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The cover shows mechanism examination and testing of stand for clock store
Photography by Timothy Hayes

Editorial – A Taste for the New?

Jonathan Ashley-Smith
Head of Conservation

The Victoria and Albert Museum recently celebrated the one hundredth birthday of its name. The future brings not only a new year but a new millennium. Birthday and new year celebrations are times for new resolutions and new opportunities as well as nostalgia for things past.

The Museum's new year resolution is to place contemporary design in the foreground of its activities. The present will be the gateway to the past, not the other way round. The physical affirmation of this resolution will be the Spiral building, designed by Daniel Libeskind. While it will itself be a statement of contemporary design, it will also create a new way of entering and understanding the Museum. It will be an arena for displays and events that demonstrate the V&A's involvement in what is not merely contemporary, but challenging, fast changing and cutting edge.

That description does not immediately match a common vision of conservation. Conservation is slow. Conservation is about things that are old and failing. It is about putting a stop to processes. Indeed, conservation has a reputation for putting a stop to anything. It could be seen as an attempt to prevent anything moving into the future. It *should* be seen as an attempt to enable the past to be seen in the future.

In reality, progress in conservation is just the same as it is in art and design. It develops slowly by building on past successes. Only very rarely does it take radical leaps. It returns to old failures and tries to revive them in a modern context. It takes advantage of the latest materials and technology.
It has fashions. Some practitioners achieve fame within their peer group, very few outside it. The majority don't even get their fifteen minutes. So following this comparison, there must be something that could be called *'contemporary conservation'*.

Because of its size and long history, because of the challenges of the Museum's varied collections, and especially because of its integration into an energetic post-graduate training and research environment, the Conservation Department at the V&A stands a chance of demonstrating some elements of contemporary activity. There is evidence of this in this issue of the *Journal*.

As with art, it is difficult to decide whether something is hot or just warm enough to be still alive. Is it modern to mention Richard Wolbers' work or faintly historic? With some events such as the opening of a new store, the newness is totally local and outside observers may wonder what took us so long.

Some activities speak more obviously of the contemporary. One of the strong research and development themes that is emerging is the use of computer imaging in conservation. Originating with Alan Cummings' enthusiasm for the subject, this theme has generated an active group of students, large enough to support each others development and to encourage the use of these techniques elsewhere in the Department.

Some other areas may not look new as immediately and obviously as 3D imaging. The fashion for energy saving has passed its hype-by date. But the problems of economy in museums are severely up-to-date. The collaborative project to find energy efficient ways of controlling dirt and pollutants in galleries is bringing new evidence and may break down old prejudices.

The discovery of old conservation techniques may at first sight seem to lead only to another chapter in the history of the profession – a past from which we have progressed. However, the discovery of Bakelite as a treatment for stone indicates that there has always been a willingness to investigate the very latest materials. This feeds into the current debate about reversibility and re-treatment, the subject of a conference at the British Museum later this year and no doubt a point of discussion in next year's fashionable debate. Just because mistakes were made in the past does not mean it is more saintly to stand back and do nothing.

The RCA/V&A Conservation Course: Changes Over Time

Simon Hogg
Research Assistant, RCA/V&A Joint Course in Conservation

The RCA/V&A Conservation Course has seen a number of important changes over recent years. Whilst remaining at the forefront of conservation teaching, it has expanded in the number of students and the diversity of subjects. One of the important aims is to increase the research output of the course and this year we expect to see the award of the first PhD.

The course numbers are presently split equally between research students (MPhil and PhD) and taught students (MA). As part of the taught programme, all MA students are required to pursue a research project in their final year, and whilst these are chosen in consultation with their tutors and course staff, they are selected by the students. Here, a tremendous amount of innovation is displayed, with subjects as varied as 'analysing the dynamics of mannequin display' to 'applying microscopic examination of cross-sections to leather dressings'. Some of this research is to be found within this *Journal* from time to time.

The importance of research as part of a postgraduate course in conservation is increasingly clear. Practising conservators must be able to critically appraise the information available and use it to make informed decisions. While conservators may not have the time or resources to investigate for themselves, they should be able to examine research presented by others, to assess the validity of that research and whether they agree with the conclusions. The converse is also true. The conservator engaged in research should be able to present their work to other conservators, and be confident in defending their research (as they would their 'practical' conservation methods). As part of this process, we encourage all our students to publish their research in appropriate journals, and to present their work at conferences. Without this communication, research can remain locked away, either in institutions, studios, or peoples' memories.

Of course, even if published, other conservators may not read the research. *Studies in Conservation* and *The Conservator* are widely read, but how many conservators have ready access to scientific journals, such as the *Journal of Materials Science?* For this reason, we encourage our students to pursue interactions outside the studio to increase their exposure to different institutions and facilities. Some of the current collaborations are on the methods of stone cleaning, the processes of patination and the computer-assisted reconstruction of fragmented objects. We also encourage interactions in reverse, and this year we ran, for the first time, a course for students from the Department of Chemistry at Imperial College, so that in addition to their chemistry studies, they could gain experience of Conservation. These students will progress next year to complete an extended research project which will contribute to their own development in chemistry and also to the needs of conservators.

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Old Treatment, New Problem: Bakelite as a Consolidant

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Bakelite is a trade name of the phenol-formaldehyde resin, which is one of the earliest synthetic polymers. It was manufactured in the first decade of the 20th century and found various applications. In the 1920s, it began to be applied as a coating for conservation purposes, on fossils and wooden objects that required consolidation. Although it was suggested in contemporary publications as an excellent coating resin, its recorded use was restricted to fossil bones in the Chicago Field Museum, in the U. S. A. and in the Natural History Museum in London, UK. Bakelite applications in conservation were discontinued in the 1940s because of certain disadvantages that soon became apparent. The lack of records and relevant information precludes any assumption on the extent of its use and in which institutions.

Its discovery is attributed to the German chemist A. Von Bayer who produced the resinous substance out of acid, formaldehyde and phenol in 1878[1]. However, Bakelite was not manufactured until 1909, when Leo Hendrick Baekeland established the Bakelite Company in the United States with branches in Europe. Bakelite was also produced from 1915 by the London-based Damard Lacquer Company and in 1926 the two companies merged to form Bakelite Limited[2].

The resin offered many advantages that current raw materials could not always provide. For instance, the rapidly-evolving technological evolution of those times required strong and durable materials for specific applications, like the insulation of electrical cables, and Bakelite was offered as the solution as opposed to the current natural or semi-synthetic substances. Furthermore, its properties allowed it to be moulded in order to produce long-lasting objects at low cost, from ornaments and handles to radiophones and furniture, rendering Bakelite a radical medium[3].

The formaldehyde family of resins are highly cross-linked polymers formed by condensation reactions. The process of polymerisation takes place in two stages. First, water-soluble oligomers of formaldehyde and phenol are created by a condensation reaction (Figure 1). The oligomers that result can be directly used for casting or as a varnish. At the second stage the oligomers are cross-linked by acid catalysts or heat, forming the longer polymer and a large amount of water is produced. The polymers can also be used as a varnish if applied as a coating, thin enough for water produced in the reaction to be released[4]. Bakelite varnish is a brittle material, described as a completely irreversible thermosetting resin. It is yellow to dark brown, unevenly transparent, light-sensitive and it darkens over time.

The first reference to the use of Bakelite as a consolidant dates from 1925 when it is suggested for the hardening of fragile fossil bones[5]. The process is briefly described thus: Bakelite Varnish was thinned with Bakelite Thinner, a flammable and volatile substance, supplied by Bakelite Ltd, about which no further information is given. This was brushed onto the bones or they were immersed in it. Residues were washed away with the thinner or with a mixture of alcohol and amyl acetate. After draining for several hours, the bones were baked in an oven for about 15 hours at 220o F. The solvent evaporated and the Bakelite was polymerised to a "hard, durable and practically indestructible substance"[6]. Apparently, the Bakelite Varnish consisted of phenol-formaldehyde oligomers, which were polymerised upon exposure to high temperatures.

