

A Description of 19th-century American Gilded Picture Frames and an Outline of Their Modern Use and Conservation

*Hugh Glover, Conservator of Furniture and Wood Objects,
Williamstown Art Conservation Center*

ABSTRACT

Picture frames are a functional component of most art collections and they are subject to wear and tear as they fulfill their housing function for paintings. Damage to picture frames can occur during exhibitions, storage, and travel, and is caused by handling, hanging processes, adverse environments, neglect, and irreversible restorations.

Picture frames are maintained by a variety of preservation specialists, and despite their ubiquity they have not become the domain of any one conservation discipline, and there is scant literature devoted to their preservation interests.

This paper will focus on the analysis of 19th century American gilded picture frames, as well as preventive care, modern modifications, and restoration/conservation treatments. The talk is derived from the cumulative experience in treating frames at the Williamstown Art Conservation Laboratory (WACC).

The paper will address frame nomenclature and the development of popular styles and constructions of the 19th century. It will outline ornament forms and materials, and give an overview of period gilding techniques. Different aspects of frame care, handling and modifications for the safety of the artwork are addressed, together with a brief overview of conservation treatments.

Finally, the many datable frame/painting combinations that survive in American collections provide a valuable source for understanding frame history and its rapidly changing styles and technology. This paper outlines evidence that helps determine whether a frame is original to its artwork.

1. Introduction

Picture frames are a component of most art collections and they are subject to wear and tear in their functional role surrounding paintings. Damage to frames occurs during exhibition, storage, and travel, and it is caused by handling, hanging processes, adverse environments, neglect, and irreversible restorations. Picture frames are maintained by a variety of preservation specialists and their preservation interests have only rarely been addressed.

An original or appropriate frame is a contextual surround that can enhance and inform the exhibition of a painting. Criteria for judging a frame's historical appropriateness, however, is woefully scarce. A starting point for understanding the technical and stylistic development of 19th century American frames can be the examination of datable frames of the period. Datable frames, particularly those that have remained

united with their paintings, provide valuable information about contemporaneous taste and technique.

Because of the clear parallels between the techniques and styles of picture frames with those of gilded mirror frames, furniture, and decorative architectural elements, the 19th century literature of gilding and decoration can provide insights into the chronology of picture frame development. There are several known workshop manuals of the period describing decorating techniques, and further examples no doubt remain to be discovered.

Rare and important forays into frame research have been undertaken by Adair (1983), Smeaton (1988), Kaufman and Wilner (1995), Gill (1996, 2003), and Wilner (2000), etc. These and the small number of exhibitions and symposia devoted to picture frames have brought an increased level of connoisseurship and scholarship to the subject. By bringing together existing frame and gilding scholarship with a comprehensive examination of dateable period frames, we can begin to construct an accurate history of 19th century American frames. Understanding the characteristics of period frames will enable us to select frames that are historically and aesthetically appropriate for the paintings they surround.

Finally, the conservation of picture frames provides a valuable opportunity to examine and analyze them closely to identify original forms, techniques, and materials. Gilding conservators have been developing more reversible and less intrusive restoration methods for the last twenty years, and conservators in general continue to fine tune preservation efforts.

2. Original and Datable Frames

Original 19th century American frame/painting combinations survive in quantity, particularly in more static collections and on portraits. This is less true of imported European examples that have changed hands more frequently. Although there are American painting/frame combinations that

can be quickly determined as original, others take more time to assess. Some frames remain questionable, and the remainder is easily determined as not original. Recognizing the history and appropriateness of the pair is likely to influence decisions made for the preservation of the frame.

Some original combinations can be identified through surviving documentation, particularly photographs, but more often they will be identified by the physical evidence on the painting, stretcher, and frame. Examples of this evidence include:

1. Corresponding period style and materials between frame and framee. Many datable components and marks on painting supports have been described by Katlan (1992).
2. Shared wood coloring and markings on the frame and stretcher back resulting from oxidation, pollution, spills, and handling. Gravity influences the deposition of grime and upper parts will be darker, and coloring may have been influenced by dust covers and backing boards.
3. Shared nail impressions and datable nails from fitting the painting, which can also indicate if and how many times the painting has been out of the frame. The dating of nails has been addressed by Edwards and Wells (1994) and Moyer (2002). The evidence available on the frame back may have been altered or lost by repetitive holes from fasteners, replacement stretchers, and other restorations.
4. Changes to a frame's rail length or rebate size imply a different painting has been installed, although small increments of rebate widening can be explained by a keyed out, altered, or replaced stretcher. The occasional use of antique frames in the late 19th century may have resulted in their adaptation to fit a new painting.

3. Characterization of 19th-century American Frames

The following section is generally organized according to the sequence of frame construction and the chronology of techniques and material use.

3.1 Nomenclature

Rectangular frames have top, bottom, and side rails, and the sides can be referred to as proper left and proper right for clarity. The rails have shaped profiles between a sight edge and back edge, and a rebate (or rabbet) behind the sight edge to house the painting. The terms front molding and top molding refer to the same feature, the most forward molding when the frame is hanging or the topmost molding when it is face up on a table (the term top molding is used here). The knoll, a more English term, describes the rounded summit of that molding. The top molding is usually located closer to the frame's outer edge, and when it is closer to the painting the frame is termed a reverse profile, or bolelection.

Forms for moldings derive from Greek and Roman architecture. Recurring frame moldings include the fillet (small flat), fascia (large flat), cavetto (concave quarter-circle), scotia (non-circular concave), cong (combined flat and concave), ovolo (convex quarter-circle), torus (large convex half-circle), astragal (small version of torus), cyma recta (concave to convex, sometimes called an ogee), cyma-reversa (convex to concave, an ogee). Examples of molding profiles are reproduced in many descriptions of traditional architecture, e.g. Benjamin (1827) (fig. 1). Later and more general terminology also applies, such as ogee, cove, scoop, hollow, flat, etc.

