Incompatible Partners?
The Challenges of Composite Objects.

Forum of the ICON Textile Group

4 April 2011

The Victoria and Albert Museum, London

Edited by Alison Fairhurst

THE INSTITUTE OF CONSERVATION

Contents

Posters

Foreword

The ICON Textile Group Meeting, held in the Hochauser Auditorium at the Victoria and Albert Museum on 4 April 2011 explored the challenges of conserving composite objects, i.e. objects made of both textile and non-textile materials.

The eight papers and seven posters all drew attention to the two most common conservation issues presented by composite objects: the often mutual intolerance of the various materials used in their composition, and the risk of the compounds or procedures used to preserve one type of material causing harm to others or restricting the options or effectiveness of their treatment. The exact nature of the challenges exhibited is unique to each artefact and situation as the paper by Nyssa Mildwaters and Suzanne Dalewicz-Kitto on the care of arms and armour composed partly of textile materials and the posters by Róisín Morris on a hat from a Diaghilev ballet costume and by Alison Fairhurst on the conservation of 18th century shoes graphically illustrate.

The papers by Morwena Stephens and Anne Amosford on the conservation of fans and Gabriella Barbieri on the treatment of an Asante Chief's costume and the poster by Sarah Owens on the conservation of a 17th century glove all discuss the additional difficulties arising from the three dimensional form and complex construction of many composite objects and the ethical dilemmas raised by the need to retain features of evidential value or to separate component parts during treatment. The paper by Vasiliki Kontogianni and Ciarán Lavelle examines the concept of incompatibility as it relates to different viewpoints on treatment.

The value of determining the nature and degradation pathways of the textile and non-textile components through study and analysis is highlighted in several contributions including Sarah Glenn's paper on wax and wax coated fabrics, Rachel Rhodes' paper on 'pearl' materials and Leanne Tonkin's poster on the metal threads of the Whalley Abbey altar frontal. Ingrid Jimenez-Cosme and Jannen Contreras-Vargas' examination of corrosion removal from metal wrapped threads stresses the importance of ongoing research into the long term impact and effectiveness of methods and materials.

The benefits of collaboration between conservators in different disciplines is mentioned in several papers including that of Howard Sutcliffe on the conservation of a collection of puppets and the poster by Robyn Haynie and Irene Kirkwood on the conservation of a Malaysian Rebab. All three authors draw attention to the importance of careful sequencing of the various treatment elements.

The challenges of composite objects are many and varied but as the forum showed conservators have a multitude of strategies for dealing with these problematic objects.

Alison Lister ACR
Forum chair

Wax Objects in Textile Conservation

Sarah Glenn
V&A Museum

Introduction

The exhibition *Wedding Dress: 200 years of wedding fashion* will open at the V&A in 2014 after undergoing an international tour. The first venue will be in Australia, followed by New Zealand at the end of 2011. Several objects in the exhibition contain wax flowers and buds which required specialist conservation treatment in the textile conservation studio in preparation for display. As there was little experience of wax objects in textile conservation, a masterclass was organised in order to provide training to conservators at the V&A. Valerie Kauffman of Plowden and Smith Ltd, London, was invited to lead the day.

The textile conservation studio at the V&A is fortunate to have a collection of wax coated flowers and objects in its handling collection which were suitable both for testing and experimentation by the participants of the masterclass. Brenda Keneghan of the Science Section undertook Fourier Transform Infrared Spectroscopy (FTIR) testing of the studio's wax collection in order to identify the type of wax present and to provide useful examples for discussion. Each participant received a folder of information detailing treatments, documentation and a bibliography.

The masterclass provided the opportunity for new skills to be learnt and incorporated into the textile conservation studio's repertoire. In the future other objects in the V&A collection containing wax-coated elements can be treated as a result of the training received.

Natural wax can be made from a variety of materials and additives and there are three main types falling under the categories of animal, vegetable and mineral (see Table 1).

Beeswax is the most abundant animal wax and is the most likely to be found in museum objects. Wax contains long chain hydrocarbons, acids, alcohols and esters or mixtures of these. It is a complex material, and according to Clydesdale (1994), approximately "284 components of beeswax have been identified, the major components are 28% monoesters, 10% diesters, 10% hydrocarbons, 8% free acids, 8% hydroxyl polyesters, 5% hydroxyl monoesters, 3% trimesters, 1% free alcohols". It is slightly acidic and can react with iron, copper, zinc and aluminium metals and alloys, causing corrosion on metal and discolouration of the wax.

ANIMAL	VEGETABLE	MINERAL	ADDITIVES/ ADULTERANTS
• beeswax • spermaceti • wool	• carnauba • candelilla • japan (sumac) • sugar cane • ouricury • rice bran • bayberry	• paraffin • microcrystalline • ozokerite • montan • ceresine • shale • slack	• Fats • Fatty acids • Paraffin wax • Resins • Vegetable matter • Rocks and stones

Table 1
Types of natural wax and additives

The wax in the objects for the *Wedding Dress: 200 years of wedding fashion* exhibition are most likely made from beeswax and it is this type of wax and its conservation treatment on which this paper focuses.

Margaret Lang's wedding outfit

In total six objects with wax and wax-covered flowers, made from beeswax and silk, were treated in preparation for the exhibition. The one with the greatest requirement for treatment was a wedding wreath of a wax orange blossom spray known to have been worn by Margaret Lang on her wedding day in 1857 (see Figure 1). The focus of this paper will be this object. The V&A plans to display the wedding outfit in its entirety, comprising the dress, wreath and posies, in the exhibition. The wreath and other small accessories are to be displayed flat on a board next to Margaret's wedding dress as they are considered too fragile to be mounted on the mannequin (Figure 2).

The wreath was in a poor and fragile condition with loose and broken elements, including a large flower which had become detached from the main wreath. Several of the buds were loose. It was generally dirty with loose particulate soiling on the petals and leaves. Some ingrained dirt was visible in the wax coatings, especially in between the petals and near fixings. The wax covered petals were very loose and were cracking in places, probably due to poor storage and handling in the past, and perhaps shrinkage of the wax. Evidence of insect activity was found between the petals, although no evidence of damage caused by the infestation was found.

In order to examine the wax in detail, a Dino-Lite™ handheld digital microscope attached to a laptop computer was used (Figure 3). It was possible to look under strong magnification, up to x200, at the surface of the wax. This proved very useful in determining how the wreath was constructed and just how fragile the wax surface and other elements were, and to tailor the treatment plan to support particular areas. Digital images were taken for records.

Cleaning

Some solvents may be used for cleaning beeswax, however identification of the wax in the first instance is needed in order to identify the most appropriate. Beeswax is known to be soluble in ether, carbon tetrachloride, turpentine, white spirit, paraffin, toluene, chloroform, other chlorinated hydrocarbons, hot benzene, hot amyl alcohol and hot ethyl alcohol. It is partially soluble in cold ethyl alcohol and carbon disulphide (Clydesdale 1994).

In order to remove some of the ingrained soiling, cleaning experiments were first carried out on a similar object made from beeswax from the studio handling collection.

According to Tímár-Balázsy and Eastop (1998), beeswax is insoluble in a number of solvents, including ethyl acetate, methyl, ethyl and isopropyl alcohols, heptane and acetone amongst others. It is also insoluble in water, as the high proportion of saturated hydrocarbons renders the wax hydrophobic. Due to recent health and safety laws, time restraints and availability, it was not possible to test all of these solvents, so a limited number were used in experiments.

Four solutions were tested; saliva, deionised water, an acetone: white spirit: isopropanol[1] mix (in a 6: 0.25: 1 ratio)[2], as well as a detergent solution of Dehypon LS45, a non-ionic detergent, used at approximately 5%. Microscopic photographs were taken before and after experiments in order to compare the results. It was found that cleaning with saliva on a cotton swab and rinsing with

[1] Although known to dissolve beeswax, a very small amount will aid removal of oily dirt. The acetone in the mix helps to speed up the rate of evaporation.

[2] Beaven, E. 2007. Conservation Report: Pair of wax portraits in original giltwood frames. Plowden and Smith Ltd.

deionised water[3] was by far the most effective method and the least disruptive to the surface of the wax. The overall aesthetic improved dramatically (see Figure 4). It was decided that this method would be used on the wreath itself and once again there was a marked improvement in its appearance.

The success of cleaning the wax with saliva on the object can be explained by the mechanism of the cleaning process with saliva, which according to Romão *et al.* (1990), can be described as follows:

1. Enzymatic action: some substances are solubilised in water when saliva enzymes catalyse dirt degradation.
2. Washing action: as a result of aqueous activity.

The lipases found in saliva catalyse degradation of fatty substances and hydrolases catalyse degradation of hydrolytic substances. The use of saliva in this case was particularly effective as it removed the hydrolytic substances that were on the surface of the wax. However, it is important to rinse the wax surface with deionised water to ensure that no trace of saliva is left[4].

Infills

The next stage in the treatment was to infill the areas in the wax which were cracked or missing. Pure beeswax was chosen as the infill material to match the material of the wax in the wreath. According to Knuutinen and Norrman (2000), beeswax melts at about 64˚C and this melting point remains fairly constant with ageing.

The beeswax was melted in a metal container on a hot plate at approximately 70˚C and mixed with pigments (raw umber, white, yellow) to match both the colour and opacity of the existing wax. The coloured wax was left to solidify on silicon release paper to ensure the most appropriate match. Often the appearance of the wax is very different when in a liquid or solid state, so it was important to view the solid wax before applying to the object (Figure 5).

Mixing the pigment with the wax was done in very subtle, gradual changes, keeping the wax in the pot liquid. However, there are no exact recipes as is often the case for dyeing, so replicating the colour and opacity exactly in the future may be problematic. As every object is unique, and as in this case, parts of the object varied in colour and opacity, it is probably easier to match infills as the need arises.

Once a suitable match is created, cracks and missing areas are infilled using the wax; this is the most delicate part of the treatment. A fine spatula is held over a spirit lamp burning methylated spirits, under extraction. A small amount of coloured wax is placed on the end of the spatula. It is important not to hold the wax directly over the flame as the wax will burn. The heat radiates along the metal to melt the wax (see Figure 6). The molten wax is drawn slowly along the crack and layered to build up the infill structure. The speed of the method is vital as the wax soon cools and hardens when the spatula is removed from the flame and becomes useless. This technique was practised on the studio samples extensively before treatment on the actual object began. It is possible to distinguish the new wax from the original if a layer of PVA is painted around the edge of the cracks, however, this is somewhat visible and makes the join between the two slightly weaker. It was decided not to use the PVA barrier, firstly because the wax needed to bond strongly with the original, and secondly for aesthetic reasons.

The workspace has to be organised and clear when using the open flame as the heat and molten wax can be dangerous to both the conservator and the object. Using this method on the wax

3 As recommended by Valerie Kaufmann, personal communication, 2010

4 Valerie Kaufmann, personal communication, 2010

elements that were still attached to the object proved to be a challenge, especially in terms of access to those areas which needed treatment. A solution was found whereby the wreath was placed on a surface which was supportive but could also be pinned into. Glass headed pins were used to hold the wreath in place and to gently hold stalks and flowers out of the way.

The petals on each flower as well as on the detached flower were treated in this way in order to strengthen these elements.

Humidification

Some of the fabric elements of the wreath were distorted and creased and were aesthetically unsatisfactory. In order to humidify these areas, a preservation pencil at approximately 20°C was used where the deformations were accessible for treatment. The temperature had to be kept fairly low in order not to disrupt and possibly damage the surface of the neighbouring wax. The fine nozzle on the preservation pencil was used in order to control and aim the flow of vapour as directly as possible to the fabric areas. A narrow cotton tape was then used to wrap the elements, held in place with an entomological pin and left for a week to settle into place. Humidification was carried out at this stage in the treatment, before the flowers were reattached, as there was considerably more access to the areas in the wreath that needed humidification. The period spent waiting for the humidification to be finished enabled further practice with the wax infills and treatment preparation time.

Consolidation

Each loose and detached flower was consolidated using the infilling method and the petals fixed back into their original position using Lascaux 360HV (thermoplastic butyl methacrylate copolymer) applied with a fine brush and held in position for ten minutes to allow the adhesive to dry. This made the flowers much more stable and the petals rigid once again, and less susceptible to movement and vibrations in the future.

Once the large detached flower had been cleaned, consolidated and supported, it was reattached to the wreath using a size 00 stainless steel entomological pin, which was cut to size and used as a splint in order to strengthen the fixing. Carbon fibre rods were considered but they proved too thick in diameter for the stems, as well as being very rigid; the pin had some 'give' which matched the other bud and flower attachments. The pin was fixed in place using neat Lascaux 360HV. In order to disguise the fixing, the splint was wrapped. The existing stalks are wrapped with silk, but it was decided to use fine Japanese kozo paper. This was painted with acrylic paint to match the stalk of the flower, cut into fine strips approximately 3-4mm wide and applied in place with a fine tweezer. This was adhered in position with a small amount of neat Lascaux 360HV.

The wreath is in a much more stable condition after treatment and is safe to be part of the travelling exhibition, although is still fragile and handling should be kept to a minimum. Aesthetically the wreath is now as complete as possible and its appearance is much improved.

Touring fragile objects

The treatment on the wax objects was carried out in order to stabilise and strengthen the structures in order that they could travel safely across the world. To this end, the mount had to fully support the wreath and to minimise the handling and movement. After discussions with the curator the decision was made that the display mount would also double as the travel mount, which could be lifted out of its box without touching the object at all.

The challenge therefore, was to minimise movement during transit without damaging the object. The wreath was held in position on its padded and covered display board between two small brass rods covered in small polythene tubing, usually used in the medical profession for catheters, which were fixed to the board. A small stitch of Skala™ polyester thread was used to fix the wreath in place so that movement would be kept to a minimum. The stitches were placed at the strongest points around the wreath, but not pulled tightly. Fixing the object to the board, albeit loosely, also eliminates the need for handling or touching the object at any point.

Environmental parameters and packing

Wax has particular environmental parameters, in particular the temperature at which it is kept. Changes in temperature may lead to several changes in the crystalline structure of beeswax: there may be a loss of plasticizers. If temperatures are high enough, the wax may begin to soften, causing extensive damage. Dirt can sink into the surface of softened wax artefacts and it is then virtually impossible to remove (Clydesdale, 1994). The recommended range is between 16 and 20˚C, and should never exceed 25˚C, as at this temperature wax will begin to soften and deform. Below 16˚C, crystallisation in the structure will begin to occur. These parameters are particularly important to adhere to, especially when the object is travelling across the world to countries with more extreme climates than the UK.

The first venue on the V&A tour is in Australia in the height of summer, where temperatures can, of course, regularly reach above 25˚C. The packing boxes and crates therefore have to buffer these high temperatures.

Boxes were made to fit the size of each object using Correx™ (polypropylene board), which is rigid and lightweight. Thick Plastazote LD45 (cross-linked closed cell polyethylene nitrogen expanded foam) was placed inside the boxes next to the objects and was used to line the crates and also to pack out the boxes within the crates. In addition to the Correx™, this creates several buffering layers which help to prevent and reduce fluctuations (Figure 7).

This method of packing was used for all of the small accessories containing wax. Plastazote LD45 shapes were cut so that they could be placed over the objects. This provides some cushioning and provides a barrier if the stitches holding the object were to fail. The condition reports provided for each object, crate and boxes within it are clearly marked so that the object is kept flat and horizontal throughout transit and installation.

Each box and crate is carefully labelled, packed and recorded by the V&A packing team to ensure that even fragile objects can travel safely. The packing for each box and crate is numbered and detailed instructions are provided to ensure that installations and de-installations run quickly and smoothly.

One crate was allocated to all of the wax objects in the exhibition to ensure that the shipping company are aware of its fragile contents and ensure that the specific temperature requirements are met. In addition to the parameters promised by the shipping agents, three irreversible temperature indicator strips were placed inside the boxes in order to monitor the temperature. A descending temperature indicator, Tempasure™, measures if the temperature drops below 15°C, an ascending temperature indicator, Chillchecker™, reacts if the temperature exceeds 20°C and the third, a six level indicator reacts if the temperature reaches 29°C or over (Figure 8). Unfortunately there is not an indicator which records temperatures ascending from 25°C. This is because the temperature strips also contain wax, and work when the small sliver of dyed wax, located between two layers of paper, melts and stains the indicator paper. Therefore using three indicators over a range of temperatures gives an idea of the temperatures reached inside the crates during transit.

Conclusion

This project was a very interesting opportunity to learn about an unfamiliar material in the context of textile objects.

The opportunity to practice treatments and experiment on the studio samples was vital to the success of the wreath treatment; the techniques and materials used were unlike any treatment undertaken in the studio before. Working on such a small scale was a challenge, and very fine spatulas, tweezers and entomological pins proved to be necessities during the treatment.

Using the studio's new digital microscope was integral to the investigation and experiments and provided a detailed record of treatment; their use in particularly delicate and fine treatments is highly recommended. As an investigative tool they proved very useful.

It is the author's hope that these objects finish their journey across the world in the same condition in which they leave the museum and the method of packing and mounting can be used for future touring exhibitions.

Acknowledgements

With thanks to Valerie Kaufmann of Plowden and Smith Ltd; Brenda Keneghan, polymer scientist; to my colleagues in Textile Conservation and to the curator of the '*Wedding Dress: 200 years of wedding fashion'* exhibition, Edwina Ehrman, of the Furniture, Fashion and Textiles department. Thanks also to Sandra Smith, Head of Conservation for permission to publish.

References

Beaven, E. 2007. Conservation Report: Pair of wax portraits in original giltwood frames. Plowden and Smith Ltd.

Clydesdale, A. 1994. Beeswax: A survey of the literature on its properties and behaviour. *SCCR Journal,* Vol. 5, No. 2.

Kaufmann, V. 2009. Notes on safe display and storage of wax models and portraits. *Plowden and Smith Ltd.*

Knuutinen, U and Norrman, A. 2000. Wax analysis in conservation objects by solubility studies, FTIR and DSC. In: *World Conference of Nondestructive Testing,* Rome. http://www.ndt.net/article/wcndt00/papers/idn555/idn555.htm Accessed: 18 May 2011

Murrell, V. 1971. Some aspects of the conservation of wax models. *Studies in Conservation,* No. 16.

Purewal, V. 1997. An Investigation into the composition of botanical wax models with a view to their conservation. *Collection Forum,* Vol. 13, No. 1.

Romão, P, Alarcão, A, Viana, C. 1990. Human Saliva as a Cleaning Agent for Dirty Surfaces. *Studies in Conservation,* Vol. 35, No. 3.

Tímár-Balázsy, Á and Eastop, D. 1998. *Chemical Principles of Textile Conservation*. 1st edn. London: Butterworth-Heinemann.

Suppliers

100% Beeswax	The British Wax Refining Co. Ltd 62 Holmethorpe Industrial Estate Redhill Surrey RH1 2NL UK Tel: 01737 761242
Lascaux 360HV	AP Fitzpatrick 142 Cambridge Heath Road London E1 5QJ UK Tel: 020 7790 0884
Dino-Lite™ Digital microscope	Absolute Data Services Ltd. 9 Moorland Road Hemel Hempstead Herts. HP1 1NQ UK Tel: 0845 056 0820
Small spatulas (no. 47)	Alec Tiranti Ltd 27 Warren Street London W1P 5DG UK Tel: 020 8930 2775
Irreversible Temperature Indicators	Temperature Indicators Ltd The Old Bakery Ashley Gardens Rusthall Tunbridge Wells Kent TN4 8TU UK Tel: 01892 514444

Figure 1
The orange blossom wedding wreath (T.10B-1970)

Figure 2
Margaret Lang's wedding dress (T.10-1970)

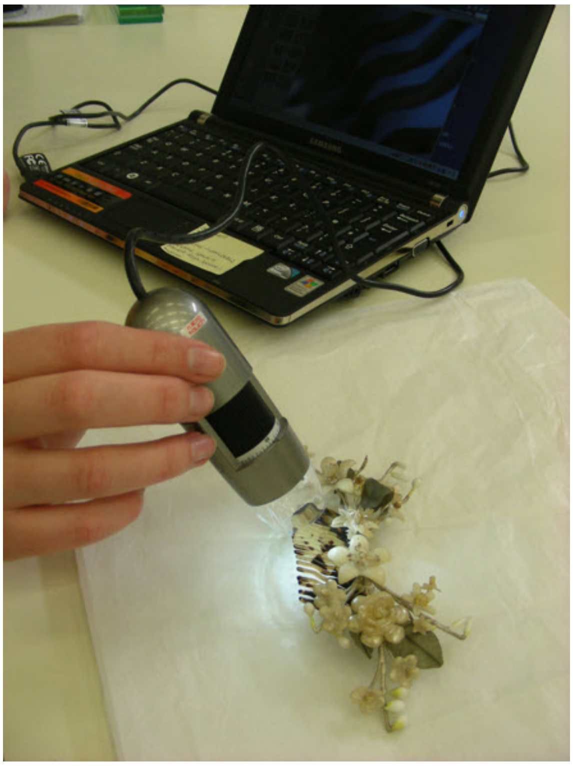


Figure 3
Examining an object using Dino-Lite™ digital microscope

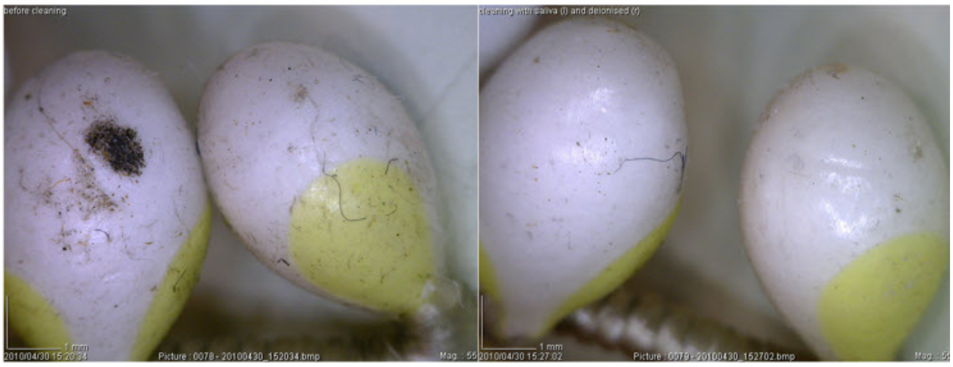


Figure 4
Before and after cleaning with saliva under x55 magnification.

Figure 5
Mixing pigments with wax on the hot plate

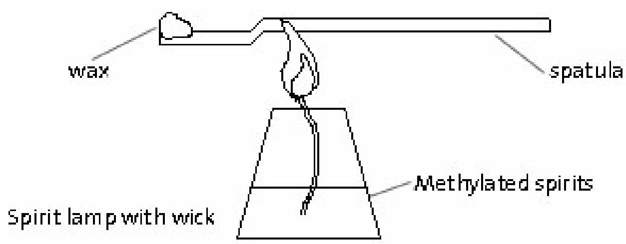


Figure 6
Heating the spatula over the flame,
taking care not to burn the wax.

Figure 7
Packing the wreath with Plastazote LD45.

Figure 8
Placing temperature indicator strips in the packing crates.

Mermaids Tears not Yours: The identification of common pearlescent beads and the effect of interventive textile treatments on them

Rachel Rhodes
Freelance Textile Conservator

Introduction

The aim of this paper is to raise awareness of the fascinating and overlooked subject of pearl beads, what they are, how they can be identified, and issues raised by finding them on textiles.

Pearls and pearlescent beads are a group of which little mention is made in conservation literature. They are considered even less in direct relation to textile conservation despite having been commonly associated with textiles for centuries. The likelihood that a textile conservator will at some time in their career be asked to work on an object that is embellished with pearls or something that looks like them is quite high. Therefore, they need to have some understanding of what real and simulated pearls are made from and what the wider implications are.

The research for this paper was carried out for the MA Textile Conservation dissertation at the Textile Conservation Centre, Southampton University. The research was inspired by finding pearls on both an Opus Anglicanum cope and a Dior couture dress while on placement at the V&A and wondering what the real similarities were between these two pearlescent beads separated by more than 500 years.

The research had three stages:

- research into the history of pearls and materials used as stimulants;
- how to identify the materials found in a selection of pearlescent beads, in a simple and, if possible, non destructive way;
- how a selection of interventive treatments might affect the various bead types.

The history and development of pearls and pearl simulants

Pearls have always been high status embellishments and at times have been governed by sumptuary laws to protect their exclusivity. The supply of natural pearls has always been limited, so, as far back as pearls can be found so can fakes. People have used all the technology available to them to produce these simulants, to extend the supply of this naturally limited resource and to make a profit. Therefore, the pearls found on textiles may not always be real. However, dresses encrusted with real pearls may be found in the modern era, one example being Princess Diana's, "Elvis dress" designed by Catherine Walker, displayed at the V&A (T1:1-2006).

What are pearls? This term is used freely in literature and museum records to describe both pearls and pearlescent beads with little regard for what this actually means. The term has been used to encompass pearlescent beads of all types from natural and cultured pearls to simulated pearls made from plastics and mixed materials. An early task therefore when considering a treatment would be to identify which type of pearl is present.

The chemistry and morphology of natural and simulated pearls

Real Pearl

Though the financial values of natural, cultured salt and freshwater pearls differ, they are all made of the same essential materials. Natural and cultured pearls are concretions formed in the body of molluscs as a defence against foreign bodies, usually parasitic worms. All natural pearls are made from layers of "nacre" which is made from 90% aragonite, a crystalline form of hydrated calcium carbonate ($CaCO_3.H_2O$) and 10% conchiolin which is a glue-like protein. Consequently they have an alkaline nature. Their chemistry is essentially the same as the shell which surrounds the soft body of the molluscs but has a slightly higher percentage of calcium carbonate and half as much water (Campbell Pedersen 2004:143, Dubin, 2004:297, Taburiaux 1985:108).

Simulated Pearls

The first pearl simulants were carved from mother-of-pearl, which is found lining the shells of molluscs that produce pearls. They are softer than pearls and more easily damaged.

It is now more common to find real cultured freshwater pearls on textiles, as the price of cultured nucleated pearls, and keshi pearls, a by-product of pearl culture, have fallen drastically since Kokichi Mikimoto perfected pearl culture in Japan, in the early 20th century. Now many types of pearl with plastic, glass, and semi precious nuclei, and non nucleated pearls are being produced around the world (Figure 1).

Roman pearls are one of the earliest synthetic simulants and date back to the 17th century. The term is used to describe hollow glass beads, coated internally and sometimes externally, with a mysterious substance called essence-d'orient, and filled with wax to give the beads a weight similar to that of real pearls. Essence-d'orient is a not a substance that a textile conservator would ever imagine having to deal with. Little has been written about it or its component parts. It is believed to be the invention of Parisian rosary bead maker, François Jacquin. He saw bleak fish being caught in the river Seine and was struck by how pearly their scales looked. He took this fish-silver as it became known, and mixed it with resin to create essence–d'orient. (Farn 1986:117-123) The mixture was used to coat the interior and sometimes the exterior of hollow glass beads. Roman pearls are incredibly common on costume right up until the 1940's.

The popularity of Roman pearls decreased with the rise of the age of plastics. The pearlescent qualities of plastics such as casein were exploited and many plastics have been coated with essence-d'orient or metallic minerals suspended in cellulose nitrate and other resins. (Coxon 1993:395-396)

It is clear that pearlescent beads form a broad and complex group. They are made in a variety of ways, usually from a combination of materials which fall broadly into three groups:

- hollow and solid glass beads
- natural materials, such as shell and mica
- synthetic and semi-synthetic plastics.

Identifying Real and Simulated pearls

A comprehensive set of tests to identify the materials present in pearls and pearls simulants does not exist. The tests have been sourced from a wide variety of literature including, gemology and ethnographic conservation. Sources are listed in the bibliography.

Tests were evaluated against the following criteria:

- can the test be carried out without removing a sample?
- is the test destructive?
- is it commonly available to textile conservators?
- is the health and safety prohibitive?
- are the results unambiguous and conclusive?

The best were used to identify the materials present in a variety of pearlescent beads sourced from the Textile Conservation Centres reference collection and vintage shops.

Identification in practice

The tests selected were:

- X-radiography
- fluorescence
- specific gravity
- texture and visual clues
- pyrolyis and smell
- chemical tests

Fourier transformed near infra-red spectrometry (FTIR) was also carried out in parallel, almost as a control, and to see if simple easily accessible tests would yield results equal to those of high science.

The tests

X-radiography

Though not a common procedure x-radiographs of the beads sewn onto a calico support, were taken (Figure 2). Two exposures were taken, the first at 50Kv for 30 seconds and the second at 30Kv for 30 seconds. The images produced (Figure 3), allowed the beads to be separated into groups and in some instances suggested a chemical and physical structure to the beads that implied materials but did not confirm them. Textiles and related materials are well placed for X-ray reference sources in particular in the work of O'Connor and Brookes(2007).