After 1930, the Field Museum of Natural History in Chicago and the Natural History Museum in London adopted the technique with only slight variations. Bakelite replaced the natural and semi-synthetic resins previously used. Compared to natural resins such as paraffin wax, glue, gum arabic,

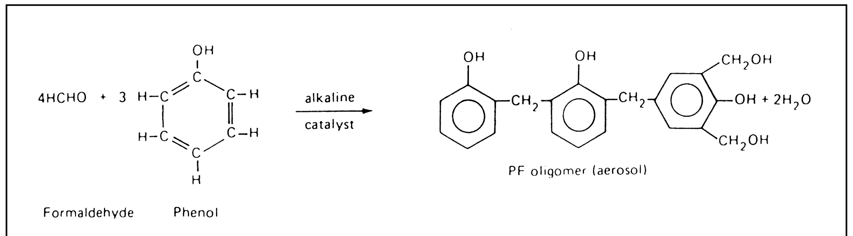


Figure 1. First stage in the polymerisation of phenol formaldehyde (C. V. Horie, Materials for Conservation, Butterworths1987, pg. 176)

mastics and Shellac, Bakelite was believed to have better properties such as its indestructibility after curing. It was reported to penetrate bone four times more deeply than Shellac, it was more elastic and left the treated specimens hard and tough[7]. By the early 1940s, Bakelite's disadvantages were apparent; it was a brittle, irreversible material, which darkened the objects. New resins, such as vinyl acetate, became more suitable for consolidation purposes since they could be easily removed by a solvent and did not alter the appearance of the objects[8].

The use of Bakelite as a consolidant seems to have been restricted to fossil bones and, to a lesser extent, to wooden objects, from the 1920s to the 1940s. Although it is possible that Bakelite may have been tested, or even applied, on other types of objects, no records have been found. Its identification on an architectural fragment in the V&A collection was unexpected and sheds some light on its use as a consolidant.

The 13th century limestone angle capital (A76-1916) was covered with an unidentified, uniform, dark brown layer that did not resemble any of the deterioration layers commonly found

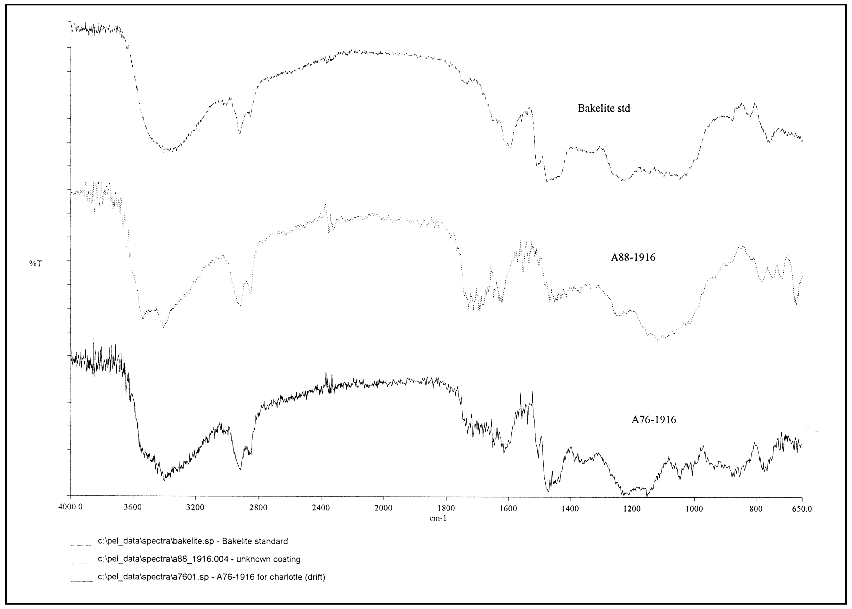
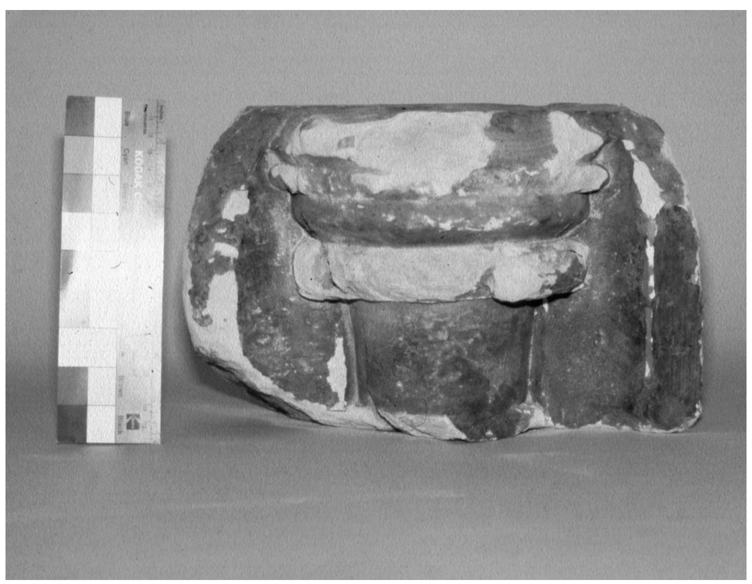


Figure 3. FTIR spectra of a. Bakelite standard, b. Bakelite coating on A88-1916 and c. Bakelite coating on A76-1916.

on stone objects, or to any known coatings (Figure 2). Its presence on some areas of loss confirmed that it was not an original layer but was applied much later, apparently for preservation purposes since the stone is heavily deteriorated. However, the dark brown layer proved inadequate for securing the loose pieces in place. Attempts to dissolve the layer with various solvents, such as white spirit, ethanol, acetone, iso-propanol, toluene, xylene and mixture of ammonia and water, completely failed.

A sample was taken for identification by Fourier Transform Infra Red (FTIR)spectroscopy in the Science Group of the V&A. The spectrum corresponded to the Bakelite reference spectrum (Figure 3). The dark brown coating was, beyond doubt, Bakelite. This raised more questions regarding the application date and the usage of Bakelite Varnish in the V&A. Was the capital an isolated case, perhaps an experiment, or was Bakelite treatment common in the Museum?

The capital was acquired in 1916 and belongs to a large group of architectural details donated in the same year by the Architectural Association. Although Bakelite was being produced since 1909, its application as a varnish before 1916 does not seem probable. A 1919 V&A publication of Recent Acquisitions describes the donation of the collection in 1916 and mentions that ‘some considerable time had been spent in cleaning the objects and “treating them for decay”[9]. Recent examination of the collection revealed that the most fragile pieces were



Photography by Metaxia Ventikou

Figure 2. Angle capital, English, limestone, 13th century. (V&A A76-1916)

Photography by Metaxia Ventikou

Figure 4. Architecture moulding with tooth ornament, English, limestone, 13th century. (V&A A88-1916)

covered by a similar dark brown layer that could be presumed to be Bakelite; objects of marble or other polishable stones had not undergone consolidation treatment. A coating from a 13th century architectural moulding (A88-1916) (Figure 4) was analysed by FTIR spectroscopy. The spectrum exactly corresponded with both the Bakelite reference and the angle capital spectra (Fig. 3 spectrum B). Although more coating samples must be analysed, it can be supposed with certainty that Bakelite was used for the consolidation of objects from this collection.

If the “treatment for decay” mentioned in the 1919 record refers to consolidation with Bakelite, this predates the earliest recorded such usage by at least six years. However, the V&A collection could have been treated with Bakelite at a later date, perhaps during the 1930's when this was common practice. A second programme of treatment within a relatively short time seems unlikely to have been carried out, but even if this is the case, the V&A architectural collection is still significant as a new example of stone consolidation with phenol formaldehyde resin.

The detection of Bakelite on stone objects reveals a previously unknown application of this resin. For over two decades Bakelite was regarded as an excellent conservation material and its identification on stone objects in the Victoria and Albert Museum shows that it could have been used as a consolidant in other types of objects as well. Conservators frequently come across old conservation materials and Bakelite must be considered as such from now on. Further study is necessary to determine the extent and implications of Bakelite's past use. It is hoped that this brief overview will serve as a useful introduction to the use of Bakelite as a stone consolidant.

