The evolution of a conservation framing policy at Tate

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Abstract

Using glazing for protecting paintings has a long history and this has been developed into a frame microclimate system that has been applied to much of the collection at Tate. The paper describes the evolution and rationale for this approach, analysing the risks addressed and assessing the benefits and shortcomings.

The principal function of a frame is to distinguish the space depicted by the artist from that of the surrounding room. A frame is a museum object in its own right, its design inevitably representing contemporary fashion. But it was soon recognised that a frame also provides physical protection for the painting it houses. It protects the painting from excessive interference and allows handling without direct contact with the painting. In the sixteenth century, portrait miniatures were also protected by glass. By the nineteenth century the museum frame with removable glazing and cloth backing demonstrated a considered and practical solution to the conservation needs of a painting.

Gradual industrialisation from the sixteenth century, accelerating during the eighteenth and nineteenth centuries, created air pollution throughout all urban areas. The use of coal for power generation, kilns and smelting in industrial cities and for domestic heating in London had a major impact [1]. As a result, the exteriors of buildings became coated with black deposits and sulphates. Most buildings were well ventilated by modern standards, being designed for the burning of coal in open fires, and exterior pollution readily found its way in. Clothes, furnishings, fabrics, wallpapers and any absorbent decorative material would need regular dusting and washing. Silver and copper alloys needed regular cleaning and polishing. In a large household, servants worked ceaselessly to keep everything clean. Wherever possible some form of protection was applied to surfaces. All paintings would have had a coating of mastic varnish applied to allow them to be dusted regularly and surface-washed occasionally. By the mid-nineteenth century copal resin was recommended to protect pigments in oil paint from being attacked by polluted air [2].

Despite this unpromising atmosphere, such was the interest in art from the mid eighteenth century, as expressed through attendance at exhibitions and academies, that the display of vulnerable old master and contemporary drawings, prints, pastels and watercolours became popular [3], by removing these works from portfolios, mounting and framing and glazing them. Cylinder glass was manufactured in large enough sheets to make window glass of sufficient size to satisfy the architectural needs of the enlightenment. Polished glass, manufactured using mechanical abrasive and polishing techniques, was highly valued and suitable for mirrors. Such methods of manufacture were not revolutionary; instead they reflect the development and perfection of difficult traditional manufacturing processes and mechanisation using cheap coal power, which continue today.

In 1850 Eastlake, Faraday and Russell proposed that glazing be applied to oil paintings on permanent display at the National Gallery [4]. In the select committee report of 1853, the keeper, Sir Charles Eastlake, was questioned on why little progress on glazing had been made. His reply was ambivalent, emphasising the disadvantage of reduced visibility (from reflections) yet re-affirming his conviction of the protection afforded [5]. This constituted the central dilemma: the recognised need to exclude pollution in conflict with significant interference with display. Ominously, the perception of this dilemma depends on the needs of the individual viewer. Artists had special viewing rights, for copying, free from the interference of the crowds and Eastlake considered the use of removable glazing to permit temporary viewing. Much of the enquiry dealt with removal of varnishes and sites for a new gallery in a less polluted location. A new gallery was never built and glazing remained the only option.

External pollution was not the only problem, the enthusiastic attentions of the public involved significant risk, from pointing, sneezing and spillage, and this would not be solved by relocation.

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Figure 1. A nineteenth century gallery frame on a J.M.W.Turner painting (Sketch for East Cowes Castle, the Regatta Beating to Windward, no2, 1827, Tate N01994). The inset door allows glazing to be removed. © Tate, London 2007

Figure 2. An unvarnished oil painted relief by Ceri Richards (Two Females, 1937-8, Tate T00307) which cannot be protected on display and has accumulated considerable dirt particularly on the top of horizontal surfaces. © The estate of Ceri Richards

A further recommendation by Faraday and Russell had been the application of backings. Because paintings were tilted for better viewing their backs were exposed to considerable dust deposition. In the 1853 report, Seguier suggested that tightly woven stretched textile be applied to the backs of frames as a dust seal. A trustee, Colonel Thwaites, expressed a concern that air should not be excluded from the canvases for fear of creating a hazard, presumably mould growth.

Following such procedures the painting is entirely enclosed. Russell, by his own admission, had not been considering the backs of paintings sufficiently but he had made glazed boxes to enclose entire paintings (and frames). Faraday was clear on the effects of enclosure, stating categorically that enclosure would not harm a painting, and distinguishing enclosure from hermetic sealing. He compares the seal of a frame enclosure with that on a Ward's case, a very successful design to transport plant specimens on long sea journeys. This is the first intimation of a microclimate. Following the 1853 report cloth backings were generally introduced (fig. 1).

