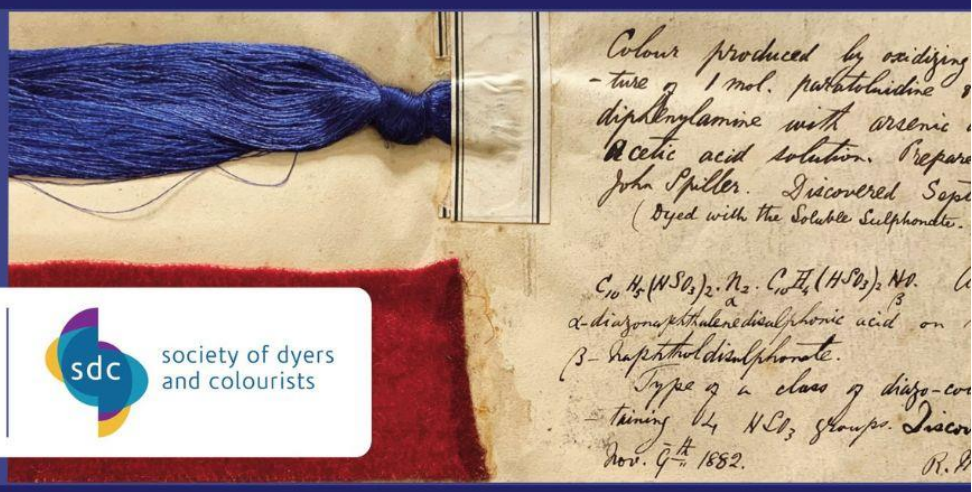
The 43rd International Conference

Dyes in History and Archaeology

23rd to 25th October 2024
Cloth Hall Court, Leeds
www.dha43.org



society of dyers and colourists

Dyes in History and Archaeology

HANDBOOK

23rd-25th October 2024

Contents

Information for Delegates

Emergency Procedures

In the event of the fire alarm being activated:

- Leave the building by the nearest exit.
- Do not use the lift
- Close any doors en-route without delaying your escape.
- Do not stop or return to collect personal belongings.
- Do not use any firefighting equipment unless you have been trained.
- You must remain at the assembly place.
- Return to the building only when authorised to do so.

First Aid

First Aid is available at reception.

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There are many local Taxi services in Leeds, please visit 3 Best Taxis in Leeds, UK - Expert Recommendations (threebestrated.co.uk) for recommendations.

Catering
Tea/Coffee breaks throughout the conference, along with a drinks reception and lunch included. Served in Merchants Hall.

Dietary requirements
Please inform waiting staff if you have a specific food allergy or dietary requirement (for example: vegan, vegetarian, halal or kosher) and you will be offered/served an appropriate meal.

Mobile phones and photography
Please ensure that your phone is switched off or in silent mode in the lecture theatre.

No photography or filming is permitted during presentations – please contact the speaker directly if you would like a copy of their presentation.

Poster sessions
The poster sessions will take place in Herringbone Suite, please take time to visit all the exciting poster presentations.

For a guide of what to do in Leeds, please click here.
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If you have any further queries, please visit the conference registration desk situated on the ground floor walkway, and someone will be available to assist you.

Organising Committee

Debbie Bamford - University of Leeds and Associate of the Society of Dyers and Colourists, UK

Joanne Dyer - Department of Scientific Research, British Museum, London, UK

Susan Kay Williams - Royal School of Needlework, London, UK

Jo Kirby - (Retired) National Gallery, London, UK

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sdc society of dyers and colourists

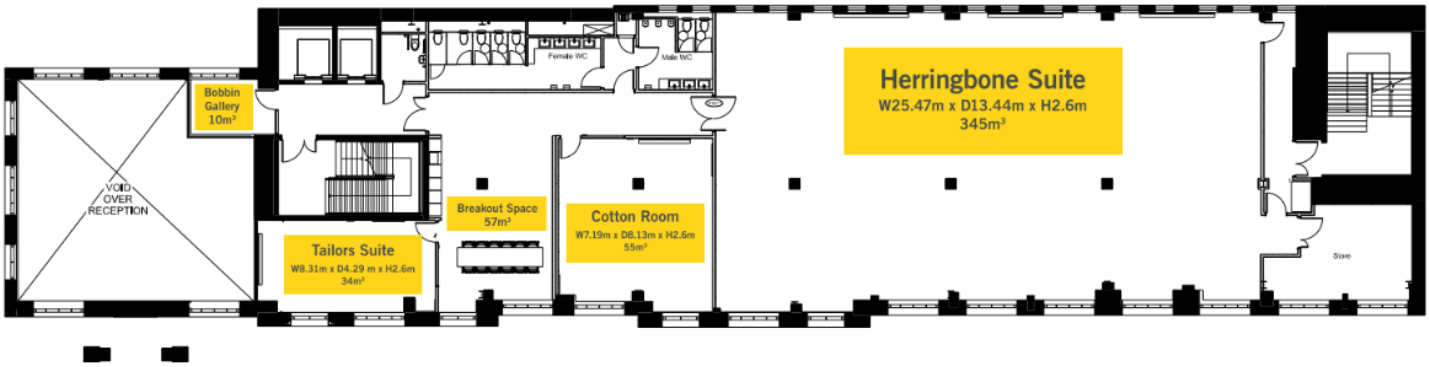
The conference is organised by
The Society of Dyers and Colourists

Venue Floorplan

Ground Floor

Wall mounted power socket Floor boxes

First Floor



Programme

Wednesday 23 October 2024

11.00 **11.30 – 12.00**	**Registration Open** - *Ground floor walkway* **Arrival tea/coffee served**
12:00 – 13:00	**Lunch** *Merchants Hall*
13:00 - 13:30	**Welcome and Keynote Speaker - Susan Kay Williams,** *SDC President* *Herringbone Suite, 1st Floor*
13:30 - 14:30	**Poster presentations** *Chair: Jo Kirby*
14:30 – 15:00	**Refreshments- Halstead Granville Tea sponsored by The Colour Group (GB)** *Merchants Hall* 
15:00 – 17:00	**Poster presentations** *Chair: Susan Kay Williams*
17:30 – 18.30	**Conference Reception** *Merchants Hall*

Thursday 24 October 2024

08:30 - 09:00	**Registration and refreshments** *Merchants Hall*
09:00 -10:20	**Session 1 - Colour from a distant time** *Herringbone Suite, 1st Floor* *Chair: Joanne Dyer*
09:00 - 09:20	**Let the lead tags talk** Dr Regina Hofmann-de Keijzer, *Independent scientist*
09:20 - 09:40	**The Identification of Tekhelet on an Ancient Egyptian (Dynasty XVIII) painted votive textile** Ms Jennifer Poulin, *Canadian Conservation Institute*
09:40 - 10:00	**A mysterious purple: a multi-analytical study of two Chavin textiles with fanged heads** Dr Rachel Lackner, *Metropolitan Museum of Art*
10:00 - 10:15	**Session Q&A**
10:20 - 10:50	**Refreshments- Halstead Granville Tea sponsored by The Colour Group (GB)** *Merchants Hall*
10:50 - 12:10	**Session 2 - Ageing, Change and Degradation** *Herringbone Suite, 1st Floor* *Chair: Sara Norrehed*
10:50 - 11:10	**A comparison of the fading of dyestuffs as textile colorants and lake pigments** Dr Jo Kirby, *Independent scientist*
11:10 - 11:30	**TooCOLD: Toolbox for studying the Chemistry Of Light-induced Degradation, a review** Professor Maarten van Bommel, *University of Amsterdam (UvA), Faculty of Science, van 't Hoff Institute for Molecular Science (HIMS)*
11:30 - 11:50	**Derciphering ageing effects in green-dyed english woollen cerpart yarns from the 1840'S** Dr Terry Schaeffer, *LACMA*
11:50 - 12:05	**Session Q&A**
12:10 – 13:40	**Lunch** *Merchants Hall*

13:40 - 15:30	**Session 3 - New lamps for old** *Herringbone Suite, 1st Floor* *Chair: Maarten van Bommel*
13:40 - 14:00	**Dye identification in Palestinian garments from the late19th/early 20th century** Dr Diego Tamburini, *British Museum*
14:00 - 14:20	**Behind the curtain: unveiling the chemistry of Gino Carlo Sensani's stage costumes** Miss Adele Ferretti, *University of Pisa*
14:20 - 14:40	**Anthraquinoid vat dyes: fastness, fabrics and fashion** Miss Katie McClure, *University of Glasgow*
14:40 - 15:00	**Francis H. Jennison´s „The manufacture of lake pigments from artificial colours"– a critical review of the first book on the production of lakes from synthetic dyes** Dr Francesca Sabatini, *Università di Milano-Bicocca & Eva Eis, Kremer Pigments*
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16:00 - 17:00	**Session 4 - Dating and Methodology** *Herringbone Suite, 1st Floor* *Chair: Katie McClure*
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16:20 - 16:40	**Dating textile heritage: new insights with 14c analysis of anthraquinone-based red dyes** Dr Ana Serrano, University of Amsterdam
16:40 - 16:50	**Session Q&A**
19:00	**Conference Dinner** *Malmaison Leeds*

Friday 25 October 2024

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09:00 - 09:20	**The codification of error, insights in the evolution of knowledge through an 18th-century dyer's manual** Mr Emelie Lupatini, *University of Antwerp*
09:20 - 09:40	**Rediscovering Forgotten Colors: The Legacy of Historical Color Terminology** Professor Natalia Ortega Saez, *University of Antwerpen*
09:40 - 10:00	**Let it Boyll: Dyes Recorded by Scottish Women after 1690** Dr Sarah Rich, *Penn State University, CVMS, Art History*
10:00 - 10:15	**Session Q&A**
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10:50 - 12:10	**Session 6 - Insect dyes and a waning tradition?** *Herringbone Suite, 1st Floor* *Chair: Diego Tamburini*
10:50 - 11:10	**Cudbear and the colours of the Atlantic Rainforest** Ms Vanessa Habib, *Independent researcher*
11:10 - 11:30	**Insect Dyes Identified In Archaeological Textiles Discovered In Northwest China** Professor Jian Liu, *China National Silk Museum*
11:30 - 11:50	**Combining HPLC-DAD-HRMS Analysis with Taxonomy for the Characterisation of Lac Dye from Kerria Species** Ms Mila Crippa, *NOVA School of Science and Technology*
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14:00 - 14:20	**Dye Plants used in Fish Skin Artefacts by the Indigenous Peoples of the Amur River: Nivkh, Nanai and Ulchi** Dr Elisa Palomino, *Smithsonian Arctic Studies Center*
14:20 - 14:40	**Use of alkalis in traditional dyeing technologies with plants** Dr Anete Karlstone, *Latvijas Universitates Latvijas vestures instituts*
14:40 - 15:00	**Rotting for Red: Archival and Experimental Research on Estonian Traditions of Decomposing Alder Buckthorn Bark Before Dyeing** Mrs Liis Luhamaa, *University of Tartu*
15:00 - 15:20	**Session Q&A**
15:30 - 16:00	**Refreshments** *Merchants Hall*
16:00 - 17:00	**Session 8 - Small mysteries** *Herringbone Suite, 1st Floor* *Chair: Jo Kirby*
16:00 - 16:20	**The 15th-Century Visconti-Sforza Tarocchi Cards: Insights into a Mysterious Yellow Dye Using LC-QTOF-MS on Minimized Samples** Dr Hitomi Fujii, *The Metropolitan Museum of Art*
16:20 - 16:40	**Hidden Treasures: Precious Textiles from the St Eustace Head Reliquary** Dr Joanne Dyer, *The British Museum*
16:40 - 16:50	**Session Q&A**

Oral Abstracts

Thursday 24 October, 2024
Session 1 Colour from a distant time
09:00 - 10:20

Oral Abstract 09:00 - 09:20

Let the lead tags talk

R Hofmann-de Keijzer[1], B Petznek[3], I Radman-Livaja[4], I Bogensperger[2], A Heiss[5]
[1]Independent scientist, Vienna, Austria
[2]Papyrus Collection, Austrian National Library, Vienna, Austria
[3]Archaeology and project management, Bruck/Leitha, Austria
[4]Director, Greek and Roman Department, Archaeological Museum Zagreb, Zagreb, Croatia
[5]Austrian Archaeological Institute, Austrian Academy of Sciences, Vienna, Austria

Lead tags were mainly used to label textiles in the north-western part of the Roman Empire between the 1st and 3rd centuries CE. In fullonicae, they marked clothing that needed cleaning, repair or dyeing, and to a lesser extent, they served to label new clothes. The tags have been excavated at 24 sites in six provinces, most of them originate from Siscia (1123) and Carnuntum (241), both cities in the province Pannonia Superior. In 2011, a Roman cesspit was excavated in the civil town of Carnuntum, dated to the 2nd century CE based on coin finds. The cesspit contained household and food waste, human faeces, pottery shards, pollen, lime, amber and hundreds of lead tags. Research into the findings provided information about the origin of the lead, the flora and fauna, the state of health, and the eating and living habits of the Carnuntum's population. 176 lead tags, 3 x 4 cm in size, have holes for tying them on and are inscribed with letters in Latin cursive script. X-ray images and CT-scans enabled the reading of the letters on the corroded tags. The inscriptions concern personal names, garments, services, colours and prices. The abbreviated terms refer to services such as cleaning, mending, dyeing and re-dyeing. Textiles mentioned on the lead tags include several types of cloaks, clothes, wool, blankets and slippers. Colour abbreviations refer to purple, red, yellow, blue, green, brown, grey and black. So far, no dyed Roman textiles have been excavated in Upper Pannonia. Therefore, dye analyses of archaeological textiles from Central European sites, archaeobotanical finds of dye plants, trade routes and ancient written sources have been studied. The presentation will give an overview of the dyestuffs that could have been used to produce these colours, with a particular attention to labels that refer to certain dyes.