Acknowledgements

I would like to thank Ms Charlotte Hubbard for all the guidance and the translation of the German article, Mr William Lindsay for the useful information, Dr Brenda Keneghan and Ms Silvia Valussi for the identification of Bakelite, Dr Paul Williamson and Ms Peta Motture for allowing me access to the Architectural Collection, and Mr Pedro Gaspar for his comments.

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An Improved Storage System for the Clock Collection

Timothy Hayes
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An important stage of the Heritage Lottery-funded refurbishment of the British Galleries has recently been completed, with the successful de-installation of the fifteen galleries and eight storage areas that formerly housed the Museum's collection of British Art and Design. A process that engaged the collaborative resources of the entire Museum, during the redistribution of objects from 10% of the Museum's gallery space.

The logistical implications of the storage project had initiated a search for alternative gallery and storage locations, which culminated in the implementation of a high density storage system for the furniture and woodwork collections, accommodated at the museum's principle store Blythe House.[1] This article describes a single component of the storage system, that was specifically designed to accommodate the displaced collection of clocks. Proposals for the new gallery scheme offered few opportunities for the display of horological objects, a position that highlighted a demand for improved access to the stored collections.

Previous storage conditions

The British Art and Design gallery and storage rooms had previously accommodated a diverse selection of clocks, illustrating the stylistic development of casework and clock design. The objects were principally interpreted as examples of cabinet design with an emphasis on decorative casework (e.g. floral marquetry, japanned decoration, figured woods, etc.), rather than on horological innovation.

The majority of clocks were spread throughout a series of storage locations that provided a minimal level of environmental and physical protection. The storage conditions of the longcase clocks offered a particularly low standard of horological storage, with objects standing directly on uneven wood-block floors, grouped in close proximity to each other and concealed underneath polythene sheeting (see Figure 1). Access to the collection was somewhat limited due to the restricted storage space, and the generally inhospitable, dusty, poorly lit and overcrowded conditions. Movement and handling of the objects was unnecessarily time consuming, occasionally hazardous and risked damage to the delicate clock components. Surveys undertaken during the preliminary stages of the British Gallery project had identified the storage conditions as being the primary cause of structural and chemical deterioration of both the wood and metal components.

Photography by Timothy Hayes

Figure 1. A view of one of the former storage locations (Room 58 Store)

Comparative review of storage systems

The principle objective was to create a facility that would improve the general standard of long-term storage and provide greater access to the collection; a designated store that would maximise the space available, without compromising the accessibility and safety of the objects.[2]

The Conservation Department does not contain a specialist section for the specific treatment of clocks. Therefore, the initial stages of research to investigate appropriate storage systems was based on communication with external horological sources. A comparative assessment of storage facilities held within other institutions,[3] revealed distinct differences in store form and function. In general, the storage systems conformed to three models:

- Standard Storeroom
  This form of store conformed to the standard museum model, providing a secure storage enclosure that offered a flexible range of environmental parameters for the long-term preservation of mixed material objects. The individual storage requirements for specific clock components were also featured.
- Study Collection Store
  This store functioned as a horological study room, which enabled greater public access to the objects under the supervision of specialist staff. The store displayed objects using a combination of open and closed storage systems, with sections of the collection maintained in an operational condition.
- Work Room Store
  This form of store provided a secure enclosure for the short-term storage of clocks, before and after their restoration to an operational condition. The store incorporated a designated area for testing the restored longcase clock mechanisms, supported on special stands that allowed open access to the mechanism, pendulum and weights.

The review of storage facilities provided the basis for an outline specification that included elements of each of these three storage models.

Blythe House clock store

The storage system had to be installed in the available space within the constraints of the project (floor loading, accessibility, programme, budget), and to meet the Furniture and Woodwork Department's criteria for storage of collection type, chronologically within each type of category, and by nationality – British or Continental.[4] A single storage area was considered the most appropriate solution, which complied with both the general constraints of the project and specific object requirements. A room was located at Blythe House, within the main furniture store (S11), offering substantial floor ($61m^2$) and wall space, with entry via a large double door. Located in the south-west corner of the building, the room had formerly served as a hoist room allowing access for outside deliveries to the second floor. Windows were arranged along the southern section of wall with the hoist entrance located at the west wall; water pipes serving radiators also ran along the two external walls. Initial concerns regarding the environmental limitations of the room, in terms of extreme and fluctuating levels of relative humidity and temperature, were partly allayed following a climatic assessment of one month duration that reported mean value parameters of 56% RH and 15°C. [5] A programme of modifications to the room, consistent with the refurbishment of the main furniture and woodwork stores, included the fitting of insulated blanking panels[6] to the interior facings of the windows and to the hoist door. It is the intention to maintain a lower temperature and improve the air circulation in the store to inhibit the metal components reactivity to any potentially corrosive pollutants.

Storage requirements and installation methodology

The decision to store the objects within the context of a study collection, influenced the planning and design process of the storage facilities and layout. The objects needed to be accessible to visual inspection of both the clock mechanism and decorative casework. A standard methodology for object storage was researched for each of the principle groups of clock. Firstly, the collection was quantified in terms of clock type, with distinct forms of clock grouped into separate storage categories. Each category was then individually assessed to determine the most appropriate method of storage.The assessment criteria considered several factors:

- Structural Condition of Object
- Individual Installation Requirements
- Storage of Clock Parts
- Accessibility
- Physical Protection
- Security

(a) Longcase Clock Storage
This category of clock formed a significant part of the collection and required the largest volume of storage accommodation. A standard longcase clock is composed of several detachable components:

- The wooden casework comprises a main case (trunk) and a mechanism cover (hood).
- The metal clock comprises a mechanism (movement), a pendulum and two or three lead weights.

The narrow proportions and height of the case components, combined with the location of the metal mechanism in the upper section of casework, can contribute to an uneven distribution of weight throughout the object. Consequently, longcase clocks require a flat wall surface and level floor, to provide support and a secure point of attachment for the main casework. Historically, long cased clocks were placed directly against a wall and secured with either a nail or screw through the backboard of the casework. A secure and level siting was an important factor for the effective operation of a clock mechanism.

A series of plinths with integral backboards offered the most practical solution to support and secure the clock casework. A system of prefabricated storage units was designed that could be fixed directly against a wall, or placed back-to-back in order to utilise the central floor space.[7] The objects could be classified and arranged into distinct groups (e.g. clocks with marquetry veneered cases), with sufficient space between objects to view the clock mechanism from both the left and right side (see Figure 2). Each clock case was attached to the unit backboard with dome-headed screws passing through the backboard of the casework. Most longcase clock backboards will show evidence of previous fixing holes, which can be reused with the addition of a steel washer to displace the pressure of the screw head. Alternative methods of attachment included the use of existing metal fixing plates.


Photography by Timothy Hayes

Figure 2. Longcase Clock Storage

The clock mechanism is normally attached to a wooden board (seat board), which rests on the top of the case sides (cheeks). The pendulum is fitted to the rear of the mechanism by its suspension spring, passing through the crutch and slotting into the back-cock. Pendulums were stored attached to their respective clocks to act as a counter weight to the dial plate, an insecurely mounted mechanism could tip forward and risk damage to the hood door glass. Clocks that were without their pendulum or that were not securely mounted to the case cheeks, were fixed into position with screws that utilised former nail or screw holes in the seat board. Lead weights were stored separately (see clock component storage).

An examination and testing stand was included in the store design to enable close inspection of the mechanism components (see Figure 3), and to provide a secure platform for the testing of longcase clocks. It is planned to have a specific group of clocks restored to an operational condition for inclusion in the future British Galleries.