Fluorescence

Ultra-Violet fluorescence was quite simple to carry out and again helped group the beads and suggested a physical structure and in some case a possible chemical nature. Some references were found to materials identification using UV but the literature is incomplete and is usually used to confirm an identification rather than to provide one. Pearl and essence-d'orient will fluoresce as they contain protein. It has been suggested that casein is the only plastic to fluoresce (Campbell-Pedersen 2004:78, 243) due to its protein nature, however, many adhesive polymers fluoresce and this fact is exploited when examining repaired glass and ceramics. Glass may or may not fluoresce depending upon its chemical composition (Simpson–Grant 2000b: 2). It would however prove incredibly useful on an object encrusted with pearls to check if they are all of the same composition or if imposters are lurking, which may require different treatment (Figure 4).

Specific Gravity

Specific gravity is a method most used by gem specialists to separate natural pearls from all others and can be so specific that it suggests which ocean the pearls come from. However, when tested it failed to produce any usable results.

Visual identification and texture

Each sample was examined for the visual characteristics outlined in Table 1, using a low power reflected-light stereo microscope. Micrographs were taken which could be further examined at a later date. Additional examination and micrographs were taken at higher magnification to look for characteristic surface patterns, not visible at low power.

Formation Marks

A vast array of information can be gleaned by looking at formation marks and surface textures of the beads with a microscope or hand lens.

Plastic and glass both exhibit characteristic formation marks. Points to observe include whether the materials were press or injection moulded and have sprue, the excess material forced out during the moulding process (Figure 5), or were machined from solid stock and show machine marks when magnified. Details of which plastics are usually produced using which methods are outlined clearly in The Conservation of Plastics (Morgan 1991:42-48).

A glassy lustre may indicate a hollow glass bead with an imitation pearl coating applied to the inner surface. When examined under magnification it should be possible to see both the inner and outer surfaces of the glass if the glass is clear (Campbell-Pedersen 2000:162).

Some colours and effects are characteristic of certain plastics, notably casein may have pearlised appearance. In plastics the gloss of a surface is dependent on the production method used. Some plastics take a gloss more easily than others for example, polymethyl methacrylate (acrylic) and the cellulosic plastics. (Morgan 1991:35).

It is important to look for layering (Figure 6). Seeing the surface coating inside the drill hole also suggests a simulant. A change in colour but not material may suggest a dyed bead carved from

	Solid material with coating	**Hollow glass**	**Natural material**	**Moulded material**	**Pearlised coating**	**Mica/ mineral glaze**
Bubbles in outer layer						
Sprue/ formation marks						
Cloissons						
Granular metallic surface effect						
Peeling coating						
Coating inside drill-hole						
Small regular drill-hole						
Overtones in colour						
Possible to focus through outer coating						
Schiller						

Table 1

Visual characterization indicators

shell or a dyed cultured pearl. Cheaper nucleated cultured pearls may also have very thin layers of nacre that will be visible around the drill hole and will be very vulnerable. Keshi and natural pearls will not show a nucleus.

Surface Textures

The traditional method for separating real pearls from other, sometimes very convincing man-made beads, is to rub them on your teeth. This does work. Real pearl, natural and cultured, will feel rough, as will mother-of-pearl. What are being felt are the edges of the nacreous layers which form this characteristic cloisson pattern as can be seen in Figure 7. Simulants do not have these ridges and feel smooth. Be aware though that very high quality simulants such as Akoya pearls and natural saltwater pearls have a very fine surface and do feel much smoother than freshwater pearls.

Figure 8 shows the colour overtones characteristic of mother-of-pearl and pearl. They are clearly distinguishable when compared with the metallic/mineral based overtone, described as shiller, in Figure 9 (in this case) found as a very thin coating on white solid glass seed beads. The grainy metallic surface in figure 10 is a clear indication of modern simulants.

The physical appearance of pearls and many pearl simulants can be found in Gems and Ornamental Materials of Organic Origin, by Campbell-Pedersen (2000).

Degradation

In addition to visual clues degradation may indicate the materials present. Glass deterioration is a complex subject which has many causes and effects, it is characterised by crizzling, weeping and pitting of the glass. In extreme cases glass may become gelatinous and lose its strength or become powdery, though this becomes much less likely with the stable glasses produced from the 18th century onwards (Carroll and McHugh 1999:28; Hamilton 2000:1-4).

Shell may exhibit Byne's disease which is an efflorescence of calcium salts thought to be caused mainly by reactions with acidic storage materials. As this is a phenomenon of calcium carbonate rich materials there would seem no reason why this would not also be exhibited by real pearls, though as yet no reference can be found to this happening (Garrell Research Group 2007:2, Doré, 1999:45-47).

Plastic beads are subject to all the problems of other larger plastic objects. These include dimensional changes, crazing, bloom and softening or embrittlement. These physical changes in characteristics should be noted, both as an indication that the beads are most likely to be plastic, and also as an indication that the beads are degrading and that further advice should be sought before continuing with treatment or storage (Morgan 1991:14-15).

Smell and pyrolysis

Burning small samples and observing the flame and reaction of the samples as well as noting the smells produced, did provide results that were readable against available literature and, along with solubility tests, were most useful in identifying plastics in general, and, more specifically, which types of plastic (Morgan 1991:37, Coxon 1993:400) (see Table 2).

Chemical tests

Generally referred to as spot testing, these tests can provide relatively quick and easy results. Tests were sourced from Oddegard (2000), Coxon (1993), Morgan (1991), Williamson (1999), Barker (1999) and Timar–Balázsy and Eastop (1998).

Sample No.	Colour of flame	Burn – extinguishes when removed/ continuous/rapid/	Reaction of sample	Odour	Suggested material
I core and coating	yellow	continuous	black soot	waxy	polyester
2 core and coating	yellow	continuous	ductile when molten	-	Polyester/ polystyrene
3 core and coating	yellow	extinguishes	powdery ash	burnt hair	pearl
4 core and coating	yellow	extinguishes	charred/ shrinks/cracks	-	glass
5 core and coating	yellow	extinguishes	shrinks/cracks	-	glass
6 core	yellow	none	melted	-	wax
6 coating	yellow	extinguishes	shrinks/cracks	burnt hair	glass/essence-d'orient
7	not tested				
8 coating	yellow	extinguishes	shrinks/cracks	-	glass
9 core and coating	yellow blue at edges	extinguishes	shrinks/cracks	burnt hair	glass /essence-d'orient
I0	not tested				
II	yellow blue at edges	extinguishes	shrinks/cracks		glass/essence
I2 coating	yellow	rapid	no residue	none	cellulose nitrate
I3 core and coating	yellow		spits/ melts	none	Casein
I4 core and coating	yellow	continuous	black soot/ hard black blob	waxy	polyester or polypropylene
I5 core and coating	yellow	extinguishes	powdery ash	burnt hair	shell (calcium carbonate and conchiolin)
I6 coating	yellow	rapid	no residue	none	cellulose nitrate
I6 core	yellow	continuous	?	none	polyester or polystyrene
I7 coating	yellow	rapid	no residue	none	cellulose nitrate

Table 2

Composition of beads as suggested by burn tests

For the spot tests the samples were separated into groups; those made from natural materials, other materials such as glass, and those most likely to be plastic. The most important materials to confirm were the presence of essence-d'orient and cellulose nitrate in the coatings and ideally the nature of each of the plastics, as these are most likely to react badly to poorly chosen treatments.

A Biuret test as described in Oddegard (2000:144) was carried out to test for protein which may suggest the presence of essence-d'orient of which protein is a major component. The Biuret test for protein, would identify both gelatine and essence-d'orient and therefore could not be used to identify essence-d'orient on beads made of gelatine or vice versa, but could only be used to prove the presence of protein. Real pearl would test positive for protein will usually be identified before this becomes necessary.

A resin acid test, as described in Rogerson (2004a:24) was used to test for acids liberated by natural resins that may be present in the coating's binding medium.

A diphenylamine spot test as described in Oddegard (2000:164) was used to confirm the presence of cellulose nitrate.

Fourier-Transform infra-red spectrometry (FTIR)
Fourier transformation is a mathematical procedure which determines the molecular bonding within a molecule by producing an infrared absorption spectrum unique to that material's chemical bonds[1].

Samples were taken and spectral analysis carried out, using a Perkin Elmer spectrum1, Fourier-Transform infra-red spectrometer fitted with a Perkin Elmer Universal Attenuated Total Reflectance Accessory. Spectra were recorded over a range of 700-4000cm^{-1} with a wavnumber resolution 4cm^{-1}, averaged over 32 scans. The spectra were studied using Thermo Galactic Grams/AI software.[2]

The results achieved are of a chemical nature and though the rough data has already been interpreted by an analyst, this analysis may not, give results which are immediately interpretable by the textile conservator.

Where a single material is involved the results matched exactly the results from the previous tests. It may be that it is not always possible to take uncontaminated samples, particularly when dealing with closely bonded composite objects such as these.

The results were not as definitive as was at first envisaged and could not be used in place of reference samples as proof of composition, as originally intended. It suffered from the same problems regarding the lack of known reference samples as the other tests; therefore it was not possible to definitively identify the composition of all of the beads. As with other tests the results of the FTIR analysis may become more useful when combined with previous test results.

Evaluation of Tests

Following the testing process it was clear that certain tests were far more effective than others. Visual examination followed by burn tests, then chemical identification tests if carefully carried out, should provide sufficient information to make a reasonable identification of most materials found within pearls and pearlescent beads. The level of identification achieved was certainly enough to begin assessing treatment options and further treatment tests; though it should be noted that this would not have been the case without the use of some destructive testing.

The effects of interventive treatments on pearls and pearl simulants

The final stage of research was to test the resilience of three common bead types when exposed to a number of interventive treatments, which might be carried out on textiles and costume. Some of the treatments might not be appropriate in reality, but without proper testing we have no evidence to rule them out. It is however, useful to know the potential effects these treatments may have on the most frequently found bead materials. To determine this, three bead types were tested; cultured freshwater-pearls, poly-era plastic beads with a cellulose nitrate based coating, and glass beads internally coated with essence-d'orient and filled with wax, as identified in the

1 Personal communication (e-mail) Emma Richardson 7 September 2007

2 Personal contact (e-mail) Emma Richardson 7 September 2007

previous tests. None of these beads had undergone any previous conservation or testing, but had been taken from the same objects as beads used in the identification tests.

The following solutions and tests were carried out:

- a weak acid and alkali solution, were used to mimic the effects of pH change during treatment.
- softened water and de-ionised water were used to mimic the effect of using these during treatment.
- two aqueous cleaning solutions were made up, one using "Orvis WA" paste which is an anionic detergent and another using "Dehypon LS45", which is non-ionic. Each was made up to a strength of 10 x cmc. 0.1% SCMC was added as a soil suspending agent, as is usual in aqueous cleaning solutions.
- Industrial methylated spirits and acetone were chosen due to the frequency with which they are used as solvent cleaning liquids.

The beads were placed individually in glass beakers and 10 millilitres of each of the solutions was added. The beads were left in the solutions, for a total of 18 hours.

The effect of freezing as a treatment for insect infestation was also observed. The beads were wrapped individually in acid-free tissue paper. This in turn was wrapped in polythene sheeting. The air was pressed out and the edges sealed with parcel tape. The beads were held at -40°C in a commercial deep freeze for 24hrs.

At the end of the test, the samples were compared with control samples to see if the test solutions had caused any changes to the samples. Beads were examined under a microscope to observe any surface changes. Micrographs were taken.

Results and observations

Treatment	Observed reactions		
	Freshwater pearl beads	**Glass filled beads**	**Poly-era beads**
Weak acid 0.2% acetic acid pH 3	damaged surface	damaged internal coating	no visible effect
Weak alkali 0.2% Ammonium Hydroxide pH10	no visible damage	damaged internal coating	no visible effect
Softened water pH 7.1	damaged surface	slight damage to internal coating	no visible effect
De-ionised water pH 6.8	damaged surface	damaged internal coating	no visible effect
Non-ionic detergent and scmc Dehypon LS45 10 x cmc	no visible damage	damaged internal coating	no visible effect
Anionic detergent and scmc Orvus WA paste 10 x cmc	no visible damage	damaged internal coating	no visible effect
Industrial methylated spirits	damaged surface	damaged internal coating	no visible effect
Acetone	no visible damage	damaged internal coating and glass surface	damaged surface
Freezing -40degrees C for 24hrs	no visible damage	glass may have been cracked by dimensional change?	no visible damage

Table 3

Effect of treatment tests on 3 bead types

Real pearls reacted poorly to weak acid, softened and de-ionised water and Industrial Methylated Spirit. Acetone appeared to have no effect on real pearl and is used by some jewellers to clean very soiled pearls (Figure 11).

The hollow-glass, wax filled beads were very susceptible to damage. At the least, dimensional changes caused the glass shells to crack and at worst the essence-d'orient component shrivelled and pulled away from the glass as is seen in Figure 12. Very surprisingly the wax element seemed unaffected for the most part.

The poly-era plastic bead, coated with a synthetic pearlescent coating containing cellulose nitrate was unaffected by all of the treatments except submersion in acetone, which is a known solvent of cellulose nitrate. (Morgan 1991:10)

The results clearly suggest that interventive treatments carried out on textile objects that have pearlescent bead embellishments are potentially problematic. Any treatment considered should be carefully planned and tested to ensure that the process involved will not adversely affect the beads, which are, inherent parts of the object. See Table 3.

Final considerations

It is clearly important that textile conservators are aware of the possibility that the real or simulated pearls found on textile objects may be made from a combination of different materials and that each of these materials may need to be treated in a different manner. Pearlescent beads cannot be treated in the same way as other glass, plastic or natural materials as their layered structure and mixed media nature preclude this. Each element if possible, should be identified prior to treatment, so that certain treatment options, which may otherwise have been considered can be ruled out if it is found that they would cause further damage and degradation. In addition each treatment should be tested on the beads before treatment is carried out.

Undoubtedly there are questions raised here that need to be answered, such as how should pearls and pearl simulants be stored given that certain elements such as cellulose nitrate cause problems with other materials? What effect do pearls themselves have on textiles as they degrade?

However, this research has shown that it is possible to identify the vulnerable materials within pearls and pearl simulants using simple, easily accessible tests that can be carried out by textile conservators, though some of these tests will need to be destructive and that it is essential to carry out identification as a large proportion of the pearls and pearl simulant group of beads are vulnerable to interventive textile treatments

Bibliography

Arnold J. 1988. *Queen Elizabeth's Wardrobe Unlock'd.* Leeds: W S Maney and Sons Ltd.

Barker M. 1999. Defining plastics. In: Quye A and Williamson C, eds. 1999. *Plastics, Collecting and Conserving.* Edinburgh: NMS Publishing Ltd, pp23-33

Campbell Pedersen M. 2004. *Gem and Ornamental Materials of Organic Origin.* Oxford: Elsevier Butterworth-Heinemann

Carroll S and McHugh K. 2001. Material characterisation of glass disease on beaded ethnographic artefacts from the collection of the national museum of the American Indian. In: Wright M, ed. *Ethnographic Beadwork, Aspects of Manufacture, Use and Conservation, Seminar organised by the conservators of ethnographic artefacts at the Conservation Centre, National Museums and Galleries on Merseyside on 22 July 1999*. London: Archetype Publications Ltd pp27-37

Cheung A. 2006. A study of sequins on a Cantonese opera stage curtain. In: Rogerson C and Garside P eds. *The Future of the 20th Century; Collecting, Interpreting and Conserving Modern Materials*, AHRC Research Centre for Textile Conservation and Textile Studies, 2nd annual conference postprints. London: Archetype, pp122-127.

Coxon H. 1993. Practical pitfalls in the identification of plastics. In: Grattan D W ed. *Saving the Twentieth Century: The Conservation of Modern Materials, Proceedings of a conference symposium, Ottawa, Canada, 15-20 September 1991*. Canadian Conservation Institute, pp395-409.

Cronyn J. 1990. *The Elements of Archaeological Conservation*. London: Routledge.

Doré J. 2001. Mother-of-pearl and Byrne's disease. In: Wright M, ed. *Ethnographic Beadwork, Aspects of Manufacture, Use and Conservation, Seminar organised by the conservators of ethnographic artefacts at the Conservation Centre, National Museums and Galleries on Merseyside on 22 July 1999*. London: Archetype Publications Ltd pp39-51.

Dubin L S. 2004. *The History of Beads from 30,000 B.C. to the Present.* New York: Harry N. Abrams

Farn A E. 1986. *Pearls; Natural, Cultured and Imitation.* London: Butterworth and Co.

Faufman M. 1963. *The First Century of Plastics; Celluloid and Its Sequel.* London: The Plastics and Rubber Institute

Fenn J. 2001. plastic beads and buttons in social history collections : a dilemma. In: Wright M, ed. *Ethnographic Beadwork, Aspects of Manufacture, Use and Conservation, Seminar organised by the conservators of ethnographic artefacts at the Conservation Centre, National Museums and Galleries on Merseyside on 22 July 1999*. London: Archetype Publications Ltd pp53-63.

Finlay V. 2005. *Jewels: A Secret History.* London: Hodder and Stoughton

Garrell Research Group. 2007. *Degradation of Museum Shell Collection.* http://www.chem.ucla.edu/dept/Organic/Garrell/research_artcons_style1.html Accessed: 31 August 2007.

Hamilton D L. 2000. *Glass Conservation.* http://nautarch.tamu.edu/class/anth605/File5.htm 1-4 Accessed: 1 September 2007.

Kunz G F and Stevenson C H. 1908. *The Book of the Pearl. The History, Art, Science and Industry of the Queen of Gems.* http://www.farlang.com/gemstones/kunz_book_of_the_pearl/ Accessed: 28 July 2007.

Lovett, D. 2006. *Plastics; Degradation and Solutions.* Unpublished notes from a lecture given at the Textile Conservation Centre, December, 2006.

Lu T and Shigley J E. 2000. *Nondestructive [sic] Testing for Identifying Natural, Synthetic, Treated and Imitation Gem Materials.* www.asnt.org/publications.Materialseval/solution/Oct00solution/oct00sol.htm Accessed: 1 July 2007.

Mills J S and White R. 1994. *The Organic Chemistry of Museum Objects,* 2nd edition, Oxford: Butterworth-Heinemann

Morgan J. 1991. *Conservation of Plastics, an Introduction.* London: Museum and Galleries Commission and the Plastics Historical Society

Newton R and Davison S. 1989. *Conservation of Glass.* London: Butterworth-Heinemann

O'Connor S and Brooks M M. 2007. *X-radiography of Textiles, Dress and Related Objects.* Oxford: Butterworth-Heinemann.

Odegaard C and Zimmt S. 2000. *Material Characterization Tests for Objects of Art and Archaeology.* London: Archetype Publications.

Rhee S. 2005. *Coating Compounds for Imitation Pearl.* http://www.patentstorm.us/patents/6890379-fulltext.html Accessed: 6th July 2007.

Rogerson C. 2004a. *Fibre Identification Techniques*, unpublished handbook, Textile Conservation Centre.

Rogerson C. 2004b. *Laboratory Manual,* unpublished handbook, Textile Conservation Centre.

Simpson-Grant M. 2000. The use of ultraviolet induced visible- fluorescence in the examination of museum objects, part 1, in *Conserve O Gram,* Number 1/9, December 2000, Washington DC, National Parks Service.
http://www.nps.gov/history/museum/publications/conserveogram/01-9.pdf Accessed: 1 August 2007.

Simpson-Grant M. 2000. The use of ultraviolet induced visible-fluorescence in the examination of museum objects, part 2, in *Conserve O Gram*, Number 1/10, December 2000, Washington DC, National Parks Service. http://www.nps.gov/history/museum/publications/conserveogram/01-10.pdf Accessed: 1 August 2007.

Taburiaux J. 1985. *Pearls: Their Origin, Treatment and Identification.* London: N A G Press.

Timar-Balázsy Á and Eastop D. 1998. *Chemical Principles of Textile Conservation.* London: Butterworth-Heinemann.

Van Ooesten T. 1999. Identifying plastics, part 2, analytical methods. In: Quye A and Williamson C, eds. *Plastics, Collecting and Conserving.* Edinburgh: NMS Publishing Ltd. pp 70-84.

Vincent J. 1982. *Structural Biomaterials,* Princeton, Princeton University Press.

Walker R. 2004. *Conserving Plastics in Nineteenth and Twentieth - Century Costume Collections.* http://www.uri.edu/hss/tmd/20th%20Centry%20Plastics.pdf Accessed: 27 July 2007.

Williamson C. 1999. Identifying plastics, part 1, physical clues and simple analysis. In: Quye A and Williamson C eds. *Plastics, Collecting and Conserving.* Edinburgh: NMS Publishing Ltd, pp55-70.

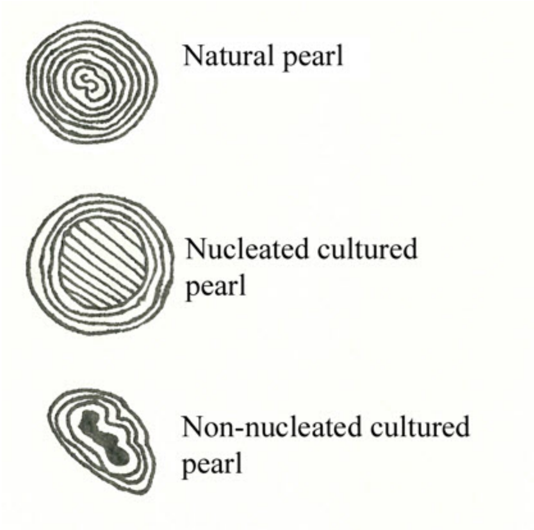


Figure 1
Structure of pearlescent beads.

Figure 2
Bead samples stitched to calico.

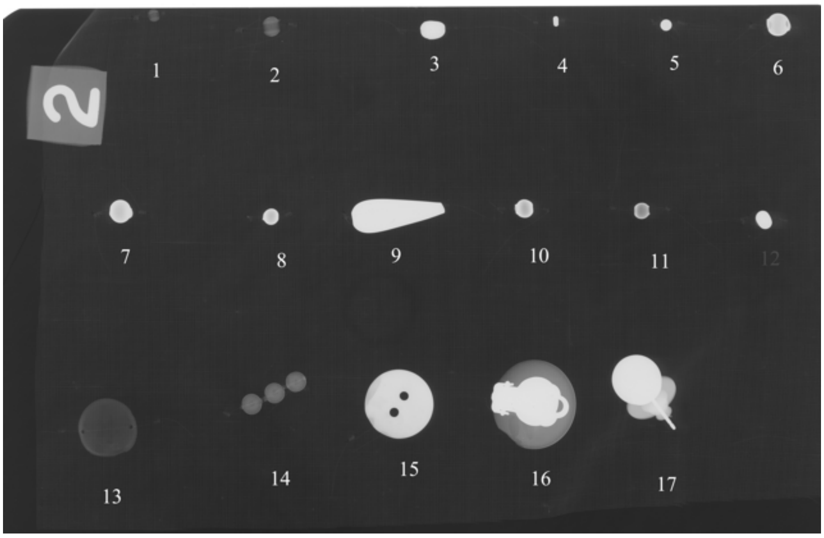


Figure 3
X-radiogram of bead samples

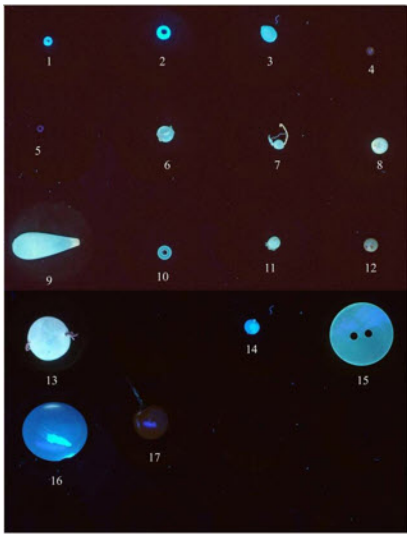


Figure 4
Fluorescence

Figure 5
Sprue

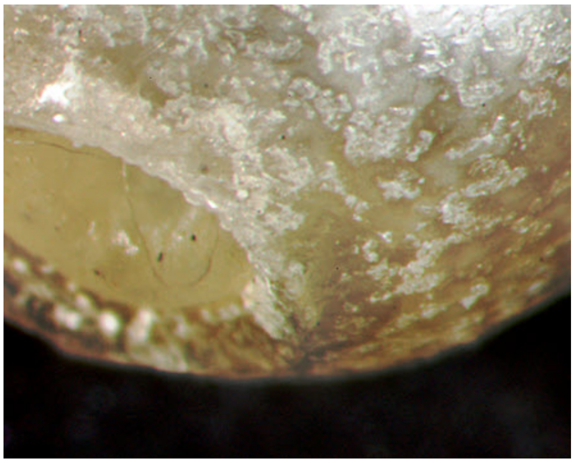


Figure 6
Layering

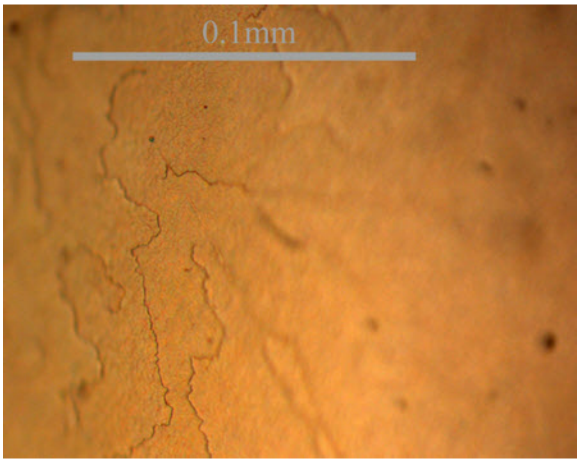


Figure 7
Cloissons

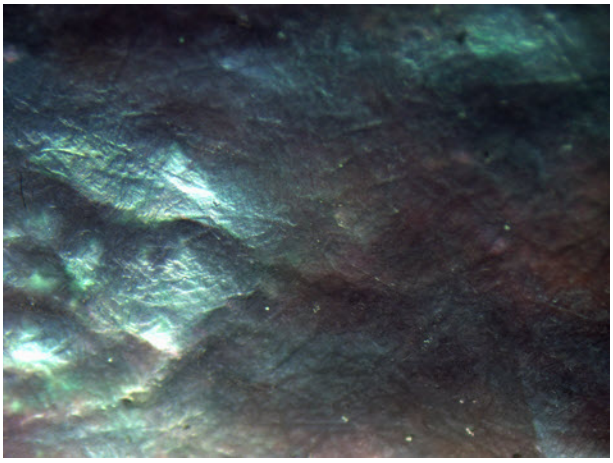


Figure 8
Overtones

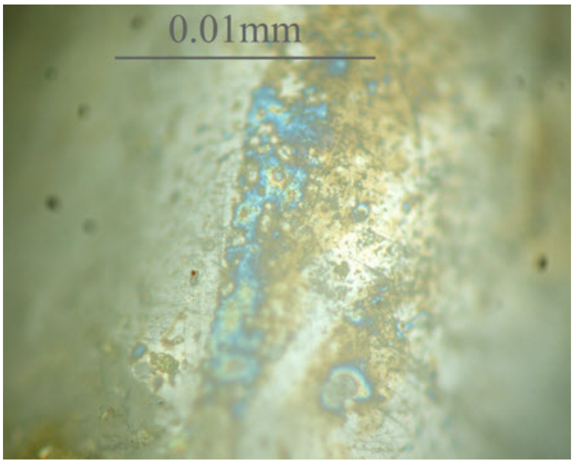


Figure 9
Shiller

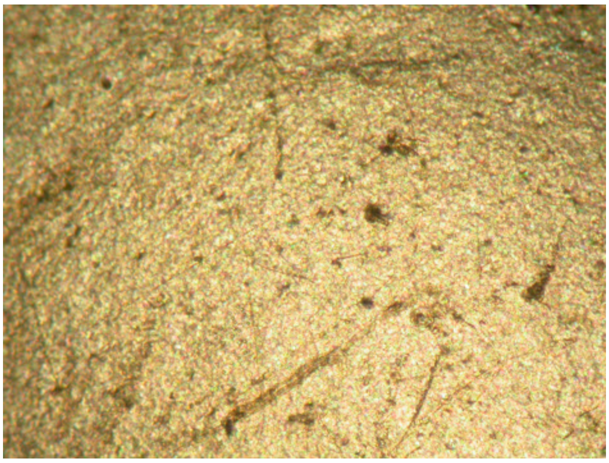


Figure 10
Plastic bead surface

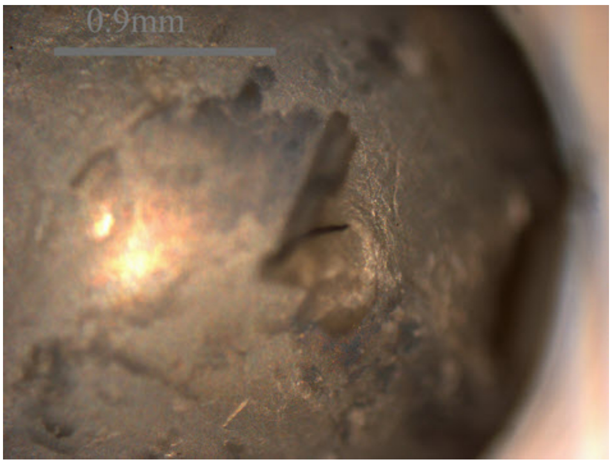


Figure 11
Real pearl treated with acid

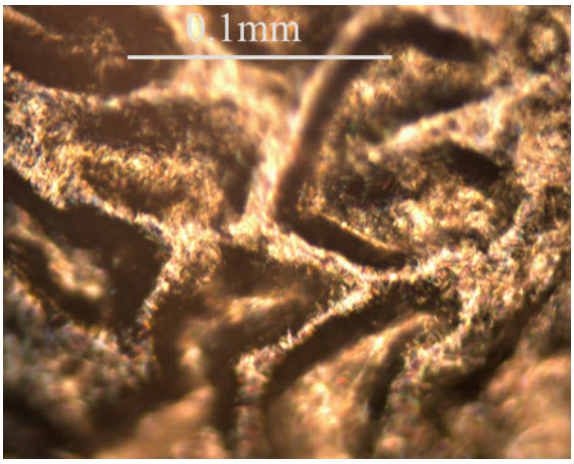


Figure 12
Damaged essence-d'orient

Gilded silver threads; corrosion and cleaning

Ingrid K. Jimenez-Cosme and Jannen Contreras-Vargas
Escuela Nacional de Conservación, Restauración y Museografía, INAH.