The inside descent from the knoll is the frame's main profile and popular forms went from cove to ogee in the first half-century, and to convex in the

last quarter of the century. The outside descent from the knoll went from plain flat (perpendicular to the wall), bevel, a small hollow within the flat, and a full scotia, all in the first quarter-century. An outside scotia with an ornamented back edge molding was popular during much of the remaining century. The silhouette outline of frames included straight, swept sided (rococo), and oval forms (neoclassical) in the first half-century, and then mostly straight sided in the second half-century.

Corners, centers, and sub-centers refer to enriched ornament at those sites, and piercing describes openings through the decoration. A mat is the liner that modifies the frame's opening to elliptical or round, and a liner is the removable inner



Figure 2. Back view of a sloped main profile edge glued to a painted perpendicular outer edge, a popular form in the second quarter of the 19th century.



Figure 3. Front view of fig. 2. The frame is water gilded and has an ovolo top molding, beveled main profile, cavetto sight edge, and a hollow in the yellow painted perpendicular back edge.



Figure 4. Back view of a four section frame with a box section recess in the main outer profile, and supporting glue blocks.

section of sight edge. A slip is an insert at the sight edge, and usually a later addition.

The styles of frames are described using a combination of old and new architectural and decorative art terms. Some frame styles are named by association with a painter, e.g., Thomas Sully, Thomas Cole, James Whistler, Childe Hassam, etc. More style terms and forms originated in Europe, for which European frame history resources are useful, e.g., Grimm (1981); Mitchell and Roberts (1996, 1996); Newbery et al (1990); Simon (1996); Van-Thiel and deBruyn Kops (1995).

The design and scale of ornament on frames evolved throughout the century in line with prevailing taste in architecture and the decorative arts. The majority of American frame ornament was derived from European and classical standards, while other sources included indigenous vegetation and flora (1845–65), the exotic from the Mideast and Asia (1850–90), Native American (after 1880), and in-

dustrial inspired patterns (after 1880). Terminology for ornament is outlined in various sources including, Lewis and Darley (1986), Meyer (1957), and Stafford and Ware (1975).

3.2 Wood Substrate

The substrate of most 19th century American frames is a relatively knot-free softwood, predominately white pine. In the last quarter-century various plain hardwoods (generally diffuse porous) were also used, and after 1860 the figurative markings of ring-porous hardwoods (e.g., oak, chestnut) were occasionally used decoratively beneath oil gilding without gesso.

3.3 Shaped Moldings

Early frame profiles were small and prepared by hand with planes, and wider rails after 1820 still involved hand planes. Successful machines for molding and shaping wood were developed in America in 1848 by C. B. Rogers & Co. and J. A. Fry & Co. (Englund 1978). The large, wide, and clean profiles from about 1840 suggest that machine shaping may have already been in use before the mid-century patent dates of these machines. Machine developments continued with cast iron frames introduced around 1850, the first vertical spindle molding machine patented by Andrew Gear (US) in 1853, and inside or center feed molders appearing in the 1860s. Demand for architectural moldings exceeded demand for picture frames and would have spurred these machine developments.

3.4 Rail Construction

Early narrow frame rails were single pieces of wood. As they widened they were formed from two glued pieces, with a slope for the main profile glued to a perpendicular top molding/outer edge (fig. 2, 3). Popular profiles on the slope included the bevel (Thomas Sully style), cove (Grecian), and ogee, often with an integral sight edge of an astragal and cavetto. Varnished cross-veneer and faux-painted veneer versions were also popular.

Frame rail developments in the second quarter in-

cluded two-section rails, square (boxed) recessed backs with supporting glue blocks, and lengthwise glued laminations for deeper rails. In the second half-century three and four concentric section rails achieved greater widths, while rail laminations, box recessed backs, and supporting glue blocks all remained common. The concentric sections of multiple section rails were gilded before assembly, seated in rebates, and fastened with angled nails in the back (fig. 4). Most reform styles (aesthetic movement, arts and crafts, etc.) after 1865 reverted to simple single rail arrangements.



Figure 5. An opened miter corner of an outer profile with a box section back recess and laminated four-part construction.



Figure 6. The distinctive Newcomb-Macklin corner joint of thin plywood inserted in the back of the miter.

3.5 Corner Joinery

Many early-century frames relied on half-lapped corner joinery in a back frame, with applied mitered front moldings. A few joiner-made examples relied on mortise and tenons in a back frame. Most frames, however, had simple mitered corners secured with glue and cut nails (fig. 5), with the nails in one direction that alternated around the corners (nails in both directions implies that nails have been added). Rails were assembled before the gesso and gilding were applied, and overlaid corner ornaments could contribute to the joinery. Tapered dovetail splines across the mitered corners were popular in Europe but uncommon in the United States. Late-century joinery methods included internal wood splines in grooves along the length of the miter, and the distinctive Newcomb-Macklin joint of thin plywood inserts over the back (fig. 6). Frames as large as doorways were generally assembled with lapped, mortised, and mitered joinery and held with draw bolts and trapped nuts.

Oval frames, popular in the second quarter, were mostly formed from a four-piece lap-joined or splined back frame and front laminations that bridged the seams, before being turned on an elliptical lathe.¹ Gilded wood mats and liners with rounded corners were mitered and fitted with wood corner inserts that were sometimes lapped or splined.

3.6 Carved Ornament

Ornament on early Federal frames was generally carved in the wood as small cross-cut sight edge decoration. Carved and gilded lengths of round rope twist ornament nailed into cove profiles were also popular. After about 1815 most ornament was molded. The use of low-relief carving was revived in late-century reform styles for foliage ornament and gouge textured surfaces, many of which were likely to have been first prepared on shaping machinery.

