**Preventing fading of brazilwood dye in works of art on paper by UV stabilised fixatives**

*Marina Casagrande (Northumbria University)*

Brazilwood pigment is a lake pigment extracted from the branches of the tree with the same name. Lake pigments are pigments made when the dye is precipitated with the aid of an inert binder or mordant, usually a metallic salt. The product results in an organic pigment.

The main component of the red dye is brasilin which whenever oxidised forms the component brasilein – a deep rep substance. Depending on its mordant, brazilwood can vary in colour between lavender, purple, cherry, deep red, rose and pink. The pigment was widely used from the 12th century until the 19th century in Europe. Its use is strongly connected to fabrics and tapestries, but also to inks, paints and varnishes. Raphael, Rembrandt and Van Gogh are some artists known for the use of brazilwood in their drawings and paintings.

Although widely used, brazilwood pigment is a very fugitive media, not lightfast and fades when heated. The exhibition of artworks containing brazilwood pigment is therefore considered a serious issue in museums and galleries. Up to this day, there are only external actions that can be taken to avoid fading of a lake pigment on works on paper. The lack of techniques aiming to decrease the fading of brazilwood on paper became the reason for this study. Is it possible to prevent the fading of the colour of brazilwood dye in works of art on paper? How to avoid its fading?

In order to address this question and issue, and taking into account solutions used in other fields of conservation, a methodology was developed to test the use of a fixative with the addition of UV stabilisers. The selected fixative was Klucel® G (hydroxypropyl cellulose), a well-known fixative used in paper conservation which is relatively safe with good ageing and reversibility characteristics.

For the initial research, three UV stabilisers were chosen: zinc oxide, an inorganic ultraviolet absorber (UVA); 2,4-dihydroxybenzophenone, an organic ultraviolet absorber (UVA); and Tinuvin® 292, an organic hindered amine light stabiliser (HALS).

The UV stabilised fixatives were applied to the samples by ultrasonic mist in four different layering setups. The tests were performed on artificially aged and not-aged samples exposing them to accelerated light ageing. The results were evaluated by comparing the measured values by colourimetry and characterization under Fourier transform infrared (FTIR).

A positive result from this experiment can represent a new direction in exhibitions and conservation of works of art on paper containing not lightfast media. Further studies with other lake pigments and watercolours can also test the methodology. The application of a fixative on the surface of an artwork is a very interventive approach and many ethical considerations must be taken into account, nevertheless, it is a new alternative for art display.

**Application of FTIR and micro-Raman spectroscopy in the analysis of binding media and blue pigment materials**

*Jack Chauncy (Courtauld Institute of Art)*

The recent acquisition of a new Bruker LUMOS II Fourier Transform Infrared (FTIR) microscope and a Renishaw Qontor inVia Raman microscope by The Courtauld prompted a project that would develop a working method for using the new instruments while revisiting archival material which had not yet been subject to organic analysis. Samples from seven paintings by Paul Cézanne in The Courtauld Gallery collection were examined using FTIR and Raman. Samples that were mounted in embedding resin were analysed using the in bult Attenuated Total Reflectance (ATR) element in the LUMOS II. This project demonstrated that despite the interference caused by the embedding resin, the binding media could be confidently characterized using ATR FTIR. Raman was used to identify the blue pigments used by Cézanne and was shown to complement elemental analysis carried out using SEM-EDX.

**The influence of paper support on the appearance of contemporary commercial drawing media in technical photography.**

*Lucy Hatch (Northumbria University)*

Contemporary artists have a multitude of commercially produced materials readily available for their use. The range of what may be termed ‘drawing’ media is broad, as are the options of paper substrate on which to apply these to. It is clear from any experience using drawing media (pens, pencils, paints, chalk, etc.) that the application and outcome can vary depending on the paper type. The combination of media and paper is what gives a work of art on paper its individual surface qualities.

Discussion of artist’s materials in conservation literature provides detailed information on specific materials, yet in practice, materials are rarely used in isolation, with contemporary artworks potentially containing a complex network of overlapping and interacting materials. For conservators of works of art on paper, this raises potential uncertainty about the material components present in any given contemporary artwork, combined with a danger of misrepresenting an element key for interpretation. Uncertainty increases the risk of unknown consequences to proposed conservation treatments.

There are many methods a conservator could utilise when seeking information on materials in a work of art, ranging from intuitive experience to advanced instrumental analysis. Technical photography methods may be chosen for their accessibility and lower risk of harm to the work of art. However, these methods rely on reference to known material characteristics to indicate a likely presence of a certain material, e.g., pigment fluorescence behaviour under UV light.

This research seeks to build on pre-existing literature on the behaviour of artist materials in technical photography by focusing on the relationship between paper substrate and contemporary commercial drawing materials. Does the interaction between paper and drawing media affect their characteristic behaviours, and does this impact on possible identification? Can the use of accessible analytical techniques such as technical photography provide any useful information on these materials? To what extent is the paper a relevant variable in interpretations?