(b) Clock component storage
Unidentified and/or damaged pendulums were stored upright in a rack, designed to support the pendulum bob, secure the rod and protect the delicate suspension spring. The numerous lead


Photography by Timothy Hayes

Figure 3. Mechanism Examination & Testing Stand.

clock weights were stored on a high, weight-bearing, shelving system.[8] A sheet of high-density foam was applied to the shelves and the individual weights, arranged on their sides, effectively embedded themselves into the foam.[9] Strips of foam were also fitted between weights as a precaution against abrasion, caused by direct contact between the finer brass sleeved lead weights and the roughcast lead weights.

(c) Spring (Bracket) clock storage
This category of clock could be accommodated with comparative ease into metal storage cabinets.[10] The relatively small dimensions of the objects and their delicate mechanical components demanded a closed system of storage that provided a secure and dust-free environment.

Conclusion

The new storeroom concentrates a substantial collection of the Museum's clocks in an environment that is accessible and conducive to the study and appreciation of both casework and clock design. The unpacking and installation process, is at the time of writing this article still in progress, with further developments of suitable clock component storage being investigated.

Acknowledgements

I would like to thank the following individuals for allowing access to their stored collections: Jonathan Betts (The Old Royal Observatory), Jeremy Evans (The British Museum), Helen Kingsley (The Science Museum), Roger Still (West Dean College). Consultation with horological experts from outside the Museum was a key factor during the development, planning and installation stages of the project. During the installation process Christopher Powell, a third year student from West Dean College, undertook a short internship that studied the condition of the clock mechanisms, carried out remedial corrections and advised on installation procedures.

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9. Plastazote Foam, Polyformes Ltd.
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Three Dimensional Digital Visualisation: Research in Progress

Angela Geary
RCA/V&A Joint Course in Conservation, Research Student

When I began my research in 1997 my aim was to explore possible approaches for the accurate capture of three-dimensional (3D) data from museum objects using existing technology and to define a reproducible and accessible methodology for this procedure. My final goal was to use the resulting 3D models in computer simulations of the likely original appearance of artefacts. While a degree of subjectivity is implicit, scholarly interpretation is paramount in this endeavour and I anticipated drawing extensively on historical and analytical information.

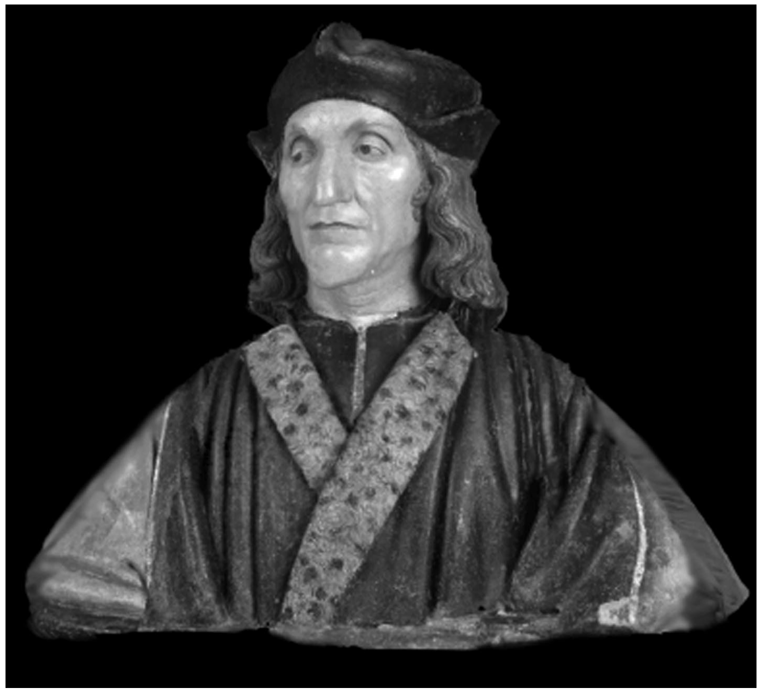

Figure 1. A model captured using VIVIDTM from Torregiano's terracotta bust of Henry VII (Museum No A.49-1935) textured and rendered in 3D Studio Max™ on PC running NT4™.

There are several high-profile current 3D-capture studies ongoing around the world, including those of the National Research Council of Canada (NRC) in conjunction with the Canadian Conservation Institute (CCI)[1] and, more recently, Stanford University's Virtual Michelangelo Project[2]. These have relied on very high specification, costly scanning devices and computer technology. From the outset, it has been my intention to use technology which is realistically accessible in terms of cost and availability. To that end I hope that the groundwork laid by my project will be useful to other institutions or individuals wishing to implement 3D capture for their collections.

I chose Northern, late Gothic, polychrome sculptures as the focus for my research. My interest in painted surfaces, allied with the extreme deterioration often suffered by these works, were significant reasons for my choice, but the extensive and well-researched collection available within the V&A was also an important factor. For the most part, sacred wooden carvings from the selected period are being scanned, but I have also collected digitised information from some stone and terracotta pieces (Figure 1). Digitally capturing the geometry of sculptures presents many technical challenges given the limitations of current technology. The dynamic and vigorous style of carving favoured from the early Renaissance amongst the limewood sculptors of Germany and Northern Europe can be particularly problematic. Deep undercut relief is often employed and drapery surges and swirls in complex undulations. The scanning devices used in the project, and indeed most currently available, cannot readily capture data from deeply recessed forms and the specific choice of objects was constrained to some extent by this factor. Dark colours and highly reflective surfaces can also reduce the effectiveness of laser-capture images.

The project has utilised a laser scanning system called VIVID™ (VI 700), and a live photogrammetric capture device: Tricorder™S4M. Both systems were lent to the Museum by Tricorder Technology plc. The former produces digital models which appear as polygonal meshes. These are of moderate resolution[3], adequate for the purposes of multimedia display. During capture, a series of scans taken as the object is progressively rotated (or translated) are needed to build the entire model. Then the multiple surfaces are registered either manually or automatically using the scanner software. I found that manual selection of reference points by visual comparison of picture images more consistently resulted in accurate alignment. It has become evident during the course of the project that the quality of this software plays a significant role in the success of the final model. With VIVID™ the capture of range data on dimension and form is limited to the parts of the objects visible to the laser scan. Undercut regions, overhanging features and so on are not completely recorded, resulting in black holes in the final model. At a later stage, the operating software can be used to correct any defects by point editing, after which the final polygonal mesh models are exported in one of the several industry standard formats for further editing, rendering and animation in modelling applications.