Oral Abstract 09:20 - 09:40

The Identification of Tyrian blue on an Ancient Egyptian (Dynasty XVIII) painted votive textile

J Poulin[1], M Veall[1], C Paulocik[2], K Bladek[1]
[1]Conservation Science, Canadian Conservation Institute, Ottawa, Canada
[2]Conservation, Royal Ontario Museum, Toronto, Canada

In the early twentieth century, Charles Currelly, first Director of the Royal Ontario Museum, participated in excavations carried out by the Egypt Exploration Fund at Deir el-Bahri. Recovered textile objects included painted linen cloths from late Dynasty XVIII. The paintings generally depict families bringing gifts to the goddess Hathor, and they were likely presented as votive offerings at the Hathor chapel. Many of the ceramics and other votive objects associated with the Hathor chapel have blue glazes, paint or beads. Of the offerings Currelly noted that "[t]he special relation of blue colour with the goddess cannot be doubted." Indeed, one of the painted votive offerings (accession number ROM 910.16.3) contains blue weft threads on the side edges of the canvas, and blue looped threads in the fringe at the top edge of the painting (Figure 1). Analysis of the blue threads at the Canadian Conservation Institute identified the dye as the rare blue form of shellfish purple (also known as Tyrian blue, *Tekhelet*, or hyacinth purple), obtained from the sea snail *Hexaplex trunculus*, which lives in the Mediterranean region. The dye analysis was performed using gas chromatography-mass spectrometry (GC-MS) with *m*-(trifluoromethyl)phenyltrimethylammonium hydroxide (TMTFTH). The alkaline extraction and derivatisation technique produced tetramethylated *leuco* forms for the available indigotin (IND), 6-monobromoindigotin (MBI), and 6,6'-dibromoindigotin (DBI) in a ratio of approximately 68:28:4, respectively. Also present in the extract were oxygenated degradation products of IND, MBI and DBI in a ratio of 78:20:2, respectively. In this presentation we will discuss the full dye analysis results for the ancient textile and detail an improved dye extraction procedure for use with GC-MS analysis. Figure 1. Painted linen (Deir el-Bahri, c. 1336–1292 BCE, ROM 910.16.3). Photographs using normal light (a) and UV illumination (b). Fringe and weft thread photomicrographs (c)–(e).

Oral Abstract 09:40 - 10:10

A mysterious purple: a multi-analytical study of two Chavin textiles with fanged heads

R Lackner[1], E Phipps[2], M Leona[1], N Shibayama[1], M Fusco[3], R Hanson[4]
[1]Department of Scientific Research, Metropolitan Museum of Art, New York, NY, United States
[2]Department of World Arts and Cultures/Dance, UCLA-University of California Los Angeles, Los Angeles, CA, United States
[3]Conservation Department, The George Washington University Museum and The Textile Museum, Washington, D.C., United States
[4]Textile Conservation Lab, Cleveland Museum of Art, Cleveland, OH, United States

The Chavin culture (ca. 900 – 250 B.C.), based in northern Peru over 3000 m above sea level, is known for complex supernatural iconography carved into stone monuments at the religious center of Chavin de Huantar. This iconography, which includes composite entities of humans joined with caymans, condors, and other powerful creatures, has been found on textiles about a thousand kilometers away, in the dry desert of the south coast of Peru. Woven of cotton, sometimes colored with mineral pigments, the textiles were unusually constructed with colored, unspun fibers wound around warp yarns to create the vertical outline of the designs with heavier weft yarns forming the horizontal features. Fragments of these rare textiles are preserved in The Textile Museum in Washington, D.C. (TM.1977.35.3) and The Cleveland Museum of Art (CMA.1985.139). Both textiles feature similar, if not identical, cross-fanged creatures and an unusual purple colorant applied after weaving. The only documented source of purple on cotton from the region—though not quite this early period—is shellfish purple from *Concholepas concholepas*. This research project was initiated to confirm the presence of shellfish purple. Fiber samples supplied by both institutions were analyzed at The Metropolitan Museum of Art. Initially, X-ray fluorescence spectroscopy (XRF) and direct insertion probe-mass spectrometry (DIP-MS) were combined to minimize sample size. These techniques failed to detect 6,6'-dibromoindigo, a marker of shellfish purple. To further investigate, we used liquid chromatography-mass spectrometry (LC-MS) and both conventional and surface-enhanced Raman spectroscopy, revealing the unusual combination of vermillion and cochineal, the latter of which has not been documented in Peruvian textiles from this early period. Therefore, these findings must be evaluated in the light of archaeological and historical scholarship. This talk will discuss the analytical pathway and assess these unexpected results in context with the textiles' origins and history.

Thursday 24 October, 2024
Session 2 Ageing, change and degradation
10:50 - 12:10

Oral Abstract 10:50 - 11:10

A comparison of the fading of dyestuffs as textile colorants and lake pigments

J Kirby[1], D Saunders[2]
[1]Scientific Department, The National Gallery, London, United Kingdom
[2]Department of Conservation and Scientific Research, The British Museum, London, United Kingdom

During an experiment examining the effect of different electric light sources, a series of dyed wool samples and lake pigments prepared from the same dyestuffs were exposed to light over the course of 14 months.[1] The wool samples given to the authors were prepared within the MODHT project (2002-5),using recipes derived from fifteenth- to seventeenth-century Dutch and Italian sources. The pigments were prepared either according to European recipes of the same period, or using late nineteenth-century French or English recipes, during a workshop on materials available to Vincent van Gogh. Although the rate of exposure to light was faster than in a museum setting, the long experimental period allowed alterations in appearance to be observed and periodic colour measurements made. These permitted overall colour differences (ΔE) to be followed, as well as changes in the samples' hue and chroma, e.g., the loss of the yellow component in greens made from blue/yellow mixtures. In addition, spectral information was gathered throughout the experiment, giving an indication of changes in the absorption of light across the spectrum as the experiment progressed. The sequence of stability of red dyestuffs is the same in textile and pigment samples: madder is most stable, then cochineal, with brazilwood the least stable. Eosin was the most fugitive dyestuff examined. Comparisons of textile and lake samples derived from the same dyestuff indicate that the colorants are more stable when used as textile dyes than in analogous lake pigments. Generally, the difference in behaviour between textile samples containing the same dyestuff, but prepared using different recipes, is relatively small; in equivalent lake pigments the variations tend to be larger. 1. Saunders, D., and J. Kirby. 2008. "A Comparison of Light-Induced Damage under Common Museum Illuminants." ICOM-CC 15th Triennial Conference, New Delhi, ed. J. Bridgland, 766–74. Paris: ICOM.

Oral Abstract 11:10 - 11:30

TooCOLD: Toolbox for studying the Chemistry Of Light-induced Degradation, a review

Maarten van Bommel[1], I Groeneveld[2], M den Uijl[1], B Pirok[1], F Ariese[3], G Somsen[2], P Schoenmakers[1]
[1]van 't Hoff Institute for Molecular Sciences, Analytical Chemistry, University of Amsterdam (UvA), Amsterdam, Netherlands
[2]Amsterdam Institute for Molecular and Life Sciences, Division of Bioanalyti, Vrije Universiteit Amsterdam (VU), Amsterdam, Netherlands
[3]Department of Physics and Astronomy, LaserLaB., Vrije Universiteit Amsterdam (VU), Amsterdam, Netherlands

The fading of organic colorants has a great impact on our appreciation of cultural heritage. Studying degradation mechanisms of dyes and organic pigments is extremely complicated. Often mixtures are present and several parameters such as the light dose, the wavelength, the presence of oxygen and the sample matrix add to this complexity. The fading of colorants is often studied using mock-up samples which are exposed to irradiation followed by colour measurements. However, identifying degradation products to reveal the exact degradation mechanism is challenging. These products need to be extracted from the sample and analysed using liquid chromatography (LC) for example. This is laborious and prone to error, especially since sample pre-treatment might affect the composition of the sample. Yet, there is a strong wish to understand the degradation of these colorants, on the one hand to understand the condition of the artwork and to develop mitigation strategies and on the other hand, to determine the original appearance. In 2019 we presented the TooCOLD project, Toolbox for studying the Chemistry Of Light-induced Degradation (TTW-15506) in which we demonstrated a proof of concept of a tool which can be used to perform degradation in solution coupled on-line with LC. Samples are introduced in an exposure cell, irradiated, and subsequently analysed. Now, we optimised and validated the technique, coupled it to 1D and 2D LC, employed different irradiation sources, investigated the effect of oxygen, peroxides and other additives on degradation, and designed a new exposure cell. By exposing organic colorants to high doses of irradiation, complete degradation profiles can be established within hours, instead of days or even weeks. In the current presentation, we will show an overview of the activities performed and discuss the pros and cons of the developed technology. In addition, we will present an outline for further studies.

Oral Abstract 11:30 - 12:00

DECIPHERING AGEING EFFECTS IN GREEN-DYED ENGLISH WOOLLEN CARPET YARNS FROM THE 1840'S

T Schaeffer[1], J Mobberley[1], L Maccarelli[1]
[1]Conservation Center, Los Angeles County Museum of Art (LACMA), Los Angeles, United States

Carpet manufacturer W.H. Worth of Kidderminster, England, began in 1842 to assemble a sample book of woollen yarns arranged according to colour. All the samples are dyed with natural dyestuffs. Most of them still vibrantly display original hues. This study focuses specifically on the "Greens" section of the book, which contains sixteen yarns samples. Of these, only six are still green. The other ten range in color from tan to dark brown. The dyestuff ingredients listed in the "recipes" accompanying the discolored samples are very similar to those listed in the recipes for samples that are still green. These dyestuffs are fustic, and either "mixture" or extract of indigo. To confirm that Worth's green recipes were followed to dye the accompanying yarns, samples of these yarns have been analysed by HPLC-DAD and FORS. Additionally, to elucidate any disparities between the ingredients listed and the dyestuffs present, and understand their current appearances, mock-ups following Worth recipes were prepared and thermally aged. Preliminary results from analyses of the historic samples showed that the discolored yarns contain a mixture of indigo and indigo carmine as the blue dyestuffs, but the green samples contain only indigo carmine. This suggested that one or more components of the indigo vat may have contributed to the discolouration. To confirm that the indigo vat was a cause of the browning of Worth's green samples, woollen yarn was dyed following a Worth's green recipe, +/- indigo in the dye bath, at several pH's. Portions of these samples were thermally aged, and their appearances monitored in order to characterize any browning processes that occurred. All mockups were analyzed with HPLC-DAD and FORS. These results were compared to the historic samples to identify any differences in dyeing conditions that might have caused the observed shifts in colour.

Thursday 24 October, 2024
Session 3 New lamps for old
13:40 - 15:30

Oral Abstract 13:40 - 14:00

Dye identification in Palestinian garments from the late19th/early 20th century

D Tamburini[1], L Durand[1, 2], Z Klink-Hoppe[3]
[1]Department of Scientific Research, The British Museum, London, United Kingdom
[2]Department of Chemistry, Université Toulouse III Paul Sabatier, Toulouse, France
[3]Department of the Middle East, The British Museum, London, United Kingdom

The dyes used to produce two Palestinian garments dating to the late 19th-early 20th century from the British Museum's collection were investigated. The garments are composite coat-dresses (*jillayeh*, accession numbers As1967,02.15 and As1967,02.21) made of blue and red fabrics, heavily embroidered and appliquéd in colourful floss thread and patches (Figure). Samples from most colours were taken and analysed by high pressure liquid chromatography coupled to diode array detector and tandem mass spectrometry (HPLC-DAD-MS/MS). The results revealed the use of natural indigo or woad for the blue fabrics, yellow from buckthorn (*Rhamnus saxatilis*) in both garments, and madder (*Rubia tinctorum*) in combination with tannins in the red fabric of As1967,02.15. Cochineal mixed with synthetic dyes was also detected in the dark red areas of As1967,02.15. Early synthetic dyes were found in all the other colours. These include Rhodamine B (C.I. 45170), Orange II (C.I. 15510), Orange IV (C.I. 13080), Metanil Yellow (C.I. 13065), Chrysoidine R (C.I. 11320), Methyl Violet (C.I. 42535), Malachite Green (C.I. 42000), Fuchsin (C.I. 42510), Auramine O (C.I. 41000) and Methyl Blue (C.I. 42780), often used in interesting mixtures. As the date of the first synthesis of these dyes is known, it can be concluded that As1967,02.15 was produced after 1887 and As1967,02.21 after 1877. The results need to be integrated in a larger debate about the time of introduction and spread of synthetic dyes in Palestine. The continuous use of historical local sources of natural dyes alongside new synthetic dyes is of particular interest, adding rightful nuances to the development of textile-making practices in this region.