Introduction

Metals have been used in textiles either for structural or ostentatious purposes. As structural elements their strength and resistance seems to be their most important characteristics, being used mainly as bars, buckles, snaps, buttons, zippers and fasteners; while when used for ostentatious aims their colour, brightness, ductility, malleability and resistance to corrosion are central, as they provide or enhance luxury, endowing a radiance usually related to their use and symbolism and are often associated with the power and divine nature of rituals and devotions, especially when used in religious garb. As a result gold and silver have been used to make textiles glow.

But even when being made with noble metals, gilded silver threads suffer corrosion, in a process that is caused by spontaneous mechanisms that invariably modifies the luxurious and brilliant character of the artefacts.

The conservation of metallic threads textiles has always been a challenge. Not long ago the dominant criteria for textiles made with them was to try to recover their clean and brilliant appearance by removing as many corrosion products as possible, almost by any means. It is well known that the methods for metal cleaning are unsuitable and even harmful for textile materials, but it was not until recent times that conservators become aware of this fact and that these treatments could damage the metals as well (Contreras, 2010).

Deterioration

The gilded silver threads constitute a very particular system in which the specific characteristics of textiles influence the deterioration effects of the textile and therefore the treatments' results. Because of this when addressing the problem of their decay it is necessary to first understand their parts separately.

Gilded silver threads manufacture

The manufacture of gilded silver threads can involve different processes like fire gilding, hammering, drawing, spinning, rolling and striping wound around a fibrous core of silk or cotton, and that is just the beginning; the fine metallic threads are then combined with silk, linen, paper, parchment, cotton or other metallic elements to make complex textiles woven in lace, brocade, embroidery, etc.

The most common gilded threads in baroque textiles were made from drawn wires, and the gilding was achieved by hammering gold leaf (Járó, 1993). The wire was then drawn several times and annealed. Heat produces two effects; annealing and diffusion. Annealing allows the mteals to retain their mechanical properties such as ductility and malleability by achieving recrystallization, while diffusion is a process in which the atoms of solid metals are transferred between them seeking to reach an homogeneous concentration in both, and therefore achieving an alloy, or a different phase of the original alloy.

It is expected that after reducing the initial rod into wires a few millimetres thick, the original gold leaf gets transformed into a plating with a range of just a few microns. As a result of the drawing and annealing processes, the gilding could not be an even layer and the atomic diffusion caused by heating would promote the formation of a gold-silver alloy.

One of the most useful and sought after characteristics of textiles is their flexibility, but when fibres are mixed with these metallic filaments, the metal limits its flexibility. As a result the use of the object can promote serious damage, such as an increased tear of the textile fibres, cracks or fractures of the metallic filaments, as well as abrasion of the thin gilding, which afterwards leads to corrosion processes.

In addition the textile structure influences the deterioration effects and the possibility to treat them, e.g., heavy and rigid embroideries usually show fewer fractures than the lighter ones.

Corrosion

Almost all metals have a strong tendency to return to their most stable form: the mineral, through a series of reactions known as corrosion. Corrosion always implies two simultaneous reactions, the oxidation of a metal and the reduction of the element with which it reacts. The corrosion susceptibility of a metal depends on its intrinsic characteristics, such as electrode potential, along with the ones of the environment such as: the surrounding pollution, pH, relative humidity and temperature.
The metals used in these threads – silver and gold – are noble metals, so their tendency to corrode is low; it has even been said that pure gold does not corrode while silver is not easily corroded by oxygen or water, yet has high sensitivity to sulphur.

$$2Ag + H2S \quad Ag2S + H2$$

As a result silver's most common corrosion product is silver sulphide (Ag_2S), also known as argentite or acanthite. This iridescent brown-grey mineral is usually passive, which means that does not easily promote further corrosion reactions that could cause the loss of the metal, so it can be even considered as a protective layer, therefore usually the greatest damage it causes is visual.

While it is commonly said that because of its high chemical stability gold does not corrode, when alloyed with silver it often forms sulphides, and as they share colour and other characteristics with silver sulphides – such as passivity – they are not normally differentiated. However, even pure gold can react to form complexes in the presence of highly oxidizing ions and certain chelating agents such as cyanide or thiourea (Selwyn, 2000).

Chemical Name	Formula	Mineral Name	Colour
Silver sulphide (I)	α-Ag_2S	Acanthite/argentite	Black
Silver sulphide (I) gold (I)	Ag_3AuS_2	Uytenbogardtite	Grey
Silver sulphide (I) gold (I)	AgAuS	Petrovskaite	Black

Table 1

Corrosion of gilded silver threads

Galvanic corrosion is one of the most common types of corrosion. In this, a corrosion cell is established when two electrodes – cathode and anode – are coupled to set up an electron flow through a corrosive electrolyte that can be in liquid or vapour form. This electron flow is enabled by the different electrode potential between the two electrodes; the metal or part of the metal with lower electrode potential becomes the anode, loses electrons and becomes oxidized, while the cathode gets protected against corrosion. In gilded silver threads even when both metals are noble, their different electrode potentials enable a galvanic couple, where silver acts as anode and gold as cathode, accentuating the corrosion of silver.

Even when the electrode potential is commonly associated only with the metal or alloy place in the galvanic series, corrosion cells do not always need two different metals; it could happen within two different parts of the same metal because a phenomenon known as polarization in which the presence of impurities, dislocations, crystal defects, surface protection or corrosion layers modify the anodic or cathodic behaviour of the metal. The relative size of each electrode is also important since the bigger the size of the cathode, the faster and deeper the damage caused by corrosion. When speaking about plated or gilded metals differential aeration is significant as well. This corrosion mechanism implies that a metal is isolated from the environment by a protective layer, usually a varnish, paint, a metal with passive corrosion or, as in the case of gilded metals, a less reactive one. However, when this layer is porous or damaged, the exposed parts become highly anodic and follow an accelerated galvanic corrosion process since all the still protected surface acts as a cathode. As a result under normal conditions silver usually does not suffer serious corrosion but because of differential aeration it can even show pitting.

In addition, as virtually no gilding technique is perfect enough to avoid pores or cracks, the gold layer allows silver to interact with the environment, providing not only the conditions for galvanic corrosion but also for differential aeration, enhancing the anodic behaviour of the exposed silver. The underlying silver reacts forming silver sulphide that migrates through the micropores of the gilding, which can be develop as an uniform layer on the surface, or beneath the gold layer, causing its separation from the silver core. In the most extreme cases, the gilding can be sustained only by the corrosion products and, as it is obscured by the silver sulphides, it is impossible to notice it with the naked eye (Tapia and Contreras, 2005).

Finally cold worked metals – as those in metallic threads – tend to suffer stress corrosion since their crystal planes suffer dislocations that also constitute anodic points. This phenomenon is accentuated if the material was not annealed or incorrectly annealed.

Conservation treatments

Even when there is no structural or chemical damage caused by silver sulphide on the silk; and its alteration is mainly aesthetical, numerous treatments have been applied in order to clean the metal threads to recover their bright and luxurious appearance.

The cleaning treatments to remove corrosion products are classified as: physical, using abrasives; chemical, using acids, alkalis and chelating agents; and electrolytic and electrochemical methods (Timas-Balazsy and Eastop, 1998). From all of these methods, chemical cleaning using chelating agents has been the most widely used for its fast results and because it can achieve high levels of cleanliness. However, its effectiveness depends on the method followed and the characteristics of the chelating agent, in this case the acidified thiourea solutions.

Thiourea

Silver sulphide is one of the most insoluble salts but can easily be dissolved in acidic solutions including chelating agents such as potassium cyanide, ammonium thiosulphate or thiourea (Selwyn, 2004). Potassium cyanide (Landi, 1998), was very popular until the 1960s, when conservators became aware of its potential danger to health and noticed that it etched silver surfaces (Daniels, 1981), hence thiourea started to be used.

Thiourea or sulphourea, is an organic compound soluble in water and in acidic solutions, which has a similar structure to urea, except that instead of oxygen the acid radical has a sulphur atom. The electrical characteristic provided by this substitution (-2) and its relatively small size makes it very efficient when reacting with transition metal ions to form stable cationic complexes (Landi, 1998; www.mfa.org, 2011). Therefore, thiourea silver cleaning solutions need to be acidic because, with an acidic pH, thiourea breaks the bonds between silver and sulphur leaving the silver in an ionic state and then forming stable silver thioureate compounds.

In 1953 Brenner proposed the use of thiourea in acidic solutions, called "silver dips" to clean silver, making it clear that the best cleaning effect was achieved with pH 1 (Barger and White, 1991). Silver dip is the common name of several formulations of acidic thiourea; Plenderleith (1958) and Stambolow (1966) reported the use of thiourea-hydrochloric acid solutions containing 1% of a non-ionic detergent, this composition became very popular, but many other acids were used. The Missouri group proposed the use of phosphoric acid (Shelly and Kunz, 1974), while others used sulphuric, tartaric and formic acid (Šramek, *et. al*, 1978, Leene, 1972; Howell, 1990; Timar-Balaszy and Eastop, 1998). Usually commercial silver dips use hydrochloric acid and their pH can range from 1 to 0, in order to provide a quick and deep cleaning.

Silver dips have been considered good conservation products because of the slow action and poor cleaning effect of mechanical, electrochemical and electrolytic cleaning methods. The most common application method is using cotton buds which, as the procedure is a fast one, are easily controllable and reduce fibre absorption.

The very acidic pH makes the reactions take place in a few seconds, but in this short time silk could be severely damaged. For this reason textile conservators looked for a safer pH range and a subsequent neutralization (Timar-Balaszy and Eastop, 1998). Another risk is the long-term consequences of the residual chlorine ions, which could react with relative humidity and form hydrochloric acid again.

Experimental

Methodology

1. The selection of the object of study responded to the following criteria:

    - average materials by period: Baroque textiles in Mexico share the same materials; silver, gold and silk.
    - conservation state: all the metal threads have a homogeneous, compact and dark corrosion layer of sulphide silver.
    - authentic metal threads: since gilded and drawn techniques in those dimensions are extremely challenging and it is difficult to find a craftsman to make replicas, current replicas could be unrepresentative due to major variations with the actual manufacture technique.

    The artefact used for this research was an 18th century Mexican Virgin cape belonging to the Franz Mayer Museum (Figure 1). Its conservation state made it possible to take samples without damaging it.

2. Characterization of materials and manufacture technique:

    First observed with the naked eye and then using non-invasive, non-destructive analytical techniques such as X-ray Fluorescence Spectroscopy (XRF). XRF was used in order to characterize the metallic threads composition in situ, before taking samples. This analysis was performed using a portable XRF named S.A.N.D.R.A. under the supervision of Dr. José Luis Ruvalcaba-Sil, Professor at the Physics Institute from the National University of Mexico, (Universidad Nacional Autónoma de México, UNAM). The instrument is equipped with a

Molybdenum X-ray tube detector, suitable for metals; each analysis was done at 45 kV and 0.350 mA for a live-time count of 2 minutes, spot size of 1mm, on 33 points.

In this case the main application of portable XRF was to ensure that the metallic threads met the requirements and were representative enough to be sampled.

3. Sampling:

After characterization two types of threads were identified; one core and two cores. In order to observe differences related to the manufacturing technique, both types were analysed; all samples were taken from inconspicuous parts, and from loose threads. This allowed 54 samples, from about 6mm long, to be taken. Each sample was mounted over a silk fabric, to facilitate the cleaning process and to evaluate the interaction between the cleaning agents and the support fabric. The number of samples matched with the amount of procedures and variables. In order to record the colour, texture and corrosion of each thread as well as evidence of silk decay, photographs were taken using a Leica DML optical microscope.

4. Cleaning:

The samples were cleaned using three different thiourea solutions: a commercial silver dip available in Mexico, called Limpiasteg 130; a formic acid-thiourea solution, and a formic acid-thiourea gel. The different formulations are shown below:

Commercial Silver Dip	**Formic acid-thiourea solution**	**Formic acid-thiourea gel**
pH 0	pH 5.5	pH 5.5
Hydrochloric acid	Formic acid	Formic acid
Thiourea	Thiourea 5%	Thiourea 5%
Water	Distilled water	Distilled water
Fragrance		Hydroxypropyl cellulose
Soap		Triethanol amine

Table 2

The three thiourea products were applied as follows:

	Commercial Silver Dip	**Formic acid-thiourea solution**	**Formic acid-thiourea gel**
Sample size	6mm	6mm	6mm
Mounting	Stitched on silk taffeta	Stitched on silk taffeta	Stitched on silk taffeta
Application	Cotton swab	Cotton swab	Paintbrush
Time	5 seconds	10 seconds	30 seconds
Clearing	Cotton bud with distilled water	Cotton bud with distilled water	Cotton bud with distilled water
Time	10 seconds	10 seconds	30 seconds

Table 3

5. Assessment:

   To observe the particular decay and effects of the three different cleaning materials on the threads, their appearance was recorded using an optical microscope and via SEM using a JEOL JSM-6460 Scanning Electron Microscope under Low Vacuum pressure, prior and after the cleaning treatment. Residues of the cleaning materials were looked for using an INCAX-sight Energy Dispersive X-Ray Spectrometer (EDX) Mod 7573 by Oxford Instruments, coupled to the SEM.

Results

XRF results determined that the main constituent elements of the upper layer (gilding) were silver (Ag), gold (Au), and Ag and copper (Cu) plus traces of nickel (Ni) and iron (Fe) for the nucleus layer. The 33 spots analysed showed a very homogeneous composition. SEM-EDX images and results revealed interesting aspects of the manufacturing technique like the heterogeneous composition of the gilding layer and the deformation of the metal grains in the longitudinal direction due to wire drawing.

Under 50x optical magnification, the corrosion layer was easy to observe; for the first group of one core threads the corrosion products appeared as a compact and uniform layer. The corrosion layer of the second group was not so uniform, appearing segmented and even detached from the metal. In both cases the silk core was yellow and had no evidence of damage, since it was well covered by the metal filament (Figure 2).

	One core threads			**Two core threads**		
	Commercial Silver Dip	**Formic acid-thiourea solution**	**Formic acid-thiourea gel**	**Commercial Silver Dip**	**Formic acid-thiourea solution**	**Formic acid-thiourea gel**
Cleanliness level	Medium to high	Medium to low	Medium to low	High	Medium to high	Medium to high
Deformation	Medium to low	Medium to low	Medium to low	Medium	Medium	Medium

Table 4

After cleaning with the different materials, the new micrographs showed evident changes due to the cleaning treatments; the cleanliness level reached and deformations.

In cross section it was clear that the gilding on the exposed side is significantly thinner than that on the unexposed one, presumably this is due to abrasion during use and because of damage caused by corrosion. Also it was quite surprising to notice that the silver sulphide crystals formed two separated layers, in the same manner the cross section exposed particular corrosion behaviour: on the one core threads the silver showed pitting corrosion, but on the two core threads the gilding layer had bad adherence to the silver support and it is possible to observe silver sulphide below the gold layer (Figures 4 and 5).

Through Backscattered Electron Imaging (BEI), those one core samples cleaned with commercial silver dip exhibited deep elimination of sulphides, but the cleaning was so aggressive that it removed the gilding as well, leaving the silver exposed in some areas. By using EDX it was not possible to determine the presence of residual chlorine ions as this instrument resolution is not reliable for concentrations up to 100ppm. On the other hand, the samples cleaned with formic acid-thiourea solution and formic acid-thiourea gel reached a medium to low level of cleanliness that was very similar, the main difference lying with the gel residues. The concentration of sulphur measured by

EDX showed that commercial silver dip dissolved more sulphides, and also parts of the gilding layer; but for the two core threads all the treatments proved destructive because of the poor linkage between the gold layer and the silver nucleus (Figure 6).

Discussion

The main objective of this work was to establish the advantages and disadvantages of three different materials used for the chemical cleaning of gilded silver threads in order to evaluate its effectiveness, but during the process other data relevant to understanding the specific degradation of the gilded wires was obtained.

During this research it was possible to observe two kinds of deterioration phenomena over the gilt layer, probably caused by differences in the manufacturing procedures that need to be further researched. Pitting corrosion, that is unusual for silver, is observed in this kind of situation because of the presence of multiple anodic and cathodic areas on the metal surface and the mechanic stress caused due to fabrication and sewing action.

It was clear that the cleanliness level reached depends firstly on the deterioration of threads that could not be homogenous along the artefact. Secondly, even using the same chelating agent (thiourea) preparations influences the results because of differences in the ionisation potential of the selected acid. Under this criterion commercial silver dip was the more aggressive by dissolving silver sulphides, including those that were in the gilding layer pores and below it; as a result, some sections lost not only corrosion but also the gilding. Although this effect was not visible to the naked eye, it was very clear when observed under optical microscope or by SEM. On the other hand, the other two materials had milder effects on the silver sulphides and had no major differences, except from the fact that it was difficult to remove the gel residues.

In general, because of the thread structure (round) none of these materials could eliminate all the corrosion; at least 40% of the corroded surface remained intact, leaving corroded and clean areas on the same strand. And it is important to remember that since there are clean and corroded areas, differential aeration will take place again, so the clean surface will show an anodic behaviour while the corroded one will act as cathode, and therefore the clean area will be exposed to a fast corrosion process.

Conclusion

From the results of this work it can be said that gilded silver threads undergo at least three different corrosion processes: stress corrosion, differential aeration, and galvanic corrosion. This makes it particularly difficult to suggest a cleaning treatment. Firstly, if the gilded layer is separated from its silver nucleus, almost every procedure will cause further damage. In addition, if using chemical cleaning it must be highlighted that gilded silver threads suffering pitting corrosion would be seriously affected by strong acids which will dissolve the silver nucleus, causing loss of material, not to mention the fact that textile fibres would suffer effects like discolouring, loss of strength, losses and even complete dissolution.

In addition, in neither case did the tested treatments achieved the complete removal of silver sulphide, given the very complex structure of the textile the surfaces cannot be completely golden and bright again; corrosion is not only present on the exposed surface, or hidden in the intricate structure of the textile ligament, but also on the inner walls next to the silk core.

Finally, it is necessary to question the purpose of cleaning; removing the corrosion products of silver could recover some of the glitter of gold but the results cannot be optimal for the objects' appearance and stability. So, conservators must be aware that because of the characteristic deterioration of the threads and the cleaning treatments currently available, cleaning corrosion will jeopardize the stability of an object in the medium or long term.

Acknowledgements

Dr José Luis Ruvalcaba-Sil, Institute of Physics, UNAM and Museo Franz Mayer.

References

Barger S and White W. 1991. T*he Daguerreotype Nineteenth Century Technology and Modern Science.* Baltimore and London: The Johns Hopkins University Press.

Barger, M S, Krishnaswamy S V and Messier R. 1982. The Cleaning of Daguerreotypes: Comparison of Cleaning Methods. *Journal of the American Institute of Conservation*, Vol 22, No 1, Art 2.

Contreras J. 2010. El Camino de la Fórmula. *Intervención, Revista Internacional de Conservación, Restauración y Museología*, México: INAH, No. 1.

Járó M and Tóth A. 1993. *Technical revolutions in producing gold threads used for European textile decoration*, Societé des Amis du Musée des Natiquités Nationales et du cháteu de Saint-Germain, Laye, Antiquités Nationales Mémoires, Outils et ateliers d´orfèvres des temps anciens, Saint Germain.

Landi S. 1992. *The Textile Conservator's Manual.* London: Butterworth-Heinemann.

Leene J. 1972. *Textile Conservation, The International Institute for conservation of Historic and Artistic Works*, London: Butterworths.

Plenderleith H. 1956. *The conservation of antiquities and works of art: treatment, repair, and restoration.* London: Oxford University Press.

Scott D. 1991. *Microstructure of Ancient and Historic Metals*, GCI, pp29-32.

Selwyn L. 2004. *Metals and Corrosion. A handbook for the Conservation Professional.* Ottawa: CCI-ICC.

Shelley M and Kunz N. 1974. Seminar on Photographic conservation. B*ulletin of the American Institute for Conservation of Historic and Artistic Works*, Vol 15, No 1.

Šramek J, Jakobsen T B and Pelikan J B. 1978. Corrosion and Conservation of a Silver Visceral Vessel from the Beginning of the Seventeenth Century. *Studies in Conservation,* Vol. 23, No. 3.

Stambolov T. 1966. Removal of Corrosion on an Eighteenth-Century Silver Bowl. *Studies in Conservation*, Vol. 11, No. 1.

Thickett D and Hockey M. 2003. *The effects of Conservation treatments on the subsequent tarnishing of silver.* Conservation Science 2002, pp155-161.

Timar-Balazsy A and Eastop D. 1998. *Chemical Principles of Textile Conservation.* Oxford: Butterworth-Heinemann.

Museum of Fine Arts, Boston, Cameo, *Conservation and Art Material Encyclopedia.* http://cameo.mfa.org/ Accessed: March 2011.

Figure 1
Virgin cape on exhibition.
Image by Ingrid Jiménez

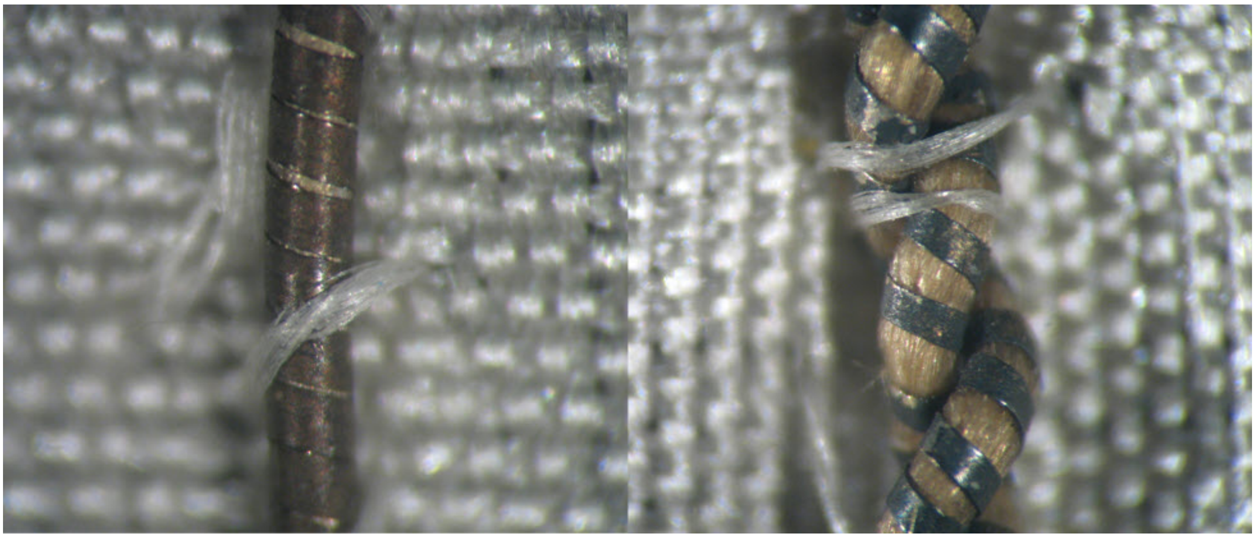


Figure 2
The two types of thread samples, before treatment, magnification 50x.
Image by Ingrid Jiménez

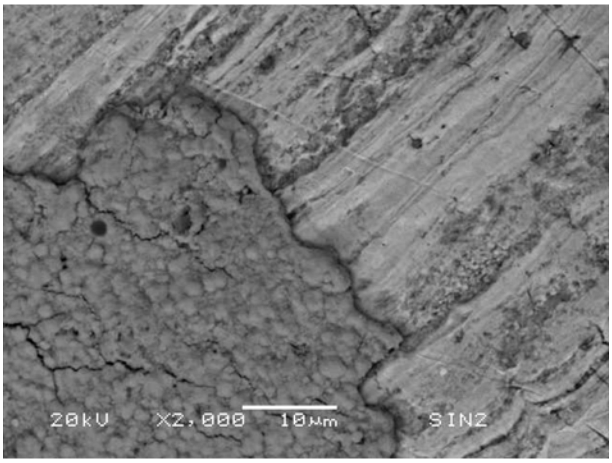


Figure 3
Gilded surface detail: on the left with a corrosion layer, on the right homogeneous gilding layer.
SEM image by Gerardo Villa

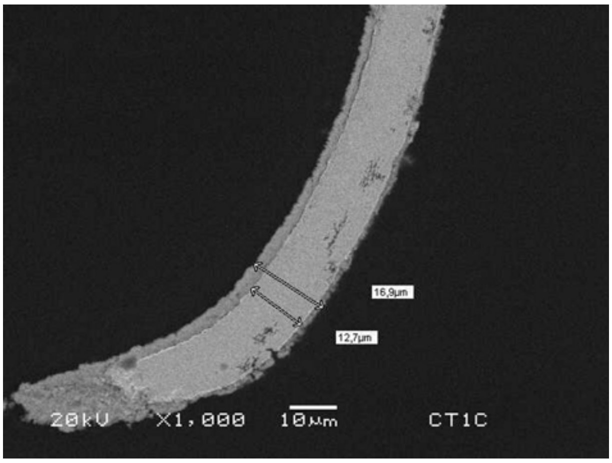


Figure 4
Cross-section detail of the one core thread, the thinnest white lines correspond to the gilding layer.
SEM image by Gerardo Villa

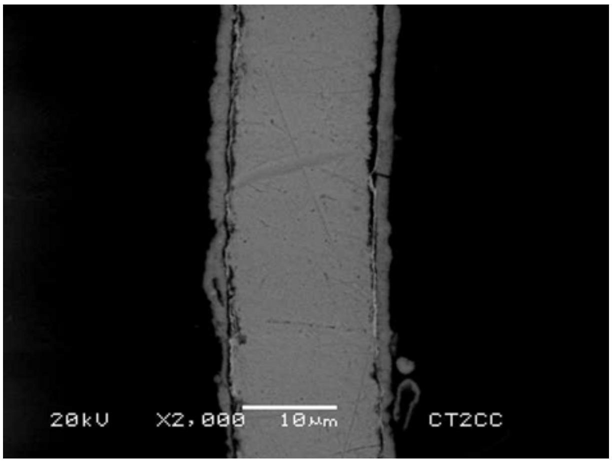


Figure 5
Cross-section detail of the two cores thread, gilding layer is straightening out from silver nucleus.
SEM image by Gerardo Villa

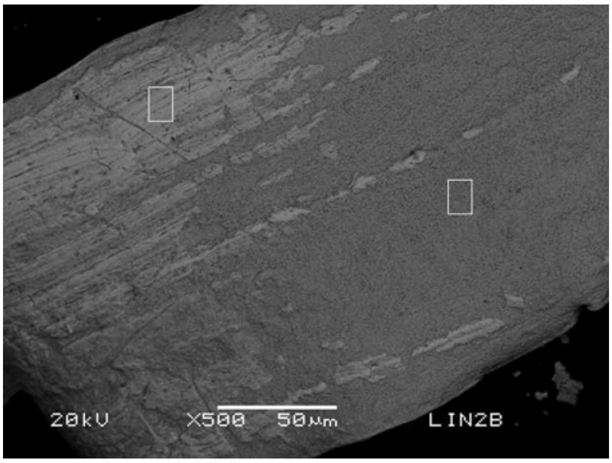


Figure 6
Detail of one of the two cores thread showing its silver nucleus.
SEM image by Gerardo Villa

Unfolding the fear: approaching the conservation of fans

Anne Amosford, *Textile Conservator, Royal Albert Memorial Museum*
Morwena Stephens ***ACR****, Textiles & Ethnographic Artefacts Conservator, Freelance, Exeter*

Introduction

This paper discusses the conservation of five folding fans. Four were from The Royal Albert Memorial Museum (RAMM) in Exeter and the other from Kingston Lacy, a National Trust property. RAMM is undergoing redevelopment and is due to reopen in December 2011. This project led to the conservation of these fans being undertaken. The fans under discussion date from the 17th to the 19th centuries and were chosen for display because they showed a range of materials and influences from around the world. The fan from Kingston Lacy needed conservation because it had sustained damage through being dropped whilst on loan.