3.7 Compo Ornament

Compo (composition) was the popular material for molded ornament beginning about 1815 and



Figure 7. Discontinuous design at the miter of late-century machine pressed ornament.

its history and technology have been described by Thornton (1985) and Wetherall (1991). Compo ornament was much faster to produce than carved wood and it was also more stable as a substrate for gilding, since wood in the American climate is prone to movement. Compo was pressed into rigid molds of reverse carved wood, molded sulfur, or resin. Pressed compo ornament continues to be available today, and the dough-like material is easily prepared (Thornton 1985).

The form, placement and detail of compo ornament evolved in fashion during the century in conjunction with developing rail forms and gilded effects. Early compo was more globular, and later examples became finely detailed. Logical early placement was to cover the corner joinery, visually strengthening the joints, and then the next vacant space, the centers, were filled after about



Figure 8. Oil-gilded tulle net as textural decoration. Sections of compo are missing and reveal the net beneath.

1820, and by 1830 the ornaments had spread to almost connect. By 1840 continuous compo top moldings were popular, and scrolled foliage and strap-work could entirely fill the main profile (a style associated with Thomas Cole). Popular top molding forms at the mid-century included the rustic twig, with ivy at the corners, followed by laurel-and-berry or reeding with corner bindings. In the third quarter diaper patterns filled the cove, and more geometric designs followed. In the last quarter detailed foliate compo was applied as distinct bands, separated by plain fillets, flats, and hollows (Barbizon style).

The compo was applied to assembled and gessoed rails and it could be bent to conform to the rail shape and curvature. It was secured with hide glue or its own tackiness after steaming, and larger pieces were held with nails/sprigs. Undercutting



Figure 9. Stenciled rustic patterns of rocks (repeated patches) initially filled the main cove after about 1840.



Figure 10. Stylized wave and foliate sand patterns were used in the third quarter.

was only achieved by raising parts from the substrate or backing it with putty fills. Compo is characterized by its pale brown raw umber-like color, its thickness varying from 1/16" to 1", the absence of undercutting, and the development of proportional shrinkage cracks on drying.

The dried compo was prepared with a thin gesso or clay (Gilders Manual 1876, 12), or gilded directly using oil gilding for the larger part and water gilding on bole for forward features.

Mechanized processes in the later century used rollers and dyes to produce compo ornamented

rail lengths (Hünkel 1991), as many ornaments on frames have been made since. Examples can be distinguished by their thin compositum cross-section, mitered corner cuts through the compositum and gesso, and discontinuous ornament designs at the miter (fig. 7). Sometimes these features are hidden beneath compositum corner overlays.

3.8 Tulle Net

Tulle net as textural decoration was popular in the second quarter-century (fig. 8). Strips of machine woven tulle lace were applied with glue to the gessoed frame rails (before the compositum), a technique that was used in Munich in the 1840s (Hünkel 1991). The textured surface is reminiscent of 18th century European cross-hatching cut in gesso. The weave pattern in the lace is generally a plain square 2 to 3 mm wide, but more complex and decorative weaves developed on the theme. Bolder cross-hatched effects at the end of the century were cast directly in the surface of compositum or plaster.

3.9 Sand Texture

Sand textured surfaces were popular after about 1840. Fine sand was applied to oil size to produce a contrasting texture and reflection. Stenciled rustic patterns of rocks (repeated patches) initially filled the main cove (fig. 9), which were later relegated to smaller moldings. More stylized wave and foliate sand patterns were used in the third quarter (fig 10). A plain narrow band of sand texture positioned towards the sight edge was eventually popular, as it had been in 18th-century European frames. Softer grit textured effects were also used in the mid-century, and on later revival styles.



Figure 11. Lively late-century plaster ornament on a top molding (the corner leaf turnover is missing), and a small inside band of compo bead-and-reel.

3.10 Plaster Ornament

Cast plaster ornament was popular after about 1870, corresponding to the development of wax and gelatin mold techniques (Millar 1897). These reusable molds were flexible and allowed for new undercut forms, and presumably still cheaper and faster production. Glue is often absent under the plaster, as are corner seams, suggesting that the plaster could be added simultaneously in a single pour onto all four gessoed rails.

Plaster ornament is characterized by its white interior, full length forms, and its greater weight and bulk, usually more than an inch thick due to its inherent weakness. Internal wire armatures were sometimes incorporated for support. Common plaster placement was as a convex half-round top molding (torus), while smaller moldings on the

same frame continued to be of denser compo. Early plaster ornament is bulky and less modeled, and may be oil gilded only, while later examples have dramatic undercut foliage, leaf turnovers, and lively surface effects of oil gilding against burnished and matte water gilding (fig 11).

As with compo, it was not essential to prepare plaster with gesso, although sealant coatings of oil or glue size were recommended (Gilder's Manual 1876, 27). Similarly, its surface was generally oil gilded with forward features water gilded and burnished. Some late century examples were also gilded with brass leaf and powders.

3.11 Gesso

Gesso is the animal glue-bound white preparation for wood, filled with inert white pigment, most commonly calcium carbonate (chalk). Some late century reform style frames have red pigmented gesso to influence the color of the final gilding, or to reduce color contrast when the gesso is chipped. New gesso was smoothed and shaped with rushes, fish skin, damp cloth, shaped pumice stone forms, or other abrasives. By the third quarter manufacturers were supplying framers with whitened up (gessoed) stock moldings prepared with templates (Gilder's Manual 1876, 11), although the regularity of earlier surfaces suggests already well developed production methods.

3.12 Gesso Recutting

Gesso recutting is rare on American frames since the primary gesso was used on unadorned surfaces, and detail in ornament was derived from a mold. An exception is the gesso-cut fluted cove that was popular as a main profile in the third quarter. Flat bands of incised, gilded, and selectively burnished, or punched gesso were popular on high-style frames from 1860 to 1885 (fig 12). Incised patterns of white within a dark pigmented gesso surface (not gilded) were popular with Eastlake styles.