Oral Abstract 14:00 - 14:20

Behind the curtain: unveiling the chemistry of Gino Carlo Sensani's stage costumes

A Ferretti[1], T Nacci[1], D Petrocchi[2], S Porcinai[2], L Triolo[2], I Degano[1]
[1]Department of Chemistry and Industrial Chemistry, University of Pisa, Pisa, Italy
[2]Opificio delle Pietre Dure, Firenze, Italy

The 19th century witnessed revolutionary advancements in the aesthetics and performance of artistic materials, driven by chemical innovations in both synthetic dyes and textile fibers design and production. Stage costumes serve as historical artifacts par excellence wherein a blend of natural and artificial materials merge within the same clothe. In addition, several additives are often employed to fulfil production demands and ensure effectiveness on stage. Moreover, the composition of these textile artifacts frequently evolves over time, undergoing numerous modifications to adapt the costumes for purposes beyond their original intent. In this context, stage costumes offer an engaging challenge to restorers and heritage scientists. In this study, an analytical approach was implemented to comprehensively characterise both the textile fibers and dyes in stage costumes designed by Gino Carlo Sensani during the 1920s and 1930s. Optical microscopy (OM) and pyrolysis coupled to gas chromatography-mass spectrometry (Py-GC/MS) enabled us to outline a wide array of natural and artificial fibers, with cotton, viscose, and silk predominating. Instead, the characterisation of dye components using high-performance liquid chromatography coupled with a diode array detector and high-resolution mass spectrometry (HPLC-DAD-HRMS) revealed the application of highly complex mixtures of dyes to achieve the desired colours. Our findings on blue hues primarily identified methylene blue, often combined with malachite green to achieve light blue tones. Alternatively, Victoria blue R was detected along with violet (acid violet 5BF) and red dyes (azocarmine B). Trace levels of tannins (gallic and ellagic acid) were detected in some samples, likely employed as mordants or additives. Our investigation could provide important insights into material composition, shedding light on the early stages of synthetic chemistry. Furthermore, in some samples SOPs degradation pathways can also be highlighted and correlated with colour alteration in the textiles, facilitating the development of optimal conservation strategies.

Oral Abstract 14:20 - 14:40

Anthraquinoid vat dyes: fastness, fabrics and fashion

K R McClure[1], D J France[2], A Quye[1]
[1]Kelvin Centre for Conservation and Cultural Heritage Research, University of Glasgow, Glasgow, Scotland, United Kingdom
[2]School of Chemistry, University of Glasgow, Glasgow, Scotland, United Kingdom

In 1901, a new blue dye was discovered by René Bohn at BASF in Germany. Indanthrene blue was the first in a new class of synthetic dyes. These anthraquinoid vat dyes were chemically exceptional. Their large, planar, fused aromatic structures make them insoluble, sterically bulky, and importantly, very stable. These qualities made the dyes challenging to work with. Their synthesis is complex; their solubilisation requires harsh chemical conditions; and they were consequently expensive. However, the chemistries of the dyes also offered favourable properties which filled gaps in the commercial market. The dyes introduced excellent light and wash-fastnesses at a time when fading was a major problem for dyers and consumers.[1] The potential of these dyes to solve real-world problems was recognised in the UK by James Morton, then a weaver and businessman, later also a dyer and chemist. Consumer hesitance to high pricing was overcome by targeting marketing and application to fade-vulnerable textiles. Limited fibre compatibility, forced by the harsh dyeing conditions, was overcome by innovative material use. Furthermore, the class introduced the first ever fast, pure green dye, Caledon Jade Green, which impacted textile design.[2] The histories of the anthraquinoid vat dyes in the UK and the Morton family textile companies are intrinsically intertwined. Through these companies, the new fast dyes penetrated everyday fabrics and artist-designed textiles throughout the twentieth century.[3] Using analysis of Morton company archives, marketing materials and textiles, this presentation discusses how the chemistries of the anthraquinoid vat dyes changed expectations of fastness, how fabrics were used, and fashion. [1]Venkataraman, Krishnasami. The Chemistry of Synthetic Dyes. Vol II. New York: Academic Press Inc., 1952. [2]Morton, James. “History of the Development of Fast Dyeing and Dyes,” Journal of the Royal Society of Arts 77, no.3986 (1920): 544-574. [3]Jackson, Lesley. Alastair Morton and Edinburgh Weavers. London: V&A Publishing, 2012.

Oral Abstract 14:40 - 15:00

Francis H. Jennison´s „The manufacture of lake pigments from artificial colours"– a critical review of the first book on the production of lakes from synthetic dyes

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In 1900, Francis Herbert Jennison published „The Manufacture of Lake Pigments from Artificial Colours" with Scott, Greenwood & Co. in London. The book drew such attention that it was translated into German just one year after its initial publication [1]. While there was already a lot of contemporary literature on synthetic dyes, it mainly deals with their manufacture, chemical composition, properties, or their use for dyeing. Although historic recipes show that the new synthetic dyes had already been in use for making lake pigments [2], only very little literature can be found on that matter. Hence, Jennison´s publication was the first monograph on the manufacture of lake pigments from synthetic dyes. The book comprises descriptions of the dyes, substrates, and various methods for lake-making. Practical examples complete the work: sixteen colour plates with original samples of lake pigments show the effect of different preparation methods and diverse types of dyes used. The colour plates were sampled and analysed by liquid chromatography coupled with spectroscopic and spectrometric detectors (LC-DAD-HRMS) to thoroughly elucidate the chemical composition and correlate with the recipes reported in the book. The data collected highlighted the mismatch between the described formulation and the effective composition, and the application of seldom or no longer used and unexplored historical dyes. This emphasizes the significance of Jennison´s book, confirming how knowing early formulations is needed to disclose the later ones. [1] Jennison, Francis Herbert: Die Herstellung von Farblacken aus künstlichen Farbstoffen. Transl. Rübencamp, Robert. Berlin 1901. [2] For further information on the historic recipes: Eis, Eva: Die 'Farben-Recepte' der Firma Heinrich Wiesel. Transkription und Auswertung der Rezeptsammlung eines Farbenfabrikanten aus dem ausgehenden 19. Jahrhundert. Bad Langensalza 2020, p. 192-194, 241-255 and 360-361.

Thursday 24 October, 2024
Session 4 Dating and methodology
16:00 - 17:00

Oral Abstract 16:00 - 16:20

Sequencing analysis and dating of yarn fragments from six Paracas mantles from bundle WK12-382

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The Necrópolis de Wari Kayan, at the Paracas site in the coastal desert of south-central Peru, is the largest archaeologically excavated mortuary complex of the pre-Hispanic Andes, and one of the best for preservation of textiles. We are investigating loose yarns closely associated with textiles from Wari Kayan 12 bundle 382 collected by the late Dr. Anne Paul in 1985 at what is now the Museo Nacional de Arqueología Antropología e Historia del Perú (MNAAHP). Preliminary studies were undertaken on these samples in the past. In this study we are sequencing multiple state-of-the-art analyses–direct analysis in real time mass spectrometry (DART-MS), ultrahigh performance liquid chromatography (UHPLC) with tandem MS, and accelerator mass spectrometry–on the same sample to “squeeze out every drop” of information possible. This study focuses on six of the outer specimens in the bundle, three Linear style mantles (4, 5, and 6) and three Block Color embroidered mantles (7, 9, and 10). These mantles include different sets of color hues and values and may represent either different time periods or different producer groups. Sequential analysis followed the scheme shown below. Plasma oxidation at low temperature (<100 °C) was used to prepare carbon dioxide for AMS radiocarbon analysis. Fibers remaining after oxidation were then combusted for light stable isotope analysis. The sequential analysis will result in fiber and dye composition, radiocarbon age, and stable isotope fractionation values, suggesting fiber origin, all from a single fragment of yarn. The results will inform models of the social relationships of production and exchange that facilitated the large-scale production of these artifacts and their deposition in particular tombs and to continue the project started over 40 years ago by Dr. Paul in her work with the Textile Department at the MNAAHP.

Oral Abstract 16:20 - 16:40

Dating textile heritage: new insights with 14c analysis of anthraquinone-based red dyes

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Historical textiles in museum collections are seldom well dated. With the exception of some textile objects which date of manufacture has been woven, embroidered, or printed on, the great majority of textile heritage is dated based on the study of the technical construction of the object, the materials present (fibres, metal threads, dyes), or comparisons with historical written sources and depictions in well-dated paintings and other decorative arts. While these approaches offer insightful interpretations, they are nonetheless far from accurate. Radiocarbon (^{14}C) dating can offer a more precise method to date the textile fibre substrate of an object [1]. Carbon rich and short lived, the carbon isotopic ratio of organic dyes in coloured textiles can additionally represent a snapshot of the atmospheric CO_2 during the years of growth of the organism (plant or insect dye) from which it was isolated, yet so far never pursued as ^{14}C target. Nowadays, the substantial decrease in sample size requirements has allowed the combined, sequential use of dye analysis and ^{14}C dating from a single-coloured yarn [2]. This strategy demonstrates the complementarity of the two methods in terms of information output and compatibility [3, 4]. Focusing on anthraquinone dyes used in historical dyed textiles, this work presents the development of a new protocol combining dye analysis by high-performance liquid chromatography (HPLC) and compound-specific radiocarbon analysis (CSRA). Blank assessment and constant contamination modelling are key parameters in highlighting the associated ^{14}C constraints within the different steps of the methodology covering the chemical extraction, chromatographic separation, and final ^{14}C analysis. The complementary combination of both techniques has the potential to support art historical interpretations about the origins of a group of textile objects selected for this study, offering a more specific chronological time window on the objects' production, and furthering discussion on historical dyeing traditions.

Friday 25 October, 2024
Session 5 Sources of information - the 18th century
09:00 - 10:20

Oral Abstract 09:00 - 09:20

The codification of error, insights in the evolution of knowledge through an 18th-century dyer's manual

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In his essay, Sven Dupré describes the transmission of artisanal knowledge evolved in the 17th c. through what he calls the "Codification of Error". This refers to the early modern practice of actively introducing evaluative notes to the main text of practical recipes, in opposition to previous "silent" changes. It involves recording how-to instructions, noting when a recipe or technique fails, and suggesting improvements. Through this codification, a more detailed description of practices would emerge—what to do and, more importantly, what *not* to do. Dupré argued that this became a crucial tool in the reorganization of knowledge that developed during the century. One rare finding documenting this method is an anonymous dyer's manuscript from Antwerp. The visible changes made to the recipes, give a unique insight into the skills of the dyer and serve as a testimonial of the knowledge improvement process. Within the manuscript, we identify two categories of recipes. First, there are the structured recipes in formal written language with a linear layout. Secondly, there are less linear recipes, written in a colloquial language. These second recipes are often marked with phrases such as 'in my opinion' or 'I think', and are assumed being derived from the dyer's own experience. Within both categories, the trial and error development is visible, albeit in different forms. For example, there are corrections made directly into the procedures, alternatively, paragraphs are added and labeled as 'nota' or 'memore'. In this paper, we provide evidence of the improvement practices implemented by the dyer through recipes that exhibit signs of refinements and changes. Additionally, the chosen recipes have been interpreted, translated, and reconstructed in both original form and described iterations. Our contribution lies in documenting how the dyer's manuscript evolved, presenting it as a testimonial of the development of artisanal knowledge.