The following period saw fundamental changes in art that would lead many artists to reject framing. At its height the concept of 'finish' was essential to any painting exhibited by serious artists, such as academicians. Finish involved a high level of obvious workmanship and detail, and even included an overall shiny varnish. Whistler was accused by Ruskin of having fallen below this standard, yet Whistler took great care to design individual frames and to consider the presentation of his work in context. His contemporaries in France at the *Salon des Refusés* challenged the establishment more fundamentally. Impressionism rejected varnish and finish. There had always been paintings that were much too big to glaze: a concern for surface absorbency, texture and large scale led artists to emphasise the virtues of mural painting. Later cubists and abstractionists rejected completion of the picture space and the depiction of perspective that had been in use since the Renaissance. Malevich talked of a suprematist painting as an object with an existence unrelated to the depiction of another event and architectonics transmuted painting into a third dimension. More prosaically many artists simply regarded the frame as an expensive afterthought that could only detract from a painting, or simply be left to the dealer or new owner. Such frames have since been considered to be 'not original'.

Modernist architects sought more light in their buildings, incorporating large windows, new lighting technology and painting walls in lighter colours. The challenge of minimising the use of material extended to furniture and frames. Not only did contemporary artists no longer want frames for their work but exhibition designers wanted to put traditional paintings in modern settings. Older frames looked dark and unfashionable and reflections from glazing that had been reluctantly accepted on sky-lit deeply coloured Victorian walls presented serious glare in modern ambiently lit galleries. Glazing had to go and dirty old frames needed to be re-gilded, or even removed and sometimes replaced by more fashionable versions.

The Tate Gallery Conservation department was established in 1956, initially to restore major paintings, but later to survey the collection. Evidence emerged of traditional paintings neglected since acquisition and contemporary works of art in good condition but also at direct risk from museum activity and longer term deterioration (fig. 2).

In 1967 the London Conference on Museum Climatology addressed the subject of the protection of works of art on display, providing important technical information [6, 7, 8, 9]. Rapid changes in relative humidity were thought to be important agents of damage: certainly the evidence of damage from very low winter humidity in the form of paint flaking from panels and from canvases with old glue linings was frequently observed. Air conditioning was installed at the National Gallery and in the 1979 extension at Tate. But most of the Tate Gallery remained unconditioned, and portable humidifiers had only limited effect in an unsealed building.

In response to the needs of a contemporary collection the concept of preventive conservation was easy to establish at Tate. A policy of examining and protecting new acquisitions had clear benefits, but required an understanding of deterioration and means of prevention. The lessons learned in 1850 were still relevant and could be revived to fit new circumstances, but needed to be applied in a way that was acceptable for the display of a collection that included a wide variety of paintings.

Beginning with the basics, a strong frame is essential for the physical protection of both frame and painting and incidentally is also a requirement for the application of a backboard [10]. Frames are often weakest at their mitred joint corners. They are strengthened by adding to the reverse a wooden build-up that overlaps the corners and provides rigidity. Together these elements provide a rigid structural box.

Backboards became a mainstay of conservation policy. Since they are not seen, there are few constraints on their application and backboards have been applied to all paintings in the collection [11]. If rigid backboards are used, they can protect from impacts from the reverse during handling. Even unframed or minimally framed paintings can have a backboard applied to their stretcher or to a special transit/handling frame to provide similar protection. Backboards can also be dust seals and impermeable moisture barriers. Earlier cloth backings were replaced with hardboard backboards with ventilation vents. Measurements were carried out on the permeability of backboards [12]. As a result oil-tempered hardboard backboards, which were well sealed with screws and tape, were adopted in order to reduce significantly moisture transfer.

In conjunction with glazing, the effectiveness of backboards proved to be much better than expected. Simple seals and moisture barriers created extremely stable relative humidity (RH) conditions within frames, which could be measured by newly available RH/T data loggers. It became apparent that it was the self-buffering of the enclosed space by the hygroscopic materials of the work of art and frame themselves that caused stability. The RH remained constant as long as moisture leakage from the frame was less than the rate of transport through the wood, glue or canvas and evaporation from their surfaces [13]. Because the quantity of water supported by the air is very small any lost air took with it very small quantities of water.

We measure RH of air because it tells us about the moisture content of the work of art in equilibrium with it [14]. The rate of moisture exchange between a work of art and its environment may be very low, particularly for a thick wooden panel. A panel's moisture content changes very slowly and is independent of short term fluctuations in RH. Provided its temperature is kept in the range for human comfort, a glazed and backboarded panel can be hung in unconditioned galleries without any damage and with only minor seasonal changes in moisture content. Even air-conditioning systems cannot match the stability or reliability of enclosures.