Approaching fans

Fans are challenging both in the materials they present but perhaps more significantly in their construction. Many conservators tend to shy away from them. Due to their structure there is little room for access to support damaged areas and no scope for adjustment and, because fans are ephemeral they are prone to further damage through inappropriate handling.

During the conservation of this group of folding fans an attempt was made to understand the factors of deterioration, conservation requirements and constraints that were particular to this object type. This would enable the development of more systematic knowledge of the folding fan and confidence in undertaking their conservation.

Construction and materials

Folding fans are constructed from a series of sticks, extending into ribs to which either a single or double 'leaf' is attached (Figure 1). Two types were encountered, one where two leaves were attached back to back to enclose the ribs and one where a single leaf was held in place by being slotted onto the ribs by means of holes cut in the leaf. The base of the sticks are secured together by a rivet, washer and sometimes a loop to which various decorative elements can be attached. Two outer guard sticks protect the whole when closed.

Materials encountered in the construction of fan sticks are ivory, bone, tortoiseshell, bamboo or wood often with applied or carved decoration. Ribs can be integral with the sticks or made from a different material before being joined. Leaves are generally made from silk, paper, silk attached to paper, vellum or 'chicken skin' (made from the skin of aborted calves) (Hermans 1992). Decoration too is found in many media such as painting, appliqué and stitched sequins and spangles. The leaf is often finished with a neatening strip known as the ribbon.

Factors of deterioration

The deterioration exhibited tends to follow a certain pattern determined by the construction, combination of materials and function of the folding fans. The folded construction leads to surface damage along fold lines, such as paint loss, abrasion and cracking. The folding can also lead to splitting along fold lines, especially at the top and bottom of the leaf but sometimes along the whole length of a fold (Figure 2). The ribbon may also split along the perimeter of the leaf over which it is folded. Tears are found in the bottom of the leaf along the edges of the ribs where there is tension between the rigid stick/rib material and the flexible leaf. The junction between the rib and the sticks, particularly where they are of different materials, can show signs of damage, such as breaks in the weaker material. The close and constrained assembly of materials with different responses to changes in relative humidity and temperature makes fans particularly vulnerable to these patterns of structural damage. There can also be corrosion staining where metal elements, such as the rivet or applied spangles are exposed to damp conditions when folded and corrosion is transferred to adjacent areas of the leaf.

The historic use of the folding fan may have further exacerbated the damage: the mechanical action of opening and closing the fan abrading the surfaces of the leaf and putting the weakened fold lines under further tension, particularly during the action of fanning when air resistance acts on the open leaf. Many fans have broken and repaired guard sticks with damage to the adjacent leaf. This generally appears to be due to the closed fan having been knocked against a hard surface. Many of the fans are covered in soiling, possibly from exposure to historic heating systems and urban pollution.

Many fans have previous repairs, possibly for continuing use or to reflect their high personal or material value. Repairs encountered include stitched (Figure 3) and adhesive methods, sometimes in combination with paper or textile patches or self-adhesive tape. Sticks and guards have been repaired with rivets and splints of card or metal. Some repairs are stable and not disfiguring while others are failing or covering large areas of original decorative surface. Singer and Hermans (1988) also point out that many old repairs add bulk and stiffness to the fan structure 'interfering with the mechanics of folding and thus causing further damage'.

Challenges for conservation

In addition to their deterioration folding fans present other challenges to textile conservators. They include the mixed, non-textile, water-sensitive materials found in fans and their tight, three dimensional, usually adhered construction. Most fans are either double-sided or semi-transparent, posing similar challenges to those of double sided silk banners. Fans often exhibit severe structural damage but present little available surface onto which to apply a support. Furthermore, the folding function of fans is a defining characteristic which may need to be preserved after conservation. Fans are frequently displayed open as art objects with their function an assumed part of their history but it is conceivable that the custodian require the fan to continue to be folded, especially where space constraints for a stored collection require this.

Approach to conservation

When planning the conservation of any object or group of objects it is important to be clear about the factors that influence treatment decisions, as discussed by Orlofsky et al (2010). The approach to treating these fans needs to address the challenges that folding fans present within the individual treatment context for each object. As with other conservation projects (e.g. those discussed by Lennard and Ewer (2010)) it is necessary to establish the reason for conservation, such as long term stabilisation or display for short- or long term exhibition together with how the object is to be supported on display and/or in storage. The mount may be determined by whether the fan is being displayed as an art object, e.g. in a frame, or to illustrate its function, which in turn will affect how both the sticks and leaf are supported.

It is essential to establish whether the fan is to be folded again as this may affect the choice of support materials, particularly adhesives. Often the custodian can be persuaded that the fan will be best preserved open with good support. This requires space and a suitable storage mount (Hermans 1992 points out that warping mechanical damage may occur if unsupported) and also, arguably compromises the integrity of the object as a *folding* fan. During the conservation of this group of fans permission was given for the fans to be preserved open so materials testing did not extend to finding a combination that would ensure long term preservation of the folding function. Another consideration is the addition of bulk that support materials would add (Singer and

Hermans 1988). The frequency with which a fan is opened and closed will have a bearing on the fan's long term condition and would need to be agreed with the custodian.

Conservation treatments are constrained to some extent by available resources, such as time and money (when much conservation is project-led and funded, e.g. Kite (2010)), analytical (in terms of the equipment and skills available and necessary to make conservation decisions), and skills where it may be advisable to collaborate with colleagues such as paper or objects conservators. It is also important to be aware of the range of materials and methods that may be suitable and to gain familiarity with applying them, in trials.

Another factor to consider is the degree of intervention involved, partly governed by the context of the treatment, e.g. display or storage, and the aesthetic wishes of the custodian but may also be influenced by the experience of individual conservators from a decorative arts or ethnographic background. Some published examples involve the necessary dismantling of fans (Singer and Hermans 1988) and/or use of repair materials contemporary to the fan or identical to those used in construction (Singer and Hermans 1988). The examples in this paper generally employ a more conservative approach of minimal intervention and easily sourced conservation materials.

Adhesives considered

The support material selected depended on the materials being supported and a range of Japanese papers were found to be useful as was silk crepeline (eg Singer and Hermans 1988) in some cases. For most fans adhesives were deemed more appropriate than stitching to apply the support and a range of adhesives were tested. They were chosen for testing based on the literature and past experience. They were tested for: strength of the bond; flexibility; appearance and ease of use. The tests were done by rating samples for each criteria rather than taking specific measurements and as such are rather subjective and should be repeated with the resources to accurately quantify the results. Examples used by other authors include a 2:1 mixture of rice starch and methyl cellulose (Brenner 2007); wheat paste (Singer and Hermans 1988; Liébard 1993) and/or heat seal adhesive (Hopper and Sloper 1983; Liébard 1993); Klucel G in industrial methylated spirits (IMS) (Hermans 1992; Liébard 1993) methyl cellulose (Liébard 1993); and an ethanol- reactivated mixture of Lascaux 360 HV and 498HV (Carroll and Young 2002).

Japanese kuranai paper 9gsm was tested with the adhesives:
- wheat starch paste (10g in 40ml water) selected as used in flexible scrolls
- 5% methyl cellulose (MC) in deionised water reactivated by humidification
- 5% methyl cellulose in deionised water /IMS (1:1);
- 15% Lascaux 360 HV and 498 HV (1:1, v/v) in deionised water and acetone (1:1) film reactivated with acetone through 'Sympatex' as used for semi-transparent overlays (e.g. Takami & Eastop 2002).
- Arrowroot starch (9%) and sodium alginate (1%) paste selected as used in basketry conservation for its strength and flexibility.

Adhesive	Strength	Flexibility	Appearance	Ease of use
15% Lascaux 360/498HV reactivated	Inadequate			Difficult to maintain correct tension in mock object.
5% methyl cellulose in water reactivated by humidification	Poor			Reasonable
Wheat starch paste	Good	Flexible	Matte	Moisture distorts substrate and curls patch, slow to dry.
5% methyl cellulose in water/IMS	Good	Flexible but peels	Slight shine	Good, tacky, dries quite quickly.
Arrowroot starch/ sodium alginate	Good	Flexible	Shiny	Good but curls paper patch

The reactivated adhesives did not appear to offer sufficient strength for repairs to fan leaves which are under tension and where there is little surface area onto which to apply a support. The wheat starch paste was difficult to use on narrow support patches as it caused the paper to curl and contained excessive moisture, distorting the substrate (Carroll and Young 2002). It would be useful to carry out more tests with aged Japanese wheat starch paste which 'provides a weaker more flexible adhesive' (Thompson 1991) and is used in the construction and conservation of scrolls.

Japanese paper was found to be a successful support material when used in conjunction with adhesives as it could be keyed into the surface of the object by lightly tamping with a brush. This ensured good contact between the object and support material.

Conservation process

The first step was to ensure that the fan was supported throughout the treatment stages by making a working mount. In most cases this was from stepped wedges of polyester felt or thin Plastazote, stitched together and covered in acid-free tissue or spider tissue. It was found to be sufficient if the mount was stepped for every three-four folds of the fan. A curved hole was cut in the mount where the sticks are joined at the base to accommodate the thickness (Figure 4). Where closer support was required it could be provided by folded acid free card (Fuenzalida Morales 2005) covered in silicon release paper.

The next stages, illustrated by the case studies, involved deciding the extent to which to reverse past repairs; the extent to which to disassemble the fan, selecting materials and methods for reversing repairs and for stabilising each damaged element. Choices about removing past repairs were governed by how damaging, disfiguring or unstable they were and also by the ease with which they could be reversed and what might be hidden beneath. In most cases any separation of the elements of the fan was localised but in one case more extensive disassembly was required.

Case studies

Mount Vesuvius, late eighteenth/early nineteenth century

Probably a souvenir from the Grand Tour and either made in Italy or the leaf was brought back and the fan made up on return.

Construction

It was constructed from fourteen carved and gilded ivory sticks, two carved ivory guards decorated with ground shell, gilding and mother of pearl backing. The front leaf of polychrome painted 'chicken skin' depicted scenes of Vesuvius and Pompeii. The reverse leaf of paper had a central sepia printed cartouche of an elegant lady. The fan was finished with a gilt paper ribbon, a metal rivet and Mother of pearl washers.

Condition

The main damage encountered on this fan included general soiling, splitting and curling of the leaf, distortion of the sticks and ribs and one of the sticks and a guard were broken. In construction the ribs were stuck directly to the leaf and this had caused further damage when the sticks had distorted.

The fan had obviously been well used as was evident in the extensive repairs. On the reverse leaf there were many thick paper repairs which were very disfiguring and one piece of leaf was completely missing. The broken guard was heavily repaired with a thick card splint bridging the break.

Conservation
After careful consideration it was decided to remove the previous repairs in order to give a more uniform image. They were removed manually using damp swabs. Cleaning was undertaken using smoke sponge for the leaf mainly on the unpainted areas. The sticks and guards were cleaned with swabs of water/IMS (1:1) avoiding the water soluble gilding.

To bridge the splits in the fan leaves, strips of fine Japanese tengujo paper tinted with acrylic paint, were feather cut and adhered to the leaf using 5% methyl cellulose in water/IMS (1:1). They were keyed into place using a fairly stiff brush and dried under slight weight.

A thicker kozo paper tinted with acrylic paint was used to fill the missing area of leaf and a cosmetic strip attached to continue the line of the ribbon (figure 5).

The break in the guard was re-attached using 10% Paraloid B72 in acetone. Conservation took 34 hours.

Cantonese Fan, circa 1860
This fan was made in China for the export market. They are sometimes called fans of 'one thousand faces' after the decorative elements depicting people in scenes of 'everyday' life.

Construction
This fan was made from fourteen carved bone sticks with two carved ivory guard sticks. The ribs were composed of thin bamboo splints adhered to the sticks. Both leaves were constructed from fine tabby woven silk adhered to paper. Decoration on the front showed scenes of small figures composed of appliquéd tabby and twill patterned fabric to imitate costume with tiny pieces of painted ivory applied for the faces, hands and feet. Facial, costume and other details were painted with polychrome pigments. Decoration on the reverse leaf was much plainer showing painted flowers. A metallic paper 'ribbon' neatened the edges of the leaves . A metal rivet and loop with a cream silk knotted tassle finished the fan.

Condition
This fan had sustained extensive damage. The top half of one guard was completely missing and where the first section of leaf would have been attached, the leaves were broken leaving the internal bamboo rib visible. There was abrasion along the folds in the leaf and some splits.

Many disfiguring repairs were present on this fan. When the fan was originally made the leaves were only adhered to each other either side of the ribs. However where the leaves were broken the exposed bamboo rib had been stuck down to the leaf with an unsightly adhesive. This was echoed with other areas of repair where patches of a synthetic fabric had been crudely adhered over lower parts of the front fan leaf where it met the sticks. The adhesive used was very shiny. Tarnishing was present on the metallic 'ribbon' and some pigments were discoloured.

Conservation
The previous repairs were considered for removal. Two types of adhesive were found, one soluble in water and the other in acetone. The painted decoration was water soluble so care had to be taken during adhesive removal. This work was undertaken under x10 magnification.

It soon became apparent that there was an inherent weakness in the sticks where the ribs had broken leaving a small section of the rib still heavily attached to the bone. As the ribs were loose within the fan leaf sandwich many had moved away from the sticks. It was easy to carefully slide them down with tweezers to meet the broken end. They were re-adhered to the sticks with a bridging strip of kozo paper using 5% methyl cellulose in water/IMS (1:1) (Figure 6).

In order to ‘support’ the fan leaves both cosmetic patches of kozo paper and support patches of tengujo were painted with acrylic paints. Loose pieces of leaf were adhered to the tengujo paper using the same adhesive and where possible slotted in and adhered either underneath accessible areas or over the surface. They were keyed into place using a fairly stiff brush and dried under slight weight.

Templates were taken of the missing areas on each leaf and either side was reconstructed separately taking into account their original size. The rib was re-inserted between the leaves before they were adhered to each other along the outer edge (Figure 7). The guard was not reconstructed. Conservation took 60 hours.

Painted vellum fan with tortoiseshell sticks, circa 1650, Netherlands/France

The oldest fan had a single leaf of vellum painted with gouache on both sides, and interwoven onto tortoise shell sticks at two points along each stick. The sticks were adhered to the reverse of the leaf and had painted decoration on the back. The obverse depicts a scene with a church and water in the foreground, set in a border with flowers either side. There were flowers on the reverse. The fan was finished with a copper alloy rivet and a layer of paint for the ribbon.

Condition

There were splits along several of the folds in the leaf, some of which had been stitched up with a coated brown silk thread. There were many splits radiating in from the perimeter of the fan. There was a hole in the centre of the fan, adjacent to a split. Some split edges were distorted, curled or creased and the stick adjacent to the front guard stick appeared to have been broken and then re-adhered.

There was significant paint loss, especially from the obverse of the sticks and the leaf, particularly along the folds and in areas of structural damage. The old stitched repairs pierced the vellum, had caused paint loss and were considered disfiguring. All surfaces were covered in generalised loose particulate and ingrained soiling.

Conservation

The fan was surface cleaned by lightly rolling ‘Groomstick’ (modified vulcanised rubber molecular trap) across the surface of the leaf and sticks. Unpainted areas of the sticks were further cleaned with deionised water using blotted swabs. Following discussions with the curator it was decided to remove the stitched repairs which were disfiguring, did not provide adequate support and were causing localised distortion.

Creased areas were humidified via ‘Sympatex’ (semi-permeable membrane laminated polyester felt) and then the realigned areas were dried under small weights.

As the decoration of the single leaf was less dense on the back it was decided to apply patches to the reverse, colour-matched to the cream vellum but semi-transparent so that covered elements of design would still be visible. Kuranai paper, which has good wet strength, was painted with acrylic paints to match the cream of the leaf reverse. Patches were water-torn, coated with 5% methyl cellulose in deionised water/IMS(1:1) and applied across splits on the reverse. The patches were tamped into place with a soft Japanese brush and left to dry under silicon release paper and small weights (figure 8). The loss in the centre had been supported from the reverse and was visually in-filled from the front by applying a colour-matched blue patch onto this support. The edges of the leaf that were detached from the guard sticks were readhered with the same adhesive using a Melinex spatula. Conservation took 17 hours.

Painted paper fan, early eighteenth century

This fan had bone sticks and a heavily painted paper leaf and lining with gold paper ribbon and copper alloy rivet.

Condition

There was a tear in the leaf with the flap adhered to the adjacent area (figure 9), splits along folds, areas of leaf detached from sticks and two sections of the leaf stuck together. There was also paint loss and damage, soiling and corrosion staining on the ribbon. Damaging past repairs included adhered paper patches on the reverse (Figure 10) and a shiny water soluble adhesive adhering the end sections of the leaf together.

Conservation

Patches were removed from the reverse mechanically and with moisture. Both sides of the leaf were cleaned with Groomstick and the sticks swabbed with water. The fragment adhered to the adjacent part of the leaf was released by humidification. Flaking paint was consolidated with 2% Klucel G in IMS. The adhesive at the folded end softened in moisture but was left as it appeared to be a deliberate intervention to hide paint loss and removal could cause damage. Splits in the obverse were patched through splits in the lining with kuranai paper and 5% methyl cellulose in deionised water/IMS (1:1); splits in the lining were faced with Cibacron-dyed tengujo tissue and wheat starch paste. Lifting edges were readhered with the 5% methly cellulose and the loss infilled on the obverse kuranai tissue patches toned with watercolours. Conservation took 53 hours.

Sequined silk fan, early nineteenth century

This fan had ivory sticks engraved and decorated with gold paint and a leaf of cream silk organza embroidered with copper alloy sequins and spangles and lined with white silk organza. It had a white silk ribbon and the leaf and lining were adhered to the paper-covered ribs, extensions of the sticks.

Condition

The fan had been dropped leading to many splits along folds in both layers of the leaf. There was severe embrittlement of the silk fabrics; corrosion of the spangles and generalised soiling.

Conservation

The sequined and spangled semi-transparent fan could not be supported from the front, so a decision was taken to remove the lining and treat the obverse from the back, while still attached to the sticks. Humidification was used to release the ribbon and lining. The reverse of the leaf was given a patched support with kuranai tissue and 5% methyl cellulose in water/IMS (1:1). The lining was humidified flat and given a full stitched support between two layers of silk crepeline. The supported lining was re-folded after humidification and re-secured to the sticks using the methyl cellulose, as was the ribbon (Figure 11). Conservation took 59 hours.

Mounting the fans for display and storage

The fans for RAMM's redevelopment had individual Perspex display mounts made by the museum's in-house technical team. They were constructed from a single 'leaf' shape of Perspex, stepped to take the displacement of the fan sticks (Figure 12). An integral shelf takes the weight of the fan and where necessary a stainless steel clip is attached to stop the fan closing. The mounts are self supporting on stainless poles which fix into Perspex bases or into a backboard. The Kingston Lacy fan went back into storage for which a 'soft' mount was made from 'Polyfelt' adapted from the working mount and covered with silk habutai.

Conclusions

While this group of fans was made from a variety of materials it soon became clear that a common approach was required for the conservation of all of them. As experience was gained in the conservation of folding fans it became possible to develop a systematic approach to their conservation which it is hoped may be of some use to other textile conservators when presented with these frequently textile-free objects.

Acknowledgements

Alison Hopper Bishop, Shelley Tobin and George Hunt, RAMM; Sarah Stanley and Robert Gray, The National Trust.

References

Brenner R. 2007. XVIII. századi festett papírlegyezo restaurálása. (Restoration of an 18th century painted paper fan.) *Mutárgyvédelem 32* , pp219-233. Extended abstract AATA No. 2010-114552.

Carroll V and Young P. 2002. The language of the fan: a composite object case study. In V Daniels, A Donnithorne, and P Smith, eds. *Works of art on paper: books, documents and photographs: techniques and conservation: contributions to the Baltimore Congress, 2-6 September 2002.* International Institute for Conservation of Historic and Artistic Works(2002), pp42-46.

Fuenzalida Morales M M. 2005. Soluciones para un país deteriorado: restauracíon de un abanico del siglo XVIII. (Solutions for a damaged paper backing: restoration of an 18th-century fan). In: *Conserva 9,* pp17-28.

Hermans J. 1992. Fans on skin: their conservation and storage. In: P Hallebeek, M Kite and C Calnan, eds. *Conservation of Leathercraft and related objects interim symposium at the Victorai and Albert Museum*. ICOM-CC, pp42-44.

Hopper CS and Sloper N. 1983. Fan collection preserved. In Newsletter (Western Association for Art Conservation) 5(1), pp 4-5. http://cool.conservation-us.org/waac/wn/wn05/wn05-1/wn05-104.html Accessed 19/05/2011.

Kite M. 2010. Modern textile conservation at the Victoria and Albert Museum: roots, evolution and rapid changes. In F Lennard and P Ewer, eds. *Textile Conservation: Advances in Practice.* Oxford: Elsevier (Butterworth-Heinemann) pp30-37.

Lennard F and Ewer P. 2010. Treatment options – what are we conserving? In F Lennard and P Ewer, eds. *Textile Conservation: Advances in Practice.* Oxford: Elsevier (Butterworth-Heinemann) pp53-62.

Liébard B. 1993. Conservation d'une collection d'un millier d'éventails au musée Carnavalet. (The conservation of a collection of a thousand fans at the Carnavalet Museum.) In: J Bridgland ed. *10th triennial meeting: Washington, DC, 22-27 August 1993: preprints.* ICOM Committee for Conservation, pp450-456.

Orlofsky P, Barker K, Clark K, Johnson-Dibb R, Kaldany M and Lehrecke B. 2010. Recording change: 1978-2008: the cleaning of a needlework sampler. In F Lennard and P Ewer, eds. *Textile Conservation: Advances in Practice.* Oxford: Elsevier (Butterworth-Heinemann) pp163-171.

Singer L V and Hermans J M. 1988. Conservation of folding fans. In: *The Conservator 12*, pp15-24.

Takami M and Eastop D. 2002. The conservation of a Korean painted silk banner, c.1800: Paint analysis and support via solvent-reactivated acrylic adhesive. In: R Vontobel, ed. *ICOM-CC 13th Triennial Meeting Rio de Janeiro, Preprints.* London: James and James (Science Publishers) Ltd., (II) pp747-754.

Thompson A. 1991. The construction of a Japanese hanging scroll. In: F Butterfield and L Eaton, eds. *Paper and Textiles: the common ground, Preprints.* Edinburgh: SSCR, pp91-94.

Suppliers

Lascaux 360 HV and 498 HV	Conservation Resources Unit 2 Ashville Way Cowley Oxford OX4 6TU UK
Japanese tengujo and kozo papers	Falkiner Fine Papers 76 Southampton Row London WC1B 4AR UK
Japanese kuranai paper, 9gsm	John Purcell Papers Ltd 15 Rumsey Road London SW9 0TR UK
Sodium alginate, acetone, industrial methylated spirits,	Laboratory Analysis Old Mill Industrial Estate Stoke Canon Exeter EX5 4RJ UK
Polyfelt, smoke sponge, methyl cellulose, Paraloid B72, Sympatex	Preservation Equipment Ltd Vinces Road Diss Norfolk IP22 4HQ UK
Silk habutai, silk crepeline	Whaleys of Bradford Ltd Harris Court Great Horton Bradford BD7 4EQ UK
Arrowroot starch	Wholefood store Exeter UK

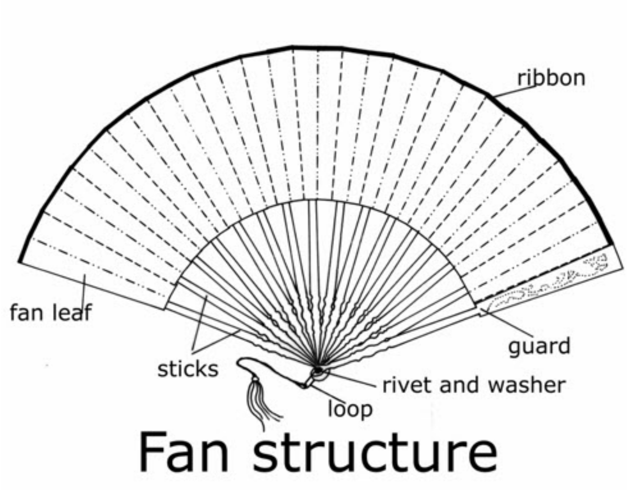


Figure 1

Figure 2
Splitting, curling and abrasion along the fold in the 'chicken skin' fan leaf.

Figure 3
Detail of single vellum leaf fan obverse showing loss and stitched repairs of splits.

Figure 4
Working mount made up of stepped layers of polyfelt.

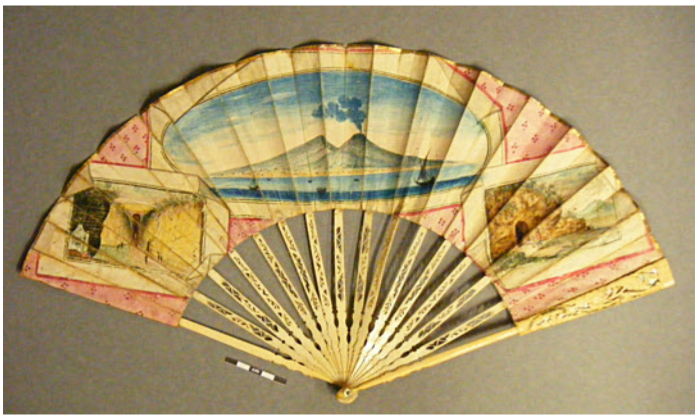


Figure 5
Vesuvius fan after conservation.

Figure 6
Rib with repair strip attached, ready for re-joining to stick (left), right stick shows completed process.

Figure 7
Extension of fan leaf after conservation.

Figure 8
Reverse of vellum leaf after conservation showing semi-transparent paper repair patches. Note that painted design extends across the sticks.

Figure 9
Paper fan showing splits with a torn flap exposing rib.

Figure 10
Reverse of paper fan, heavily soiled with large unsympathetic paper patches.

Fig:ure 11
Sequined and spangled organza fan after conservation and reassembly.

Figure 12
Perspex fan stand seen from the reverse (still with blue protective covering on the base), supporting Vesuvius fan.

Problems with Protective Clothing: the conservation, storage and display of textiles within an arms and armour collection.

Nyssa Mildwaters *and* ***Suzanne Dalewicz-Kitto***
Conservator, Royal Armouries and Conservation Manager, Royal Armouries

Introduction

When discussing arms and armour collections the image that most readily comes to mind, among the public and conservators alike, is that of a knight clad head to toe in heavy plate armour. Although this image is not incorrect it is important to recognise that it represents only a single style of armour from one particular region of the world. Similarly the metal encased knight does not provide us with an accurate representation of the wide variety of materials, which can and are used in the construction of objects found within arms and armour collections.

Textiles are a prime case in point. Although all too often over-looked, textiles have played an important part in the construction and decoration of armour through the ages, ranging in use from the more minor elements of linings, paddings and fastenings through to being the main constituent in some Japanese and Indian armours. Textiles in this type of collection are however rarely found in isolation, but rather in conjunction with metals, wood, leather and plastics all of which bring their own challenges. As generally the most ephemeral component of an armour or associated weaponry, textiles are often the first to be lost or damaged. In the past this has led to a focus on the study and care of the more robust and commonly surviving metal, wood and leather elements. However without the surviving textile components our understanding of the use and function of many of these objects is at the very least incomplete.