Oral Abstract 09:20 - 09:40

Rediscovering Forgotten Colors: The Legacy of Historical Color Terminology

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While our current vocabulary for colors tends to be rather limited, historical sources from the Northern and Southern Netherlands reveal a rich array of color names, demonstrating that colors were once associated with a diverse palette of hues and shades. These color names often corresponded to the material being dyed, the ingredients used, the dyeing method, or even the quality of the dye recipe. In historical texts, we encounter terms reflecting specific natural dyes and their resultant hues. Colors were described with great specificity, often linked to the natural world or everyday objects, such as “feuillemorte”, “assgrau”, “lyfverve”, “gout gheel” or to the material to be dyed such as “fustian black” for example. These descriptions provided a rich, nuanced understanding of color that went beyond the basic terms we use today. Before the color revolution of the nineteenth century, standardization of color-making was largely absent. Nevertheless, a related color terminology was in use during the preceding period, though many of these terms have fallen out of use today. For some, we can still imagine what the colors might have looked like. Reworking these recipes highlights the complex relationship between chromatic language and color perception. Historical color names were not just labels; they conveyed information about the source materials, the cultural significance of the colors, and even the economic and social contexts in which they were used. Understanding and reviving this rich color terminology allows us to appreciate the intricate art and science of historical dyeing processes, bridging the gap between past and present perceptions of color. References [1] Sven Dupré, Natalia Ortega saez, The Colourful Language of Dyeing Black, A Revolution in Colour: Natural Dyes and Dress in Europe, c. 1400-1800, edited by Maria Hayward, Giorgio Riello and Ulinka Rublack (in press)

Oral Abstract 09:40 - 10:10

Let it Boyll: Dyes Recorded by Scottish Women after 1690

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Beginning in 1690, a young Quaker woman named Christian Barclay began cataloging recipes for food, medical remedies, and dyes, most likely in preparation for managing her own household when she married the following year. Many of the recipes were likely created and dictated by her mother—also named Christian Barclay—whose skill with herbal decoctions in healing the sick was widely recognized around the Aberdeen countryside. The Barclay dye recipes align with taste in textile colors during the early 18th century, and the recipe names—"Maiden's Blush," "Peapingo," and "A True and Durable Copper Colour"—derive from the familiar lexicon of dye colors at the time. But several of the recipes (particularly one which attempts to approximate a Bowday scarlet with ingredients more locally at hand) also evidence an inventiveness that exceeds general dye cultures of the time. The Center for Virtual/Material Studies in the Department of Art History at Pennsylvania State University is attempting to make all sixty-seven dye recipes in the Barclay manuscript using ingredients that are as historically accurate as possible (including "weinston," "wine lees," and "good ole pish") in the hopes of better understanding the chromatic environment that was engineered and enjoyed by resourceful women of Scotland's early Quaker community. This presentation will present a number of wool samples already dyed according to Barclay recipes, and will discuss many of the problems and questions that have arisen in the process. Special attention will be paid to the delightfully ornamented recipe entry for "Wine," its use of wine byproducts as ingredients, and the surprising color it produces.

Friday 25 October, 2024
Session 6 Insect dyes and a waning tradition?
10:50 - 12:10

Oral Abstract 10:50 - 11:10

CUDBEAR AND THE COLOURS OF THE ATLANTIC RAINFOREST

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Lichen dyes from *crotal* and *corcur* have been known for many centuries in Scotland, the latter included in the patented Cudbear by the master dyer Cuthbert Gordon in 1758. Less well known are Gordon's explorations of other colour producing plants in Britain at this time. A century later the botanical investigations of William Lauder Lindsay were published on over 30 colour producing lichens then known, the majority found in the temperate rain forest in Scotland and its associated coastline. Even later in 1916, economic necessity led to a re-evaluation of indigenous dye plants in a time of national emergency. It is evident however that Scottish merchants also imported dye plants which were in use internationally, for example logwood, indigo and madder. Through European trading links and colonial opportunity, merchants competed to develop colours to market their wool cloth. How did imported dyes affect the long enduring use of local dyes in these markets? Was there a loss of craft dyeing skills in the highlands of Scotland as the population was displaced for it appears that Cudbear, for example, continued to be used for longer and more widely than has previously been supposed. Colour producing lichens were also imported to satisfy the market as local sources began to be depleted. Using the records of 18thc merchants and wool manufacturers this paper will consider why and if local dyes continued to be admired and whether they were able to be integrated with imported dyestuffs into known dye practices.

Oral Abstract 11:10 - 11:30

Insect Dyes Identified In Archaeological Textiles Discovered In Northwest China

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Many well-preserved textiles unearthed from archaeological sites, such as Zaghunluq, Subeixi, Sampula, Niya and Dunhuang, in Northwest China, have been analyzed for dye identification by high performance liquid chromatography coupled with mass spectrometry. Dyes from madder, indigo, poplar, cork tree, weld, safflower, etc. have been reported in the previous papers. In this talk, we present the intriguing findings of insect dyes in archaeological textiles dating from the Early Iron Age (the 7th to 3rd centuries BCE) to the Tang Dynasty (the 7th to 10th centuries CE). Kermes, Polish cochineal, Armenian cochineal and lac, which were unlikely native to China, have been successfully identified based on the ratios of anthraquinones (e.g. carminic acid, kermesic acid, laccaic acids), revealing that the transmission and exchange of insect dyes through Eurasia had emerged even in prehistoric times. In some cases, a mixture of an insect dye and madder was found in a single red thread of the archaeological textile. This is probably because the plant dye is normally less expensive than the insect dye. In addition, this paper is the first to report that the dye extract from yan-zhu-jie (Porphyrophora ningxiana), a pest of licorice, being detected--in a red woolen cloth discovered at the Shengjindian site (the 3rd BCE) in the Turpan Basin. This suggests that a local scale insect might have been used to color textiles no later than the Western Han Dynasty.

Oral Abstract 11:30 - 11:50

Combining HPLC-DAD-HRMS Analysis with Taxonomy for the Characterisation of Lac Dye from *Kerria* Species

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[4]Corporacion Colombiana de Investigacion Agropecuaria, Centro de Investigacion Palmira, Valle, Colombia

Lac dye is one of the red dyes of animal origin used in Asia since antiquity to create colourful textiles. Lac-producing insects belong to the genus *Kerria* (Hemiptera: Tachardiidae) which includes 29 species mainly distributed across Asia. Historical documents refer to India, Myanmar and Thailand as the preferred areas to purchase sticklac (the raw material composed of insects and its resin that contains lac dye) of different grades and colouring properties. Although qualitative differences in the raw material have been recorded in the past, systematic studies on the molecular variability of lac dye obtained from different lac insects and/or geographical regions remain scarce. This work aims to fill this knowledge gap by combining taxonomic studies with molecular analysis using high-performance liquid chromatography coupled with a diode array detector and high-resolution mass spectrometry (HPLC-DAD-HRMS). Firstly, we collected sticklac from areas where local communities still use this raw material for dyeing, including Bhutan, India, Taiwan, Thailand and Vietnam. The study of the lac insects' morphology enabled specific *Kerria* species to be identified from commercial sticklac. However, the need of a taxonomic revision of the genus *Kerria* became clear. HPLC-DAD-HRMS analysis showed variations in the chemical profiles of lac dye samples in terms of relative abundance of the main chromophores (laccaic acids) as well as potential molecular markers of species. Multivariate statistical analysis, including principal component analysis (PCA), was used to highlight differences and similarities between taxonomically-verified and unverified lac dyes from different regions. The created dataset has the potential to refine the provenance of lac-dyed modern and historical textiles. This presentation offers the first insight into the morphology and chemical diversity of *Kerria* species. It fosters more accurate identifications of the source used to dye textiles throughout history, while contributing to a better understanding of the circulation of the raw material worldwide.

Friday 25 October, 2024
Session 7 Traditional dyeing: fruits of forest and river
13:40 - 15:30

Oral Abstract 13:40 - 14:00

Tikuna/Magüta blue: chemical composition and considerations for community-based participatory research (CBPR) in technical art history

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This work is a continuation of a presentation given at the 42nd DHA about the investigation of blue colorants from the Tikuna/Magüta people from the Amazon Forest. That study was motivated by historical documents that suggest the existence of a still unknown blue colorant among technical art historians and conservation scientists, produced by the reaction of the juice of the naicü fruit with iron. Twenty-three items from four different museums were investigated to explore the existence of the unknown blue. However, it was not detected. In this work, the analytical results from the investigation of a mockup of the unknown blue colorant are presented. The sample was prepared by the Tikuna/Magüta people and investigated using Raman spectroscopy (including computational simulation), Fourier-transform infrared spectroscopy (FTIR), fiber optics reflectance spectroscopy (FORS), scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDS), microfadeometry, and high-performance liquid chromatography with diode-array detection (HPLC-DAD). The analytical investigation came with ethical concerns associated with the examination of spiritual items and community engagement. The people who produce the unknown colorant are still alive and, ideally, should benefit from the scientific research. Additionally, naicü is a plant present mostly in protected lands and can't be easily accessed. Because these topics are scarcely discussed in technical art history and conservation science but should be systematically considered to guarantee more socially responsible research, the challenges and methods used in this project are also presented. Many methods are available to engage with communities but community-based participatory research (CBPR) approach was the one chosen. CBPR is a well-established approach in fields like health and archaeology, and its principles, challenges, and advantages in technical art history will be addressed in this presentation.

Oral Abstracts 14:00 - 14:20

Dye Plants used in Fish Skin Artefacts by the Indigenous Peoples of the Amur River: Nivkh, Nanai and Ulchi

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Along the Amur River basin in Eastern Siberia, the Indigenous Nivkh, Nanai, and Ulchi Peoples crafted robes and accessories from fish skin, central to their diet and shamanic attire. They used various salmonoid species, carp and pike. Female salmon and whitened carp skins were used for robes, while pike skin, valued for its strength, was reserved for hunters' shoes and leggings. Garments were embellished with intricate appliqué and embroidery. Decorative motifs included spirals, scrolls, floral and animal designs such as turtle, toad, lizard, snake, and fish scales, protecting hunters from unseen threats like harmful demons or bears. Decorations were dyed with plant or mineral dyes or painted with birchbark stencils. The fish skin robes resembled Manchurian clothing, with a T-cut and wide left flap attached to the right flank. Black painted borders edged the hem, neck, front panel, and sleeves to ward off evil. Some garments featured indigo-dyed linings and cotton bands with chain embroidery and metallic pendants on the hems to reflect light and repel malevolent spirits. Red, blue, yellow and black were the predominant colours in Amur decorative elements. Natural dyes played a crucial role in ornamentation. Minerals were collected from the Amur River shores, ground with dry red caviar, and diluted with water for use. Orange-red hues were created from natural earth pigment or ochre, which was soaked in fish blood and heated. Safflower petals, introduced from the Silk Route around the 3rd century C.E., were used for their pure red dye despite the low red component concentration, while the higher concentration yellow components were discarded for lack of lightfastness. Black was produced from carbon black. Blue indigotin derived from knotweed, successfully cultivated in Russian territories by 1835. Natural commelinin, obtained from the petals of the Asiatic dayflower has been used as early as the 11th century as blue dye.

Oral Abstract 14:20 - 14:40

Use of alkalis in traditional dyeing technologies with plants

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The use of natural dyes in textile dyeing has a long and rich history that reveals a diverse range of dyeing technologies. The traditional dyeing methods handed down from generation to generation, which European peasants used to dye their fabrics and yarns, still preserve little-explored dyeing techniques. The study of the ethnographic heritage of Latvia or, on a broader scale, the region of North-Eastern Europe can provide new insights into the diversity of natural dyes. Combining information from written sources with the results of practical dyeing experiments makes it possible to gain more knowledge about the dyeing methods used in the past. It opens the way to their use today.
This report will give insight into the effect of the use of alkali on obtaining reddish tones when dyeing different plants. The author took the basis for the technologies used in the experiments from unpublished and published written sources: materials from the ethnographic expeditions of the Board of Monuments stored in the Latvian National Museum of History, materials from ethnographical expeditions stored in the Repository of Ethnographical Materials of the Institute of Latvian History of the University of Latvia, and from published sources, as an example, the book of Martha Bielenshein [1], etc. The roots of *Potentilla erecta* (L.) Raeusch., *Rumex acetosa* L., the bark of *Prunus padus* L., and the underbark of *Betula pendula* spp. were used in dyeing experiments. [1] Bielenstein, Martha, 1935. *Die altlettischen Färbmethoden. Studien zur indogermanischen Altertumskunde*. Veröffentlichungen der volkskundlichen Forschungsstelle am Herderinstitut zu Riga, Band II, Riga: Druck u. Verlag der AG “Ernst Plates”.

Oral Abstract 14:40 - 15:00

Rotting for Red: Archival and Experimental Research on Estonian Traditions of Decomposing Alder Buckthorn Bark Before Dyeing

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Alder buckthorn (*Frangula alnus* Mill.) is a small tree whose berries, leaves, and bark have been historically used for dyeing textiles. Several Estonian archival sources and historical textile legends describing local 19th-century dyeing traditions mention that alder buckthorn bark was used to dye woolen yarn red. According to written descriptions, the bark was left to rot outside for months before dyeing, either on the ground or underground. Although the method of fermenting alder buckthorn bark in wood ash lye to achieve red is well known, the combination of rotting the bark and using the boiling method for dyeing red has not been reported. In this paper we give an overview of descriptions found in Estonian archives about rotting alder buckthorn bark, and of practical experiments that were compiled based on this information. Both methods of rotting - on the ground and underground - were tested for shorter and longer periods. Unmordanted and alum-mordanted woolen yarns were dyed with rotted bark and were tested for lightfastness and pH sensitivity. It was investigated whether the different pretreatments of the bark affect not only the colour but also the dye composition of the dyed wool significantly. Furthermore, samples from 19th century Estonian textiles mentioning the use of alder buckthorn bark were tested with HPLC-DAD, and compared with the reference yarns dyed with rotted bark. The results show that rotting alder buckthorn bark has a strong effect on colours achievable with the boiling method, and that both unmordanted and alum-mordanted yarns can be dyed different shades of red. The dyed yarns can be used as visual references when searching for alder buckthorn bark dyed textiles in the museum collections and as references to refine interpretation of dye analysis results.