3.13 Bole

Bole is colored clay mixed with glue size and a small fat component applied as the preparation for

water gilding (The Painter, Gilder, and Varnisher's Companion 1883, 78). Different bole colors were popular throughout the century, beginning with shades of mauve, grays after about 1830, and later red colors. Red oil paint was used to prepare for some late-century oil gilding. Some modern reproductions of early-century styles are inaccurately prepared with red bole.

3.14 Water and Oil Gilding

The term *gilding* is used here in the broad sense to describe all applied metallic finishes on frames and some of these finishes do not include gold.

Nineteenth-century use of water and oil gilding was an integral part of the frame's decorative development. Water gilding alone dominated until about 1820, and then faster oil gilding was introduced for the compo parts.

Popular second-quarter plain molding frames that had no compo were typically profiled with an ovolo top molding, a main cove or bevel, and a small fillet or torus before a cavetto sight edge. They were water gilded on mauve bole and burnished along the top molding and the fillet/torus close to the sight edge. A similar contemporaneous profile decorated with compo corners/centers would be oil gilded only on the compo, and water gilded between the ornaments. An exception is found on some of the earliest compo that may be only water gilded.

The proportion of oil to water gilding on frames increased with the introduction of more compo, but water gilding continued to be the choice for the plain matte or burnished surfaces between the compo/plaster bands, and for burnished highlights on forward features of the compo/plaster. Plain small moldings between the bands of ornament, such as fillet, torus, and hollow, were usually burnished water gilding, and flats were usually matte water gilding. In all cases of combined oil and water gilding it was practical to complete the water gilding before the oil gilding since the brushed oil size could be neatly lapped onto the edges of the water gilding.

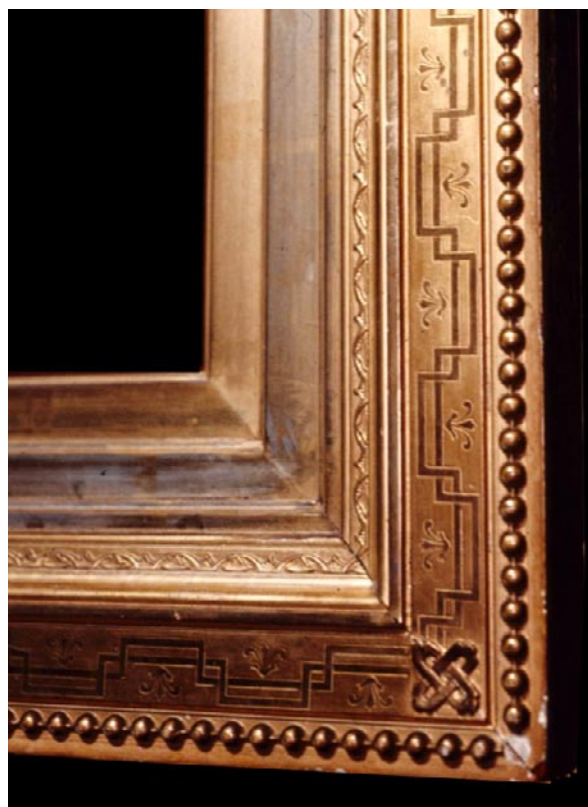


Figure 12. Incised, gilded, and selectively burnished flat bands were popular on high style frames during the 1860s to 1880s (the main outer profile has been removed).

The solid gilded and matte effect common on flat liners popular after 1840, wide bevels and flats popular in the last quarter, and other plain surfaces, were achieved with double water gilding and matting size (Gilder's Manual 1876, 17; Savory 1875, 67). Burnished sight edges next to a painting were rare but they were used for works on paper that were spaced away from the gilding with a paper mat (Gilder's Manual 1876, 16). Oil gilding alone was unlikely to have been used for an entire frame until the last two decades of the century.

3.15 Oil Size

Recipes for 19th century oil size included resin mixtures and aged linseed oil, colored with red or yellow resins and pigments (The Painter, Gilder, and Varnisher's Companion 1883, 65, 78). A visual assessment of the period's oil size suggests that most was lightly colored yellow, if colored at all. Chrome yellow colors were used occasionally by



Figure 13. Mecca gilding of faded yellow varnish on silver leaf on an outside ovolo, with oxidized silver where the varnish is thin or broken.

mid-century, and brighter red pigmentation was used in the late century.

3.16 Coloring yellow

Coloring yellow, a distemper prepared with yellow pigment in glue size, was used during the first half of the century to economically color the outside plain wood profile, usually a flat, bevel, or scotia, and it was used to prepare recesses for water and oil gilding (*The Painter, Gilder, and Varnisher's Companion* 1883, 79; *Gilder's Manual* 1876, 12).

3.17 Gold leaf

Gold is alloyed today with copper for red shades, and silver for lemon/green shades. More shades of gold leaf are probably available today than were available for most of the 19th century. The color of most 19th century gold leaf visually corresponds to the present day red colors of about 23½ K, although the color of old gilding is now altered with grime, oxidized coatings, and handling. A preference for a redder color is indicated in a letter

from Thomas Cole to Asher B. Durand in 1837, where he specifies: "...the best gold not the pale."² Domestic gold beaters were also producing cooler shades of gold (Fennimore 1991, 140). Lemon/green shades were popular for reform styles, and are specified in James Whistler's correspondence of the 1870s (MacDonald et al 2003). A late-century example of lemon/green gold on such a frame examined by x-ray fluorescence spectroscopy (XRF) revealed a high zinc component, rather than silver.

True gold powder (shell gold) is described in most gilding manuals (e.g., *The Painter, Gilder, and Varnisher's Companion* 1883, 74) but its use for gilding frames was likely limited.