Sample sheets have been produced which combine three different commercially available artist papers with a range of commercially produced ‘wet’ and ‘dry’ drawing media. Image sets are currently being collected of these sample sheets using technical photographic techniques, such as: visible/ reflected light, raking light, UV-induced fluorescence (UVf), UV reflectance (UVr), near infrared reflectance (IRR), false-colour infrared (FCIR), and photomicroscopy to produce a multispectral image set. The multispectral image set will be used to examine whether the paper support has caused a difference in the appearance of the drawing media and if any patterns in their appearance could be used to aid in material identification. The potential for errors in interpretation will be considered. In Initial observations indicate that the research is likely to find that paper substrate is a relevant variable in the appearance of drawing media in technical photography.

**Application and removal of synthetic resin varnishes using greener solvents and mixtures**

*India Ferguson (Courtauld Institute of Art)
Advisors: Clare Richardson (The Courtauld Institute of Art) and Gwendoline R Fife (SRAL).*

This project aimed to explore greener alternatives to commonly used solvents in painting conservation, exploring their uses through applied practical testing. This aimed to begin to fill a gap in research in the field of greener solvents where very little specific conservation related practical testing, or investigations into longer term solvent effects, had been undertaken.

The focus was on testing solvents which could provide greener options for the application and removal of synthetic resin based varnishes, an area which in most cases requires extensive solvent usage. Empirical testing methods where used to test what solvents were most applicable for the different uses. A wide range of traditional and nontraditional solvents were tested, this included solvents not commonly used yet within conservation such as D-Limonene and Cyrene. During the project the testing was expanded to include a wider range of paint sensitivity and range of surface coatings to provide a more rounded view of the different solvents capabilities. Testing carried out for the application of the synthetic resin based varnishes, using Laropal A81 and Paraloid B72, focused on finding alternatives to aromatic solvents such as Xylene and Shellsol A.

The results of the study showed that there are a wide range of solvents available to conservators, which for specific uses, could provide greener alternatives. For the removal of both synthetic resin based varnishes and natural resin varnishes, greener solvents provide a greater range of options for conservators to choose from. For the application of varnishes several suggestions were able to be made that provide alternatives to aromatic hydrocarbons for the making up of Laropal A81. Additionally, the solubility data produced in this study will hopefully aid other conservators in making informed choices about greener solvents.

**Ageing Properties of Metalpoint Grounds and Styli on Accelerated Ageing Samples Using Fourier-Transform Infrared Spectrometry (FT-IR)**

*Angela Lugo (Northumbria University)*

Drawing in metalpoint on paper is a traditional technique widely popularised in 15th century Europe, before losing favour by the early 1600s. Short-lived revivals of the technique persisted over the centuries, with recent 20-21st century artists expanding upon preparation materials, recipes, and drawing styli. Investigations specifically addressing the ageing properties of modern metalpoint materials has been largely unexplored. Metals such as aluminium, bronze, copper, gold, and silver were applied over a 100% cotton paper prepared with a selection of traditional proteaginous and commercially available acrylic-based grounds. Samples were aged at 77% humidity at 80°C over a series of four weeks and examined using Fourier-Transform Infrared spectroscopy. The results from analysis aim to better understand the chemical and physical degradation process between various metals and grounds.

**Artificial Ageing of MS3 for use as a Picture Varnish: Solubility, Removability and Chemical Changes**

*Saffie Patel (Corutauld Institue of Art)
Advisors: Prof. Aviva Burnstock (The Courtauld) supported by Dr. Bronwyn Ormsby and Dr. Judith Lee (Tate).*

This project assessed the ageing properties of MS3 and its suitability for use as a conservation-grade picture varnish. It was carried out in collaboration with Alegria Spencer, who investigated the optical properties of aged MS3, focusing on colour and gloss change.

Sample films of MS3 and MS2A were artificially aged for the equivalent of 49 years of museum light exposure using an illuminant without UV, and another set was exposed to light that mimicked daylight through window glass. MS3 was found to have very similar ageing properties to MS2A, remaining soluble in apolar non-aromatic solvents after accelerated ageing without UV. Exposure to UV light increased the polarity of both varnishes, requiring a solvent with 40-50% polar component. Transmission FTIR analysis confirmed increased carbonyl groups after ultraviolet ageing in MS3 and MS2A, with a more prominent band in the MS3 samples. Empirical observations were made about the handling properties of MS3 dissolved in Stoddards solvent at different concentrations, and its behaviour as a retouching medium.