Friday 25 October, 2024
Session 8 Small mysteries
16:00 - 17:00

Oral Abstract 16:00 - 16:20

The 15th-Century Visconti-Sforza Tarocchi Cards: Insights into a Mysterious Yellow Dye Using LC-QTOF-MS on Minimized Samples

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In 2021, a collaborative project involving The Morgan Library & Museum, Yale University, The Metropolitan Museum of Art, and the Centro per la Conservazione ed il Restauro dei Beni Culturali “La Venaria Reale” launched a comparative technical analysis of 15th-century *tarocchi* cards through a multidisciplinary approach. The Accademia Carrara (Bergamo, Italy) and The Morgan Library & Museum of New York own portions (26 and 35 cards, respectively) of one of the oldest surviving *tarocchi* deck, known as Visconti-Sforza, Colleoni or Colleoni-Baglioni deck. A total of 31 cards from this deck were analyzed to determine the color palette, binding media, and artistic technique, also including some “replacement cards”, created at a later date to replace lost or damaged cards. The *Three of Staves* owned by the Accademia Carrara was found to be made with peculiar materials and techniques, possibly pointing to a different hand and/or production time. In particular, the use of an organic yellow colorant as opposed to yellow ocher, lead-tin yellow, and mosaic gold - commonly used in the other original and replacement cards - was riveting. Liquid chromatography quadrupole time-of-flight mass spectrometry (LC-QTOF-MS), a technique with high-mass accuracy and sensitivity, was used to conclusively identify this organic yellow. Given the extremely small size (approximately 0.3 square mm) of samples removed from the card, two different extraction methods (HCl [i] and BF_3 methods) were tested on contemporary yellow reference materials to determine the best approach for low-quantity paint samples. The BF_3 method [ii] proved more effective and was then applied to the specimens from the card. Persian berries and weld dyes were successfully identified in yellow and blue-green colors, respectively. These results provide an invaluable contribution to the research on manufacture and attribution of these miniaturized paintings on paper support, in the context of contemporary Northern Italian illumination.

Oral Abstract 16:20 - 16:40

Hidden Treasures: Precious Textiles from the St Eustace Head Reliquary

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The St Eustace Head reliquary (1850,1127.1) has long fascinated researchers [1], however its innermost secrets were only discovered some 100 years after its acquisition by the British Museum. Dating from the late twelfth to early thirteenth centuries, the reliquary is composed of a wooden core overlaid with silver-gilt metal, forming a golden bust of a man wearing a gem-encrusted diadem. During restoration work in 1956, relics were found inside the core, thirteen of which were wrapped in precious textiles. The relics were returned to the Roman Catholic Diocese of Basel, in Solothurn, however the textiles (1850,1127.1. a-k) remain in the Museum collection. Preliminary studies [2-4] revealed that some were likely of Eastern/Central Asian origin, possibly predating the reliquary by 600 years or more, but any subsequent analysis was limited by the textiles' existing Perspex display mounts. Preparations for an exhibition permitted access to four of these textiles. Multiband Imaging (MBI) and fibre optic reflectance spectroscopy (FORS) were used to obtain preliminary indications of the dyes and to facilitate selective sampling for further analysis. Scanning electron microscopy (SEM) observations confirmed the use of silk throughout. Dye analysis by high pressure liquid chromatography mass spectrometry (HPLC-MS) supported the possible geographic origins of some textile fragments. For 1850,1127.1.a, the use of sappanwood and a luteolin-based yellow dye indicated a Chinese or Central Asian origin. A mixture of kermes and cochineal found in the mauve stripe of 1850,1127.1.c and the combination of weld, indigoids and madder found in 1850,1127.1.f suggested Mediterranean origins for these textiles. Finally, the unusual combination of sappanwood, orchil, indigoids and a yellow dye containing flavonoid glucuronides, which are mostly detected in plants from Middle Eastern/Central Asian sources, suggested a less straightforward origin for textile 1850,1127.1.g. The study provides a window into the availability and (re)use in sacred contexts of precious textile imports in the thirteenth century.

About the Society of Dyers and Colourists

The Society of Dyers and Colourists (SDC), founded in 1884, stands as the leading provider of global colour education and qualifications. A registered charity since 1962 and recipient of a Royal Charter in 1963, the SDC remains the only organisation globally authorised to award Chartered Colourist (CCol) status, symbolising excellence in the field of coloration.

A hub for education and knowledge

As a Royal Chartered Body, the SDC offers qualifications ranging from beginner to degree-level, enabling professionals to pursue advanced studies in textile dyeing through an innovative "earning and learning" model, and also confers the distinguished status of Fellow (FSDC) to its top members, recognising their contributions to the industry.

Coloration Technology is the flagship journal of the Society of Dyers and Colourists it is the world's leading peer-reviewed journal dealing with the application of colour. It is the only journal covering all aspects of coloration technology, including chemistry, physics, technology, engineering, and management.

The industry's leading membership organisation

Committed to promoting the study and science of colour, the SDC facilitates global networking opportunities across the coloration industry, spanning design, manufacturing, and retail sectors. The membership body offers a range of webinars, short courses, and publications to support education and professional development in textile colour management. With a growing international network of company and educational provider members, the SDC serves as a vital hub for professionals involved in the study and application of colour.

Celebrating a rich heritage

In 2024, the SDC is celebrating two significant milestones: its 140th anniversary and the centenary of the Colour Index™, the definitive classification system for dyes and pigments used by manufacturers and researchers worldwide. First published in 1924, the Colour Index™ continues to be an essential global reference for the coloration industry.

SDC unveils spectacular digital Textile Collection

The Society of Dyers and Colourists (SDC) has launched its groundbreaking digital Textile Collection archive, a comprehensive online resource that opens the doors to centuries of textile dyeing and printing history. For the first time, this newly unveiled collection is now easily accessible to researchers, professionals, and enthusiasts around the world.

Featuring more than 50,000 artefacts, journals, and books – such as the Turkey Red Collection and handwritten dyers' notebooks recording the transition from natural to synthetic dyes – the archive is being meticulously catalogued by the SDC's historical collections officer, Shelley Hollingdrake.

"We are only at the beginning of this exciting journey, but the new website already allows us to engage with our community in a truly meaningful way," said Hollingdrake. "From 19th-century dyes to scientific equipment, the collection offers a unique glimpse into the evolution of colour science and its global impact. It's incredibly rewarding to share the rich history of textile dyeing with a wider audience."

Compiled in honour of the Society's 140th year in operation, the interactive archive not only highlights the artistry and science of the past but also provides an invaluable tool for modern-day research and education. The collection can be explored online at

www.collections.sdc.org.uk

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Catalogue of posters

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P22	**“Like the Colour of the Fox" - Archival Records and New Experiments for Dyeing Red with Alder Bark**	**Krista Wright[1]**, Liis Luhamaa[2], Riina Rammo[2], Saara Tahvanainen[1], Riikka Räisänen[1]	[1]Colour4CRFATS project, University of Helsinki, Helsinki, Finland, [2]Colour4CRFATS project, University of Tartu, Tartu, Estonia

Poster Abstracts

Poster Number: P01

Non-destructive spectroscopic analysis and multivariate cluster analysis to potentially elucidate red dye mixtures on woolen historical textiles

J Alcantara Garcia[1], I Degano[2], C Celani[1], K Booksh[1], A Speed[1], C Chen[1], O Jaeger[1], M F Delgado-Cornelio[1]
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Knowing dye mixtures/chromophore profiles on historic textiles is ideal for making display, storage, and conservation decisions. Chromatographic methods remain the best way to accurately identify dyes, but needing specialized professionals who take samples – as minimal as they may be – makes them impossible to use routinely. The successes of nondestructive analytical instrumentation like diffuse reflectance spectroscopy are expanding the analytical capabilities of more institutions, due, in part, both to the equipment's lower cost and portability. Diffuse reflectance, commonly called fiber optic reflectance spectroscopy (FORS), is a low spectral resolution technique that is unable to identify complex mixtures in the same way many separation methods do. Still, the published successes with selected dyes on fabrics, inspired us to explore chemometric methods on FORS' low-resolution information, aiming to find a nondestructive way to group and assess historical textiles. Well-provenanced woolen red textiles from Norwich (204) served as the FORS dataset that was analyzed with chemometric methods (cluster analysis algorithms) to explore if it was possible to identify chromophore combinations. The UV/VIS region, particularly 380-469 nm, showed a narrow visible region as primarily responsible for the observed clustering behavior. To verify the cause of clustering, selected samples from each cluster underwent high-performance liquid chromatography diode array detector (HPLC-DAD) and liquid chromatography-electrospray ionization mass spectrometry quadrupole time of flight (LC-ESI-Q-ToF). This preliminary, ongoing work suggests that it is plausible to identify dye mixtures – at least on red, woolen, late 18th c. textiles from Norwich. To the naked eye, the separation is simply by hue, so questions such as the actual chromophore mixture, faded textiles, etc. remain. Simultaneously, this specific dataset presents the textile conservation community with a way to nondestructively assess similar textiles.

Poster Number: P02 Withdrawn

Poster Number: P03

Unlocking black secrets in 18th-century Netherlands: the Leiden textile sample books (1690-1791) in Museum De Lakenhal

J Boulboullé[1], A Serrano[2], **J Zijlmans**[3], B Reissland[4], I van der Werf[4], I Joosten[4], A Proano Gaibor[4], R Kliphuis[3], E Greuter[5], M Van Bommel[2,6]
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This poster presents the research potential of a unique collection of textile sample books in Museum De Lakenhal in The Netherlands. This collection comprises a series of 33 books with thousands of black wool samples produced in the Dutch city of Leiden between 1690 and 1791. The sampled broadcloths were coloured with locally-sourced dyestuffs (e.g. madder), but also imported ones (indigo or logwood), and sold on international markets to consumers all over the world. Leiden followed strict regulations for the production of black woollens, implementing a system of several grades to control the colour quality that local dyers achieved with different recipes. This collection hence embodies a wealth of historical information on early modern dyeing crafts knowledge, international trade histories and colonial interactions, quality control, and standardization processes of colour and textile making.
With meticulously registered grades and black samples, spanning a hundred years, these books represent an unparalleled documentation of Dutch textile cultural heritage in a global context, calling for collaborative research approaches to decode Leiden's (changing?) grading practices and unravel the untold stories woven into their fabrics. However, due to the precarious condition of the books and their interlocked pages (figures 1-3), it has been impossible to unlock their secrets. A digitization research project explores for the first time how the content of the books can be made accessible without changing their physical condition as frequent handling or altering page deformations causes the loss of (historical) information. Some preliminary studies on the manuscripts and samples were already carried out by students that show the research potential of this understudied collection. With this poster we aim to open a conversation on potential research questions for further collaborative investigations of this collection, contributing to the planned exhibition "Leiden Cloth Industry. Working for the Export" (2028) at Museum De Lakenhal.

Poster Number: P04

Milking the orchil

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As part of the attempt to recreate the ancient dyeing practices described in the Stockholm and Leyden papyri[1,2,] the recipe Stockholm 109 containing goat milk was investigated. The historical text was interpreted to create protocols for orchil dyeing using present-day materials. This paper will report on the preliminary results comparing dyeing with Stockholm 109 to Whitworth's standard recipe without milk[2]. Extracts from dyed yarns were analysed by chromatography to understand the chemical basis for the observed colour.
The lichens used include two *Lasallia pustulata* from Devon and Portugal, and a *Roccella tinctoria* from Lanzarote. The orchils of Devon and Lanzarote dyed yarns dark purple, while the Portuguese orchil produced wools in a soft rosy colour. Chromatographic analysis showed that the purple yarns contained higher dye content than the pink threads. Although the extracts from dyed wools show individually unique chromatographic features, those from yarns dyed with Devonian *Lasallia* are similar to *Rocella* in that the primary orceins reported in the literature[3] are present along with several unknown colourants, whereas those of the Portuguese *Lasallia* contain mainly the primary orceins and fewer others. Stockholm 109 containing goat milk in orchil appears to have the effect of enhancing the uptake of certain colourants such as α-hydroxyorcein, and especially α-aminoorcein and imparting more red onto the yarns.
In conclusion, the pretreatment of the yarn, the source of lichen, the method of orchil preparation and the presence of additives, such as milk, in the dyebath could all affect the final colour of orchil dyed wools. How the technique of Stockholm 109 may affect other dyestuffs will be investigated in the future.