3.18 Non-gold gilding

The terms "mecca gilding" (origin uncertain) and "changing varnish" refer to resin or pigment colored varnish glazes (*The Painter, Gilder, and Varnisher's Companion* 1883, 64). The technique of coating burnished silver leaf with yellow varnish to

imitate gold was popular before the mid-century and in the last quarter. Stenciled matte patterns on the varnish were occasionally used to represent fluting, etc. Examples of mecca gilding are visually recognized by the faded yellow varnish coating, and oxidized silver where the varnish is thin or broken (fig. 13).

Brass-leaf gilding became popular in the last quarter-century, generally applied using the oil gilding technique and always protected from oxidation with a varnish coating. Brass leaf gilding was initially used on secondary surfaces (e.g., outside coves) but by the end of the century it could be used overall or in combination with mecca gilding and Roman gilding with bronze powders. Brass leaf is visually recognized by its varnish coating, sometimes a wrinkled appearance due to its thickness, large leaf size of more than 5-inches (gold leaf is 3 3/8-inch square), and general or localized darkening due to oxidation.

Mass production of bronze powder and its preparation as paint in a de-acidified varnish was developed in mid-19th century London by Sir Henry Bessemer in answer to costly German imports (Bessemer 1905). Bronze powder gilding is found on American frames after about 1880 and the technique has been termed Roman gilding since at least 1909 (Ford and Mimmack 1909, 42). Methods varied from applying the powder as paint in a glue or varnish medium, to dusting the powder onto oil size (The Painter, Gilder, and Varnisher's Companion 1883, 120), and various varnish coatings were applied for protection from oxidation (Ford and Mimmack 1909, 43, 58). Examples can incorporate a modest burnish within the bronze, and brighter burnished highlights of water gilding on bole. Roman gilding is visually recognized by its dull and oxidized color, UV fluorescence of coatings, and broken particles under magnification. The tin-based gold powder, *aurum mosaicum* (The Painter, Gilder, and Varnisher's Companion 1883, 75), probably had little application on gilded picture frames.

3.19 Tone and varnish coatings

Gilded surfaces, except burnished parts, were brush coated with a thin size layer to matte and even the finish, adding contrast to the bright burnished passages. Coatings varied from plain glue size (The Painter, Gilder, and Varnisher's Companion 1883, 110-111), glue size or water colored with resin/dye/pigments, termed ormolu (Gilder's Manual 1876, 10; Savory 1875) or vermeil (The Painter, Gilder, and Varnisher's Companion 1883, 80), or the later use of thinned shellac (Ford and Mimmack 1909, 59). Thick and glossy varnish was not applied on gold leaf as it would interfere with the gold color and reflection, but thick and evenly applied varnish was a necessary barrier for non-gold gilding to prevent tarnishing.

The gilding on some reform style frames of the late century was mildly abraded and toned with colored varnish to better complement the painting. The gilding of mainstream frames was intended to be clean, bright, and only subtly toned. The practice of using stronger pigment, stain, and dye-toned coatings purposefully pooled within design recesses to mimic collected grime (antiquing) may have seen occasional use in the late-century, but it has been more common since the 20th century for effects and reproductions. Equally, intentional abrasion of gilding for the ageing effect (distressing) was uncommon until the 20th century.

4. Frame Wear, Care, and Use

4.1 Environment

Gilded wood objects are ultra-sensitive to environmental conditions and they are probably more sensitive than most paintings. In adverse climates gilded wood experiences detachment and loss of gilding/ornament, while an accumulation of grime leads to surface darkening and cleaning campaigns that may well cause damage.

The protected bright gilding that survives on shadow-boxed frames of the second half-century illustrates how more exposed gilding has now

been altered by grime, abrasion, and staining from moisture and grease during handling.

4.2 Handling

All gilded objects should be handled with non-marring gloves to avoid abrasions and staining, and even paper towels or cotton cloth will suffice. In practice, however, gilded frames are still handled with bare hands as the frame is considered a safe means of handling the artwork. Other handling precautions include using soft support pads, not lifting empty frames by the thin sight edge, and avoiding contact with loose parts. Ziploc-type bags labeled with marker pens are useful for saving detached parts.

4.3 Dusting

Occasional dusting of frames with a clean soft brush and vacuum is recommended to remove the dust that eventually becomes grime and attracts moisture. Light-weight dust covers can help in dustier storage areas (e.g. clear 0.35 mil (9 μm) polyethylene). Over-zealous dusting results in progressive abrasion that removes the gold (<1 μ thick) and reveals the bole and gesso preparation layers. Varying degrees of this condition are very common, especially on the shelf of the bottom rail. Aqueous cleaning results in the removal of water gilding and toned coatings which is another common condition.

4.4 Hanging hardware

The early 19th century hanging device was a ring and screw combination located singly or as a pair in the top rail. Simpler early devices included wire, leather, and sheet metal loops, located in the top rail. Some rural portraits were not originally framed and had the loop device attached to the top stretcher bar. Paired screw eyelets located in the side rails were popular after about 1825, and heavier frames could have custom hardware.

Modern practice is to fit steel D-rings for hanging, Oz-clips for some crating, and mending plates for securing the artwork, attached with pan-head sheet-metal screws (countersunk screws for Oz-clips). Secure fittings reduce the incidence of re-

peated screw holes, but events can lead to new holes in the frame and stretcher backs, and care is necessary to avoid excessive holes or obscuring historic evidence. A direct-reading caliper is useful for optimizing the length of screws added to a frame. Redundant early hardware can be preserved on the frame, or stored separately if necessary.