This backboard and glazing design, later modified with an inner polyester film, has been used at Tate for 30 years, allowing works of art to be stored, exhibited in different galleries and loaned (fig. 3). It is difficult to attribute with certainty any damage

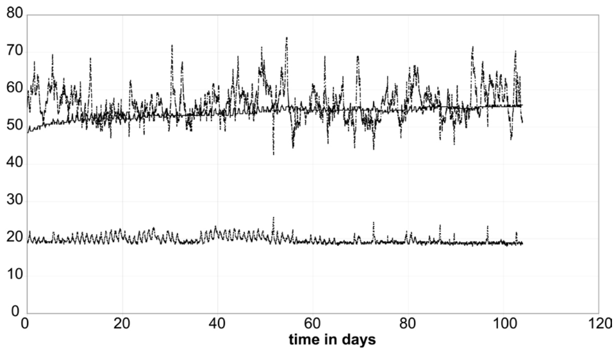

Figure 3. Graph showing the relative humidity and temperature inside and outside a framed, glazed and back-boarded oil painting on stretched canvas kept in an unconditioned gallery at Tate Britain (Tate) at a temperature around 20°C (lowest line on graph). The stability of RH inside a frame (the continuous line) is well documented.

to specific causes, but the low level of observed damage contrasts with previous experience. There are also benefits for paintings that cannot be glazed. The variation of a backboard/canvas microclimate depends on transport through the front of the enclosure and this depends on the nature of the painted surface and varnish.

Sulphur dioxide pollution measurements indicated that good seals could prevent the ingress of pollution. Even in polluted conditions, levels inside a frame enclosure are negligible, suggesting that little penetration occurs [15]. In order to test this, in 1980, linen canvas samples that had been kept in the gallery conditions for 24 years, some in enclosed containers, were examined in detail. Strong evidence emerged of protection afforded by enclosure. The colour, dirt deposition, pH and strength of enclosed samples remained significantly better than exposed canvases [16]. This related to the polluted conditions during the period.

The application of glazing to the front of a painting, for mechanical, chemical and hygroscopic reasons, is key to the provision of a microclimate. Fortunately the reflection problem has a solution, which has allowed the conservation benefits of microenvironments to be realised [17]. Low-reflecting glass cuts reflections significantly to one or two percent and if lit carefully can avoid inevitable green or purple fringes being noticeable from most angles. Over a period of years, as low reflecting glass has become more affordable, it has been introduced into framing practice. With nineteenth century frames this has been simple to implement, providing obvious benefits, even to those initially reluctant to accept glazing. Low reflecting glazing can also be applied to many earlier frames, but can visually spoil some elaborately carved lightweight frames. Early twentieth century frames can often accommodate glazing but unframed works present a problem. Where the surface is obviously vulnerable, such as exposed canvas, unvarnished paint or impasted surfaces, display vitrines can be used. A simple glass or acrylic box with a solid plywood backboard, preferably painted the same colour as the gallery wall, can look acceptable, especially when kept thin and wide so that it is visually well separated from the painting.

For lighter coloured objects, often works on paper, the reflections from acrylic are masked by the high general reflection, and are frequently accepted, but for dark objects in light galleries the reflections are unacceptable. As low reflecting glass has found its way into many museum collections, the reflections from acrylic and even ordinary glass are no longer considered acceptable for display. Low reflecting acrylic sheeting with a scratch resistant surface is now available but remains very expensive.

Glass is a brittle material. Risk analysis of the breakage problem has allowed simple and reliable procedures for the safe handling and transport of glazed paintings to be developed [18, 19]. This has allowed us to combine better display with improved conservation within an economic framework required by the huge expansion of display activity at Tate. The availability of low reflecting glass, the application of the principles of preventive conservation, risk analysis, a systematic working environment and an engaged pre-emptive approach to the needs of display are all necessary to achieve this result.

The benefit of consistent procedures for fitting glass and strengthening frames over many years provided confidence that taping was not necessary to protect a painting if the glass broke. We therefore ceased to tape glass for Tate works. We cannot extend this rule to works brought in on loan since we are not always certain of the rigidity of their frames or the fitting and age of the glass and we were aware that some lenders would expect their glass to be taped. We were comfortable with our risk analysis to a maximum size of glazing around one square metre. Since we have not tested larger pieces we specify that any glazing of larger paintings is done with laminated glass. But as laminated glass becomes more affordable we may extend its use to all glazed paintings.

We also concluded that the use of acrylic glazing confers no advantages and, since it is unacceptable for display of many paintings, it is no longer used for loans. This prevents extra handling to change glazing and disturbance to the painting. It also avoids other drawbacks of acrylics, such as their tendency to develop an electrical charge leading to dust deposition and sometimes transfer of unbound pigment from a painting surface and their susceptibility to abrasion. Where the frame is relatively flexible, acrylic is still used, for example, on works of art on paper which are predominantly white paper and much less susceptible to reflections.