1. Preliminary findings were presented at DHA41 Visby in 2022.
2. https://www.mamiesschoolhouse.com/papyri-project-ve-index
3. Beecken, H., et al. (2003). Orcein and Litmus. Biotechnic & Histochemistry, 78(6), 289–302.Text

Poster Number: P05

Unveiling the mysteries of logwood ink recipes: a spectroscopic and mass spectrometric investigation

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The spread of logwood bark (*Heamatoxylum Campechianum L.*) in Europe as a dyestuff date back to the 16th century, while its incorporation into ink formulations only began in the 18th century (*logwood inks*). Renowned for their broad spectrum of achievable colours and their non-corrosive impact on paper, logwood inks have been used by many artists, for instance by Vincent van Gogh in his drawings. While their spectroscopic properties have been extensively discussed in literature, a gap remains in understanding the associated molecular profiles, the effects of different ink recipes, and the potential synergy between spectroscopic and chromatographic techniques. In this work, several 19th-20th century formulations of logwood inks, differing in inorganic salts, additives and oxidation time, were reconstructed according to historical recipes. The investigation of organic components was performed on reference mock-ups of logwood inks (on either glass and paper support) by Raman spectroscopy and liquid chromatography coupled to diode array and tandem mass spectrometric detectors (LC-DAD-ESI-Q-ToF). Raman analysis yielded spectra predominantly characterised by bands associated to the -COH bending, -C=O and aromatic -C=C- stretching, highlighting significative shift of vibrational modes depending on the inorganic salts used in the recipe. Thus, the specific profiles observed for of Al-, Al/Cu-, Fe-, and Cr-based logwood inks can serve as a unique fingerprint, aiding their non-destructive differentiation and identification. In parallel, LC-ESI-Q-ToF enabled us to expand the dataset for logwood inks identification, by detecting compounds never or seldom reported in the literature (G-compounds and hematein derivatives). By combining LC-DAD and Raman results, we achieved valuable insights on the oxidation pathway of haematoxylin to hematein, particularly in relation to different ink recipes. The proposed method is particularly valuable in forensic and heritage science, where the composition of inks can offer crucial insights into the origin and authenticity of documents or artworks.

Poster Number: P06

Cochineal Reds in Iberia and France: A comparative study of wool dyeing recipes from 18th-Century sources

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The Royal Factory of Covilhã, founded in 1764 by the Marquis of Pombal, is the perfect example of the Portuguese Industrial and Cultural Heritage [1,2]. But this fascinating wool manufacture, although rich in history, lacks a comprehensive study of the dyeing processes used in Portugal in the 18th century, as well as a thorough documentation of its production. Considering this lack of documentation, and the inspiration which the Marquis of Pombal took from the French textile technology and politicians, namely the Manufactures des Gobelins and the French minister Jean-Baptiste Colbert, and also the industrialization ideas and techniques inspired by Cardinal Richelieu [1], this comparative study of the recipes used in France and in Spain aims to understand the influence these countries had on the Portuguese wool industry. Moreover, the French and Spanish influences cannot be overlooked when trying to determine the Portuguese wool industry, especially the dyeing process. This decision to study various manuscripts from these countries lies in the known presence of two master dyers in Covilhã: the Spanish dyer Bernardo Rodriguez [3]; and the French Jean Baptiste Salessis [1,4]. The Royal Factory of Covilhã, as well as its sister manufactures from Portalegre and Fundão, were charged with the task of producing and dyeing the uniforms for the Portuguese armed forces, to lower the import of English wool broadcloths and promote the industrial development within the country's borders [1,5]. The main colours produced were blue, from indigo, and red, either from madder or cochineal. This first approach in the research into the natural dyes used in the the Portuguese textile industry of the 18th will focus on the reds, i.e. scarlet and its various shades, obtained from the Cochineal insect, since this was one of the main colours produced in Covilhã, until the last quarter of the 19th century.

Poster Number: P07

Identification of modern synthetic colorants by high performance liquid chromatography

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High performance liquid chromatography (HPLC) is commonly used in identification of organic colorants. Most frequently, it is used for identification of natural dyes such as madder lake or cochineals in textile samples. In lesser extent, it is used in identification of pigments in paintings, both natural and synthetic. This work focuses on identification of colorants in paintings from the 19th century onward, where the correct identification of colorant is important for the dating of the artworks and for the understanding the artwork's origin. For this purpose, HPLC with UV-Vis and fluorescence detectors was used. As both detectors are very sensitive to analysed colorants, their tandem connection can provide a complete information of the composition of pigment mixtures. In this work, method of pigment extraction via oxalic acid was optimized, and separation method was developed. After optimizing the methods, a database of standard materials – red synthetic organic colorants was created. These standards cover the most used red colorants in the last century, including synthetic anthraquinones, azo dyes, naphthol dyes or quinacridone dyes. As the last step, samples from artworks from the collections of the National Gallery Prague were analysed. Synthetic alizarin was identified in paintings of artists from the 20th century (Václav Špála, August Brömse), which demonstrates its popularity among artists of that time. The popularity of naphthol dyes, which started as soon as they were introduced to the market around 1910 and continued onwards, is shown by results of artworks of Josef Šima and Zdenek Beran, who both used dyes from naphthol group. Acknowledgements This work has been financially supported by the project of the Ministry of the Interior of the Czech Republic: The Development of a Strategic Cluster for Effective Instrumental Technological Methods of Forensic Authentication of Modern Artworks (VJ01010004).

Poster Number: P08

Honouring ancestral Afro-spiritual Winti textiles of Suriname pre-1850: sources and colours of natural red dyes

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In the seventeenth century, enslaved Africans taken captive by Europeans brought various aspects of their culture such as religion, plant knowledge and knowledge about dyeing traditions to Suriname, South America. Some of these customs were retained in their original form (Africanisms) whereas others were modified (creolisation) through the exposure to other African, Indigenous and European (French, English and Dutch) cultures, resulting in the formation of the *Winti* religion. *Winti* is an Afro-Surinamese religion in which textiles and colour, amongst other things, play a significant role. All deities, who are of African or Amerindian origin, are associated with a single colour or combination of colours in a particular pattern of which red, white, blue, black are commonly observed colours. The colour red is associated with the modern-day *Piai Ingi*, *Kaptin Ingi* and *Watra Ingi Winti* ancestral guides and has cultural significance in various Sub-Saharan African and Indigenous American cultures. European missionary and soldier accounts have recorded the use of red dyes by the enslaved Africans and Amerindians in Suriname during the colonialism. However, little is known about the historical process through which natural dyes, African and Amerindian botanical knowledge, and cultural and religious beliefs became connected in *Winti* textiles. My doctoral research attempts to trace the creolization and African retention relating to use of the colour red by the African diaspora within *Winti* by comparing dyeing traditions and colour significance of West African and Indigenous American cultures in the seventeenth to nineteenth century. This poster presents an overview of important red plant-based dye sources, their cultural significance and use by indigenous Amerindian and Sub-Saharan African cultures on historic textiles in Suriname.

Poster Number: P09

Approach to the color study in a Valencian silks collection from the 16th-19th centuries: Non-invasive methodology

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Cloths made with natural textile fibers suffer physicochemical, photochemical and biological degradation processes characteristic of their composition. Un example, can be some induments historical, artistic and cultural interest, such as the Valencian silk dresses dyed with natural dyes dated around the XVI-XIX centuries belonging to collection of Museum Gonzales Martí from Valencia . Are pieces that, due to the use to which they were subjected by their original owners, already showed mechanical deterioration, sewing, composures, stains, etc. and alterations suffered in its polychromy due to humidity, improper handling, oxidation, etc. More and more museums prefer not to alter their delicate textile pieces. The research presented here focuses on the color study of dress using non-invasive techniques such as optical study carried out with portable instruments such as Dino-Lite (digital microscope), spectrophotometry, FORS and RAMAN spectroscopy. All these tests have been carried out in a room attached to the museum's conservation laboratory. These measurements have been used to evaluate the colors and configure a color database, so that, in parallel, color standards have been prepared dyeing threads and satin silk following the recipes of Valencian master's dyers silk in addition to other contemporary treatises. These patterns have been analyzed using the same techniques as the samples, reporting interesting conclusions for the knowledge of the natural dyes used to Valencian silks dye of this period. Likewise, we consider that the studies carried out on these textile pieces could be a technique aimed at preventive conservation, so that the application of these analytical techniques, systematically repeated, would be key to detecting textiles degradation quickly. This practice would help with better maintenance and restoration, both fibers used to make the piece and of its dyes.

Silk sample CE20007 Experimental reproduction

Poster Number: P10- Withdrawn

Poster Number: P11

How does Kew's 19th century archival collection contribute to the revival of indigo dyeing in West Bengal?

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Royal Botanic Gardens, Kew has a 19th century collection from India that reflects the colonial interest in indigo as a lucrative commodity which was exported all over the world. Blocks of indigo dye, jars containing seeds and boxes of plant material are vegetal witnesses to Kew's participation in efforts to make indigo production more efficient and streamlined. The current revival of indigo in West Bengal reflects a different set of interests. This paper reports on recent PhD fieldwork in the former colonial landscapes of West Bengal where I am collaborating with a local organization whose aim is to revive indigo as an ethnobotanical practice. Although information about dyeing is widely available, the practice itself stopped over 150 years ago and the practical knowledge and skill is scarce in West Bengal. As part of the collaboration, I tap into Kew's colonial collection of material and textual archives - recipes and examples of high quality indigo – and connect it to the present day revival. In this way, knowledge produced in an institutional location can be activated in the hands of dyers in West Bengal. Moreover, knowledge flows back as Kew is able to acquire new materials that fill the gaps in the colonial collection where the dyers themselves and the craft practice of indigo have been absent.

Poster Number: P12

Dyeing and the weight of sorrow: Endurance of natural dyes on Victorian mourning dress

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The end the 19th century was marked by groundbreaking technological advances in the European chemical industry. In 1856, William Henry Perkin, a PhD student at the Royal College of Chemistry in London, accidentally obtained the first synthetic dye, mauveine. Queen Victoria loved the color, which she helped to popularize by wearing a mauve dress for her daughter's wedding in 1858, and synthetic dyes soon flooded the market. Only three years later, in 1861, she switched her wardrobe to exclusively black after the passing of her beloved husband, Prince Albert. She maintained this custom during her whole life, establishing a trend in mourning protocols that would rapidly spread worldwide. With the goal of studying the use and effects of early synthetic dyes in relation with the new established mourning etiquette, we started a survey on a group of black garments from The MET collection. Despite historical accounts of synthetic dyes having drastically replaced natural dyes by this time period, analysis with x-ray fluorescence, scanning electron microscopy and liquid chromatography-mass spectrometry found that only natural dyes were used on dresses and veils from late 1800s to early 1900s. Tannin-based dyes were applied to weight the dull crape required for the grieving process in an apt metaphor representing the weight of sorrow that the first stages of mourning attire embodied, especially for widows. These color and fabric requirements would lead to the continued use of natural dyes to obtain black silk textiles even after synthetic dyes were fully introduced in the market. This project rewrites the timeline of the replacement of natural dyes with synthetic dyes in textile manufacturing and sheds light on the relationship between the cultural practices of Victorian mourning fashion and the technical resonance of textile materiality.

Poster Number: P13

Dyes in suzani Central Asian embroideries from the collection of The National Museum of Art of Romania

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On the occasion of the re-opening of the Oriental Art Gallery from the National Museum of Art of Romania (MNAR), planned for September 2024, five suzani textiles were received by the museum's Conservation Department to be prepared for the exhibition. Such objects are extremely rare in Romania, and a multidisciplinary team was assigned for their characterization, including dyes investigation. Suzani (needlework) are large handmade traditional embroideries from Central Asia (Uzbekistan and neighbouring countries), crafted by the bride and her family as part of her dowry. With a ceremonial role, they are then used as curtains, blankets, bedcovers, wall hangings etc. The ornamental structures are dominated by floral motifs, in clear compositions, with a border and central field, according to the pattern of the rugs. The preferred colours are red, green, yellow, blue and brown. Suzani embroideries caught the attention of specialists rather late, and there is little information with reference to them in literature [1]. One publication only reveals the dyes used, based on analytical investigation but synthetic dyes were identified in many cases, although the objects were presumed as being from before the middle of the 19th century [2]. For the five suzani embroideries in the MNAR collection, which are dated from the 19th century, analysis performed by LC-DAD and LC-DAD-MS evidenced the use of natural dyes. In most cases, colourants were extracted from the yarns by acid hydrolysis, by dimethyl sulfoxide when indigo-based dyes were supposed to have been used, and with supramolecular solvents for the precise identification of the flavonoid dyes-based biological sources [3]. The identified biological sources - Mexican cochineal, madder, indigo-based dyes, yellow larkspur, pagoda tree and others - will be discussed together with written sources regarding their use and other analytical data reported for similar objects preserved in Uzbekistan [2].