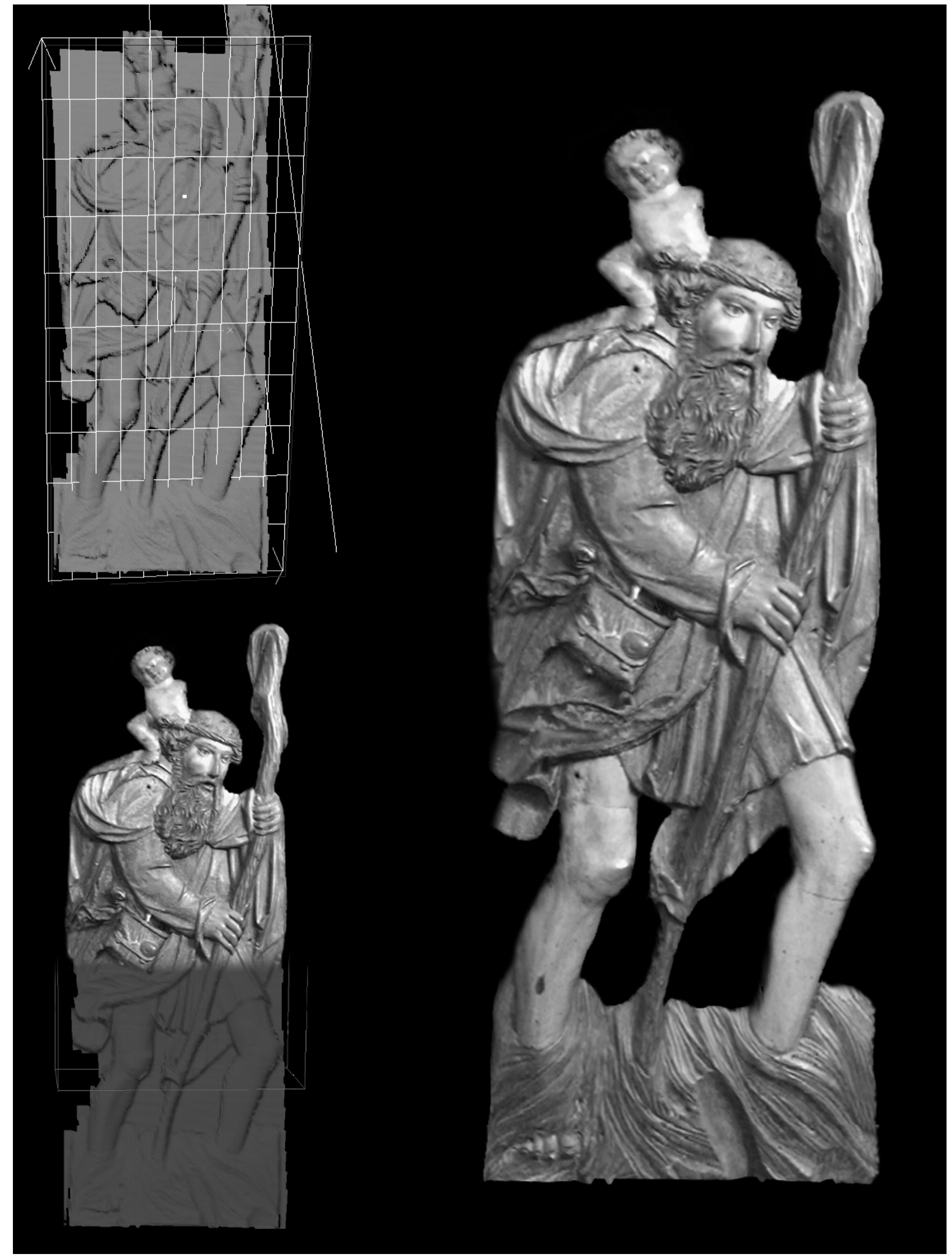

Figure 2. This image shows three stages of assigning a 2D colour bitmap to a model of a Flemish polychrome sculpture of St. Christopher (Museum No A.1304-1872). First the planar mapping projection is positioned and scaled to maximise accuracy. The second image shows the texture half way through rendering. Finally, the fully rendered model is complete. Textured and rendered in Cinema 4D XL™ on Power Macintosh™ running Mac OS 8.5.1™

A secondary, but essential, element in creating a realistic model is the two-dimensional (2D) image or texture map wrapped around the 3D form (Figure 2). The quality of the 2D digital images provided by VIVID™ are disappointing; too low in resolution and often poorly focused due to the lack of manual control over the camera optics. For this reason, and to allow fine control over the final appearance of the models, high resolution digital images are captured from large format colour transparencies or 35mm slides of the objects. These are then manipulated as required using applications such as Photoshop™. In this respect my study has benefited from Nicholas Frayling's research into 2D computer[4] imaging.

In respect of visualisation, surface characteristics are of particular interest to me. My research engages with all aspects of the paint, gilding and other decorative layers. Determination of original appearance relies to a considerable extent on scientific analysis, documentary and historical evidence. Valuable colour referencing data can also be extracted from cleaning tests and samples. Given the functional nature of these symbolic sculptures, it was not unusual for their surfaces to be subject to many changes in the course of time. Successive layers of repainting may have been applied, and during the Reformation partial or complete destruction may have been the final fate of the original polychromy. Normal ageing, as well as the attentions of earlier restorers, also contribute to surface change. Digital imaging is extremely well suited as a tool for exploring and reconstructing changing appearance, drawing together all the available visual and technical information.

Once a model is captured, refined and exported, it can be adapted to a wide range of visualisation applications, both educational and professional. In conservation there are many advantages in using high resolution 3D models as a form of documentation. It can be far more informative and flexible than conventional photography or 2D imaging. The models can be rotated and viewed from any angle, dimensional change can be recorded and analysed to a high degree of accuracy and volumetric data can be extracted. The process of conservation treatment can be aided by allowing the possible outcome of proposed conservation strategies to be viewed virtually and evaluated prior to implementation. Treatments which are not normally feasible in reality because of their invasive nature can also be explored. Virtual representations of objects may present an alternative, in some cases, to restoration. To this end multimedia consoles can be displayed alongside conserved, but unrestored objects, serving to illustrate the visual outcome of restoration and enhance the viewer's understanding of the piece. Objects can also be placed in interactive virtual environments which reproduce their original setting, such as churches or cathedrals. This simulation can incorporate factors such as changing ambient light: sunlight at different times of day or year and candlelight. There are also obvious implications in 3D image-processing for the accessibility of collections. Databases of artefacts, on display or in storage, can be explored on consoles by gallery visitors and scholars, or anywhere in the world via the internet and CD-ROM distribution. It is also possible to produce accurate facsimiles of objects to scale from captured data. One use for this could be enhanced access by touch for visually impaired visitors.

At the conclusion of my research I plan to use immersive technologies such as head-mounted displays and walk-in environments for the display of virtual presentations produced as the outcome of the project.

In October 1998 a third computer-imaging research student, Athanasios Velios, joined Nicholas Frayling and myself on the Course to study the 3D capture and digitally-assisted surface alignment of fragmented objects. This is an exciting time to be exploring this rapidly-evolving area, as our small group gradually expands in size and diversity.

Acknowledgements

I am grateful to Professor Alan Cummings and Richard Cook for their continued support of my project, both practical and moral. Many thanks also to: Michael Le Fleming, Duncan Hughes and Graham Arnold of Tricorder Technology plc.

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2 http://www.graphics.stanford.firenze.it/projects/mich/

3 Approximate resolutions between 0.3mm and 10mm depending on scanning distance and zoom level

4 Frayling, Nick., *An exploration of the original appearance of Nicholas Hilliard's portrait miniatures using computer image manipluation,* V&A Conservation Journal 28, July 1998, pp.4-6.

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Not So New Methods of Cleaning

Shayne Lang
Senior Furniture Conservator, Furniture Conservation

All MA students on the RCA/V&A Joint Course in Conservation undertake a ten-week research project in their final year. My research project took the form of a literature review of two of the innovative cleaning techniques for painted and decorated surfaces introduced by Richard Wolbers in the mid 1980s. The dissertation evaluates the literature published in response to Richard Wolbers' introduction of resin and bile soaps and Carbopol™ solvent gels in order to assess how claims made for these materials compared with experimental results reported in the conservation literature.[1]

Many of the concerns raised about Wolbers' cleaning methods have focused on their potential or actual impact on oil paint surfaces. Although his methods can be applied to a wider range of materials, my dissertation took this substrate as its starting point, outlining the drying and degradation of linseed oil paint films. Traditional methods of cleaning using solvents and alkaline reagents and their effect on an oil paint layer were discussed in order to provide a context for the development of Wolbers' methods and materials. The theoretical basis of two of Wolbers' innovations – resin and bile soap gels and Carbopol solvent gels were considered, followed by a review of studies which examine aspects of the activity or clearance of these materials. The literature review summarised significant findings and evaluated experimental methodology in order to compare results which were sometimes contradictory and thus find a way through the maze of claims and counter-claims surrounding the methods and materials Wolbers introduced.

Wolbers introduced both new techniques for use with traditional materials, such as solvent gels, and adopted an aqueous approach for solvating layers which had proven resistant to solvents or alkaline reagents, or when the use of such traditional cleaning materials represented a significant risk to the paint layers underneath. These methods were intended to allow a more controlled cleaning process and to facilitate the selective removal of unwanted layers from the underlying decorative surface. Wolbers set out the theoretical basis and discussed the use of these materials in a booklet[2], which originally accompanied a two-week programme of lectures and practical workshops in 1988. These 'Notes', reissued in 1989 and 1990, have been the primary written source of information for conservators seeking to understand or test Wolbers' methods. The 'Notes' were divided into sections on case histories, fluorescence microscopy, surface coatings and cleaning materials. Nine case histories of complex cleaning problems set out how and why Wolbers used his 'new methods' to solve practical problems which would have been insuperable using traditional cleaning methods. The results were inherently empirical and offered no experimental confirmation of the mechanism or effects of such cleaning treatments.