A heavy-duty hanging scale was used to crudely measure the failure point of a common D-ring with a stand-up wire loop (item U711, United Manufacturers Supplies Inc.). The wire loop failed by unwinding from its strap at around 520 lbs, despite the strap being fixed with only small screws in softwood (No. 8 x 1 in. screws in sugar pine). With safety margins that include an allowance for one hanger to temporarily hold the whole weight, perhaps 150 lbs is a reasonable maximum loading for a pair of these D-rings. Most framed paintings weigh less than 150 lbs, even when they are fitted with laminated safety glass. A record of the weight of heavier objects can be useful, as would further load tests of hanging devices. Old braided steel wire corrodes and becomes brittle and should be replaced with a stainless type. A single wall fixture combined with a connecting wire on the back of the frame is less secure than two wall fixtures, one for each D-ring. Failures within the hanging arrangement can be disastrous.

4.5 Labels

Frame makers can be identified from the occasional inscriptions found on the frame back. These can be printed paper glued on the wood, pencil inscriptions, and late-century marks applied by carving, ink stamp, and engraved metal coupons. A selection of late century marks are illustrated by Smeaton (1988), and many New York and Boston makers have been recorded by Katlan (1987). Other frame back inscriptions record dimensions, style, owner, and hanging location, etc.

Ideally, owner records should include copies of maker's labels/marks since they are fragile and subject to loss. Surviving labels can be protected in place with an overlay of 5 mil (0.127 mm) Mylar

attached with double coated tape (3M 415) on an isolation layer (B72), and detached labels can be encapsulated in Mylar envelopes.

Exhibition labels have traditionally been placed on frame and stretcher backs. A less intrusive and longer lasting location is on the painting's backboard encapsulated in Mylar, and/or placed in the owner's records. Modern inventory marks are applied between soluble varnish coatings to a discreet part of the frame, usually an outside corner and/or the back. Troublesome old inventory labels include gummed paper on water gilding, and pressure adhesive labels or masking tape on oil gilding.

Gilding that has been covered with a title plate is usually better preserved than adjacent surfaces and indicates an earlier condition. The silhouette revealed when plates are removed may need to be masked with pigments. The introduction of new title plates will eventually result in the same irregular coloring to the gilding.

4.6 Rebate Modifications

Frame rebates are sometimes modified to improve the fit of a painting. When an aperture is too large to neatly and safely house a painting the sight size can be reduced by fitting flat or L-section wood slips (or a liner) within the rebate. Mitering the ends of the slips is often sufficient to hold them in place, rather than adding fasteners or adhesive. L-section slips can double-serve by also centering the painting. The decision to only paint the reveal of the new slip, include a cavetto profile, or gesso and gild the reveal with oil or water gilding depends on the frame's existing gilding quality and the extent of the reveal. Linen covered liners were popular in the second half of the 20th century and they can be original to a 20th century frame, but they are a later addition to a 19th century frame and were added to modify the sight size.

A keyed out stretcher or a larger painting can require the widening of the rebate. Wood may need to be removed with a sharp chisel or router, although this obviously involves the loss of original material and detail.

Strips of polyester felt tape with an adhesive backing (e.g. Decco tape) are now generally fitted to rebates to cushion the edges of the painting. Attachment of the felt is improved by first dusting the rebate with a brush, and/or coating it with thin varnish (e.g., B72, shellac).

4.7 Glazing

Glazing is added to frames for the protection of artwork, generally for specific exhibitions and travel. Modern glazing materials are light-weight thermoplastics (acrylic or polycarbonate) or heavier-weight laminated glass, and most have proprietary coatings to reduce UV light and reflection. A glossary of glazing terms and a comparison of glazing materials are available as technical leaflets on WACC's website.³ Glazing is fitted in the rebate (or in front of a liner) and is backed with dark colored and felted wood or acrylic spacers. The increased protrusion of the painting in the back can be enclosed within an added build-up (see 4.9).

4.8 Microclimates

Sealed microclimate enclosures are used to stabilize environmental influences during exhibition and travel. The history, development, and design of various enclosures have been described in recent literature: e.g., Kamba (1993); Richard (1995); Wadum (1995); Sozzani (1997); Phibbs (2002). The painting is enclosed behind glazing within the frame (or travel frame), or larger enclosures such as vitrines can also include the frame.

Sozzani demonstrates that the moisture content of wood within the enclosure (i.e. stretcher, panel, cradling, interior frame and build-up, etc.) helps control RH during temperature variations, and a silica gel component can be a hindrance. The method described uses gaskets fitted between the glazing and rebate, and between the back of frame or build-up and an aluminum sheet backing, plus additional seals as needed.

Phibbs describes a simple method that uses a single piece of Marvelseal covering the object's back and sealed to the front edges of the glazing with double-

coated adhesive tape. Phibbs also describes a more labor intensive method that involves two pieces of Marvelseal per edge, bonded to the front and back edge of the glazing with hot melt adhesive, and folded and heat sealed over the painting's backboard.

Factors influencing the choice of microclimate method include size, weight, shape of the packaged artwork, rebate size of the frame, the exhibition environment and duration, and individual preferences. A small data logger enclosed within the envelope can give an after-event assessment of temperature and RH.

4.9 Build-up

A build-up is an addition on the frame back that extends the rebate's depth to improve the housing of protruding artwork. A build-up is usually made from four pieces of straight grained and light-weight wood (e.g. sugar pine, tulip poplar), ½–1½ inch deep, and attached to the frame back with a minimum number of woodscrews. Joining the corners of the build-up with splines or lap joints adds useful support to the frame's own corner joinery, and beveling and painting the outside perimeter reduces visibility. A build-up for an oval or round frame can be prepared from birch plywood cut to a circle with band saw and jig saw. Reasons for adding a build-up include protecting the back of protruding artwork, as a component of glazing and microclimate set-ups, and as a support for failing frame joinery. Build-ups do push the hanging object away from the wall, but they also hold hardware and can provide an insulating air space behind.

5. Restoration

Frame restoration/conservation treatments address structural and surface security, the housing accommodation, and the restoration of appearance. The condition of gilding on frames is rarely perfect and it reveals its history of use as a patina. A complete restoration to its original bright condition is generally impractical and often undesirable.