For object conservators, with little training in the specialised area of textile conservation, the prospect of dealing with potentially complicated composite textile objects, such as those found in arms and armour collections, can be a daunting challenge. Bearing this in mind the following paper will discuss some of the problems encountered and solutions found, both past and present, by the Conservation Department at the Royal Armouries.

The Survival of Textiles at the Royal Armouries

The Royal Armouries houses the United Kingdom's National Collection of Arms and Armour. The collection originally started life at the Tower of London as the working armoury of the Medieval Kings of England (Parnell 1996:45). Today the Royal Armouries houses a large and varied collection made up of armour, long arms, edged weapons, artillery and of course firearms from both the UK and around the world.

Given the collections origins, as a working armoury, the Royal Armouries is very fortunate to have so many objects where original textiles still survives in situ. Indeed there are accounts that whilst still a military institution soldiers on fatigues were made to clean objects housed around the Tower, including at least one of the collections three suits of armour belonging to Henry VIII, using a combination of oil and brick dust. Such rough treatment over even a short period of time will undoubtedly have led to the loss of numerous textile components in addition to the more gradual deterioration caused by general wear and tear, inappropriate storage conditions and, in some cases, simple neglect.

It has also proved fortuitous that upon setting up a dedicated Conservation Department in the 1940's, the Royal Armouries employed several very talented armourers giving the department a strong mechanical or craftsmanship basis rather than the more chemically orientated departments found at some of the other large arms and armour collections and armouries across Europe around this time. In practise this meant that armours and objects were repaired and, in some cases, restored but never chemically stripped or re-gilded as was, and in some cases still is, common practice in other European armour collections.

Although some of the repairs and restorations carried out at the Royal Armouries and other institutions, such as the Metropolitan Museum of Art in the USA during the 20th century are, to paraphrase Stuart Pyhrr (1996:110), easier to explain today than to justify, they did not necessarily lead to the complete loss of associated textile components that is evident in collections which have been chemically stripped such as that of the Palace Armoury in Malta and the Imperial Palace Armoury in Vienna. A state of affairs for which all those responsible for the study and preservation of the Royal Armouries' collection are extremely grateful.

The Importance of Textiles

The study of the surviving textile components on arms and armour objects can provide a wealth of technological and contextual information, which may not be available or even visible in any other historical sources. Where textiles survive they can provide information about the original construction and manufacture of particular objects. They can demonstrate how an object was used as well as hide evidence of the re-use. The type and style of surviving textile fragments can reflect changes in fashion and developments in technology. There is the potential for textiles to provide evidence about trade routes as well as shedding light on the spread of ideas between different cultures and regions. Finally, and in some ways perhaps the most exciting of all when discussing arms and armour, is that the survival of composite textile armours such as brigandines and jack of plates (types of padded fabric jackets reinforced with metal plates) can give unique insights into the provisioning of lower class or ordinary foot soldiers 'with whom padded and quilted armours were always popular' (Ffoulkes 1988:89) and who are rarely seen in the historical record in any other way.

The potential significance of textiles should clearly never be far from the minds of those responsible for the preservation and study of collections such as those held by the Royal Armouries. The importance of composite textile objects should also ensure that their immediate conservation needs and longer term preservation requirements are an on going priority even in those institutions where it is not possible to have a permanent full time textile conservator within the Conservation Department.

Separating Components

The prospect of conserving a complex composite textile object can at first glance be an intimidating task for any conservator, whether their background is in objects or textile conservation. When faced with such an object one of the questions which will almost inevitably arise at some point is; is it possible to separate the individual components present?

It is in those cases where materials are merely associated with each other rather than physically attached that the separation of individual components can be both the easiest and the most effective method of preventing further deterioration. Take for example the case of a 1972 Walther PP Pistol (XII.11248) still in its original presentation box. Unfortunately the long-term storage of the pistol in its box had allowed time for the red dye contained in the box's velour lining to migrate into the object's white plastic grip giving one side of the pistol a distinctive pinkish hue (Figure 1). The pistol is one of large number of boxed firearms in the Royal Armouries collection and it is simply not practical or desirable to remove all of those objects at risk of this sort of discolouration and potential deterioration from their associated boxes. The solution in this case however was extremely simple; a barrier of Melinex (polyester film) was placed between the object and the offending textile (Figure 2). Although the plastic element of the object has not been completely separated from its associated textile component it is no longer in direct physical contact. As this example shows, the separation of particular components of a composite object can be achieved very effectively in certain circumstances, however few composite textile objects are so easily divided.

Where the individual materials that make up an object are physically attached to one another, whether through stitching, adhesion or riveting, the decision to separate the components present becomes a much larger undertaking with important ethical issues to be taken into consideration such as what information may be lost during the process of separation? Will any damage to the individual materials occurring from separation outweigh that which may occur if left in-situ? How will separation of the components affect our understanding of the object in question from both an academic and visual point of view? Finally, is it possible to ensure that the separated components will remain together into the future?

It is therefore vitally important that prior to starting any conservation treatment where components, particularly textiles are being separated from one another, that the conservator establishes whether the textile present is in fact original or in any way historically important. Once separation/removal has commenced it is essentially impossible to return the object to its pre-treatment state. On at least one occasion, that the authors know of, original textile was removed by a conservator following reassurance from a member of curatorial staff that the fabric had to be a recent addition, only to find half way through the work that the textile was in fact almost certainly original to the object.

It can be easy for both conservators and curators alike to assume that any textile remaining on an object that appears to be in a good condition or that retains a vibrancy of colour is likely to be a more recent historical addition. After all we know that the replacement of textile components like straps and linings often continued long after objects ceased to be used for their original function. Unfortunately such convenient visual cues can be misleading, one need only look at the gun-shields from Henry VIII's arsenal with their bright yellow and red fabric lining in the collections of the Royal Armouries and the Victoria and Albert Museum, to see that some original textiles can survive in a remarkably good condition (Metcalf et al 1996).

The decision to separate the individual components of a composite object should, in the authors' opinion, be taken only after every other available option has been carefully considered and dismissed. Although comprehensive documentation can and has been used effectively to record an object and its construction, there is no getting away from the fact that at the very least original stitching is being lost. At the Royal Armouries this sentiment combined with a practical understanding of the departments strengths and weaknesses, including the absence of a specialist textile conservator, means that wherever possible the Conservation Department will avoid the physical separation of objects beyond that of inserting a barrier layer such as Melinex between components.

Adjusting Treatments

A conservator faced with a complex composite object must look to how the existing treatment options for the individual elements identified, such as wood or metal, can be adjusted to suit the combination of materials present. When developing a course of treatment sympathetic to all the elements of a particular object, in addition to understanding and making allowances for the differing reactions of materials present to chemical treatments, whether in the form of solvents for cleaning or consolidants and adhesives for stabilization, it is also vitally important to understand how repairs to one material may effect others associated with it from a physical perspective. For example, when dealing with mail that is physically attached to an underlying textile, such as one finds in the majority of Japanese armours, the conservator must consider how any physical repairs to the mail may affect the underlying textile. The replacement of missing metal links will redistribute tension and stress across the mail, though beneficial to the areas of mail around a hole or area of damage, such a course of action may potentially lead to further deterioration of an underlying textile that has become torn or weakened as the textile will feel a corresponding redistribution of tension across its own surface. This is not to say that mail should not be repaired but more simply that in addition to considering the types of materials present we as conservators must bear in mind how all the elements present interact physically as well as chemically.

Adaptations to one's existing panoply of skills and techniques need not be drastic, in fact more often than not the most effective and sympathetic treatments used at the Royal Armouries have been those where a very simple alteration to familiar working practices has been implemented. For example, during the recent conservation of a pollaxe (VII.2044) dating to around the 16th century with the original textile covering the object's wooden shaft still apparently present. A method of filling the numerous woodworm holes visible in the textile-covered shaft was required to make the object more visually complete for display (Figure 3). The presence of textiles ruled out the use of materials such as glass micro-balloons or wax as fills, as it would have been extremely hard to fill the holes without some residue accidently finding its way onto the surrounding textile. After careful consideration the solution found was to use twists of roughly colour matched Japanese tissue coated with Lascaux 360HV:498HV (water dispersion of butyl methacrylate copolymer), in a three to one ratio. Once dry the twists could be carefully inserted into the woodworm holes and the adhesive re-activated using a drop of water to ensure the twists would stay firmly in place (Figures 4 and 5). This method, whilst being extremely simple, allowed the holes to be successfully filled without worrying about an adhesive or filling material soaking into or staining the surrounding textile. The fills are also easily removable with minimal solvent use.

Adjusting treatments in the way described above or to include the use of Melinex barriers between metal and textile components during solvent cleaning, or the use of localised suction during mechanical corrosion removal, to prevent the acidic dust produced settling on a surrounding textile, are all relatively straightforward. However it is important to remember that a conservation treatment does not need to be complex to be effective.

Protective Coatings

The use of protective surface coatings is a traditional feature of the care and maintenance of arms and armour both through time and across the world. The application of protective coatings such as Renaissance Micro-Crystalline wax to the surface of metal objects is an important aspect of preventive conservation at the Royal Armouries. The application of coatings, particularly to metals, is designed to protect an object's surface from contaminants, pests and fluctuations in the surrounding environmental conditions as well as mitigating against deterioration caused by handling. Preventing the deterioration of any one of the materials that make up a composite object is extremely important given that 'If one part of a composite piece deteriorates, it can attack other materials, for example as metal corrodes it will create acidity that will attack and break down the organic components' (Horie 1992:342).

Any coating being applied to an object should of course be carefully chosen to ensure that it will not deteriorate with age, potentially making both the object difficult to interpret and the coating itself problematic to remove. Even when a coating has been carefully assessed and found to be suitable for the object and materials in question, incautious application can cause staining to surrounding elements as well as potentially attracting dust, dirt and even moisture. For example the traditional coating applied to the metal components of Japanese armour is Japanese Clove Oil. While good quality Japanese Clove Oil does not cause staining when it comes into contact with textiles or other organic components, some leading museums have been concerned by the fact that the oil does not always dry and therefore may attract dust. The experience of the conservators at the Royal Armouries however has been that if applied using the correct traditional Japanese techniques the oil will become dry to the touch, meaning that dust accumulation no longer presents a problem. In some cases therefore it is the manner of application, as much as, the product being applied, which can determine how successful or appropriate a protective coating is.

As part of a wider project to assess the merits of a variety of different products, which have been used as protective metal coatings for arms and armour both in the past and at present from an objective conservation point of view, the Royal Armouries has investigated the affect of seventeen of these protective coatings on cotton and silk substrates (Kitto 2007). As both cotton and silk are relatively commonly found in composite textile armours, particularly those originating from Japan and India, unbleached cotton and silk were chosen as suitable sample materials to provide a basic understanding of any effects the selected coatings may have on organic materials should they accidentally come into contact during application. The combined results of the accelerated age testing and photolytic deterioration testing (Figures 6 and 7) can be seen in the Table 1 below.

Material	Suitability with Organics
Renaissance Micro-crystalline Wax	Permanent
Staples Wax	Permanent
Japanese Clove Oil (1% clove oil in mineral oil)	Permanent
Ghee	Permanent
WD 40	Permanent
Pendleton Royal – Light Gun Oil	Permanent
G403 (grease)	Permanent
Rangoon Oil	Permanent
OX 24 (synthetic oil)	Permanent
BrunOx Oil	Permanent
Coconut Oil	Temporary (6 months)
3in1 Oil	Temporary (6 months)
Supertrol 001	Unsuitable
Lanolin	Unsuitable
Standard Clove Oil	Unsuitable
Boiled Linseed Oil	Unsuitable
Youngs 303 Oil	Unsuitable

Table 1

Although only a small range of coatings from traditional, military and conservation sources were tested the results have proved that some materials which may not at first glance have appeared suitable for use on composite textile objects such BrunOx Oil should not necessarily be immediately ruled out by conservators. There are of course limitations to these tests, the most obvious being that the majority of textiles found on objects have been dyed or treated in one way or another, something which was not replicated here. It is hoped however that more testing of this nature will be carried out in the future on a wider range of textiles in order to further increase our knowledge of how the protective coatings we have used both in the past and at present affect the textiles they may come into contact with.

Modern Materials – A Problem for the Future

The Royal Armouries active collections policy not only ensures that the museum continues to collect and preserve objects that represent the development of arms and armour both in the UK and around the world, but also ensures that the Conservation Department is responsible for an increasing number of objects made from modern materials and textiles. When dealing with objects acquired from a military background however this process can be made even harder by the fact that the materials present are likely to be at or at least very near the very cutting edge of recent technological developments. Even where objects have been donated directly from a manufacturer, the companies responsible for the research and development of a particular object and its component materials are perhaps understandably unwilling to share detailed and potentially commercially sensitive information regarding their products.

It is also important to bear in mind the fact that, in addition to the use of textiles such a Kevlar® and Nomex®, objects for modern military and law enforcement use may also have been coated with chemicals to provide fire or mould resistance as well as potentially to provide infra-red reflectivity and radar adsorption where comprehensive camouflaging capabilities are required (Musgrave 2004:55). As well as the chemicals applied to the objects before use conservators must also be aware that it is also possible that those who used the objects applied further chemicals such as the insect repellent DEET (n-Diethyl-m-toluamide), 'which will attack and melt nylon and destroy plastics as well as affecting other materials such as paint and wood finishes' (Kitto 2004:196), whose long term affect on modern composite objects is unknown.

Although the Royal Armouries has had relatively few problems with modern composite textile objects to date, it is important to be aware that these objects have the potential to be extremely problematic in the future, as other complex modern objects such as the NASA spacesuits at the Smithsonian Institute have demonstrated (Baker and McManus. 1993). Bearing this in mind the Royal Armouries Conservation and Curatorial teams hope in the future to conduct an in depth survey of the modern materials present in our collection in order to better prepare for and hopefully mitigate any longer term preservation issues.

Effective Collaborations

When dealing with large or complicated composite textile objects collaboration with other conservators, perhaps from specialist disciplines and museum curators is essential as no one person is likely to have all the knowledge required to fully understand, interpret and treat a complex object. Involving a wide range of individuals, even if just via email, will allow the conservator to consider every option available to them and how those options may in turn impact upon the object they are required to treat. Collaborative projects are also an excellent opportunity to learn a great deal about an individual or even a group of objects, whilst making use of resources not normally available on a day-to-day basis.

Even if an object is being prepared primarily for display other considerations such as future storage and the effect of any treatment on future research should also be carefully thought through. Where a collaborative project has been particularly effective some aspects of the work carried out can often be taken and applied to other similar objects. For example in 1996 a collaborative project was carried out between the Royal Armouries and two independent textiles conservators, with the aim of conserving a 17th century suit of Japanese armour presented to James I in 1613 using 'minimal remedial intervention whilst retaining the appearance of traditional display' (Guppy et al. 1997:59). The treatment of the armour was an undoubted success however perhaps the most important outcome of the project was in fact the development of a new mounting system that allowed the armour to be fully supported whilst, still appearing to be mounted on the objects traditional wooden armour stand. The mounting system developed by Guppy, Singer and Wylie is now used to support almost all the Japanese armours in the Royal Armouries collection both on display and during storage (Figures 8 and 9). Without the combined skills of the individuals involved in this project and the time and money allocated, it is unlikely that such a successful mounting system would have been developed, the value of such collaborative endeavours should therefore never be under estimated.

Final Thoughts

Given the enormous variety of objects and materials that fall under the heading composite textile objects within an arms and armour collection, this paper has only been able to begin scratching the surface of this exciting though often problematic area of conservation. Despite this the proceeding discussions have hopefully demonstrated that conservators, whether object or textile specialists, should not be afraid of tackling these types of composite textile objects. The creation of sympathetic conservation treatments can easily be achieved if both the physical and chemical properties of all the elements present are understood, and any potential problem are approached with a willingness to modify and adapt, existing tried and tested techniques and materials.

Whilst the sentiment expressed above remains true, it is also very important for individual conservators to know the limits of their expertise and not be afraid to admit that the treatment of a particular object may require the input of a conservator from another area of the profession who has a slightly different skill set to their own. This is not to say that either a textile or an objects conservator should be thought better placed to treat these types of objects but rather that all those with skills relevant to the treatment of a particular object should be utilised. Collaborative projects where the knowledge and expertise of multiple individuals, including conservators, scientists and curators, are combined can after all produce some truly excellent results and should in the authors' opinion be undertaken wherever possible.

Bibliography

Baker M and McManus E. 1993. Spacesuits: NASA's Dream – Conservator's Nightmare. In; Grattan, D. ed. *Saving the Twentieth Century: The Conservation of Modern Materials.* Ottawa: Canadian Conservation Institute pp223-228.

Ffoulkes C. 1988. *The Armourer and His Craft: From the XIth to the XVIth Century*. New York: Dover Publications.

Guppy A, Singer P and Wylie A. 1997. A Seventeenth-Century Suit of Japanese Armour with Original Textile Components: its Description, Conservation and Mounting. *The Conservator.* Number 21 pp59-69.

Horie C V. 1992. Conservation and storage: leather objects. In: Thomson J M A ed. *Manual of Curatorship*. Oxford: Butterworth-Heinemann.

Kitto S. 2004. Plastics in arms and armour in the Royal Armouries collection. *Arms and Armour Journal.* Volume 1, Number 2 pp189-203.

Kitto S. 2007. Skin Deep: An Investigation into Protective Surface Coatings on Arms and Armour. In: Reichl-Hamm C. ed. *The Universal Heritage of Arms and Military History: Challenges and Choices in a Changing World. ICOMAM 18th Triannial Conference, Vienna.* Wein: Heeresgeschichtliches Museum pp215-227.

Metcalf S, North A and Balfour D. 1996. The Conservation of a gun-shield from the arsenal of Henry VIII. Textiles meet arms and armour: The benefits of a multi-disciplinary research approach. In: Smith R. ed. *Make All Sure: The conservation and restoration of arms and armour*. Leeds: Basiliscoe Press pp76-90.

Musgrove P. 2004. Textiles in Deployable Shelters. In: *Technical Textiles for Security and Defence. Conference Proceedings.*

Parnell G. 1993. *The Tower of London.* London: Batsford.

Pyhrr S. 2006. A history of arms and armour conservation at the Metropolitan Museum. In: Smith, R. ed. *Make All Sure: The conservation and restoration of arms and armour.* Leeds: Basiliscoe Press pp105-113.

Figure 1
Photograph showing the results of dye migrating into the white plastic grip of a 1972 Walther PP Pistol (XII.11248) from its velour lined box.

Figure 2
Photograph showing the Melinex barrier inserted into the 1972 Walther PP Pistol (XII.11248) case to separate the pistols plastic grip from the red velour lining of the case.

Figure 3
Photograph showing woodworm holes in a section of the textile lined shaft of a 16th Century pollaxe (VII.2044), prior to treatment.

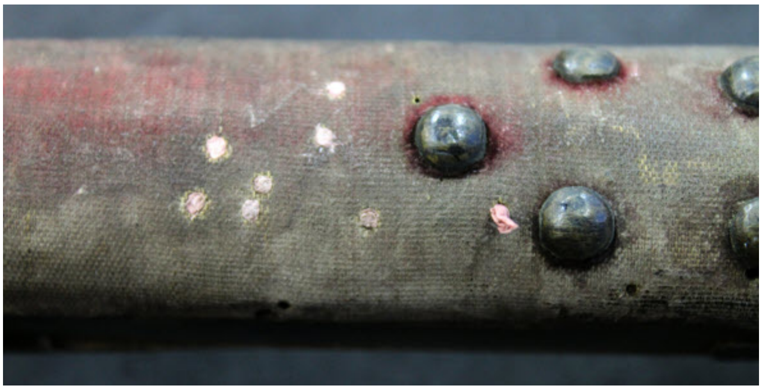


Figure 4
Photograph showing a section of the pollaxe shaft (VII.2044) during treatment, with the woodworm holes being filled using adhesive coated twists of coloured Japanese tissue.

Figure 5
Photograph showing a section of the pollaxe shaft (VII.2044) after treatment, with the Japanese tissue twist secured in place.

Figure 6
Photograph showing ten of the seventeen protective coatings being tested by the Royal Armouries on their cotton samples immediately following application of the coatings.

1 Control
2 WD40
3 3in1 Oil
4 Microcrystalline Wax
5 BrunOx Oil
6 Pendleton Royal Light Gun Oil
7 OX24
8 Lanolin
9 G403
10 Japanese Clove Oil.)

Figure 7
Photograph showing ten of the seventeen protective coatings being tested by the Royal Armouries on their cotton samples following photolytic deterioration testing.

1 Control
2 WD40
3 3in1 Oil
4 Microcrystalline Wax
5 BrunOx Oil
6 Pendleton Royal Light Gun Oil
7 OX24
8 Lanolin
9 G403
10 Japanese Clove Oil.)

Figure 8
Photograph showing a front view of a Japanese Armour (XXVIA.214) stored on the mounting system developed by Guppy et el (1997), with the traditional wooden stand still forming an integral part of the mount.

Figure 9
Photograph showing a side view of a Japanese Armour (XXVIA.214) stored on the mounting system developed by Guppy et al (1997). The shoulders in particular are fully supported in a way not possible using only a traditional wooden mount.

Conservation of an Asante Chief's War Costume

Gabriella Barbieri
Textile Conservator, National Museums Scotland (NMS)

Introduction

This paper will present the investigation, conservation and display of a group of objects known as the Kwamin Regalia (Figure 1), a mixed media 19th century costume ensemble from Ghana, West Africa. The garments were worn by Kwamin Intsiaku, Chief of Sarman, and were acquired at Elmina, a former Portuguese port on the Ghanaian coast and the first European settlement in West Africa. The outfit is to go on display in the World Cultures Galleries of the Royal Museum in Edinburgh, part of a major redevelopment project currently underway at National Museums Scotland (NMS), opening on 29 July 2011.

The Objects

The Kwamin Regalia consists of several items, six of which have been selected to go on display: a war shirt (*batakari*), a war hat or headdress, a necklet of war charms (*asuman*), a bandolier and two satchel-type ammunition bags (*ntoa*). The bandolier and bags contain no textile elements and were conserved by Artefact Conservation so will not be discussed in this paper.

The *batakari* (A.1906.517.11.1) is of very simple construction: a T-shaped tunic made up of numerous narrow strips of hand-woven cotton with black stripes on a brown ground, stitched selvedge-to-selvedge to form the garment. There are no shoulder seams – the strips run from the hem at the front, over the shoulders, to the hem at the back. Both the front and back of the shirt are covered in protective amulets or talismans. These mostly consist of rectangular or cylindrical wooden cores, covered in plain, bold-coloured fabrics of various types: red, white and blue cottons, black cotton velvet, and red wool. However, some of the charms are covered in reptile skin, thought to be snakeskin.

An interesting feature of this *batakari* is that it also has two very distinctive motifs on the chest – a heart and an arrow. Research to date has suggested that such a feature is unique to the NMS shirt. The wood used for the heart and arrow appears to be balsa wood, and is different from that used for the other amulets, which is thought to be palmwood (Hoadley1990)[1]. It may be that the types of wood used are significant. However, both are very lightweight, and were probably locally available, so the reason for their use might be purely practical.

Also of note are a handful of charms on the back of the shirt, which are covered in printed cottons and may be of European (British or French) origin[2]. The Asante traded both with Europeans (who were coming into Ghana along coastal trading routes) and with Islamic peoples from North Africa (McLeod 1981) and these fabrics may have come into their possession via either route.

The hat (A.1906.517.11.2) is made from the same ground fabric as the shirt, and is also covered with protective amulets. These include triangular amulets, as well as rectangular and cylindrical ones. It has a square crown which is covered in reptile skin (again, believed to be snakeskin) and is surrounded by four cloth-covered charms in the shape of dumbbells which give it additional height.

1 Personal communication with Verena Kotonski, Assistant Artefact Conservator, NMS.
2 E-mail communication with Dr Philip A. Sykas, Research Associate, Manchester Metropolitan University.

The necklet (A.1906.517.11.3) consists of two amulets of roughly the same size: one covered in red wool and the other in yellow silk. The neck cord is made up of a double-strand of plaited blue, red and white cords. Damage to the covering fabric reveals glimpses of the contents of the amulets – both contain thick pieces of animal skin, with the fur still intact; the red amulet also contains additional layers of fabric, one of which looks like a ribbed silk.

Unfortunately museum records do not show a precise date for the Regalia, or much information about how the objects were originally acquired; however, what is known is that the garment and its associated accessories were accessioned into the museum in 1906, and are believed to pre-date 1903.

Cultural Context

The Asante's use of these garments can only be understood in the context of their ideas about mystical power, so it is worth looking at this concept in a little more detail. Protective powers were sought from areas and peoples outside Asante society and the Moors, in particular, were thought to possess special powers. Pieces of Koranic writing were believed to be especially powerful and were consequently much sought after. Muslim talismans could be purchased for considerable sums, and the number of charms on a war shirt showed the wealth and status of the wearer (McLeod 1981).

The first mention of *batakari* in Europe appears in a travel account entitled *Mission from Cape Coast to Ashantee*, written by Thomas Edward Bowdich in 1819. As part of his account he describes in great detail a cap and coat covered in amulets, and goes on to describe how the amulets were created by Islamic scholars, noting that chiefs wore them in the belief that they provided magical protection against arrows, bullets and spears:

> *"But the most surprising superstition of the Ashantees is their confidence in the fetishes or saphies they purchase so extravagantly from the Moors, believing firmly that they make them invulnerable and invincible in war, paralyze the hand of the enemy, shiver their weapons, divert the course of balls, render both sexes prolific, and avert all evils but sickness (which they can only assuage) and natural death."*
>
> (Bowdich 1873: 223)

It is possible that European cloths – in this case the printed cottons – were used for similar talismanic purposes.

At least one of the *batakari* in the British Museum's collection is known to have been obtained on the battlefield (McLeod 1981), while photographs in Cole & Ross (1977: 19-20) show relatively modern-day (1976) chiefs wearing amulet-laden shirts, hats and war charms alongside their swords and rifles – leaving little doubt that, even as late as the last quarter of the 20th century, these costumes and accessories were associated with war and battle. However, *batakari* are also known to have been worn in peacetime: at enthronements to emphasis a chief's role as military leader, or by the elite at funerals, suggesting that their protective functions also extended to situations where the normal order of things had been disrupted in some way[3].

Instrumental Analysis

The analytical techniques used in investigating the Kwamin Regalia were carried out by NMS's Analytical Research Section, and included:

[3] E-mail communication with Fiona Sheales, Curator of African Collections, British Museum. The has five examples of *batakari*.

- Optical microscopy & Scanning Electron Microscopy (SEM)[4] – to identify constituent materials;
- X-Radiography[5] – to look at the amulet structures beneath the textile elements of the hat and necklet;
- X-Ray Fluorescence (XRF)[4] – to investigate the contents of the necklet charms;
- High Performance Liquid Chromatography (HPLC)[6] – to identify any organic dyes present.

This paper will focus on the investigations carried out on the necklet, since these gave the most interesting and informative results.

It was clear from a visual and tactile examination of the amulets on the necklet that there were several additional layers present underneath the face fabric. The object was therefore X-rayed (Figure 2) to see if any other structures or materials could be identified. Each amulet was found to contain additional, smaller bags or pouches. The pouch inside the yellow amulet appears to contain a powdery substance – possibly a deteriorated material.

An incidental and highly interesting finding revealed in the X-radiograph was that one of the strands in the neck cord was markedly more radio-dense than the other two, showing up as a bright white strand (Figure 2), and suggesting the presence of an inorganic substance or pigment, possibly lead white. It was thus decided to carry out XRF analysis of the necklet (Figure 3) to try to identify the inorganic substance(s) in the cord and the unknown contents of the amulets.

The X-ray beam was focused on the yellow amulet and each of the coloured strands of the neck cord in turn. Figure 4 shows two of the spectra obtained: for the blue strand (top) and for the white strand (bottom). The XRF analysis showed that the denser area seen in the Xradiograph of the cord was a lead-rich material which appears to be present in both the blue and red strands, though the lead (Pb) signal is stronger in the analysis of the blue strand. In contrast, the white strand showed much lower peaks for lead. Iron (Fe) and chromium (Cr) were also noted in the coloured strands, with chromium being strongest in the blue strand. This is presumably related to the pigments and/or mordants used.

Samples of the blue and red threads were also analysed using HPLC; however, the results obtained were not as informative as had been hoped, and further investigation is required. Nevertheless, indigotin was characterized in the blue sample, suggesting the use of a natural (*Indigofera tinctoria* species) or synthetic indigo; the red sample appears to be a natural dye containing three components, the main one of which seems to be alizarin, though the spectrum is not a perfect match.

Unfortunately, despite a number of areas analysed, no clear results could be obtained for the contents of the yellow amulet, indicating that the latter were most probably organic in origin.