Concern about Wolbers' cleaning methods has focused around three primary issues – the possible deposition of residues of non-volatile components from cleaning formulations, the complexity of aqueous cleaning formulations and the role of individual components, and the possibility that fatty acid compounds may be leached out of oil paint films. Research over the last ten years has shed some light on these issues and has allowed for the original claims made for resin and bile soaps to be evaluated.

The literature review highlighted problems in some of the research which has been undertaken to evaluate Wolbers' methods. The complexity of the theoretical foundation of these methods has not been fully grasped by some researchers and this has produced contradictory conclusions. Other researchers have limited the application of their findings by using non-standard formulations with the result that their experimental data cannot be used to inform conservation practice. Some papers were characterised by a lack of rigour – researchers drew broad and occasionally specious conclusions from narrow experimental data.

Some of the confusion which is evident in the literature has been a result of the haphazard dissemination of both basic principles and changes to formulations and clearance procedures. The 'Notes' intended to accompany a two-week programme of lectures and practical experience of the methods have been the primary source of information. These were never formally published and as a result bootlegged photocopies have circulated the profession as conservators have tried to come to grips with new approaches to cleaning. Wolbers is planning to publish a book on his methods in the near future, which will at least partly address this problem. Communicating changes as these new methods evolve remains problematic. Although clear and logical guidelines for clearance procedures for aqueous cleaning solutions and solvent gels were published in a conservation newsletter in 1990[3], it is apparent from the literature that this has been insufficient to ensure they are widely known and understood.

More than ten years after the introduction of Wolbers' cleaning methods it is still not possible to make an informed and objective comparison of the potential damage from a traditional cleaning treatment and that which may occur as a result of using Wolbers' methods.

Wolbers has made a significant contribution to conservation. Whether individual conservators adopt his methods or not, he has facilitated and extended the theoretical basis for cleaning which has had an inevitable impact on conservation practice. Many of the materials used by Wolbers are not new to conservation. Enzymes have been used in paper conservation, wax pastes in paintings conservation, gels in furniture conservation. However, perhaps Wolbers' most significant contribution to conservation practice has been to propose a coherent cleaning strategy based on a general chemical characterisation of both the substrate and overlying layers which can be used to formulate a conservation treatment as controllable and selective as possible. This general approach may prove to be as important as the new materials introduced to solve individual cleaning problems.

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2. Wolbers, R., Sterman, N. and Stavroudis, C., *Notes for the Workshop on New Methods in the Cleaning of Paintings,* Getty Conservation Institute, 1990.
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So that's why Textile Conservation has such a Big Studio! – Tapestry Washing at the V&A

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Introduction

The Textile Conservation Section moved into their new purpose-built studio in December 1995 (See V&A Conservation Journal 20, July 1996). The studio is separated into two areas – a 'wet' area and a 'dry' area. This article focuses on the wet area, the new equipment designed to assist in the washing of large textiles and the first tapestry washed in the new studio.

Approximately one third of the total studio space is designated as a wet area. This is located at one end of the studio and is bordered by a series of drains set into the non-slip tiled floor to prevent any movement of water into the dry area. A wash table is located here, but for very large objects such as tapestries, the table is wheeled out and a wash bath constructed on the floor (Figure 1). Tapestries by their very nature are large and often weak especially when wet. Specialist equipment and a large space are required to allow such objects to be kept flat during washing and to minimise handling whilst wet.

Equipment & construction of the wash bath

When constructing a wash bath on the floor, plastic tubes are used to form the walls and a large piece of strong polythene is used to make the floor. The size of this bath can be varied to accommodate different sized objects. The bath is filled with water using a hosepipe connected to a de-ionised water supply. Previously, the textile was rinsed either by hosing, or walking a spray bar connected to a hose up and down the bath. This was slow and cumbersome, so with the move to the new studio plans were made to improve this operation. A lightweight mobile gantry with spray bars attached was specified by the V&A and constructed by Borley Brothers, Cambridge (Figure 1). The gantry, which is made from powder coated aluminium, is strong enough to support two conservators allowing access to the centre of the tapestry during washing (Figure 2). The wheels on the gantry can be locked into position to prevent any movement when someone is standing on it. The two spray bars, each fitted with fifteen nozzles, are connected to the main de-ionised water supply

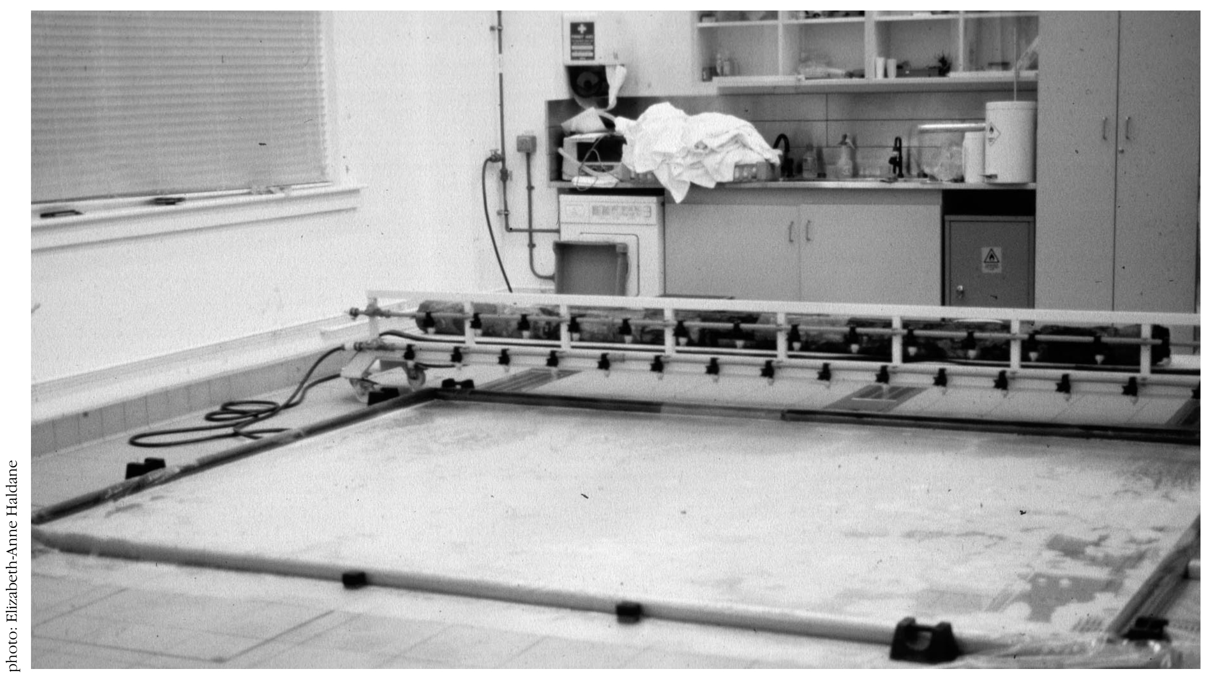


photo: Elizabeth-Anne Haldane

Figure 1. Textile Conservation Studio, showing floor drains, wash bath and gantry

(Figure 3). The rate of flow can be varied and each nozzle can be switched on and off independently to accommodate different sizes of textiles. As the gantry is mobile, it can be pushed up and down to distribute the water evenly over the object.

The dimensions of the studio limited the length of the gantry to 4.5m; this in turn limits the size of tapestry that can be washed. The critical measurement is the height of the tapestry as this is at right angles to the warps. When rinsing it is preferable for the water to flow in the warp direction as the warps are the strongest part of the structure. If the water flows in the opposite direction the pressure may break the weaker wefts causing the warps to split apart.