The extent and location of restoration interventions to a frame are generally weighted toward achieving

a successful presentation of the painting, and less visible frame damage may be left untreated. Quick restoration methods using different materials are often applied when they are reversible and reasonably durable, such as inpainting gesso losses, or filling dimensional losses with wax.

Reversible gilding techniques have been in development since the 1980s, initially published by Herbert and Small (1991) and Thornton (1991), and their development continues for the preservation of all historic gilding. The following is a brief description of gilded frame restoration methods for common situations.

5.1 Loose structure

Loose frame corners can compromise the structure and lead to loss of local decoration. The condition of the joinery is assessed by gently manipulating an empty frame on a table. The original 45° angle of most miter joints has been reduced by wood shrinkage and regluing with hide glue is not generally effective. One method of supporting loose frame corners involves adding birch plywood L-plates, or a full build-up to the back, secured with hide glue and/or woodscrews. Flat metal L-plates fitted with screws are less practical since the joint usually remains flexible. Half lapped corner joints can be reglued with hide glue, or supported with plywood L-plates.

Glue failure in laminations within a rail sometimes leads to gesso losses along the seams. The laminations can be glued with hide glue after isolating the gilding with temporary varnish, or they can be secured with woodscrews from the back. Gesso loss can also be caused by wood shrinkage against the long grain of glue blocks on the back, and the blocks may need to be shortened before the damage is restored.

5.2 Loose decoration

Breaks or splits within wood parts are generally secured with hide glue, and connections with gaps or end-grain can be secured with carvable epoxy between isolation layers of B-72 (Ellis and Hegin-

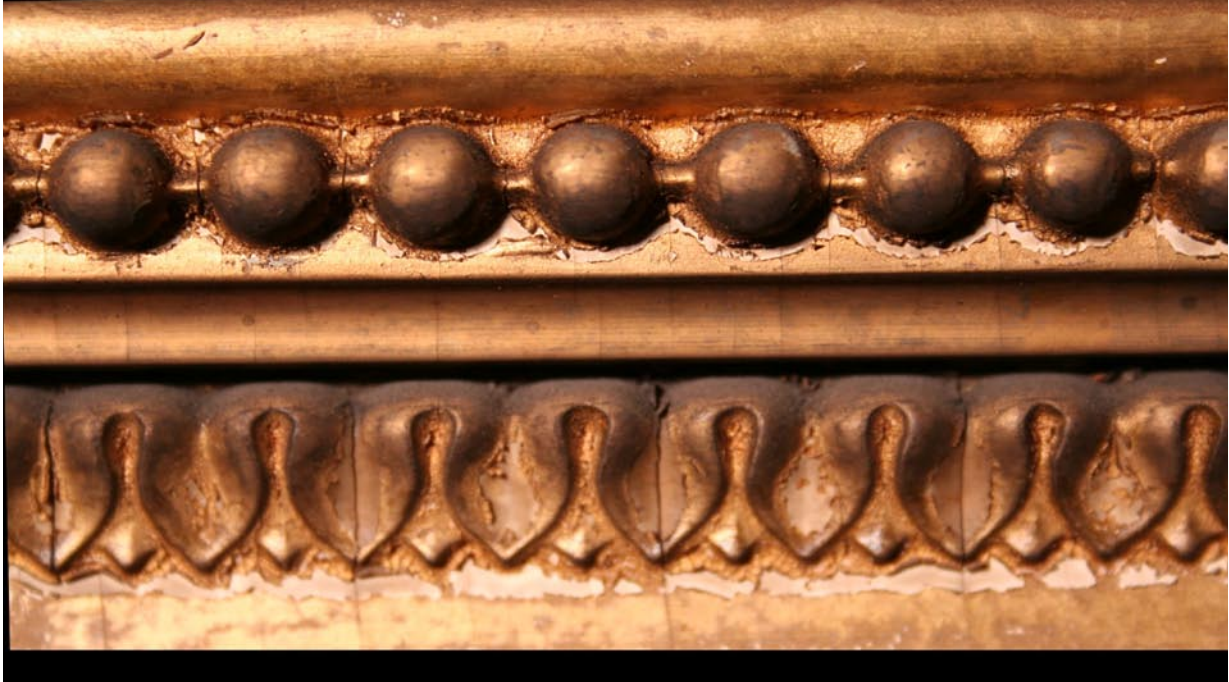


Figure 14. Micro-flaking in oil gilding at the base of compo ornaments resulting from insufficient sealant or an excess of glue or oil size.

botham 2002). Loose compo ornament is effectively and reversibly secured with B-72/acetone adhesive (Koob 1985), as are small sections of plaster. Adhesives to consider for larger sections of loose plaster include hide glue, PVA emulsion, and polyvinyl butyral.

Loose gesso on wood is a common condition where wood movement is greatest, such as edges of outside angles and convex forms. Loose gesso can be successfully secured with gelatin or rabbit skin glue size (about 4%), applied with a small brush without contacting the gilded surface.

Micro-flaking in the top surface of oil and water gilding layers also occurs. In water gilding it is rare and probably results from ineffective sizing of the gesso or excess glue in a coating on the gold leaf. Micro-flaking in oil gilding is more common particularly at the base of compo ornaments and in the interstices of tulle net, resulting from insufficient sealant, excesses of glue and oil size (fig. 14), or contraction of over-coatings. Careful handling of these surfaces may be the most practical means of their preservation.

5.3 Inpainting

Small losses of gesso and gilding are masked by inpainting with stable and soluble pigment systems that can incorporate mica pigments (e.g. acrylic emulsions, MSA and PVA colors, watercolors, etc.). Coloring all the revealed white on a frame facilitates monitoring new losses, and can be useful before events when frames are frequently handled and their conditions are inspected and reported.