Conservation of War Shirt

Original Repairs

One of the first ethical problems encountered when conserving the shirt was how to deal with the numerous existing repairs in the ground fabric (Figure 5). These were clearly an integral part of the object's history, but many of them were crudely executed and unsightly. They were also structurally disruptive in that they pulled areas of the fabric together, causing distortions to the weave and potentially putting strain on already weak areas of the ground fabric. The problem was compounded by the fact that there was no way of knowing if these repairs were original (as a

[4] Dr Susanna Kirk, Analytical Scientist, NMS.

[5] Dr Jim Tate, Head of Conservation & Analytical Research, NMS.

[6] Lore Troalen, Analytical Scientist, NMS.

result of use), or had been undertaken more recently in its history (after it had been acquired for the museum). Since it was impossible to be sure of the origin, and therefore the significance, of these repairs, and since they appeared to be stable, it was decided to leave them *in situ*, but to provide additional support where necessary.

Two slightly different support strategies were implemented depending on the location and nature of the damage present. Larger splits and tears located in the loose body of the shirt and which afforded easy access, were stabilized by means of a localized patch support using custom-dyed cotton lawn and laid couching (Figure 5). Where necessary, the support patches were made up of strips of dark brown and tan-brown dyed cotton to match the stripes in the ground fabric. Smaller areas of damage located in the upper part of the *batakari*, where access was impeded by the lining, were stabilized by applying a colour-matched nylon net overlay (Figure 6). Such an approach meant that whilst vulnerable areas were reinforced, supported and protected from further damage during handling, the original repairs could still be readily interpreted.

Where the repairs were located around the lower and upper sections of the neckline, it was felt that additional measures were needed because these areas would be under extra strain once the shirt was on the mannequin; indeed, it would have these stresses from the distortions of wear that caused the damage in the first place. Reinforcement strips of dyed cotton lawn were therefore stitched onto the reverse faces of the upper and lower apexes of the neck opening, where the greatest strain would occur.

Amulet Infills and Overlays

The amulets themselves also exhibited several areas of damage and loss as a result of wear and abrasion damage, with some of the red wool amulets having additionally suffered insect damage. The problem here was that the damage to the covering fabric was informative – it revealed the wooden structure of the underlying amulet cores, both in longitudinal and cross-section, and that information was critical in identifying the type of wood used.

Patching or infilling those areas would stabilize the damage but it would also conceal the underlying – and potentially culturally significant – component materials. A compromise approach was therefore adopted, with the extent of intervention being dictated by the extent of damage. Thus, those amulets that were deemed to be most vulnerable e.g. where the covering fabric had deteriorated to such an extent that there was a risk of the core sliding out of its casing and being lost (Figure 7a), received a more extensive conservation treatment such as a full patched support (Figure 7b); whereas those amulets that were judged to be fairly stable and/or at less risk, received a less interventive treatment – e.g. a localized overlay support treatment using dyed nylon net (Figure 8). The latter reinforced the damaged area and enabled detaching amulets to be re-secured to the shirt, but also continued to allow visual access to the structure of the wooden core.

Conservation of War Hat

The main treatment undertaken on the hat was the stabilization of the delaminating reptile skin on the hat crown. The skin was in quite poor condition: it was very dry and many of the scales were delaminating, with the translucent top layer lifting away from the base layer. In some cases the former had peeled back almost completely from the latter, curling up on itself, and was attached at one small point only, making it extremely vulnerable to loss (Figure10a).

In consultation with Artefact Conservation[7], it was decided to stabilize the lifting scales, using isinglass as the adhesive. Isinglass is a natural, collagen-based glue obtained from the swim bladder of various fish species. The type used in this case was derived from Salianski sturgeon swim bladders, obtained from A P Fitzpatrick.

[7] Jill Plitnikas, Artefact Conservator, NMS.

There were two main reasons for using isinglass: a) its collagen base was felt to be sympathetic to the skin substrate; and b) Artefacts conservators had had good results with it in the past on other animal skins. Its mechanical and chemical properties were clearly also important considerations and a full review of these may be found in Foskett (1994) and Schellmann (2007).

Preparing Isinglass[8]

The raw isinglass had to be refined first:

Cut or tear the unrefined isinglass (approx. 42g) into small pieces and place in a glass jar.

Cover with deionized water and heat to a max. 60°C (avoid overheating as that will affect the collagen structure and the adhesive properties); stir occasionally.

Once the isinglass has dissolved, filter the solution through a fine mesh (e.g. nylon stocking). If the viscosity is too high, water can be added so that the solution will be liquid enough to flow through the mesh.

The filtered solution is then poured onto Melinex® (polyester film). The film should not be too thin as it will shrink considerably during drying, producing very thin flakes which will be difficult to handle. A fan can be used to speed up the drying process and prevent mould formation.

Once all the water has evaporated off and the film is dry and hard, peel the film away from the Melinex® and break up into small pieces. Store in a glass jar. 42g of raw isinglass produces approx. 35g of purified isinglass.

When required, dissolve the purified flakes in deionized water to the required concentration, e.g. 1g isinglass in 25ml deionized water, by heating the solution in a water bath. A 4% solution is commonly used as an adhesive for consolidation purposes.

Since the surface tension of isinglass is generally quite high, it is sometimes preferable to work with a wetting agent to enable the adhesive to wick under the lifting flakes more effectively. Polar solvents such as ethanol or mixtures of 50:50 deionized water:ethanol can be used for this purpose.

Consolidation of Reptile Skin

The skin was first swabbed with deionized water to remove surface dirt. As well as lifting soils and so improving the overall appearance of the snakeskin, this also offered the opportunity to observe how it would react to moisture, which would be an important consideration in its subsequent consolidation treatment. The isinglass was applied as a 4% solution in deionized water, using a very fine paintbrush and working under magnification to carefully slide the paintbrush under the top layer of each individual lifting scale (Figure 9a).

Once the isinglass had reached its tack point, the top layer was gently pressed home onto the base layer using a silicone-tipped brush (Figure 9b). For the 'curly' scales a porcupine quill – which has a fine, pad-like point – was used. The tip was inserted into the curled up scale and rolled gently backwards and forwards to make contact with the base layer. Finally, small glass beads, with an interleaf of silicone-release paper, were placed over the treated scales and left overnight to provide gentle pressure while the isinglass dried fully.

[8] The preparation stage was carried out by Verena Kotonski, Assistant Artefact Conservator, NMS.

Good results were achieved with the isinglass (Figures 10a & 10b). There was a slight change in the appearance of the skin after treatment, mainly in the form of an increased sheen to the consolidated scales; however, that could also have been due to the fact that the top layer reflected light differently once it was lying flat. At all events, it was felt that this minor change in surface appearance was outweighed by the more important considerations of stabilizing and preserving the skin, and the object, as a whole.

Conservation of Necklet

The conservation of the necklet presented very similar ethical problems to the conservation of the amulets on the shirt. Surface damage on both the red and yellow amulets offered glimpses into the underlying layers – which were thought to be culturally significant – but it also destabilized the amulets as a whole and was visually distracting. Again, a compromise approach was adopted, this time dictated by the agents of deterioration, which were different for each amulet.

Red Amulet

The damage present on the covering fabric of the red amulet was mainly due to insect attack (Figure 11a). This could be deduced from the morphology of the holes, as well as from the presence of moth cases and webbing fragments. Firstly, the amulet was documented & photographed extensively in order to record the underlying layers, which would be subsequently covered up by the conservation treatment. A localized patch support using a colour-matched fine wool fabric was then inserted to reinforce the area and infill areas of loss (Figure 11b). The large hole at the top-left corner of the amulet, where the latter is attached to the neck cord, was additionally given a nylon net overlay to reinforce that area, as it was felt to be particularly weak.

Yellow Amulet

In contrast, the damage present on the silk fabric of the yellow amulet was primarily due to abrasion damage through wear, with the silk splitting along the bottom edges and around the corners (Figure 11a). A further factor to be borne in mind was that the silk was inherently much more fragile than the red wool and so could not take much support stitching. It had already started to fail along the stitched seam at the bottom edge and was secured by only a few threads, which themselves seemed perilously close to giving way. It was therefore decided to encase the whole amulet in dyed nylon net. Care was taken to stitch as little as possible into the weak silk, and, apart from a couple of lines of stay stitching down the centre of the amulet to allow the net to follow its slightly bumpy profile, all other stitching was worked into existing stitch holes. The advantage of this approach is that it is easily reversible and still allows the underlying layers of the amulet to be seen (Figure 11b). An additional advantage is that the dyed net helps to restore some of the bright yellow colour to the silk.

Mounting for Display

One of the first challenges encountered was gauging the size of the mannequin needed. Unlike the defined and often extreme shapes of historical Western costume, the very simple T-shape of the shirt gave no clues as to the size or shape of the person who had worn it: the chest and shoulders are wide, but the sleeves are narrow in comparison. A further, significant, problem is that the neck opening is very narrow – only a slit – with no neck shaping. This puts considerable strain on the apexes of the opening at the centre back and centre front. Matters are complicated further by the physical nature, shape and positioning of the component parts: the wooden amulets are rigid and a row of them is positioned very close to the top of the shoulder, making it impossible for the garment to drape and adapt to the curves of the shoulder and back.

In order to reduce the stresses and strains generated around the neckline when the tunic was dressed on the mannequin, the shoulders were built up slightly with polyester wadding in order to make them a squarer shape. Nevertheless, there was a limit to how much could be done without raising the shoulder profile too high. Additional padding on the torso back and sides also helped to fill out the profile and support the tunic and amulets, thereby minimizing the strain around the neck and shoulders as well as imparting a more 'human' shape overall. However, as with many other aspects of the conservation work undertaken on the Kwamin Regalia, its mounting for display necessitated a certain degree of compromise.

Conclusions

This paper has examined the conservation, investigation and display of a complex and enigmatic mixed-media costume which presented several ethical issues – both in terms of practical work undertaken and in terms of interpretative approaches adopted. Perhaps quite appropriately, just as the Kwamin Regalia as an object is more than the mere sum of its parts, so the success of the project has been largely due to the spirit of exchange and collaboration – across scientific, conservation and curatorial departments – which has ultimately guided the conservation treatments implemented and the ethical decisions made.

Acknowledgements

This whole project was a team effort and the author is extremely grateful to all NMS members of staff who helped, as well as to the many external specialists who shared their expertise.

References

Bowdich, T. E. 1873. *Mission from Cape Coast to Ashantee.* Second Edition. London: Griffith & Farran. http://www.archive.org/stream/missionfromcape00bowd Accessed: 22 May 2011.

Cole, H. M. & Ross, D. H. 1977. *The Arts of Ghana*. Los Angeles: Museum of Cultural History, University of California.

Foskett, S. 1994. An investigation into the properties of isinglass. *SSCR Journal* Vol. 5 No. 4, pp11-14.

Hoadley, R. B. 1990 *Identifying Wood: Accurate Results with Simple Tools*. Connecticut: Taunton Press.

McLeod, M. D. 1981. *The Asante*. London: British Museum Publications.

Schellmann, N. C. 2007. Animal Glues: a review of their key properties relevant to conservation. *Reviews in Conservation* 8, pp55-66.

List of Suppliers

Melinex® Film	Preservation Equipment Ltd Vinces Road Diss Norfolk IP22 4HQ England Tel: 01379 647400 info@preservationequipment.com www.preservationequipment.com
Salianski Isinglass	A.P. Fitzpatrick Fine Art Materials 142 Cambridge Heath Road Bethnal Green

London
E2 5QJ
England
Tel: 020 7790 0884
info@apfitzpatrick.co.uk
www.apfitzpatrick.co.uk

Silicone tipped brush (in soft (ivory) & firm (grey) with 5 different tip shapes).	Available from all good art & craft shops or from Preservation Equipment Ltd – details as above.

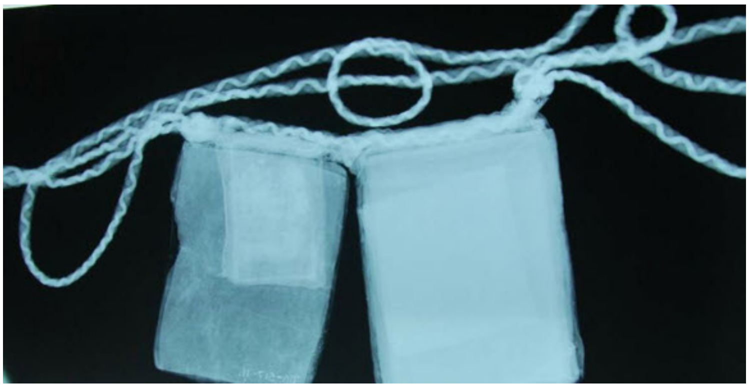


Figure 2
X-Radiograph of necklet.

Figure 1
The Kwamin Regalia, mounted on its mannequin for display in 'People & Possessions', Royal Museum, Edinburgh.

Figure 3
XRF analysis of necklet.

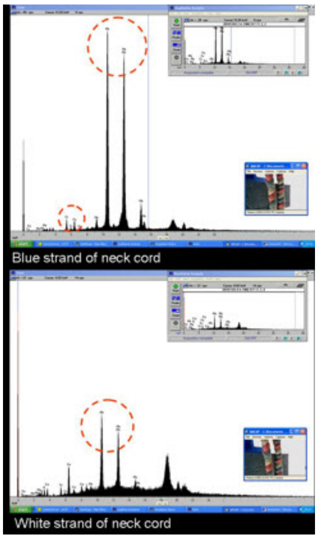


Figure 4
XRF spectra for blue and white strands of neck cord.

Figure 5
Original repair on war shirt, after localized patch support.

Figure 6
Original repair on neckline, after nylon net overlay support.

Figure 7a
Damage to amulet covering fabric, before conservation.

Figure 7b
Damage to amulet covering fabric, after conservation.

Figure 8
Net overlay support to amulet covering fabric.

Figure 9a
Applying isinglass to consolidate reptile skin on war hat.

Figure 9b
Using a silicone-tipped brush to re-adhere scales on hat crown.

Figure 10a
Delaminating scale on hat crown, before conservation. .

Figure 10b
Delaminating scale on hat crown, after conservation.

Figure 11a
Necklet amulets, before conservation.

Figure 11b
Necklet amulets, after conservation.

It's a small World: Preparing a collection of mixed media puppets for display at the Detroit Institute of Arts

Howard Sutcliffe
Textile Conservator, Detroit Institute of Arts

Introduction

The Paul McPharlin Collection of Puppets and Theater Arts was established at the Detroit Institute of Arts (DIA) in 1951 with the gift of Paul McPharlin's sizable collection of rare books and puppets. He was considered by many to be the pre-eminent authority on puppetry during the first half of the 20th century. A skilled performer and puppet maker, he established the Marionette Fellowship of Detroit troupe in 1929, organized an important puppetry exhibit for the Chicago World's Fair in 1933, and was a founding member of the Puppeteers of America (Bell 2000). Further additions to his collection purchased using the McPharlin fund now mean the DIA is a repository for nearly 1000 puppets.

The subject of this paper will be the conservation and display of a set of six late 18th century Italian Comedia dell'Arte glove and rod marionette puppets that formed part of the first bi-annual rotation of puppets displayed in a new state of the art gallery dedicated to the collection that opened at the end of 2010 (Figure 1). These rare and early mixed media puppets had been very well used before being accessioned in the early 1950's and were exhibited extensively subsequently to that.

It is fair to say that most were in a terrible state, with the main condition issues falling under the remit of the Textile and Objects Conservators. The paper will explore the challenges presented by their media, size and condition along with the main treatment points and the rationale behind the sequence of treatment by both conservators. The eventual mounting and display solutions will also be examined along with a brief discussion of some treatment procedures that would be done differently with the benefit of hindsight.

European Puppet Traditions

Puppetry is an ancient art form, thought to have originated about 30,000 years ago. It is used in almost all human societies both as entertainment and ceremonially in rituals and celebrations. It takes many forms but they all share the same basic process of animating inanimate objects.

Italy is considered by many to be the early home of the puppet theatre in Europe due to its widespread influence during the Roman period. From the basic beginnings of simple shadow and stick puppets evolved three-dimensional rod puppets and by the medieval period in Europe, marionettes – jointed puppets operated with rods and strings had taken to the stage.

Puppets offered the visual delights of opera and musical theatre and the excitement, comedy and pathos of drama in a more modest form that was within the pockets of ordinary people. The Catholic Church used them to perform morality plays and it is believed that the word marionette originates from the little figures of the Virgin Mary or Mary dolls. The 16th century saw comedy introduced to the plays that ultimately led to a church edict banning puppetry. Puppeteers responded by setting up stages outside cathedrals and became even more ribald and slapstick – a move which gave rise to the Italian comedy called Commedia dell'Arte (McCormick et al 2010).

Commedia dell'Arte

The presence of Commedia dell'Arte as a staple of Italian Puppet Theatre has endured for over 400 years. It is characterized by improvisations from standard plot outlines and the use of stock characters, often in traditional masks and costumes. Its complexity is enormous as the improvised forms, regional variations and characters involved are myriad. Of the countless scenarios in Commedia dell'Arte that have found their way to the puppet stage, the subject of the misfortunes of the central character, who is often the victim of a series of practical jokes, is one that cropped up in almost every company's repertoire. So too is the fate of two young lovers who face the opposition of one or more parents. Comic masked characters are wholly involved in complicated, often outlandish, but always hilarious strategies to get the lovers together, an enterprise that invariably succeeds by the end of the show (Bell 2000).

The Puppets

There are two distinct types of puppet in the DIA's Commedia set. The male figures, Pantalone, Il Capitano, the Old Man and Young Man are all glove puppets in which the main body is essentially a fabric sleeve. There is a hole in the base of the solid neck to accommodate a finger to enable movement of the head. Their arms are tubes of fabric that also accommodate the operator's fingers allowing for animation. The two female characters, Old Woman and Young Woman are rod operated marionettes that feature hard construction bodies jointed to the heads to which a rod (in both cases now missing) would have been secured. The arms are jointed at the shoulders and elbows to allow for movement using strings connected to a controller (which are also now missing).

The Lovers (Young Man and Young Woman) will form the focal point for the treatment discussion as they are an example of each type of puppet and out of the group of six also happened to be in the worst condition.

Materials

After thorough evaluation of the condition of each puppet it became clear that all six were going to require a good deal of work for both the author and the Objects Conservator, John Steele. Under his care fell the heads, glass eyes, torsos and arms and hands and some of the weaponry. The costumes and a lot of the associated decorative materials like feathers, leather, metal trims and buttons were treated by the author.

The head of each puppet was made up of a carved wooden core that was covered in a material that is similar in appearance to composition ornament or compo. Recipes for this material which is malleable when wet and dries hard like plaster, generally include animal glue, linseed oil, a hard resin and a bulking material usually powdered chalk or whiting. The use of compo which was widely utilized in the 18th century as a cheap substitute for wood carving in architectural decoration enabled the puppet makers to achieve an extraordinary degree of modelling for the expressive facial features (Thornton and Adair 1994).

The lower arms of the two female puppets and the hands of the males were made from a cardboard core around which compo was used to build out the shapes and define the fingers. The upper arms of the female puppets and their torsos appear to be made of a paper pulp and animal glue mix covered with a layer of pink paper. The exposed areas like the décolletage were also covered with compo, which was painted like the heads using oils.

Treatment Protocol

The protocol for the treatment of each puppet was determined as much by conservator workloads as it was by the treatments that needed to be performed. Both John and the author work as solo conservators in their respective labs and both have full workloads with frequent rotations and loans, so fitting in a brand new rotation of objects was exactly that.

For the most part the textile treatments were more involved than the object treatments and were undertaken first; the author also had the availability to fit the treatments into his schedule before John could get them into his. In the majority of cases this worked out well as the textile treatments could be undertaken without the need for the object treatments taking place first. Precautions, such as wrapping in tissue or plastic were then taken to protect the conserved textiles while the subsequent object treatments were carried out.

The one exception was the Young Woman whose badly damaged sleeve could not be conserved until the elbow joint had been repaired. The tangle of shredded cloth around the broken joint made it very unclear as to how much of the sleeve actually remained and what went where so the author waited to treat that until after the joint had been repaired to minimize movement knowing that whatever was done to conserve the sleeve would remain pretty fragile.

At first the scale of damage to the some of the textiles was of concern in terms of the time treatment was going to take versus the time that was actually available, so the author worked on the puppets like Pantalone and Il Capitano that were in better condition first in order to become familiar with their scale and construction before moving on to the elderly couple and finally the Young Woman and Young Man.

The Costumes

Some of the puppets have replacement textiles – the character Pantalone's costume for example is almost all 20th century reproductions. Both of the Lovers' costumes and those of the Elderly Man and Woman appear to be original – and it is likely that all were made using old apparel textiles that predate the late 18th century date of the puppets by some time.

The Young Woman

A striking aspect of these puppets is that their miniature costumes are generally quite right for the period in which they were created. The Young Woman's low-necked robe à l'anglaise over a petticoat and stomacher is consistent with the style prevalent during the 1780s (Figure 2).

Description

The gown is ivory silk brocade with small polychrome flower motifs, the front edge of which is trimmed with white metal lace. The tight elbow-length sleeves, which are separate from the main body of the gown, are trimmed with ruffles, and separate cotton lace under-ruffles. There are also pink silk ribbon bows at the elbows.

The gown's skirt is open in front to show a petticoat front and stomacher worn beneath. The petticoat front is made from horizontal bands of cotton lace pleated onto a cotton ground and further decorated with three pink silk ribbons and bows. The stomacher is made from vertical lengths of a metal thread braid applied to a cotton ground. It is trimmed using metal thread lace along the top and bottom edges. The puppet has two underskirts, one linen and one cotton that help to give the gown its characteristic shape.

Additional embellishment is provided in the form of a black silk velvet choker with small paste pearls and a small glass cameo, which hangs from the top of the stomacher at centre front. There is also a wire and fabric corsage attached to the puppet's proper right side close to the waist and similar fabric flowers in her hair.

Each elbow hinge consists of a wooden dowel that runs through the top of the forearm and inserts into a pair of holes in the open elbow end of the upper arm. Small paper or felt discs adhered to the dowel ends hold it in place and allow the hinge to move freely. In addition each forearm was also originally attached to the upper arm and puppet controller with a string that held it in a semi-perpendicular position.

Condition

Overall the puppet was in fair to poor condition and exhibited signs of general wear and tear from use. The clothing was soiled and there was abrasion and isolated weak spots throughout. As mentioned the sleeve ruffles had been severely damaged due to the elbow joints tearing through the silk. There was also abrasion to and extensive loss of the fabric at both sleeve tops. The pink ribbons used on the petticoat and elbows were so degraded as to be virtually non-existent with the cotton selvedge warps the only elements keeping them intact.

Object Treatment

The elbow on the proper left arm of the young woman was broken and had been previously restored, which prevented it from moving freely. The hinge end of the upper arm was broken into two fragments and had been repaired with a white, PVA-like adhesive.

John used organic solvents to soften this adhesive allowing the repairs to be disassembled. Remaining traces of adhesive were removed from the break edges with a scalpel. The fragments were then re-adhered in their proper alignment using 100% Lascaux 498 HV acrylic adhesive. The dowelled forearm was positioned back in the holes and the felt pads either side of joint that prevent the dowel from sliding out were re-adhered also using a small spot of Lascaux 498 HV. When a missing digit or part of a joint had to be replaced Apoxie Scuplt two-part epoxy putty was used to recreate the missing element. The broken part of the hand or joint was first sealed using Beva B-72 and the putty moulded in place and then removed while it dried, further refinement by carving could then be carried out before the replacement piece was fixed in place using Lascaux 498 HV. The new elements were toned with Golden Fluid Acrylics to match the surrounding surface.

Textile Treatment

While John was working on the joint repair, the cotton petticoat and underskirt (the two elements of the costume that were not friable silk or stitched in place) were removed from the puppet for wet cleaning. The textiles were surface cleaned using low-powered vacuum suction to remove particulate surface soiling and the stitches securing the ribbons to the petticoat were released and the ribbons removed. The petticoat and underskirt were each soaked in a bath of deionised water for 30 minutes before being washed using a 5% solution of Orvus WA anionic detergent. The textiles were sponged to help release particulate soiling before being rinsed thoroughly in deionised water and then air dried.

Once the puppet was back in the textile lab the rest of it was surface cleaned using low-powered vacuum suction and the arms were deconstructed (as much as possible) for treatment. The missing areas of silk on each of the sleeve tops were in-filled using small patches of silk taffeta dyed to match the original. The paper pulp arm was coated with a thin layer of 50% Jade 403 PVA adhesive and left to dry. The patch was then positioned on the arm and the adhesive reactivated using a heated spatula. Each sleeve was then encapsulated using an overlay of dyed nylon net coated with 12% Lascaux 360Hv:498Hv used 50:50 in deionised water. The adhesive was applied wet to the net, allowed to dry and reactivated using a heated spatula.

The ruffles were removed from each sleeve and the seam released to allow them to be flattened and aligned. Each was humidified using dampened Gore-Tex. Patches of silk habutai dyed to match the original were applied to the reverse side of each ruffle and secured using lines of laid thread couching. The degraded silk was very fragmentary and the stitches did cause some fracturing of the fibres as it was being carried out. As a result overlays of appropriately dyed nylon net coated with the same 12% Lascaux mix were also applied to the front of each ruffle to further support the extensive damage in these elements. Once complete the ruffles were reformed and stitched back in place.

The isolated areas of structural weakness in the gown itself were supported using overlay patches of adhesive coated nylon net applied using the same method.

The ribbons were untangled and humidified to allow alignment using dampened Gore-tex. They were supported using new ¼" polyester ribbons as an underlay and encapsulated front and back using nylon net dyed a darker pink to help restore some of the colour lost to fading. The net was again coated with the same 12% Lascaux mix. Once the adhesive film had been reactivated using a heated spatula the edges of each ribbon were stitched to fully secure. The ribbons were then retied and stitched back in place on the petticoat and the elbows.

After the petticoat and underskirt had been fastened back in place, the gown was humidified using an ultrasonic humidifier to relax any distortions and generally 'fluff up' the appearance of the costume. A bustle support made from pleated nylon net was made to fill out the back of the gown's skirt and was tied to the puppet around the waist between the underskirt and gown.

Mounting

A mount was made for display and will also be used for storage. It consists of a metal plate and rod with an Ethafoam plug which connects with the base of the puppet's torso. Without its original rod control, the head had a tendency to fall to one side so an external brace was added at the back, painted to match the gown, to hold it upright (Figure 3).

The Young Man

Unlike the Young Woman's costume her lover's outfit is consistent with the look prevalent in menswear during the early to mid 1700's.

Description

The Young Man (Figure 4) wears a long dropped shoulder coat with full skirt that has pleated panels inserted in the side seams. The coat has no collar but does have oversized turned-back cuffs that extend almost to the elbow which is very much consistent with early 18th century style. It is made from yellow silk brocade and has a half lining of red silk damask. The sleeves are lined with cotton. The centre front opening, cuffs and pocket plackets are trimmed with yellow metal braid and there are painted metal buttons down the front proper left side opening, at the cuffs and at the centre of the pocket plackets. He also sports ruffles of cotton lace at the cuffs and a cotton lace shirt collar and frill around the neck.

The actual puppet sleeve is made up from a waist-length cream silk waistcoat trimmed with braid and with small brass ball buttons down its centre front and the skirt is the same yellow silk brocade as the coat. The coat is stitched to the sleeve at the back and front neckline.

The puppet carries a sword made from card and leather. The scabbard is wrapped in dark red silk velvet with a metal tip and the hilt is decorated with the same buttons found on the puppet's coat – they are, however, not painted.

Condition

Overall the Young Man was in very poor condition. The puppet had extensive particulate soiling and substantial structural damage to the coat and skirt. The silk was extremely friable and was extensively split, probably resulting from a combination of mechanical damage and degradative processes such as acid-hydrolysis and photo-oxidation catalysed by the chemicals used in the weighting process. There was additional extensive loss and abrasion across the shoulders and large areas of loss on the sleeves which had been previously repaired by darning through to the coat's cotton lining.

The waistcoat was in good condition. The silk skirt however was also extensively damaged with very large splits and areas of loss. Much of the damage had at some point been fixed using strips of masking tape applied to the reverse which was now brittle and the adhesive powdering.

Treatment

The puppet was surface cleaned using low-powered vacuum suction to remove particulate surface soiling, the silk was just too friable to clean further. To enable treatment stitches attaching the coat to the waistcoat were cut and the coat removed from the main puppet. Due to the fragility of the silk none of the old repairs were removed as this would have caused a lot more additional damage.