It is calculated that the largest tapestry, which could be washed completely flat on the floor, is one with a maximum height of 3.7m. The gantry can then pass over the tapestry with an overall clearance of 30cm at the sides to accommodate the walls of the bath.

History of the tapestry

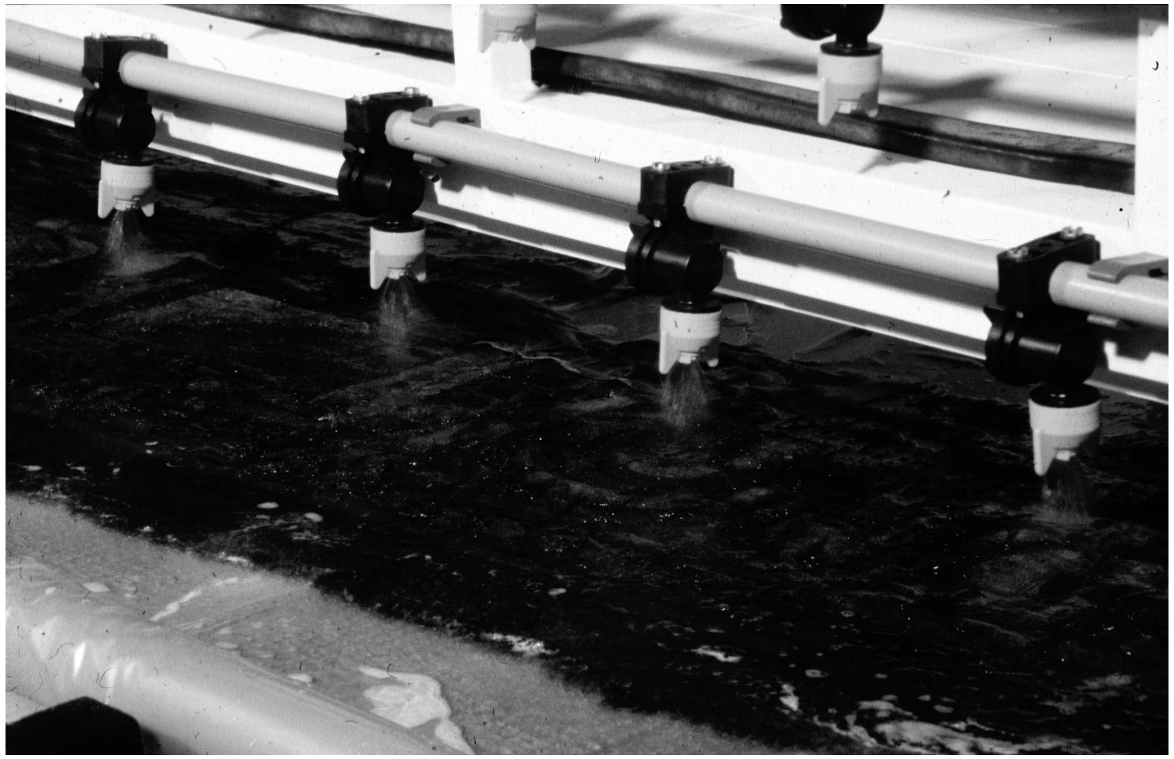
The wet cleaning of textiles, including tapestries, is no longer a routine treatment at the V&A as it is an irreversible process and because the conservation profession now has more knowledge about the potential damage which may be caused by washing. An extremely dirty tapestry, chosen as one of my projects and undertaken during the second year of the MA course in Conservation in 1997/8, provided the first chance to use the floor of the wet area and try out the new gantry. It was an early 17th century all wool tapestry (Museum No. HH 522 1948) thought to have been made at Mortlake which at the time was the centre of the English tapestry industry. It measured approximately 3.5m in height by 2.6m in width. The tapestry had been sent to the studio for cleaning prior to photography. It is to be included in a catalogue of English tapestries currently being written by Wendy Hefford who has recently retired from the V&A Textiles and Dress Department.

The tapestry is mainly composed of patterning with quite a small allegorical cartouche in the centre. Although little is currently known about the tapestry, it is interesting because it is largely intact. The remaining tapestries in the series from which this belongs have all been altered, or cut down. This is the only tapestry left in its original condition apart from a few minor patches.

The colours on the front of the tapestry were faded in comparison with the reverse but they were remarkably bright for a tapestry of this age. However, heavy soiling occurring on both sides, which made the tapestry feel stiff and brittle, obscured them. There was also a large disfiguring stain in the upper part of the tapestry, which may have been caused by water damage. The tapestry was generally weak including large holes probably caused by rodents and some moth damage. The heavy soiling was contributing to the general acidity of the textile. Vacuuming alone did not remove the soiling so the decision was made to wash the tapestry. It was also hoped that washing would improve the visual appearance of the tapestry for the forthcoming photography and improve its flexibility allowing further conservation work to be carried out.

V&A Photo Studio

Figure 2. The gantry in use, sponging the tapestry



V&A Photo Studio

Figure 3. Detail of the nozzles on the spray bar

Stabilisation and testing

Weak areas were supported with net and slits stitched together to stabilise the tapestry prior to washing. Extensive tests were also carried out to ensure that the dyes were water fast and would not bleed during the washing process. The washing solution that was chosen was one of a number tested during this project. The basic solution consisted of the detergent *Synperonic N*[1] and sodium carboxymethyl cellulose, which prevents soil re-deposition. Due to the nature of the soiling on the tapestry and the concern that the pH of the bath would drop when such a soiled object was placed in the water, triammomnium citrate was also added to the solution. Triammonium citrate acts as a buffer, maintaining a pH range of between 6.5 and 7 in solution. It also acts as a chelating agent for metal ions and helps to break up particles into smaller pieces and encourages them to disperse. Washing solutions containing triammonium citrate have been successfully used at the National Museums and Galleries of Merseyside for the cleaning of textiles[2]. It is more commonly used in the conservation of paintings where it has been found to remove both organic and inorganic particulate matter, which had proved difficult to remove with other solvents.[3]

Washing

Four people were involved in the actual washing of the tapestry. It was allowed to soak for an hour each in a bath of half-strength washing solution then full strength solution. Following this the tapestry was sponged all over to agitate the dirt and rinsed repeatedly (Figure 2). Both sides of the tapestry were treated in this manner, though care had to be taken to avoid any felting of the wool through excessive agitation. The baths and the sponging treatment all released a considerable amount of soiling from the tapestry.

The tapestry was thoroughly rinsed then rolled up in white terry towelling to soak up the excess water. The bath was then dismantled and plastic pallets covered with a layer of monofilament mesh were put in its place to make a raised platform for the tapestry to sit on so that air could circulate underneath (figure 4). The tapestry was unrolled face side up onto the pallets and left to dry.

V&A Photo Studio

Figure 4. The tapestry after washing laid on drying platform

The tapestry was vastly improved after the wash; it was cleaner, less distorted and felt soft and flexible to the touch. Unfortunately the stain at the top of the tapestry was not completely removed and is more obvious now that the surrounding areas are clean. However the benefits to the overall condition of the tapestry far outweigh this visual distraction. The tapestry is still structurally too fragile to be displayed and would require a full support before this would be possible. The primary value of this object is as part of the study collection and it is unlikely that further treatment will be undertaken in the near future. The washing process took nearly ten hours to complete and the tapestry dried out in approximately sixteen hours. All involved were happy with the facilities and the new equipment.

Acknowledgements

With thanks to Val Blyth, supervisor for this project and to Lynda Hillyer and Albertina Cogram for helping with the wash.