Poster Number: P14

Multiband Imaging and Dye Analysis on a late Sixteenth early Seventeenth-Century Embroidery Panel and its hidden documents

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This study aims to combine multiband imaging (MBI) with other analytical techniques and dye analysis to investigate materials, production techniques, and provenience of a late Sixteenth early Seventeenth-century embroidery panel from the collection of Nordiska museet in Stockholm. During preparation of a major permanent exhibition at Nordiska Museet a embroidery panel was undergoing conservation treatment. The textile has been registered in the old museum card catalog as a late 16th century embroidery piece made in a Ukrainian monastery. However, during the conservation treatment handwritten paper letters were revealed underneath the embroidery layer that started to raise questions. Were these letters used purely as a support for the embroidery, could they provide any historical context of the object, or if they even could have been hidden there. MBI proved to be a helpful mapping tool to investigate construction, manufacturing technique and improve readability of the found documents. The results of MBI also guided sampling for further analysis with optical microscopy (OM), fiber optic reflectance spectroscopy (FORS), and scanning electron microscopy energy dispersive X-ray spectrometry (SEM-EDS). Combined with dye analysis through high-performance liquid chromatography mass spectrometry (HPLC-MS) several natural dyes have been identified. In addition, some of the letters have been read and together with the analytical results clues to the origin of the embroidery have been discovered. *The investigated silk embroidery panel (NM.0036514) held by Nordiska Museet, Stockholm, Sweden.*

Poster Number: P15

The Blue that Once Was: Preparation of Aniline Blue Model Fabrics for Investigating the Light-fading Characteristics of the Historic Textile Dye

G Roxas, A Quye

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Aniline blue is a di- or triphenylated derivative of rosaniline homologues found in the magenta dye. Dye manuals written shortly after 1860, when aniline blue was first synthesised, refer to three types varying in solubility and application method: spirit blues, soluble blues and alkali blues. They are among the early aniline dyes that became commercially prominent in the late 19th century due to their brilliance and wide range of colours despite having a reputation for low fastness. Their popularity suggests their likely presence in historic textiles from the period. This study aimed to prepare model fabrics that adequately represent historical samples. Such modern reconstructions are useful for investigating the dye's photodegradation and gauging its level of sensitivity towards different lighting scenarios, and to offer collection care recommendations. This paper discusses the review of literature to clarify the terminology used in historic dyeing recipes and to inform the chosen dyeing method for preparing model fabrics. At present, aniline blue is used more commonly as a biological stain rather than textile dye. Descriptions from historic dye manuals were compared to those of more recent references such as handbooks and chemistry textbooks to explain the chemical constitution and application of the different types of the historic aniline blue in modern scientific terms. The biological stain, Acid Blue 93 (CI 42780), established as a modern equivalent of a soluble aniline dye, was used in preparing model fabrics following a corresponding recipe from 1885. References Travis, Anthony S. The Rainbow Makers: The Origins of the Synthetic Dyestuffs Industry in Western Europe. London; Bethlehem, PA; Lehigh University Press, 1993. Hummel, J.J. The Dyeing of Textile Fabrics. Manuals of Technology. London: Cassell & Company, Ltd., 1885. Venkataraman, K. The Chemistry of Synthetic Dyes. Vol. 2. 8 vols. New York: Academic Press, 1952.

Poster Number: P16

Effects of visible light and heat as an index of deterioration of cultural textiles and cultural paper products dyed with Amur cork tree.

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A wide variety of dyes are used in cultural textiles and generally require non-invasive analysis. However, analysis requiring sampling provides a variety of information that cannot be obtained by non-invasive analysis. For example, in the case of textiles dyed with Amur cork tree, which is mainly composed of berberine, non-invasive spectroscopic analysis shows that they were dyed with plants containing protoberberine. Dye extracts from these cultural textiles can be subjected to HPLC to identify the type of dye plant. Furthermore, if Amur cork tree is used, the origin can be determined from the composition ratio of protoberberine. Focusing on the formation of berberine-derived deterioration products, an attempt was made to quantify deterioration based on the deterioration of berberine due to ageing and storage conditions of cultural dyed textiles. Furthermore, the fluorescence properties of berberine were used to non-invasively measure the environment surrounding the berberine molecule using the fluorescence lifetime of berberine. A correlation between the obtained τ2 values and the amount of deterioration products of berberine obtained from HPLC was reported. Amur cork tree has been used not only for dyed textiles but also for dyeing paper, as represented by sutras in ancient times. Therefore, an evaluation of whether the deterioration indices of culturally dyed textiles dyed with Amur cork can be applied to dyed paper showed that in some cases the deterioration process is not equivalent to that of dyed textiles. The presentation will summarise the results of forced deterioration tests on silk and paper dyed with Amur cork tree by visible light and heat, and discuss the scope of application of the deterioration index.

Poster Number: P17

The Colors of Tutankhamun: An archaeological study and documentation of the natural dyes found in the Tutankhamun textile collection

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There are three primary sources of knowledge regarding ancient Egyptian textiles: depictions of textile production, written descriptions, and surviving textiles, which are the main focus of this research. Tutankhamun is widely known for the luxurious and beautiful objects found within his tomb, discovered by Howard Carter in 1922. These textiles provide a fascinating glimpse into the nature and extent of a pharaoh's wardrobe during the New Kingdom. This collection is among the most important pieces of ancient Egyptian textiles. The tomb contained hundreds of textiles and cloths, many of which were dyed, found tied around the necks of statuary and stored in large chests. Some of the textiles were simple rolls of cloth, while others were part of elaborate ceremonial robes adorned with embroidery. The dyes have never been studied, and their manufacturing process remains unknown. The study will therefore apply multidisciplinary methods to understand the manufacturing techniques of the collection for the first time. Analytical techniques will be applied to eight samples as a preliminary analysis. EDXRF, HPLC-DAD, and fluorimetry in the Visible were applied and have yielded great results, which will help to study the dyes and this approach to studying dyes will provide new information about 18th Dynasty textiles. The research focuses on the history of dyes from Tutankhamun's textiles to understand the significance of the dyes used in his textiles, which will generate substantive and new information about ancient Egyptian textile production, particularly those used by and during the rule of Tutankhamun. Understanding the dyeing technology will further our understanding of social, political, and religious ideology, as well as technical innovations in textile manufacturing, spinning, and dye recipes and application.

Poster Number: P18

Enlightening Dragon's Blood compound identification through HPLC-MS analysis

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[2]Department of Conservation and Restoration, FCT-UNL, LAQV-REQUIMTE, Monte da Caparica, Portugal

Dragon's blood, the red resin produced by the *Dracaena* and the *Daemonorops* species, is a precious traditional Chinese and folk medicine used by different cultures since ancient times. Its several therapeutic functions include blood circulation activation, relieving inflammation and pain, improving haemostasis, urinary incontinence, wounds, and intestinal and stomach ulcers [1,2]. Historical mentions of its use can be traced back to ancient Greece and ancient Arabia, and it was first listed in A.D. 77-78 in "*De Materia Medica*" by the Greek doctor Dioscorides (A.D. 40–90) [3]. Historical written sources also mention its use for artistic purposes as a dye or pigment for paintings, paper banners and posters, and wood varnish, although it has never been identified in historical objects. Its deep red resin or sap is created after external injury or microbial invasion. This red colour is mainly attributed to 7,6-dihydroxy-5-methoxyflavylium (dracorhodin), 7,4'-dihydroxy-5-methoxyflavylium (dracoflavylium) and 7,4'-dihydroxyflavylium (Fig.1). A total of 185 phenolic compounds have already been identified in dragon's blood samples from both species [1]. HPLC-MS analysis allows the identification of the chemical profiling and assesses its origin and quality [2]. Furthermore, the mass fragmentation pattern can facilitate the detection and identification of several flavonoid compounds by using different mass spectrometric platforms. This work will present a complete analysis of anthocyanin and anthocyanin-derived compounds through HPLC-MS studies with different Dragon's Blood samples, including *Dracaena cinnabari spp.*, *Dracaena draco spp.*, and *Daemonorops draco spp.*, with various ages. This will allow a better understanding and clarification of the existence of fingerprint compounds throughout different sources, allowing their quick identification. This work received financial support from project Revive-2022.01243.PTDC and FCT/MCTES (UIDB/50006/2020 DOI 10.54499/UIDB/50006/2020) through national funds.

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Poster Number: P19

Assessing ionizing radiation-driven effects on early synthetic dyes via supramolecular solvents extraction

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[2]National Museum of Romanian History (MNIR), Bucharest, Romania

Textile artifacts are perpetually subjected to detrimental influences such as biological and environmental factors, leading to degradation and discoloration, thus impacting their preservation and historical value. Gamma irradiation, known for its potent fungicidal and bactericidal properties, is an effective disinfection method. However, its application in artifact preservation is constrained by the necessity to limit the maximum dose to avoid compromising the integrity of dyes and textiles fibres. Investigating the effects of gamma irradiation on dyed textiles is critically important, yet, until recently, literature has been sparse, focusing primarily on mechanical properties. Previous research focused on the effects of gamma radiation on natural dyes, using both classical acid hydrolysis extraction and a mild extraction technique with supramolecular solvents [1]. Recently, most 19th-century traditional textiles in museums have been found to be dyed with synthetic colorants. Building on previous research presented at DHA41, this study expands the scope to investigate more early synthetic dyes. Specifically, it examines potential changes induced by gamma irradiation on textiles dyed with synthetic dyes, addressing the demands for gamma irradiation disinfection of 19th-20th-century textiles. Irradiation experiments were conducted at approximately 2 kGy/h, targeting dose values up to 13 kGy. Wool yarns dyed with selected early synthetic dyes, representative of the main classes, were subjected to these conditions. Post-irradiation, dyes were extracted from fibers using supramolecular solvents. The extracted dyes were analyzed via reversed-phase liquid chromatography with UV-Vis detection (RPLC-DAD), complemented by chemometric analysis to elucidate any irradiation-induced modifications. This study aims to establish a database of early synthetic dyes and their behavior under gamma irradiation, thereby informing suitable disinfection procedures for historical textiles. By identifying and assessing possible alterations in synthetic dyes, this research provides critical insights into the safe application of gamma sterilization, ensuring both effective disinfection and the preservation of Cultural Heritage objects.

Poster Number: P20

Metal salts weighting of silk: an exploration of historical practices and manufacturing processes

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The treatment of silk with metal salts aiming to increase the fabric weight and drapeability was common practice in 19th and 20th century Europe, with tin salts being the most common choice. Such procedure, referred to as silk weighting or loading, is nowadays believed to accelerate and aggravate the deterioration of historical silk textiles and is considered as one of the most pressing issues in costume conservation.[1-2] This practice was mostly carried out by dyers, as metal salts often played more than one role and not only contributed to added weight, but also acted as mordants or colourants themselves. To allow to determine the role these salts may play in silk degradation, it is essential to first understand how the weighting treatments were carried out. Building on previous studies[2], a variety of historical documentary sources were reviewed, including dyers manuals and technical journals, with a particular focus on patents published between 1800 and 1945, mentioning the loading of natural silk; the studied sources were in English, German, French or Italian. In order to fully contextualize this practice, not only recipes but also publications on complementary treatments and specialised machinery were reviewed. The findings of this study highlighted how standalone silk weighting was primarily a western practice, quite well spread geographically, but not so long-lasting, as within two decades it reached its peak in popularity in the 1920s and saw the start of its decline. The other key takeaway is the large number of patents for *"protective treatments"* aimed at counteracting the negative effects the processes might have on the silk. These related patents were published as early as the 1890s, indicating how contemporary practitioners were already aware of the potential pitfalls of the loading practices.

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Poster Number: P21

Historic tapestries dye analysis- A comparative study between hyperspectral imaging and high liquid performance chromatography

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This collaborative research deployed a high-resolution ClydeHSI Art Scanner, with a push-broom visible to very near-infrared (VNIR; 400–1000 nm) and near infrared (NIR 900–1700 nm) hyperspectral cameras, for the characterization and analysis of several 16th century tapestries on display at Hampton Court Palace [1]. Wool and silk model tapestry samples, designed for the MODHT EU research project and dyed based on original medieval recipes, were also scanned and used as an external reference library [2]. Further processing of the hyperspectral reflectance cubes with Spectral Angle Mapping (SAM) algorithm developed individual mapping of each dye on the tapestry surface enabling the study of the tapestry weaving techniques. In this work, several samples from the Historic Royal Palaces Tapestry Fragments Archive were scanned with the high-resolution ClydeHSI Art Scanner while the data was processed using the same analytical protocols developed as part of this research. Different coloured areas targeted through the individual mapping of the dyes produced following HSI SAM analysis were subsequently sampled. The tapestry weft yarn samples were analysed by an external laboratory using HPLC. The comparative study between the application of HSI and HPLC will provide an independent platform for the assessment of the successful application of this non-invasive method on the characterisation of dyes and discuss any potential limitations. Furthermore, the HSI analysis of the MODHT samples following light ageing will provide further evidence on the impact of fading and degradation in the application of this novel analytical method. [1] Vlachou-Mogire, C.; Danskin, J.; Gilchrist, J. R.; Hallett, K., Mapping Materials and Dyes on Historic Tapestries Using Hyperspectral Imaging. *Heritage* 2023, *6* (3), 3159-3182. [2] A. Quye, K. Hallett, H. Carretero, *Wrought in Gold and Silk; Preserving the Art of Historic Tapestries*, in, National Museums of Scotland Enterprises Ltd, Edinburgh (2009). European Commission Grant agreement ID: EVK4-CT-2001-00048

Poster Number: P22

“Like the Colour of the Fox" - Archival Records and New Experiments for Dyeing Red with Alder Bark

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In Finland and Estonia, bark of grey alder (*Alnus incana*) and/or black alder (*Alnus glutinosa*) was used as a source for red color. This dye was used on wool yarns, linen fishing nets and on small leather items. Also, the shaman drums of the Sámi people were depicted with red alder bark dye. This red dye was seen like blood, and thus the dye had spiritual aspects too. Ethnographic data comes from the 18th to early 20th centuries. In Finland, the exact recipes for alder red are lost. It seems that dyeing red with alder bark was such a well-known activity, so there was no need to explain the recipes. Experiments to dye red shades have produced only yellows, greens and browns with either the boiling or the fermentation methods. Three recipes from Kodavere parish, East Estonia, explaining the process for dyeing red with alder bark, were recently found in the archives of the Institute of the Estonian Language. These recipes contain several previously unknown details, such as the use of freshly collected bark and the importance of dyeing during sunny weather. The dye baths were prepared either with boiling water or wood ash lye. The yarns were dipped in the bath many times and dried in the sun between the dippings. The color of dyed yarns was described as “not yellow, not red, but like the color of the fox.” Our experiments based on Kodavere recipes show promising results with dark brownish red and some orange tones. It was possible to dye wool and linen “fox-red” - but also fur pieces, fish scales and fish bones were dyed successfully strong orange. The dyed materials and their Cielab measurements are important when creating the ethnographic color palette of the past.