**The Treatment of 19th Century Copies: The study of Louis' Pisani's Botticelli's *Madonna of the Magnificat* and the value of Artist Copies**

*Mary Scott (Northumbria University)*

The collections of institutions vary, but a possible similarity amongst many is the acquisition of copies. For instance, the Laing Art Gallery holds many copies within their collection, but one in particular is a painting done by nineteenth century artist Louis Pisani. This specific piece is a copy of Botticelli’s *Madonna of the Magnificat*, painted at the Uffizi Gallery in Florence, Italy where the original is housed and displayed. Botticelli has become a household name throughout the continent but did not become popular in England until the nineteenth century when he was re-discovered. As his popularity skyrocketed, people were wanting to have their own Botticelli’s in their household, whether it was to display their rank and wealth to other members of society or to own a piece of their favourite artist who has long since passed. The use of artist copies has been in circulation over the centuries, as a way for the nobility and other wealthy members of various regions to add a masterpiece to their own collection when the original was unavailable to them. Louis Pisani, an exceptional artist, has surviving works that not only show off his talent for painting but showcase some of his successful copies of well-known works such as the *Madonna of the Magnificat*. The copy of *Madonna of the Magnificat* can become an excellent source of not just the copyist’s work but Botticelli as well. The aim of this study is to examine and treat Nineteenth century copy of Botticelli's *Madonna of the Magnificat* by Louis Pisani from the Laing Art Gallery collection while also examining the value of works of art in the nineteenth century, specifically the role and value of artist copies in the nineteenth century and in modern times.

**Protocol for characterisation of indigo and Prussian blue using FTIR and Raman microscopy**

*Kyoko Takemura (Courtauld Institue of Art)*

This project aims to establish a protocol for the application of FTIR and Raman microscopy for the characterisation of pigments in experimental paint samples and samples from paintings with a special focus on the two types of blue pigments, indigo and Prussian blue, both of which are difficult to identify in a paint layer based on elemental analysis and optical microscopy alone.

A selection of samples from paintings that contain unidentified blue pigments prepared as cross sections from The Courtauld archive were analysed using FTIR and Raman microscopy. These were combined with examination of their morphology and elemental markers using optical microscopy, X-ray fluorescence spectroscopy (XRF), and scanning electron microscopy-energy dispersive X-ray spectroscopy (SEM-EDX).

Alongside the cross sections, unaged samples of five types of media and paint mixtures containing indigo or Prussian blue were prepared and analysed with FTIR and Raman microscopy to create a database and define a protocol for future technical investigation using the instruments at The Courtauld. Naturally aged samples prepared in 1965 were also analysed for comparison with the freshly prepared materials.

The results of this study have demonstrated the effectiveness of FTIR and Raman microscopy in characterising both organic and inorganic materials, conveying spectral information of both types of artists’ materials in pure and in complex mixtures from paintings, and Raman has been found more useful than FTIR in terms of characterisation of indigo and Prussian blue. It is also important to point out that optical microscopy, elemental analysis using SEM-EDX prior to FTIR and Raman microscopy is indispensable to achieve precise characterisation of these blue pigments.

**A gateway to colour: paint cross-sections for the study of English medieval painting**

*Kate Waldron (Hamilton Kerr Institute, University of Cambridge)*

Paint samples are typically associated with conservation and scientific methods of examining paintings, but this was not always the case. The first samples were taken at a time when there was not the separation between the sciences and humanities that exists in modern academia, and when the figure of the conservator did not yet exist. This talk will look at the value that paint analysis had for nineteenth-century scholars of medieval painting, and will trace how the study of paint samples – most commonly photographed in cross-section - has come to be seen as beyond the concern of academic art historians. As a result, the significant impact of colour on the devotional experience of the medieval churchgoers who viewed these paintings has never been adequately explored in this field. Interdisciplinary research is already enriching the work of earlier scholars who foregrounded materials in discussions of colour and light in medieval religious culture, but paintings urgently need to be brought into these discussions. Until their chromatic and material complexities are more fully appreciated by a wider public, many English medieval paintings will remain unrecognised as fragments of cultural heritage that are worth preserving for future generations. Due to their fragmentary condition, this appreciation can only result from the combined insights of art historians and conservators. Preserved in archives, there is potential to make greater use of paint cross-section samples to facilitate freer communication between technical investigation and twenty-first century art history.

**Effects of the traditional aqueous cleaning on modern oil paint with commercial alkyd binder product**

*Lok Hang Wan (Northumbria University)*

Alkyd has been used as a binder since the mid-20th century and is a fast-drying medium that has become a popular alternative to slow-drying oils. Despite the widespread use of commercial alkyd mediums by artists, there is still a lack of research on how these products affect modern oil paint, which frequently experiences water sensitivity issues.

This project aimed to investigate the effects of cleaning commercial alkyd-oil paint with traditional water swabs methods, as well as examine the impact of different concentrations of alkyd content on the water sensitivity of the oil paint film. To address this issue, a range of accelerated-aged samples of alkyd products mixed with commercial ready-made ultramarine blue oil paint at various ratios, from 10% to 50% of commercial alkyd products, were examined. Four brands of alkyd medium made for artist use were included in the study.

The samples were divided into half: half were aqueous cleaned and half were left non-cleaned. The paint films were then analysed using a range of instruments, including a glossimeter and colourimeter to measure colour differences, and a scanning electron microscope (SEM) to examine morphological surface changes. The results of this study could provide insights into the use of alkyd mediums with modern oil paint.