Areas of complete loss on the shoulders and some parts of the sleeves were in-filled using patches of silk habutai dyed to match the original. The small scale of the puppets was a real issue with this particular treatment as access to the damaged areas was so tight. The patches were first tacked in place and then fully secured using lines of laid thread couching worked in light green hair silk. As was the case with the Young Woman the silk was extremely fragmentary, so to further secure the stitched supports overlays of appropriately coloured adhesive nylon net were applied to the entire exterior of the coat. This time 15% Lascaux 360Hv:498Hv 50:50 in deionised water was used.

The degraded masking tape was removed mechanically from the inside of the silk skirt. The tape was so degraded that it came away quite easily despite the fact that it had been applied to very weak silk. Areas of loss here were also in-filled using patches of silk habutai dyed to match the original applied to the reverse. Again the patches were tacked in place first and then fully secured using lines of laid thread couching. Overlays of appropriately coloured adhesive nylon net were then applied to the main areas of damage on the obverse. Once fully supported the coat was reattached to the puppet body at the neckline.

An internal support was made to give the body structure while on display. The core was made from Ethafoam carved to shape and covered with cotton jersey. Small pads were made to fill the arms and a skirt support made of pleated nylon net was stitched in place around the waist. The cotton ruffles were humidified using an ultrasonic humidifier to relax any distortions and reform their original shape.

Mounting

A simple mount featuring a painted metal plate and rod that passes through the centre of the Ethafoam support was made for display and like the other puppets will also be used for storage. A length of monofilament thread was tied around the waist to further secure the coat to the puppet. The sword was also fixed to the puppet's hands using monofilament (Figure 5).

Treatment Evaluation

In hindsight one of the things the author should have explored further with the treatment of the Young Man was different concentrations of adhesive for the overlays. The silk was so fragmentary that the adhesive films started to release almost immediately, as the adhesive was basically just adhering to the surface silk dust that was constantly being produced. A higher concentration of adhesive might have prevented this but of course at the same time would likely have stiffened the fabrics considerably, although that that would not have been of great concern in this case. Fortunately the combination of the silk underlays and net overlays did provide enough stability to allow stitching around the edge of each overlay and some support lines to help hold everything in place.

Another notable problem involving treatment protocol also revolved around the use of adhesive films to support the textiles. In retrospect it would have been better if some of the object treatments had been carried out before the textile treatments – especially those that involved the creation of new digits on the puppet hands. Sanding of the epoxy created dust and while efforts were taken to minimize contamination some of the dust did get onto the treated textiles and stuck to the adhesive coated nylon. Like the silk dust the dust from the epoxy also started to inhibit the efficacy of the adhesive film causing lifting of the overlays. Again stitching had to be used to secure the edges of overlays once the dust had been removed by surface cleaning.

Conclusion

It is pleasing that the conservation work undertaken on the Commedia dell'Arte puppets turned out as well as it did given the level of damage some of them exhibited, the number of puppets requiring treatment (24 in total for the first rotation alone) and the time constraints involved in the project. The conservation of mixed media objects can be a delicate balancing act. The conservator has to strive to ensure that the treatment of one element does not have a negative impact on the condition or treatment of another. Ultimately this project was a successful collaboration between disciplines and a good learning experience for the two conservators involved as they are going to be working on many more rotations of puppets for a number of years to come.

Acknowledgments

I would like to thank John Steele for his input to the presentation that accompanied this paper and the information he provided concerning the object treatments he performed on these puppets. Alfred Ackerman, Conservator of Paintings for supporting this paper. Paul Cooney, Conservation Imaging Specialist for his assistance in recording the progress of the conservation treatments. Jim Storm, Conservation Mount Maker and Pre-program intern Joseph Young for their help with the mounts.

References

Bell, J. 2000. *Strings, Hands, Shadows: A Modern Puppet History.* Detroit: Detroit Institute of Arts/University Lithoprinters.

McCormick J, Cipolla A and Napoli A. 2010. *The Italian Puppet Theater: A History.* London: McFraland and Company Inc.

Thornton J and Adair W. 1994. *Applied Decoration for Historic Interiors: Preserving Composition Ornament.* Washington DC: National Park Service Publications.

Figure 1
Display case with the group of six Commedia dell'Arte puppets and stage.

Figure 2
Young Woman before conservation treatment

Figure 3
Young Woman after conservation treatment

Figure 4
Young Man before conservation treatment

Figure 5
Young Man after conservation treatment

Composite materials and composite context: Factors in the Conservation of Egyptian Polychrome Textiles

Vasiliki Kontogianni
Archaeological conservator, KE Department of Prehistoric and Classical Antiquities, Greece.
Ciarán Patrick Lavelle
Freelance conservator, 'MShed Museum of Bristol' project for Bristol Museums, Galleries and Archives.

Introduction

The paper explores those factors that influence the conservation of composite objects. Two fragments of an Egyptian Cartonnage were treated by the authors during a two years period. The incompatibility of the materials themselves, the condition of the objects and the aesthetic and ethical perspectives of the conservators led to two different display suggestions. The project suggests that incompatibility is not related only to physical aspects. Factors relevant to the perception of context may also influence the treatment. In such cases "incompatible partners" may also be the conservators that undertake the treatments.

The Objects

Two fragments of an Egyptian Cartonnage were delivered to the conservation laboratory, Department of Archaeology and Conservation, Cardiff University. The fragments are likely to belong to the same object, were part of the Wellcome Collection of the Swansea Egypt Centre, Swansea University. Their treatment was undertaken by the authors during their studies on the BSc course in Conservation of Objects in Museums and Archaeology at Cardiff University. The leg fragment was treated during the academic period 2008-09 (Figure 1). The torso fragment was treated the following year (Figure 2).

Background Research

Technology

The word cartonnage is the term used for plastered layers of cotton or linen fibre or papyrus, which is flexible enough for moulding while wet against the irregular surfaces of the body which are often decorated with paint or gilding (Shaw and Nicholson 1995). This method was used in funerary workshops to produce cases, masks or panels to cover all or part of the mummified and wrapped body. The plastered surface also gave an even surface for the painting of motifs with greater stability than was possible with a solo linen shroud.

The exact method of construction is not fully understood and varies relevant to date and provenance (Hatchfield 1998: 72). The basic steps usually were:

- Preparation of a core (probably to body shape) of mud or straw.
- Application of sized linen over the core. The linen was soaked in gum Arabic or animal glue (Hatchfield 1998: 72).
- Application of layer of plaster over the linen (Scott *et al* 2004:182).
- Application of second layer of fine plaster that served the application of paint.
- Application of paint layer: this consisted mainly of pigments with gum Arabic as the binder (Scott *et al* 2004:182).

Macroscopic observations on the leg and torso fragments match the layer descriptions above. Some sources mention the presence of coarse gypsum and calcite below the linen (Scott *et al* 2003: 41). Natron (sodium carbonate mineral) has also been detected as a residue from the embalming process. This was mainly found where the cartonnage was constructed directly over the body (Scott *et al* 2003: 43).

Dating of the Fragments

Although provenance and dating is not certain due to lack of relevant documentation, it is likely that the construction of the fragments occurred after the 12th Dynasty (1991-1786 BC). The date is stated to be the beginning of cartonnage use (Scott *et al* 2003: 41). Analysis of pigments for dating purposes is of limited use since certain pigments and painting techniques were used within an extended period (Scott *et al* 2004: 179). However, it is possible that the fragments date sometime between the Ptolemaic and Roman period (310 BC to 395 AD) (Ikram and Dobson 1998). The use of whole cartonnage cases became rare during this period whereas the use of head cases and pectoral cartonnage pieces were more common (Wallis-Budge 1925).

The use of cartonnage for such long periods indicated the popularity of the technique. This was mainly due to the lower cost of the technique against the construction of elaborate coffins from wood, a precious and rare material. Cartonnage could be used to cover up defects of low quality raw materials (Hatchfield 1998: 71).

Condition Assessment and Past Conservation Treatment

The leg fragment:

The leg fragment suffered extended linen, plaster and paint layer loss, especially around the edges (Figure 3). The central area and semi-detached edges were deformed and parts were overlapping. The object seemed to have been flattened but there is no documentary, pictorial or clear physical evidence that the fragment was originally curved. Mechanical forces due to rapid changes of relative humidity and use have caused cracking of the successive layers (Figure 4) (Jaeschke 1995). Deformation and cracking might have occurred as early as during the removal of the cartonnage from the body. The body would have provided physical support to the cartonnage but on removal the cartonnage would deform under its own weight (Jaeschke 1995).

Past conservation treatment included consolidation of the paint layer with a mixture of 1% methyl cellulose (MC) w/v in water and Industrial Methylated Spirit (IMS) in 1:1 ratio and adhesion of the fragment on a linen support by the same mixture. The adhesive was also used on thin Japanese tissue to support semi-detached areas. The consolidation of the paint layer was successful. However the adhesion of the fragment on the linen support had failed and the object was totally detached from it. The selection of the thin Japanese tissue seemed to be inadequate to support the semi-detached areas (Figure 3).

It was apparent that the relaxation of deformations and the backing support of the detached areas were the main conservation challenges. The restoration of any possible curvature was deemed to be a risky prospect. Any attempt to manipulate the object more than was necessary to relax the deformations could be damaging, since the plaster and paint layer had been consolidated in the current shape. Removing the consolidants would be practically impossible and would require excessive use of wet cleaning.

The torso fragment:

Like the leg fragment, the torso fragment had suffered extended plaster and paint layer loss, especially around the edges of the breaks where the fragments were separated (Figures 5, 6 and 7). There were also multiple micro-fragments of pigment, gesso and linen on the temporary support. The object has retained a portion of its curvy shape, especially along the top edge.

The previous conservation treatment took the form of the consolidation of the frayed edges with Paraloid™ B72 (ethyl methacrylate co-polymer) 3% w/v in acetone. The torso fragment was stored on a linen mount, fitted to roughly shape the curvature of the cartonnage, which was then placed in a Corex box. The fragment was not attached to the linen mount; instead it sat freely on the surface. The retention of curvature and the reconstruction of the separate pieces of the cartonnage were the main objectives of the conservation plan.

Incompatible Partners I: Interaction of the Materials

The combination of inorganic and organic materials can produce unstable composite products in the long run. Physical damage may occur due to the differential thermal expansion and moisture absorbance of such materials. The organic layer (linen) picks up moisture spontaneously as opposed to the gesso layer which although hygroscopic responds more slowly. The presence of binder increases the hydroscopicity of the gesso (Timar-Balazcy and Eastop 1998: 119). However, when animal glue is used as a binder it behaves in a paradoxical manner; the glue shrinks with an increase in relative humidity while the gesso and linen expand. This effect may cause excessive mechanical damage and separation of the successive layers (Timar-Balazcy and Eastop 1998: 275). Such factors can make composites of these materials difficult to conserve.

Incompatible Partners Part II:

So far the incompatibility that was encountered was in the interaction of the materials that compose the fragments. The fact that the fragments differ in their physical state, their previous conservation treatment and their support requirements suggest a new aspect of incompatibility; that is the inevitable difference in conservation treatments despite the fact that the fragments have the same origin and composition. The main difference between the leg and torso fragment was that the torso fragment retained its curvature whereas the leg fragment did not, if there had been any. That had a major influence on the treatments, especially on the mounting process.

Conservation Framework

Despite this aspect of incompatibility both conservators worked within the same conservation framework. The concepts below became the foundation upon which the treatment plans were developed. The condition of each individual object and its composition was the starting point for developing the general framework. The current conservation ethics were kept in mind. The "use" of the object after the end of the treatment was an important issue that was taken into account at this embryonic stage.

- Condition of the object (composition, state of preservation, context, past conservation treatments).
- Ethics (reversibility, minimum intervention to physical and conceptual integrity, green policy).
- Owner's Requirements (research, exhibition, storage, handling collections).

Conservation Aims: Leg Fragment

The aims were:

- Removal of the previous backing supports from the semi-detached areas and application of new support after the relaxation of deformations.
- Protection of the object from fluctuations of relative humidity/temperature and dust.

Conservation Aims: Torso Fragment

The aims were:

- Reconstruction of the cartonnage.
- Creation of a mount that fully supports the curvature of the fragment, protects it from further mechanical damage, and is easy to handle whether on display or in storage.
- Protection of the object from fluctuations of relative humidity/temperature and dust.
- Decompose the composite.

Working within this framework, it was necessary to test conservation materials and methods mainly for the relaxation of deformations. The experimentation was carried out on a replica in order to minimize intervention on the original objects.

Creating a Replica

Vasiliki and fellow student, Stefanie White, prepared a cartonnage replica, as both students were working on Egyptian polychrome textiles. The replica was created and used to understand the technology and nature of the original materials and their deterioration process. The production was based on bibliographical sources and past analysis of cartonnage artefacts (Hatchfield 1998: 71). It was also used for testing conservation materials and different applications that have been used in similar case studies. The linen was sized with animal glue and left to dry. The gesso that was applied after was a mixture of plaster and animal glue. The pigments used at the paint layer were applied with gum Arabic as a medium.

The replica was subjected to prolonged heating and mechanical damage (Figure 8). The aim was to replicate the condition of a severely damaged cartonnage. Extended cracking on the gesso and paint layer, material loss in all layers, dehydration and deformation were achieved by:

- deformation prior to heating.
- dehydration by heating the replica at 80°C for 10 hours.
- application of mechanical force to produce further cracking.
- opening holes.

The replica was used for the following tests:

- Test 1: Physical behavior of the replica to rehumidification.

- Test 2: Testing the mechanical and adhesion properties of polymer/backing systems for adhesion/consolidation of semi-detached areas.

Relaxation of deformations can be achieved by re-humidification of the linen substrate (Elston 1995: 17). Since animal glue and gum Arabic are water soluble (Hatchfield 1988: 71), as well as gesso (Jaeschke 1995: 23) the risks of re-humidification were assessed.

Polymers for the adhesion and consolidation of fragile, fragmented and torn cartonnage should meet the following criteria:

- even film formation
- low shrinkage
- flexibility
- matt appearance
- reversibility
- of sufficient strength
- non toxic

The polymers tested were selected according to the available literature for the conservation of textiles (Timar-Balazcy and Eastop: 1998). The test was focused on water soluble adhesives because of:

- water's surface tension - less penetration compared to organic solvents
- compatibility with the water sensitive gesso and polychrome.
- COSHH regulations with regard to bench work.

The polymers were brushed over different backing supports and left to dry (different grades of Japanese tissue, synthetic and natural textiles). Shear and peel strength, flexibility and appearance of these polymer/backing systems were assessed macroscopically. Then the samples were adhered by rehumidification on the replica (linen side) and their adhesion properties were assessed.

Experimentation Results

The experimentation on the intentionally damaged replica showed that the localized re-humidification on deformed parts produced good results. The amount of moisture was enough to relax any deformation while not affecting the plaster and paint layer. Weight application on regular intervals on those areas prevented shrinkage and newly formed deformation. It was therefore decided to apply the method on the deformed areas of the original fragments.

The assessment of the mechanical properties of various adhesives and backing supports showed that the combination of MC 3% in deionised water applied to a thin single layer of fine Japanese tissue was the best option. These materials were strong enough to hold detached parts together while leaving the flexibility of the cartonnage unaffected. MC has high thermal stability and it is recommended in textile conservation. Its high viscosity even in low concentrations (as 1%) gives minimum flooding migration which is desirable in this case. Lastly MC is resistible to biological attack (Feller and Wilt 1990: 55). Acrylic and vinyl polymers applied at thin Japanese tissue were stiffer and less compatible with the linen fabric, hence they were ruled out.

The Interventive Conservation Process: the Leg fragment

The relaxation of deformations was carried out by local humidification on the linen followed by application of weight (Figures 9 and 10). The weight was lifted in regular intervals to avoid damage to the paint texture. The realigned areas were then supported by fine Japanese tissue sized with MC 3% w/v in de-ionized water. The tissue was reactivated over the area by humidification in order to avoid excess use of water. Since the semi-detached areas almost entirely covered the sides, it was decided to apply strip lining on the reverse side (Figure 11).

The Interventive Conservation Process: the Torso Fragment

The conservation process began by strengthening and supporting the damaged areas with a medium grade Japanese tissue and methyl cellulose 3% in deionised water. This treatment was used previously for the treatment of painted Egyptian shrouds (Cruickshank *et al* 1999). Small strips of Japanese tissue covered the damaged areas and were used to reattach the separated sections (Figure 12). Larger patches and/or strips were then placed over these smaller patches where applicable, to add strength. The MC adhesive was applied by brushing the tissue on the linen. Weights were applied for short intervals over the tissue as on the leg fragment. It was decided that rehumidification was not needed here since the shape was partially preserved.

Incompatible Partners: Part III

Display Mount Decisions – More Factors?

The final steps of the process regarded suggestions for the display of the objects and their final return to the owner. Although the condition and shape of the object provided the main guideline, new factors made things more complicated than expected. How did each conservator perceive the context of the object? How did ethical and aesthetic perspectives influence their decisions? Finally, did their choices meet display purposes?

It was during this process that it came apparent that the factors that dictate incompatibility in composite objects are not just limited to the composite materials, their condition and potential conservation. Conservators working on the artefacts are also subjected to incompatibility. Ethical and aesthetic perspectives are unique to each individual. This led the authors to start out on the same path but to end up with a product different in aesthetic style and execution.

Constructing the Display

Display Objectives for the Leg Fragment

It could be argued that since the leg fragment was removed from its original position and had irreversibly lost its shape, if any, it became an artefact in its own right. The original ritual context should be retained in combination with the new one. The fact that the object suffered many changes through its lifetime was also taken into account. Thus the priorities were to provide protection to the object and prolong the effectiveness of the conservation materials in any given condition, whether it is for display or storage.

The concept of supporting the object on a leg mount and therefore restoring the original context was considered. However this option was discarded for two reasons: a) the preservation of the materials would not be benefited by such a display; b) aesthetic and ethical considerations of viewing the fragment displayed on a disembodied leg mount in a museum setting could be displeasing, perhaps even scary or upsetting to visitors. The use of a graphic representation of the original context could be used to demonstrate the original use. Since similar materials are usually displayed vertically it was decided that framing the object was the most appropriate method of display (Cruickshank *et al* 2007: 7).

Creating a Display Mount for the Leg Fragment

The previous backing linen was used for preparing the backing support for the final display mount. This linen was washed by soaking in hot water; it was then stretched in order to dry in an isotropic manner (Cruickshank *et al* 2007: 9). The linen was then applied to a Plastazote support covered with acid free tissue; it was then sewed on to the Plastazote with polyester fibre. The leg fragment was adhered to the support with MC 3% w/v in deionised water at the areas that were already covered with Japanese tissue. The whole assemblage was placed within a wooden frame (Figure 13). An acid-free card cut in a rectangular shape was placed around the fragment in order to allow some space between the object and the Perspex window.

Display Objectives for the Torso Fragment

The preservation of the original curvature was the main factor when considering a suitable display mount. A cast of the unique shape of the cartonnage had already been made for supporting the cartonnage during conservation. A framed display mount was originally considered for the torso fragment so as to have a similar aesthetic appearance to the leg fragment display. However, creating a mount which placed the object in context became an important goal for the conservator (Figures 14 & 15), as this would present the artefact in a directly identifiable manner to the museum visitor. Unlike the proposed use of a leg shaped cast as a display choice for the leg fragment, a torso cast would be more aesthetically appealing to museum goers as torso casts can be seen daily at clothing stores.

Creating a Display Mount for the Torso Fragment

The cast of the cartonnage made from plaster bandages and used to support the cartonnage through its treatment was covered with washed white linen and attached to the cast by sewing it tight at the back. The cartonnage itself was then attached to this cast using a number of Japanese tissue tabs so as to provide a surface that supports the unique curvature of the whole cartonnage. The cast only extends a few centimetres beyond the edge of the cartonnage but supports it fully. The torso mount was made by making a cast of the conservator's torso with plaster bandages; this cast was then strengthened using medium grade glass-fibre sheeting and epoxy resin. Once this cast was set it was then squared off using Corex and Plastazote to create a light weight and strong boxed half torso cast which sat level on a flat surface. This cast was then covered in a piece of washed white linen to give the appearance of a mummified torso. Velcro strips were used to connect the small shaped mount to the larger torso shaped mount. In that way the fragment can be displayed in two ways depending on the museum requirements. It can either be displayed alone on the small shaped mount (Figure 15) or on the larger torso shaped mount which provides an element of context to the viewer (Figure 16).

Conclusions

Both objects have been returned to the Swansea University Egypt Collection and are now on display. The museum decision to display the objects shows that both options were acceptable although different in style and execution. The following points were the main outcomes of the project:

- the composite nature of objects is not the only factor that dictates incompatibility.
- the history, preservation and previous conservation treatments may influence the treatment of two similar objects.
- the ethical and aesthetic views of conservators may differ and result in different conservation and display outcomes, even to related materials.
- differences may occur even when the same ethical standards are followed.

This case study demonstrates that the display of an artefact may fall into objective criteria. There is not one way to go about it and these decisions are neither black or white, nor right or wrong.

Future Food For Thought

The project also brought up some interesting questions for future debate:

- do different treatments make related artefacts incompatible?
- if so, do we need an international set of standards or code of ethics to standardise treatments on such materials?

Acknowledgements

The authors would like to thank the Swansea Egypt Centre, for providing these beautiful pieces of Egyptian funerary art; The staff of the Department of Archaeology and Conservation at Cardiff University for choosing us to undertake this exciting conservation challenge; The Icon Textile Group for accepting our paper and all the members for listening to our presentation at the Conference; Special thanks to Jane Henderson, tutor at Cardiff University and friend for her guidance and support throughout our training and our career to date; Stefanie White, fellow student who participated in the testing of the cartonnage replica; Phil Parkes, Senior Conservator Cardiff University Conservation Services for his assistance during the project; Chris Wilson, Cynon Valley Museum, for the construction of the frame for the leg fragment.

Vasiliki would like to thank her supervisors at KE' Department of Prehistoric and Classical Antiquities (W. Crete), Stauroula Markoulaki (Senior Archaeologist) and Yianni Christodoulako (Architect) for supporting her attendance on the conference during a very demanding period on the project in Crete.

Bibliography

Cruickshank P, Delaunay H and Harrison L. 2007. Painted Textiles and Canvas Paintings: a Collaborative Approach to Lining and Mounting. *The Conservator, 30,* pp5-18

Cruickshank P, Morgan H and Shashoua Y. 1999. The Use of Temporary Facings in Lining a Fragmentary Ancient Egyptian Shroud. *Studies in Conservation, 44,* pp29-38

Cruickshank P, Pullan M and Potter J. 1999. Recent treatments of painted Egyptian shrouds: The influence of condition and intended role. *The Conservator,* Volume 23, Issue 1

Elston M. 1995. Technology and Conservation of a Polychromed Wooden Sarcophagus. In: Brown C, Macalister F and Wright M, eds. *Conservation in Ancient Egyptian Collections. Conference held by UKIC, Archaeology Section and International Academy Projects 20-21 July 1995*. London: Archetype Publications pp13-21

Feller R L, and Wilt M. 1990. *Evaluation of Cellulose Ethers for Conservation.* United States of America: The Getty Conservation Institute.

Hatchfield P. 1988. The Use of Cellulose Ethers in the Treatment of Egyptian Polychromed Wood. In: Watkins S C and Brown C E, eds. *Conservation of Ancient Egyptian Materials. Preprints of UKIC Archaeology Section, Bristol December 15-16th* . UKIC

Ikram S and Dobson A. 1998. *The Mummy in Ancient Egypt: Equipping the Dead for Etnerity*. London: Thames & Hudson.

Jaeschke R L. 1995. A Method of Reshaping Cartonnage without Water. In: Brown C, Macalister F and Wright M, eds. *Conservation in Ancient Egyptian Collections. Conference held by UKIC, Archaeology Section and International Academy Projects 20-21 July 1995*. London: Archetype Publications pp23-28

Scott D A, Dennis M, Khandekar N, Keeney J, Carson D and Dodd L S. 2003. An Egyptian Cartonnage of the Graeco-Roman period: examination and discoveries. *Studies in Conservation, 48,* pp41-56

Scott D A, Dodd L S, Furihata J, Tanimoto S, Keeny J, Schilling M R and Cowan E. 2004. An Ancient Egyptian Cartonnage Broad Collar – Technical Examination of Pigments and Binding Media. *Studies in Conservation, 49,* pp177-192

Shaw I and Nicholson P. 1995. *The British Museum Dictionary of Ancient Egypt.* The British Museum Press.

Timar-Balazsy A and Eastop D. 1998. *Chemical Principles of Textile Conservation.* Oxford: Butterworth-Heinemann

Wallis-Budge E A. 1925. *The Mummy: A Handbook of Egyptian Funerary Archaeology*. KPI Paperbacks.

Figure 1
The front side of the leg fragment before treatment.

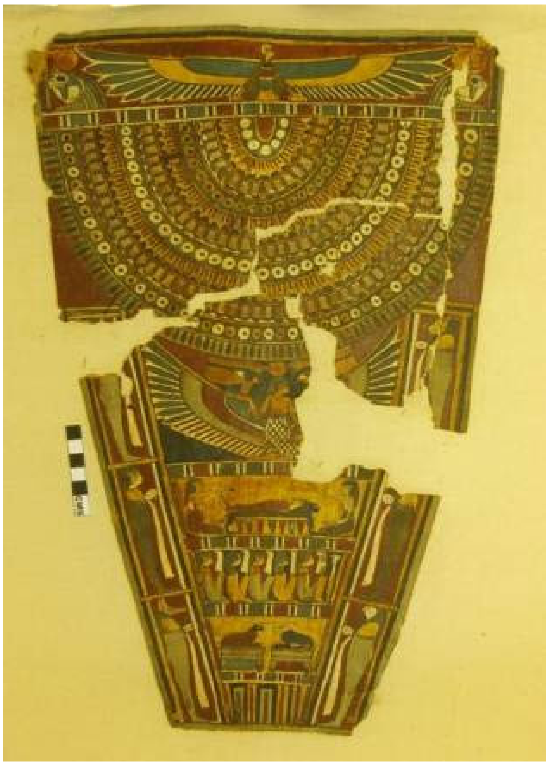


Figure 2
The front side of the torso fragments before treatment.

Figure 3
Leg fragment - Extended material loss and deformation on the reverse side and previous backing support of the edges with Japanese tissue.

Figure 4
Leg fragment - Cracking on the gesso and paint layer due to mechanical forces.

Figure 5
Large fragment of torso fragments before treatment.

Figure 6
Large fragment of torso fragments before treatment.

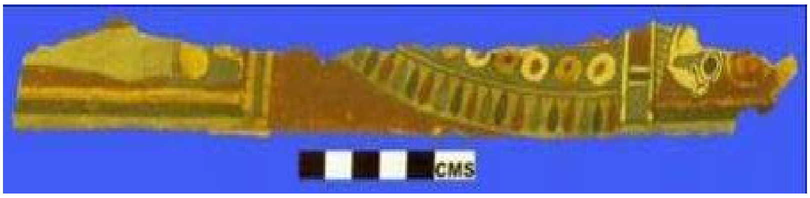


Figure 7
Small fragment of torso fragments before treatment.

Figure 8
The deformed replica after heating.

Figure 9
Rehumidification and application of weight. A layer of silicone release paper and Plastazote was placed between the object and the weight.

Figure 10
Adjustment of previously overlapped areas after humidification.

Figure 11
Strip lining with sized Japanese tissue.

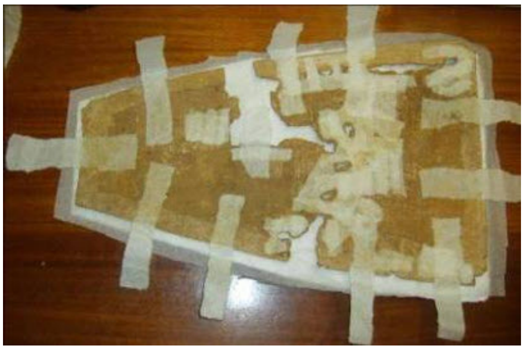


Figure 12
Torso fragment after reconstruction.

Figure 13
The object in its final display wooden frame.

Figure 14
Image of the mount making process of the torso fragment.

Figure 15
Image of the torso fragment on the backing mount.

Figure 16
Image of the torso fragment on the torso cast.

THE TEXTILE CONSERVATION CENTRE

UNIVERSITY OF Southampton

Incompatible Threads? Defining a Cleaning Strategy for the Whalley Abbey Altar Frontal

Leanne Tonkin

Introduction:

This poster presents the findings from the Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray Spectroscopy (EDS) analysis conducted on the metal threads used to embroider the central cross orphrey on the Whalley Abbey altar frontal. Distinct patterns of deterioration were noted on the gold threads encouraging further investigation. SEM allowed a more detailed examination of regions of interest, including areas of corrosion and EDS provided information on the composition of the metal components and corrosion products. The results of the analysis helped to define the cleaning strategy for the object which was conserved in 2009 by the author as a student project at the Textile Conservation Centre (TCC), Winchester, UK.