References:

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2. Chapman V., *The Conservation of a Painted Silk Tambourine – and Triammonium Citrate,* Painted Textiles, UKIC Textile Section Forum Postprints, 21st April 1997
3. Carlyle et al, *Triammonium Citrate: An Investigation into its Application for Surface Cleaning,* Dirt and Pictures Separated, UKIC, January 1990

Manufacturers of the gantry:

Borley Brothers
General Engineering and Crane Hire
6&9 Church Road, Teversham ,
Cambridge CB1 5AW

Washing Solution:

Concentrate to be mixed 1:9 with water for full strength

Synperonic N (at 27%conc)
20g/litre
Triammonium citrate
10g/litre
SCMC
0.5g/litre

Energy Efficient Pollution Control in Museums and Galleries

May Cassar
Project Leader, Museums and Galleries Commission

The Department of the Environment, Transport and the Regions is funding a research project focussed on efficient pollution control in museums and galleries, under the Partners in Innovation Programme. The research involves a unique partnership of heritage organisations, academia and industry; the Museums and Galleries Commission, The Bartlett University College London, EMCEL Filters Ltd, the Victoria & Albert Museum, the Museum of London, the Manchester Museum and the Horniman Museum.

What will this research deliver in practice? The aim of the project is to compare the effectiveness of pollution control in air-conditioned and naturally ventilated museum buildings and to investigate ways in which pollution can be controlled while achieving energy savings.

The first part of the project measures concentrations of nitrogen dioxide, sulphur dioxide, hydrogen sulphide and particulates in and around the two museums with air-conditioned galleries: the Victoria & Albert Museum and the Museum of London, and the two naturally ventilated museums: The Manchester Museum and the Horniman Museum. The monitoring campaigns will take place in two phases, one during the winter and one in the summer.

At this stage of the 18-month project, the winter campaign has just been completed. Preliminary results show that air-conditioning with chemical filtration has been effective at reducing concentrations of externally generated nitrogen dioxide and sulphur dioxide. Perhaps not surprisingly, it has also been found that one of the naturally ventilated buildings which is well sealed from external conditions, was able to control these pollutants well. Small rooms and a cell-like building layout was found to assist passive pollution control, by restricting the ingress of external air and by increasing the available wall and floor area on to which pollutants can be deposited.

Both airborne and deposited particulates have been measured. In store-rooms it was found that airborne particle concentrations increased when staff or visitor activities took place. Generally these concentrations fell back rapidly to background levels when these activities ceased. In galleries with many visitors, particle concentrations sometimes exceeded levels measured externally. These levels were maintained throughout the day and only declined slowly when the museum was closed.

The highest concentrations of surface-deposited particles in the naturally ventilated buildings were measured externally, at entrances and in the most visited areas. The lowest concentrations were found in rooms such as stores where there was little human activity. Particle deposition in air-conditioned galleries was lower than in the non-air-conditioned store.

These results on the winter monitoring campaign provide a partial picture of indoor air quality in the four participating museums. A summer monitoring campaign will follow. Alterations to the fabric and services, in one of the air-conditioned museums and one of the naturally ventilated museums, are planned in order to test a range of measures that might improve pollution control without incurring an energy penalty. The research will end in March 2000, following which, guidelines for museums, based on the findings of this project, will be published.

For further information contact May Cassar, Museums & Galleries Commission on telephone: 0171-233-4200. You can find the Museums & Galleries Commission at www.museums.gov.uk

Science Surgery con.sci@vam.ac.uk

V&A Photo Studio

The Bullerswood Carpet, T31-1923 7650mmx3980mm

Bullerswood

The Bullerswood carpet, designed by William Morris and woven by Morris & Co, Hammersmith, UK, *circa* 1880 (Museum No. T31 – 1923) is one of the objects going on display in the V&A's new British Galleries, opening 2001. The carpet has rarely been displayed and is still very rich in colour. However, due to its size it will be rolled to display half.

Work to examine the light fastness of various areas on the Bullerswood carpet will commence shortly. Selected areas on the reverse will be exposed to intense illumination (30000 lux from a UV filtered tungsten-halogen source) and the resulting changes in spectral reflectance monitored. Reflectance data are converted to colour co-ordinates to determine colour changes. The findings and their influence on decisions affecting display will be published.

Synthetic polymers

Interest in the degradation and preservation of objects made from synthetic polymers has increased dramatically over the last few years. The Historical Plastics Research Scientists' Group (HPRSG) meets several times a year to discuss work carried out in this field. The Group's co-ordinator is Anita Quye of the National Museums of Scotland and the assistant co-ordinator is Brenda Keneghan of the V&A. Although there is not, as yet, a definitive textbook dealing with this area, there are a number of sources of information worth listing:

1. *Saving the Twentieth Century: The Conservation of Modern Materials:* the proceedings of a conference held in Ottawa in 1991, published by the Canadian Conservation Institute.
2. *Ours for Keeps?:* a resource pack produced by the Museums & Galleries Commission containing a chapter on Twentieth Century Materials and a specific chapter on plastic dolls.

Following on from the very successful *Classic Plastics Clinic* held in 1997, the National Museums of Scotland have produced a book on the collection and care of historical plastics. The book contains contributions from the members of the HPRSG and the expected publication date is autumn of 1999.

Florentine Workshop

On the 21 April 1999 a whole day was dedicated to communicating the message of 'how important display cases are' to a professionally diverse audience in Florence, Italy. The workshop, *LA VETRINA PER IL MUSEO caratteristiche e requisiti di funzione,* was hosted by the Opificio delle Pietre Dure with their superintendent, Giorgio Bonsanti opening the session.

The aim of the workshop was to demonstrate the rudiments for the best assessment, application and optimisation of display case performance to museum personnel, public and private bodies. The presentations looked at each of the key areas of a display case in turn: assessing performance, pollutant levels, cleaning materials, construction materials, lighting, and monitoring equipment and methods. The workshop proved highly successful, attracting a large number of participants from Italy, Monaco, Geneva and the UK. The size of the audience would seem to indicate that there is a need for more of these international exchanges.

Postprints, including the V&A contribution, will be published in Italian and English later this year by the Opificio delle Pietre Dure.

Illustration of group at conference

Conservation Department Staff Chart

Head of Conservation
Jonathan Ashley-Smith

Secretary
Annabel Swindells

Head of Science and Information
Graham Martin

Science
Boris Pretzel
David Ford
Paula Mills
Brenda Keneghan

RCA/V&A Course Director
Alan Cummings

RCA/V&A Course
Helen Jones
Alison Richmond

Students

Paul Cadman, *MPhil*
Display Cases

Francesca Cappitelli, *MPhil*
20th Century Materials
(with Tate Gallery)

Rowan Carter, *MA*
Furniture

Pedro Gaspar, *MPhil*
Cleaning Inorganic Materials

Laura Davies, *MA*
Social History Objects
(with Museum of London)

Victoria Doran, *MPhil*
Composition Frames

Nicholas Frayling, *PhD*
Computer Visualisation

Angela Geary, *MPhil*
Computer Visualisation

Elizabeth-Anne Haldane, *MA*
Textiles

Annie Hall, *MA*
Metals

Victoria Hobbs, *MA*
Ethnographic Materials
(with Horniman Museum)

Fotini Koussiaki, *MPhil*
20th Century Materials
(with Tate Gallery)

Magdalena Kozera, *PhD*
Photograph Mounts and Frames

William Lindsay, *PhD*
Risk Assessment

Lyndsey Morgan, *MPhil*
Metal Patination

Heather Porter, *MA*
Upholstery

Kirstie Reid, *MPhil*
Metal Patination

Cecilia Rönnerstam, *MA*
Portrait Miniatures

Shiho Sasaki, *MA*
Japanese Prints

Ricard Sundström, *MA*
Painted & Decorated Surfaces

Silvia Valussi, *MPhil*
20th Century Materials

Thanasis Velios, *MPhil*
Computer Visualisation

Metaxia Ventikou, *MA*
Sculpture

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Furniture
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Books
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Nigel Bamforth
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Frances Hartog
Zenzie Tinker

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Alan Derbyshire
Merryl Huxtable
Elizabeth Martin
Michael Wheeler
Victoria Button

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Danny Norman
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Simon Fleury
Chris Gingell

Paintings
Nicola Costaras
Katharine Donaldson
Fran Downie

July 1999