Wherever possible, the principle of the microenvironment was extended to unframed and unglazed paintings too. Transit frames are made for unframed modern paintings to protect them during handling and transport (fig. 4). These frames are wrapped in polyethene film to isolate the paintings from their environment [20]. The same frames are

Figure 4. An unvarnished painting with a vulnerable surface protected when off display, during handling, storage and transit, by an L-section frame wrapped in polythene. The reverse is protected by a backboard either attached to the storage/transit frame or to the painting stretcher.

used for storage, with the wrapping left in place. A backboard is attached to the stretcher or the transit frame to provide physical protection for the rear. The space between the painting and the backboard is a microenvironment. Its stability depends on the paint film. An acrylic film is a poor moisture barrier, whereas a varnished oil film is very much better. A varnished traditional oil painting in a heavy frame can provide almost as much RH stability as if it were glazed.

Internal pollution levels in frame enclosures remain to be studied. Two acids, acetic and formic, are produced by the degradation of various materials that may be enclosed [21]. Acetic acid is found naturally in certain woods, such as oak, or from the hydrolysis of man-made adhesives such as polyvinyl acetate. If the wood or adhesive is in close proximity to a work of art or is part of that work of art then acid build up is inevitable. Although the actual quantities available are very much less than for external pollutants, proximity and duration of exposure are important. A pollutant continuously generated at low levels and trapped within an enclosure will eventually cause noticeable damage. Similarly formic acid is generated by the degradation of adhesives, wood products such as MDF, resins such as phenol formaldehyde and urea formaldehyde. The precursors to these acids are formaldehyde or acetaldehyde, respectively, which then oxidise to the formic or acetic acids. Although the aldehydes have been measured and are an indicator of a problem, they may not be immediately damaging.

Other weaker organic acids generated by the degradation of natural resins and other organic material are also likely to be present. They have been studied less because their effect is likely to be masked by that of acetic and formic acids. Fatty acids from oils and amino acids from proteins may have a contribution to make to acid hydrolysis. For example degrading oil medium releases fatty acids to react with lead white pigment to create lead soaps, which increases the transparency of the paint and may give rise to protrusions. Sulphur dioxide from earlier pollution sorbed onto the surface of museum objects such as canvas or paper is likely to contribute to degradation which in turn releases more pollutant.

An interesting example is brown staining on the reverse of a painting by Morris Louis [22]. The unpainted cotton canvas has darkened most not at the extreme edges where the canvas is in good contact with the acidic wood of the stretcher but further into the canvas plane over the chamfered front surface of the stretcher and particularly where the wooden stretcher has an open joint between two sections of wood. This indicates that material is being given off by the stretcher but its ultimate effect does not simply depend on proximity. Whether the pollutant emitted is an aldehyde or a resin acid is not known but we could speculate that the degradation product, or emission, is transported by air currents and perhaps oxidised before it reacts. The need to understand such details reliably has become urgent for planning long-term storage in microenvironments. Louis's response was to paint the front of his stretcher (fig. 5)

The solution to chemical degradation is to introduce materials into the enclosure that absorb or neutralise acidity, oxidation or any other pollutant. This could either be applied directly to a work of art, say in the form of deacidification [23], or to control the quality of the gas inside. The introduction of chemicals is not likely to be reversible therefore we are reluctant to apply them directly to an object and, since their effect

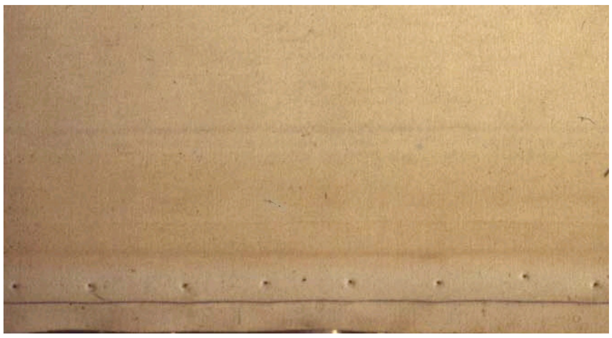

Figure 5. The reverse of a painting on cotton duck removed from its stretcher revealing brown discoloration associated with the stretcher.

is preventive, we need to apply them to objects that are still in good condition. With any successful chemical control, the controlling agent is consumed and some method of identifying when it needs replenishing is required. But an enclosure provides a stable and measurable environment that enables us to prevent the most serious degradation reactions [24]. Since it is already our main tool it should be refined further to incorporate pollution scavengers and both the frame and painting should be treated appropriately before enclosure.

Conclusions

The frame microenvironment offers a unique conservation measure, combining physical and chemical protection. Further work is needed to ensure chemical stability.

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