Figure 1 The Whalley Abbey altar frontal after conservation.

Brief Background and Description to the Whalley Abbey Altar Frontal

The Whalley Abbey altar frontal (fig 1) belongs to Towneley Hall Museum, Burnley Borough Council, Lancashire and is associated with the Whalley Abbey vestments which are thought to be one of only two complete sets of pre-Reformation English High Mass vestments in existence. The altar frontal consists of two side pillar orphreys of similar style depicting pairs of saints, one male and one female and could date from the late 14th to the early 15th century. In the centre of the altar frontal is an early Tudor cross orphrey showing the crucifixion, c. 1500. The three orphreys have been mounted on to a late 18th to early 19th century crimson silk and have been edged with a silver bobbin lace typical of the early 17th century.

Results from SEM-EDS Analysis Conducted on the Central Cross Orphrey

The SEM-EDS analysis revealed that there was silver, gold and copper content in the make-up of the metal strips which wrap around an 'S' spun silk core. The analysis also highlighted the unusual triple wound joins where the metal strip is wrapped around the silk core three times (fig 2a). These joins occur along the length of the metal threads used to embroider the cross orphrey. Significant tarnishing is noticeable in these areas, which suggests the construction of the triple wound join is causing increased oxidation of the alloy composition of the metal threads, creating a layer of corrosion of similar thickness to the metal strip. The triple wound joins seem to be trapping extra moisture from the atmosphere between each layer of the strips and when combined with oxygen is significantly increasing corrosion in these areas (fig 2b).

An exposed area of the metal strip which was found beneath a corroded layer appeared to be in reasonable condition (fig 2c). The level of gold content was much higher on the exposed area in comparison to the negative reading of gold content on the corroded area (table 1). This observation implied that the corrosion layer was protecting the original metal strip to a certain extent. The analysis of the triple wound joins on the metal threads revealed an unusual 'Z' spun characteristic of the central metal strip when usually metal threads are 'S' spun (fig 2a). These areas contained a lower content of gold and silver and high contents of corrosion products, for instance, silver sulphide. The areas of the thread which were wrapped with a single metal strip displayed a much lower presence of corrosion and an increased presence of gold and silver. Hence, even if cleaning was possible, it is the method of manufacture that has caused this severe corrosion, thus, there are no guarantees that the corrosion will not reoccur in the future.

The analysis also revealed the vulnerability of the surface of the metal threads (fig 2d). Wet-cleaning or solvent cleaning would have, potentially, removed some of the surface of the metal filament which would have resulted in losing evidence and encouraged further corrosion to the exposed areas, hence hindering the long-term preservation of the orphreys. Comparing the images produced from the SEM-EDS analysis, explain how the metal threads may deteriorate at different rates despite belonging to the same object, therefore the level of deterioration cannot be characterised at any one time.

Conclusions

The outcomes of the analysis using SEM-EDS further characterised the metal threads used to embroider the central cross orphrey on the altar frontal. The analysis highlighted how the manufacturing techniques have contributed to the enhanced and varied levels of deterioration that have occurred along the length of the metal threads. The results also indicate how the corrosion layer protects the precious metal strip beneath. These observations reinforced the reasons why wet-cleaning and solvent cleaning was not carried out in order to secure the long-term preservation of the orphreys.

All results in weight%								
Spectrum	In stats.	O	S	Cl	Cu	Ag	Au	Total
Exposed metal	Yes	3.8	0.8	0.1	5.8	69	**35.7**	115.2
Corroded surface	Yes	14	8.5	2.2	12	59	**-0.2**	96.46

Table 1 Results from EDS analysis of the metal strip shown in figure 2c. The exposed area indicates a high content of gold remains preserved beneath the corrosion layer.

Acknowledgements:

Thanks to: Susan Bourne, former Curator at Towneley Hall Museum, Burnley Borough Council, for her permission to research and treat the Whalley Abbey altar frontal.
Dr David Dungworth, Material Scientist, English Heritage, for his kind help with examining the metal threads.
Dr Paul Garside, Conservation Scientist, British Library, for his comments on the metal threads.
Frances Lennard, Reader/Senior Lecturer, Textile Conservation, University of Glasgow, for her supervision of the overall research.
The Textile Society, for their generous financial support which funded this research.

References:

Berkouwer, M. 2002. The Conservation of ecclesiastical textiles. *Ecclesiastical Textiles: Papers from the Joint Forum for Conservation Issues, 20 November 2001.* London: Council for the Care of Churches (CCC), 27-35.

Garside, P. 2002. *Investigations of Analytical Techniques for the Characterisation of Natural Textile Fibres Towards Informed Conservation.* (Unpublished Ph.D. thesis, University of Southampton.)

Rogerson, C. and Garside, P. 2006. Instrumental analysis of metal threads as an aid for interpretation and preservation of a fifteenth-century tapestry altar frontal and super altar frontal. In: F. Lennard and M. Hayward, eds. *Tapestry Conservation: Principles and Practice.* Oxford: Butterworth-Heinemann Publications, 48-56.

Tonkin, L. C. 2009. *Developments in the Conservation of Ecclesiastical Textiles: the Whalley Abbey Orphreys c.1309 - 1500.* (Unpublished MA Dissertation, Textile Conservation Centre, University of Southampton.)

Image Sources:

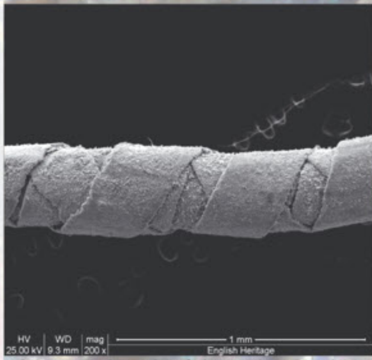


Figure 2a Sample of the triple wound join and enhanced corrosion taken from the background of the centre cross orphrey.

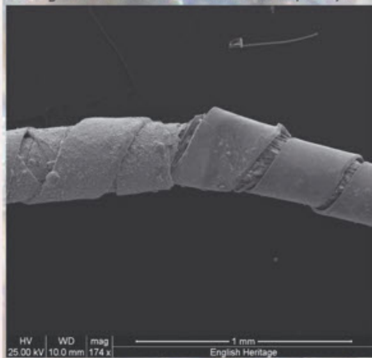


Figure 2b The enhanced corrosion can be seen where the metal filament is triple wound in comparison to the better condition of the rest of the thread.

Figure 2c Exposed area of protected metal strip and the thickness of the corrosion layer.

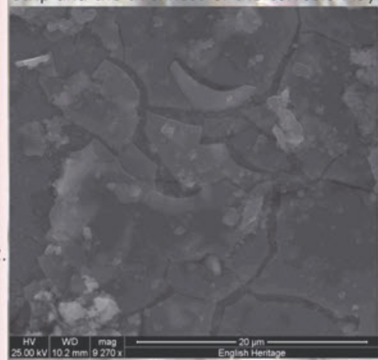


Figure 2d Detail of the deterioration of the surface of the metal strip.

All samples were examined and mounted for examination and carbon coated on a carbon coater, 'Polaron CC7650'. Samples were examined on a scanning electron microscope, model: FEI INSPECT F.

Contact details:
Leanne Tonkin,
Textile Conservator,
People's History Museum,
Left Bank, Spinningfields,
Manchester, M3 3ER, UK
+44 (0)161 838 9190
leanne.tonkin@phm.org.uk

The Conservation of a Malaysian Rebab

Robyn Haynie, Artefacts Conservation Intern and Irene Kirkwood, Textile Conservator
National Museums Scotland

The Rebab

- 3-stringed musical instrument used in Malay culture for traditional ceremonies
- Collected by ethnomusicologist Jean Jenkins in the late 1970's
- Instrument materials: painted wood, metal, skin, textile, glass beads

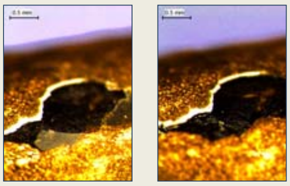
A.1980.329 All images © Trustees of NMS

Challenges of the Project

- One of thousands of objects needing treatment prior to installation in the newly renovated Royal Museum at the National Museums Scotland
- Both Textile and Artefact Conservators were operating under tight deadlines
- Conservation efforts had to be coordinated between two conservation sections
- Before any conservation work began curatorial input was solicited to inform the conservation approach

Artefacts Conservation

Painted wooden surfaces were stabilized prior to Textile Conservation work.



Area of prior consolidation on bow before and after treatment

- Flaking areas of past consolidation were resolubilized with Industrial Methylated Spirits
- New areas of lifting paint were consolidated with 2% Methylcellulose in 1:2 Industrial Methylated Spirits and deionised water

The Bow

An existing painted metal sleeve repair, constructed from condensed milk tin with interior text "Made in Malaysia", hid a complete break

- A 3cm bamboo dowel was inserted into the bow, and adhered with 50% Paraloid B72 (ethyl methacrylate co-polymer) in acetone bulked out with glass microballoons and pigment
- The break was doweled and filled to add strength while retaining the historical metal sleeve repair

Textile Conservation

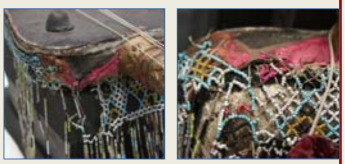
Two areas of damaged and missing fabric on the body of the instrument were stabilised to enable the reattachment of the beaded net.

- An area of loss adjacent to the spike was infilled with dyed cotton lawn, which was stiffened with the application of a layer of lightweight Reemay® (17gsm). The Reemay was coated with a 20% solution of Lascaux™ acrylic adhesive in a ratio of 1:2 Lascaux 360HV:498HV and heat set to the reverse of the cotton.
- The cotton lawn was cut to shape and one edge partially inserted in the gap between the spike and the leather , and the other edge shaped to butt up next to the original fabric. Nylon net was laid over the join and stitched in place with Tetex polyester crepeline thread.

Textile and Artefacts Interaction

Textile Conservator Irene Kirkwood oversaw and advised on two critical aspects of the treatment undertaken by Artefacts Conservation Intern Robyn Haynie:

- The adhesion of the textile fabric to the body of the instrument using cast films of 50:5 Lascaux™ acrylic adhesive
- The restringing and stabilization of the beaded net overlay on around the body of the instrument



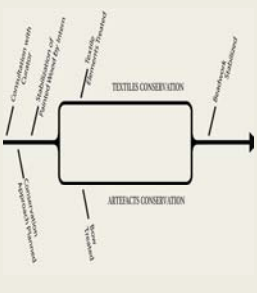
Beaded netting on top of instrument before and after conservation

Untreated Rebab bead and textile ornament loosely tethered to instrument

Rebab ornament after textile treatment

Rebab ornament after artefacts treatment

Treatment Timeline



Conclusions

Collaboration on re-adhering textile to instrument and restringing/stabilizing beadwork strengthened conservation approach

Interaction with Textile Conservator on a composite object enhanced Intern education

Irene Kirkwood and Robyn Haynie examining object and discussing conservation treatment

Arts & Humanities Research Council

STITCH, PATCH AND ADHERE: treatment of a 17th century leather glove.

Sarah Owens - sarahjgowens@hotmail.com

Figure 1. Leather glove, before conservation treatment.

Figure 2. Leather glove, after conservation treatment.

Introduction

This early 17th century leather glove, belonging to Platt Hall, Manchester, was treated in 2009 during the Master of Arts in Textile Conservation, at The Textile Conservation Centre. The conservation project was recently short-listed for the Icon *Student Conservator of the Year Award* 2010. The glove is a mixed media object, comprising of a leather section and an embroidered gauntlet consisting of eight tabs with round top edges. The tabs are constructed using layers of different materials, embroidered with silk threads, metal thread, metal strip and metal spangles.

Figure 3. Humidification.

Figure 4. Stitched support.

Figure 5. Adhesive trials.

Figure 6. Adhesive treatment.

Conservation treatment

Treatment required a variety of solutions for the different materials, and ethical considerations were central in the decision-making process. Treatment on the leather section involved surface cleaning and humidification (Figure 3). Contact humidification was selected to reduce the creasing and distortions caused by previous flat storage. The rise in humidity enabled the glove to be gently manipulated into shape and the fingers lightly padded. The technique selected reduced creases, yet retained evidence of use. Open seams in the leather were re-sewn (Figure 4) and the tears/slits in the leather underwent adhesive treatment.

Since accessibility was a major issue, tests using a practice glove were undertaken to establish the most effective method of reactivating the adhesive with such restricted access (Figure 5). Materials and treatment methods were selected from the flat and three-dimensional adhesive tests. The leather section was treated using patches of Reemay® toned with acrylic paint and pre-cast Beva 371 adhesive film, in combination with strips of the pre-cast adhesive film. The adhesive was re-activated using a heated spatula (Figure 6). The inside of the glove had a combined adhesive and stitched patch support (Figure 7). Nylon net was used for the stitched support as it can be neatly trimmed to shape and encases the area of loss, without being visually distractive. Reemay® and pre-cast Beva 371 adhesive film were additionally used to support the leather gap inside the gauntlet.

Figure 7. Inside of gauntlet, after stitched and adhesive treatment.

Figure 8. Exposed layers, after adhesive treatment.

Adhesive treatment was also chosen to support the exposed layers on the embroidered gauntlet (Figure 8). Stitched support was deemed to be inappropriate as access for stitching was extremely limited; the surface fabric is degrading, and the under-laying paper is extremely brittle. After testing, a colour matched semi-transparent fabric coated with a solution of 12% Lascaux 498HV and 360HV (50:50) was selected for its adhesion and handling qualities.

Conclusion

The leather section has been successfully supported with a combination of stitched repair to the open seams and adhesive treatment to the tears. Stitch and adhesive support to the embroidered gauntlet fulfilled the treatment objectives by providing stability and making the join between the leather section and gauntlet neat and visually pleasing. The overall appearance of the glove has been greatly improved, treatment has successfully given support to the glove and the bespoke mount enables the textile to be handled and researched safely (Figure 2).

Figure 9. Detail, before treatment.

Figure 10. Detail, after treatment.

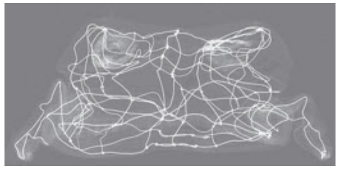
A courtier's hat – the conservation of a mixed material accessory

Roisin Morris, Textile Conservation, Victoria & Albert Museum

Context

This poster illustrates the treatment of a hat from the Ballet Russes production *Le Chant de Rossignol* that debuted in 1920 with sets and costumes designed by Henri Matisse. The hat was worn by one of the courtier characters and prepared for display in the 2010 autumn exhibition, *Diaghilev and the Golden Age of the Ballet Russes* 1909-1929, at the Victoria & Albert Museum. The construction elements – corroded iron wire framework wrapped in paper, fragmentary brim support and painted napped cotton cover – are incompatible, which has caused staining and structural damage to the paper and the textile layers. A desire to stabilise the structure for display and travel was supported by a curatorial request to reshape the profile, leading to the removal of the cover and a treatment that involved discussions with metal and paper conservation colleagues.

The courtier's hat before conservation.



X-radiograph before conservation shows the crushed metal frame.

Detail of front seam stitching and losses to the painted surface.

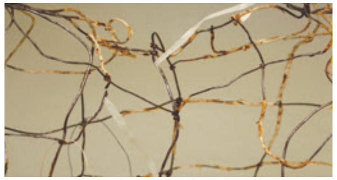
Beginning to remove the cover. Several stitching threads were found at the brim.

Separating the layers revealed their poor condition.

Detail of the paper-wrapped and heavily corroded wire as well as a thin aluminium wire repair at a joint.

Detail of front proper left side. The paper wrapping here was in relatively good condition.

Frame during conservation – corrosion partially removed and coated, paper readhered & shape partially reformed.

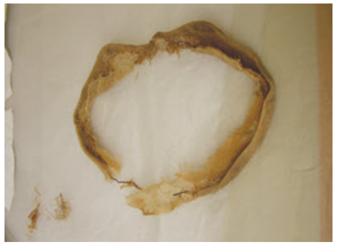


The corrosion was removed using wet & dry sandpaper and the frame was coated with 20% Paraloid B72 in acetone.

The breaks were supported using Japanese paper strips & 10% Klucel G in acetone.

The frame after conservation.

The disassembled hat during conservation.



The sparterie (straw-like buckram) brim support with broken brim wire and fragmentary sparterie.

It was placed on a template taken from the brim and larger pieces were orientated.

The brim wire and cotton gauze were realigned & supported.

The brim support was placed on a piece of nylon net and pinned in place.

Stitch support lines were worked around the large fragmentary pieces to hold them in position – after treatment.

Beginning to place on the brim support.

The brim support was re-positioned inside the felt brim shape.

A stiff support and barrier cover were prepared to protect the frame from the cover and encourage a better shape.

Re-assembling the elements and restitching the cover

Re-stitching lining and encasing label.

Reverse after conservation.

Front after conservation.

Leather, Latchets and Lace:
Eighteenth Century Shoes and their Conservation

The trend in shoes from the seventeenth century onwards saw the combination of different materials such as fine silk brocade, metals (in the form of embroidery threads as well as buckles) and different types and grades of leather. Many shoes from this period survive, some held in large collections while others are just odd pairs in a more diverse collection of objects. In order to preserve them for future reference and enjoyment, many of the shoes need to undergo conservation treatment in some form or another be it remedial or merely preventive. The combination of different materials make any form of conservation challenging as each material has dissimilar requirements for preservation. Practically, the remedial conservation of such shoes is challenging as access is difficult to all parts and compromises have to be made. Below are some points to bear in mind when faced with a pair of shoes.

Many materials are used in the construction of shoes, most obviously leather and textiles (silk, linen, wool and cotton) but also wood, metals and paper. Further elements are introduced in the decorations and embellishments not to mention buckles.

The methods of construction utilised in the 18th century are not fully documented. Consequently , shoes that are now in what would be considered poor condition are valuable because of what they can tell us about techniques and materials used. This should be taken into consideration when conserving such shoes so that evidence is not lost or concealed.

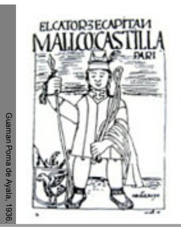
Shoes, like clothes, were sometimes altered. It is not unusual to find the vamp and tongue slashed to allow for higher insteps or widening feet. This was disguised in use by the buckle, the application of braid (lace) or by an insert of complementary material. Shoes could be altered in other ways such as painting/re-dying or completely recovering.

Makers often inserted paper labels towards the end of the eighteenth century and these can usually be found on the insole. Handwritten markings can also be found in similar places which may indicate the wearer, the maker or the size. Details of the shoe size can also some times be found right in the toe of shoe which is not easily spotted if it is not known where to look.

The sole and shape of the uppers can give an indication of wear and whether the shoes, which were all constructed as 'straights' (ie no shaping for left and right) during this period, have been alternated regularly between each foot or have always been worn on the same foot. The wear on the sole, scuffing on heels and staining may also be indicators of whether or not the shoe has been worn outside or only inside.

The uppers of many shoes are solely of a decorative outer textile, often silk brocade or damask, lined with linen. The linen was probably stiffened at the time of construction but the years have softened it. Such shoes therefore need adequate support to hold them in shape but not so much that they then take on an artificial shape. Some distortions are signs of wear (for example if the wearer had bunions) and may also give evidence of whether shoes were continually worn on the same foot or were interchanged. It might be preferable to retain these particular distortions.

Alison Fairhurst
2011



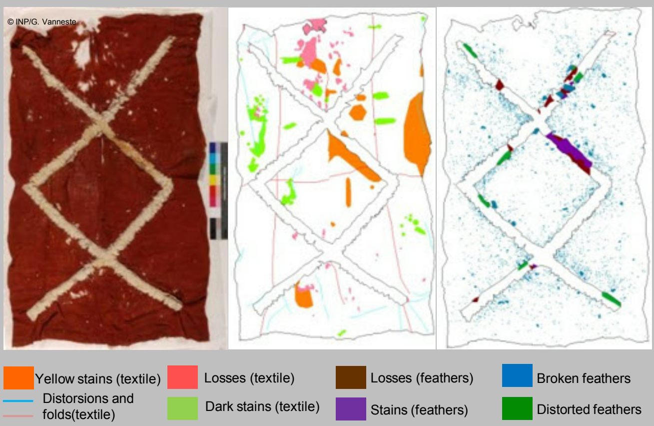
TEXTILE AND FEATHERS:

STUDY AND CONSERVATION ISSUES OF A FUNERARY PRE-COLOMBIAN PONCHO (130-210 AD)

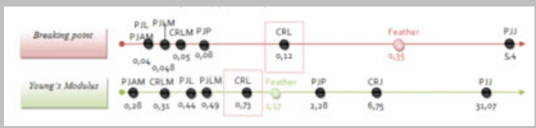
By Enard Emilie, Fabien Ferrer-Joly[1], Amandine Péquignot[2], Patricia Dal-Prà[3] and Frédérique Vincent[4].

[1] Curator, Musée des Jacobins, 32000 Auch - Fr
[2] Museum national d'Histoire Naturelle, CRCC, 75005 Paris - Fr
[3] Private Textile conservator, 75012 Pari s- Fr.
[5] Private Organic Artefacts Conservator, 93000 Montreuil - Fr

I chose to lead my thesis research on a composite garment made of textile and feathers.



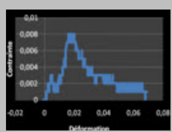
The poncho before treatment / Conservation statement of the textile and the feathers



PJA : Japanese paper/starch
PJAM : Japanese paper/starch-Tylose blend
PJL : Japanese paper/Lascaux®
PJLM : Japanese paper/Lascaux® blend
PJP : Japanese paper/Paraloïd B72
PJJ : Japanese paper/Jade R

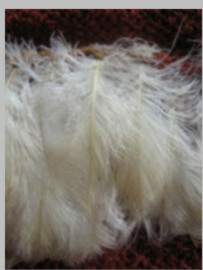
CRA : Crepeline/starch
CRAM : Crepeline/starch – Tylose blend
CRL : Crepeline/Lascaux®
CRLM : Crepeline/Lascaux® blend
CRP : Crepeline/Paraloïd B72
CRJ : Crepeline/Jade R

NYL : nylon thread/Lascaux®
PA : Paraloïd B72 thread



Comparision between the consolidation techniques (breaking point, Young's Modulus)

Consolidation of a feather on the poncho



Feathers after consolidation

The poncho on the form (face and back)

THE PONCHO AND ITS MATERIALS

The garment is made of two lengths of plain weave textile sewn together along one edge with a basic stitch. Aside, feathers have been knotted together on strings then applied by sewing on the textile background.

The textile, made of Camelid fibres (probably *Alpaca*) is fragile, has losses, dark stains, deep folds and lost its original shape. The white feathers from a Peruvian seaside bird, the Guanay Cormorant, are stained, bent and broken. Eventually, the naturaly tinted brown cotton threads are well-preserved.

THE CONSERVATION ISSUES

The sewing that makes the link between both materials makes treatments a challenge. The flipping of the poncho is delicate and the back side of the feathers is difficult to access.

Due to the bad preservation state of the feathers, a scientific investigation was done on the consolidation of broken feathers.

We decided to evaluate diverse techniques and adhesives widely used in both organic materials and textile conservation Tensile tests were applied to an experimental set of white feathers of various sizes to observe the preservation of mechanical properties of the material (Young's modulus, elasticity, etc.). The transparency and color of consolidations were compared by optical microscopy and visual observation on light table. The selected technique for the treatment of the object was a lining of silk crepeline (for its strength) with Lascaux 360HV adhesive, acetone-reactivated (for its elasticity).

The textile background was also consolidated after reshaping in a more traditional way : by sewing with restoration stitches on a new dyed fabric.

STORAGE AND EXHIBITION

A special tray for storage and transport was made of neutral cardboard and polyethylene foam with an unwoven wrapping and a lid. It suits both the object and the storage unit.

The poncho will be exhibited in the museum next year for a special show about this thesis project. Therefore, a form was conceived in order to support the poncho and to show the poncho as a garment, by seeing the neck slit. This form can be used for other ponchos or tunics conserved in the Museum.

Emilie Enard, Private Textile Conservator / 21 rue Léon Frot 75011 PARIS (France) / emilie.enard@gmail.com / 00 33 617 930 624

Fractured and Flaking

The conservation and display of a painted textile banner

by Holly Clarke and Philippa Hiscutt

Above: Banner (side A) prior to treatment, showing fracturing and soiling

Below: Banner (side B) after treatment, showing improved surface and blending of the net

The concept of an 'unusual' combination of materials may be connected to the conservators' individual experience.

This 19th century protest banner was in the Low Parks Museum collection and was allocated to two final year undergraduates from the University of Lincoln;

The combination of extensive **soiling**, two **flaking** painted images, **fractured** cotton backing and numerous textile **additions** (e.g. Union Jack panel, tassels, silk trim) were **unusual** and challenging to us. This poster deals with the resolutions of just some of these challenges presented to us.

The banner was fully conserved and mounted for display to be shown at the summer 2010 graduate exhibition, **Suspension of Time**.

Washing the banner: A calculated risk

Aqueous washing was the ideal point to start the extensive treatment required to restore aesthetic value and stability. Washing would remove soiling, and **relax** the cotton backing so that the fractured areas were more **cohesive** with the unpainted backing, allowing **support** and **consolidation**.

Testing for washfastness with a concentrated solution of Dehypon LS45 on blotting paper.

1. Full **solubility testing** of dyed and painted areas was carried out to ensure aqueous washing would be safe.

All tests were successful apart from the blue dye of the Union Jack panel.

Removal of the Union Jack panel to enable washing was considered inappropriate due to the multiple lines of tight machine stitching which would be **unethical** or difficult to replicate.

Preparing a cyclododecane impregnanted test sample. In water, the cyclododecane mask was disturbed both by water and movement leading to bleeding of inks.

2. **Cyclododecane**, a volatile binding media, was considered as a 'mask' for the Union Jack. It would form a **water impermeable** barrier which would subliminate from the textile after treatment. (Jägers and Jägers, 1999)

Samples were made with water soluble inks and the aerosol form of cyclododecane. All tests were **unsuccessful,** though it would be interesting to investigate other forms of volatile binding media in the future for similar problematic treatments.

Sponging of the Dehypon LS45 solution to increase detergent action, with nylon tulle for protection of the fragile surface

3. **Solvent cleaning** was not considered appropriate due to the banner size and **health and safety** issues.

Reeves and Shore (1982) solved the problem of redepositing fugitive dye by angling the area of concern towards the gutter end of the bath. We made a **calculated risk** to wash the banner according to this method as no other alternative seemed available in the time allocated. 3% Dehypon LS45 in distilled water was used and **no dye loss** was reported.

Mounting the banner for exhibition

All painted areas were sealed with **25% Beva 371 in white spirit** to prevent further flaking and facilitate heat sealing of the support to one side. The support was **custom dyed** nylon net, for which we tested and used Jacquard Acid Dye in Ecru. After trying many dye recipes, Ecru simply gave a shade that **blended** with the backing and the painted images. The net was pinned and sewn to support the fracturing and losses.

Below: Painting just **some** of the pieces that made up the banner mount

The intention was that **both images** would be visible, but this obviously presented a problem for an exhibition with limited **space, time and budget** and many prototype designs and models were made with little success.

A **'eureka'** moment meant that a wooden frame was constructed, with the object surface covered in wadding and calico. For the reverse image, a hole was cut, supported with **Melinex.** An angled mirror and **visitor prompts** helped viewers seen both the conservation processes and the images.

Above: Banner on display at the exhibition, 2010.
Right: Example of dyed net blending with painted image

Textile Forum 2011

UNIVERSITY OF LINCOLN

Holly Clarke is currently studying for her MA Conservation of Historic Objects at the University of Lincoln. She enjoys all aspects of conservation but is particulary interested in textiles, painted surfaces and ethnographic materials.
holly.clarke87@googlemail.com

After completing her degree, **Philippa Hiscutt** is working at Hampton Court Palace as the conservation technician within the textile studio, with a varied role. She hopes to pursue a career in textile conservation.
philly@hiscutt.com

Selected Bibliography:

Jägers, E. and Jägers, E. (1999) Volatile Binding Media – Useful Tools for Conservation in Oddy, A and Carroll, S. (eds) Reversibility – Does it Exist? British Museum Occasional Paper no.135 p.37-42

Lochhead, V. (1995) Conservation of Painted Trade Union Banners. In: Preprints of the UKIC Conference 'Lining and Backing: The Support of Paintings, Paper and Textiles' London: UKIC, p.96-101

Reeves, P. and Shore, S. (1982) A Preliminary Conservation Treatment Report on Ten World War I Flags from the California State Capitol, The WAAC Newsletter. Vol 4, No. 1. [online]