Attendee list - *Correct on 16.10.24, 10:30am*

**Online Delegate*

Lastname	Firstname	Job Title	Company	Town
Alcantara-Garcia	Jocelyn	Associate Professor	University of Delaware	Newark
Armitage	Ruth Ann	Professor of Analytical Chemistry	Eastern Michigan University	Ypsilanti
Audinet*	Karthika	Academic Coordinator	Cotsen Textile Traces Study Center	Washington
Balfour-Paul	Jenny	Senior Honorary Research Fellow	Exeter University	Teignmouth
Bamford	Deb	PGR	University of Leeds	Shipley
Barnaville*	Doreen	Textile artist	.	Cardiff
Bergstrand	Margareta	artist	independent	Stockholm
Bertasa	Moira	Heritage Science	Historic Royal Palaces	East Molesey
Blackburn	Richard	Professor of Sustainable Materials	University of Leeds	Leeds
Bommel	Maarten	Professor of Conservation Science	University of Amsterdam (UvA), Faculty of Science, van 't Hoff Institute for Molecular Science (HIMS), Analytical Chemistry	Amsterdam
Bonner*	Jennifer	Dye Features Editor	Journal of Weavers, Spinners and Dyers	Durham
Boulboullé	Jenny	Lecturer	University of Amsterdam, Dept. Art and Culture	Amsterdam
Brunel-Duverger	Lucile	PhD	C2RMF	Paris
Cardon	Dominique	Emerita Senior Scientist	CIHAM/UMR 56 48, CNRS, Lyon, France	Colognac
Chen	Victor	Volunteer	Indianapolis Museum of Art at Newfields	Indianapolis
Claisse*	Pauline	PhD student	Archéosciences Bordeaux	Bordeaux Cedex
Clayton	Graham	CEO	Society of Dyers and Colourists	Bradford

Connelly Ryan*	Cindy	Preservation Science Specialist	Library of Congress	Washington
Crippa	Mila	PhD candidate in Heritage Science	NOVA School of Science and Technology, Lisbon	Monte de Caparica, Caparica
Dallel	Mohamed	Conservation Scientist	LRMH - Ministry of Culture	Champs-sur-Marne
Daniels	Vincent	Visiting Researcher	British Museum	London
Danskin	Jon	Sales Engineer	ClydeHSI	Clydebank
de Keijzer	Matthijs	Independent Scientist	University of Applied Arts Vienna	Vienna
de Souza*	Diane	None	student of natural dyeing	El Prado
Dyer	Joanne	Colour Scientist	The British Museum	London
Eastwood*	Fiona	Committee member	Ditchling Dyers	Brighton
Eis	Eva	R & D	Kremer Pigmente GmbH & Co KG	Aichstetten
Espírito Santo	Mara	Student	Facultade de Ciência e Tecnologias da Universidade Nova de Lisboa	Caparica
Esson*	Joan	Professor	Otterbein University	Westerville
Ferretti	Adele	PhD student	Department of Chemistry and Industrial Chemistry, University of Pisa	Pisa
Filarowski	Andrew	Technical Director	Society of Dyers and Colourists	Bradford
Fujii	Hitomi	Research Associate	The Metropolitan Museum of Art	New York
Geiss-Mooney*	Margaret	Conservator/Independent Researcher	In Private Practice	Springfield
Ghnaim*	Wafa	Senior Research Fellow	The Metropolitan Museum of Art	Arlington
Gillions*	Beth	Textile Conservator	Victoria and Albert Museum	London
Görgényi*	Adrienn	designer, dyer, printer	Dye Lab Malmö	Malmö

Gray*	Deborah	Textile Artist	Deborah Gray Textiles	Oban
Halvorsen*	Emily	Artist	Kolør	Stavanger
Hardman	Judy	dyer	N/A	Whaley Bridge
Havlova*	Marketa	Conservation Scientist	Národní Galerie v Praze	Praha
Hemingway*	Vicky	Retired	Gloucestershire Guild of Weavers	Stroud
Henderson	Marie	Tutor	Poldrate Arts & Crafts centre	Longniddry
Hendriks	Laura	Senior academic associate UAS	University of Applied Sciences and Arts of Western Switzerland (HESSO, HEIA-FR)	Frioburg
Hewlett*	Jeni	Director/dyer	Chester wool company	Chester
Hintsanen*	Päivi	visual artist, writer	Coloria.net d:sgn	Jyväskylä
Hofmann-de Keijzer	Regina	Independent scientist	University of Applied Arts Vienna	Vienna
Holdstock*	Dr Christine	Colour Scientist	University of Leeds (retired)	Leeds
Hollingdrake	Shelley	Historical Collections Officer	Society of Dyers and Colourists	Bradford
Hosier*	Rachel	MA student	Independent	London
Hulme	Alison	Professor	University of Edinburgh	Edinburgh
Jæger*	Julie Nogel	Teaching associate professor	Royal Danish Academy -- Institute of Conservation	Copenhagen
Jordan	Charlene	Postgraduate Research Student	University of Glasgow	Glasgow
Karlsone	Anete	Senior Researcher	University of Latvia, Institute of Latvian History	Riga
Kay-Williams	Susan	President	SDC	London
Kirby	Jo	(Retired)	None (formerly National Gallery, London)	Norwich
Krotova*	Alina	PhD student	University of Antwerp	Antwerp
Kutzke*	Hartmut	Associate professor	Museum of Cultural History, University of Oslo	Oslo

Lacey	Kay	Independent Scholar	Independent Scholar	Swindon
Lackner	Rachel	Fellow	Metropolitan Museum of Art	New York
Liu	Jian	Head of Department of International Exchanges (Intangible Heritage)	China National Silk Museum	Hangzhou
Luhamaa	Liis	Textile specialist	University of Tartu	Tartu
Lupatini	Emile	PhD	University of Antwerp	Antwerp
Major*	Janet	Independent Researcher	N/A	Norwich
Martin*	Kathleen	Textile Conservator	Denver Museum of Nature and Science- Conservation	DENVER
Martin*	Susan	Tutor and consultant to Museum Wales	Natural dyer	Cardigan
McClure	Katie	PhD Student	University of Glasgow	Glasgow
McDowell*	Gary	Lecturer	School of the Art Institute of Chicago	Chicago
Mcgregor*	Kirsteen	Technical Demonstrator / workshop facilitator	National Trust / Freelance	Stockport
Mellegård	Viveca	PhD Candidate	Royal Botanic Gardens, Kew and Royal Holloway, University of London	London
Mieites Alonso	Maria Goretti	Manager of Laboratory	The Metropolitan Museum of Art	New York
Mounier*	Aurélie	Research Engineer	Archéosciences Bordeaux	Bordeaux Cédex
Neevel	Dr Han	Conservation Scientist (chemist)	Cultural Heritage Agency of the Netherlands (retired, 14 August 2024)	Utrecht
Niiranen*	Susanna	Senior researcher	University of Jyväskylä	Jyväskylä
Norrehed	Sara	Heritage scientist	Swedish National Heritage Board	Visby
Orr*	Debbie	Creative Director/Owner	Herbarium Dyeworks	Donaghadee

Ortega Saez	Natalia	Tenior Track Professor	University of Antwerp	Antwerpen
Palginõmm*	Kerttu	Specialist	University of Tartu	Tallinn
Palomino	Elisa	Research Associate	Smithsonian Institution	Firenze
Parsons*	Anne	Retired	Independent	Sheffield
Pereira-Pardo*	Lucia	Postdoctoral Researcher	INCIPIT-CSIC	Santiago de Compostela
Peters*	Ann H	Consulting Scholar	Penn Museum	Philadelphia
Petroviciu	Irina	researcher (chemist)	National Museum of Romanian History	Bucharest
Phipps*	Elena	Independent scholar	Independent scholar	New York
Porter*	Cheryl	Director	The Montefiascone Conservation Project	London
Proano Gaibor	Art	Researcher	Cultural Heritage Agency of the Netherlands	Amsterdam
Pybus	David	Alum Industry Researcher (Independent)	University of Durham	Dumfries
Quye	Anita	Professor in Heritage Science	University of Glasgow	Glasgow
Rammo	Riina	Associate Professor	University of Tartu	Tartu
Řeřichová*	Jaroslava	conservator	Museum of Prague	Prague
Rich	Sarah	Associate Professor and CV/MS Director	Art History and CV/MS, Pennsylvania State University	State College
Ringgaard*	Maj	conservator PhD	independent researcher	Bagsværd
Rogers*	Leslie	Professor of the Practice	School of the Museum of Fine Arts at Tufts University	Detroit
Roxas	Gracile	Textile Conservation Intern	British Library	London
Sabatini	Francesca	Resercher (RTDa)	Università di Milano-Bicocca	Milano

Santisteban-Delgado*	Nathalie Miguelina Brígida	Antropóloga	Grupo de Estudios Precolombinos de la Sociedad Catalana de Estudios Históricos y Universidad de Arte Diego Quispe Tito de Cuzco	Cuzco
Sarda	Marie-Anne	Senior heritage curator	Institut national d'histoire de l'art	Paris
Sasaki	Yoshiko	Lecturer	Kyoto Saga University of Arts	Kyoto
Saunders	David	Honorary Research Fellow	British Museum	St Albans
Schaeffer	Terry	Scientist Emeritus	Los Angeles County Museum of Art	Los Angeles
Scharff	Annemette	Conservator	The Royal Danish Academy, Institut of Conservation	Copenhagen
Serrano	Ana	Assistant Professor	University of Amsterdam	Amsterdam
Sevilhano Puglieri	Thiago	Assistant Professor	University of California, Los Angeles (UCLA)	Los Angeles
Stark*	Georg	Blockprinter vat dyer	Indigo workshop Blaudruckerei	Jever
Svarnyk*	Mar'yana	MA student	University of Tartu	Tartu
Tallontire*	Carole	Designer/owner	Laikstyle	Belper
Tamburini	Diego	Scientist: Polymers and Modern Organic Materials	British Museum	London
Teixeira	Natércia	Assistant Researcher	LAQV-REQUIMTE/ICETA	Porto
Troalen	Lore	Analytical Scientist	National Museums Scotland	Edinburgh
Turnbull*	Louise	Textile artist & natural dyer	N/A	Harrogate
Vanden Berghe*	Ina	Head Textile Research Lab	Royal Institute for Cultural Heritage Brussels	Brussels

Vandermeersch*	Joke	Independant Textile Restorer	Textile Studio	Kessel-Lo
Vasilca	Silvana	PhD (chemist)	National Institute for R&D in Physics and Nuclear Engineering " Horia Hulubei"	Magurele-Bucharest
Verhecken*	Andre	chem.eng.	retired	Mortsel
Vettorazzo	Chiara	PhD researcher	University of Antwerp	Antwerpen
Vlachou-Mogire*	Constantina	Heritage Science Manager	Historic Royal Palaces	East Molesey
Wakefield*	Jennifer	Postdoctoral Researcher	Museum of Cultural Heritage, University of Oslo	Oslo
Walsh	Penelope	designer	AO Textiles	London
Whitworth	Isabella	Not applicable	Independent Scholar	Hatherleigh
Wright	Krista	Post-doctoral researcher	Unversity of Helskinki	Helsinki
Zhang	Zofia	Textile Conservation Student	University of Amsterdam	Amsterdam
Zijlmans	Dr Jori	Curator	Museum De Lakenhal	Leiden