5.4 Gesso Fills

Gesso losses on frames are common and their restoration can be prioritized to address those that are most prominent in the hanging position. Fills within bright or flat surfaces are more demanding to execute than fills within ornament or darker toned gilding. Several methods for filling the losses in gilding have been described by Thornton (1991).

Polymer binders prepared with inert fillers (calcium carbonate, calcium sulfate, kaolin, microballoons, cellulose powders, etc.) are used for reversible fills. Shelton (1996) has described the use of Aquazol (poly(2-ethyl-2-oxazoline), Thornton

(1991) describes the use of B-72, and polyvinyl alcohol has been used by Herbert and Small (1991) and Thornton (1991). Acrylic resin (previously cellulose ether) is used in Kolner brand burnishing clay. The use of regular protein gesso is also popular due to its reliability and performance, and Salimnejad (2002) has demonstrated that a protein bound gesso prepared with zinc oxide (35%), bismuth oxide (10%), and calcium carbonate (55%) provides an x-ray dense material. The drying of polymer gesses tends to result in strata within the fill's thickness, something that is not apparent in regular protein gesso that sets initially by gelling.

Gesso putties for deeper fills and proprietary spackle compounds like Modostuc (calcium carbonate, small amounts of barium sulfate, a polyvinyl acetate copolymer binder) can be quick to use, and wax for small fills can be quicker still. Recipes for fills are designed for the size and location of the loss, reversibility, less density than original material, working properties, and the gilding layers that will be applied.

5.5 Ornament fills

The reproduction of ornament losses by molding and casting is common restoration practice, and small losses can be reproduced by direct modeling of a fill material. For molding and casting extant ornament is used as the pattern for producing flexible molds. Quick setting dental putty (vinyl polysiloxane impression material) probably reduces the risk of silicone oil contamination, and RTV silicone rubber poured within dammed boundaries is useful for larger molds. In both cases the original surface is coated with a temporary isolation coating (B-72, B-67, petroleum jelly, wax, etc.). Extant ornament patterns do not always survive and it may not be possible to fill the loss accurately. In these cases similar frames can provide a pattern, and sometimes fills can be creatively modeled based on adjacent patterns. Historically appropriate new compo from a modern supplier may also be considered. Images of damaged repeat ornaments can be overlaid in Photoshop to help visualize the parts that do not survive.

Options for the casting material include new compo or plaster, or thermosetting polymers such as polyester, polyurethane, or epoxy resin. At the Williamstown Art Conservation Center (WACC) we generally use a low-viscosity epoxy resin (West System) bulked with microballoons, or a proprietary bulked epoxy resin (Woodcast). Steps that aid the casting process and reduce air pockets include prepainting the mold with a base color, and warming the mold and the precatalyzed casting material under a heat lamp. The back and edges of the cured casting are reduced with files and abrasives until it fits the lacunae. Parts that fit well are secured with B-72/acetone adhesive, and parts that have only a small contact with the substrate are secured with small spots of carveable epoxy on a B-72 isolation layer. Wax, gesso, or spackle type fills may be necessary to complete the edges of the new fill before the gilding is applied.

Carved wood fills for American frames are rarely necessary since the medium is less common, and late century carving is generally in low-relief and more robust. Options for fills in carvings include new wood, carvable epoxy, wax, or casting methods. Fill selection considers the type and size of the loss.

5.6 In-gilding

New fills are gilded and colored to match adjacent surfaces. Dull and toned gilded effects can be quickly achieved by inpainting with pigments that include mica or shell gold. Brighter effects require gilding with a corresponding shade of leaf applied on a matching base color and surface quality. The selection of leaf shade is aided by temporarily fixing small pieces of each option onto the extant gilding with B-72.

A gilding method for attaching new leaf is selected for its gilded effect and reversibility. Sawicki (2002) has compared the performance of non-traditional mordants and concludes with the successful application of Plextol B-500 (an aqueous emulsion of ethylacrylate/methyl methacrylate copolymer) for reproducing matte gilded effects (and it can be manipulated to produce shinier effects). Oth-

ers have described the use of acrylic resins, acrylic emulsions, Aquazol, polyvinyl alcohol, and wax (Thornton 1991; Moyer and Hanlon 1996; Sheldon 1996). In some circumstances traditional oil and water gilding methods can be reversible, and garlic juice (Cennini (1960), 97) and glair could perhaps also be considered. Reversible gilding systems are also used to apply new leaf onto original bole where old leaf has been abraded. Newly-leafed passages are then toned with abrasion if necessary, followed by colored coatings.

5.7 Cleaning

An undisturbed distribution of moderate grime on gilding is perceived as a desirable and historic patina. Naturally acquired grime concentrates on upward facing surfaces although some frames have been inverted to show the cleaner underside. Cleaning the gilded surface is considered when the grime is excessive relative to the painting and exhibition environment. Factors that complicate cleaning treatments include solubility of gilding and toning layers, the risk of abrasion, embedded grime, loose gesso and ornament, cleaning system residues, and the need for an even result on an often topographically irregular surface.

An initial cleaning involves dusting with soft brushes and a vacuum; the next level involves safe solvent wipes (e.g. petroleum benzene on cotton), and finally tailored aqueous and solvent systems can be used to reduce grime further.

5.8 Previous treatments

Common previous treatments to frames include the introduction of different adhesives, crude fills, bronze overpaint, and over-cleaning. Other examples include frame size changes, and over-gilding with leaf. Only the all-too-common bronze overpaint will be briefly discussed here.

Partial or complete bronze overpaint was applied generously to gilded frames in the 20th century. Its removal usually reveals a superior gilded surface and this implies the motive for its application was

usually to hide grime rather than other damage. Bronze overpaint is visually recognized by its even and dull brown oxidized color, and its untidy application. Bronze powder pigment was prepared in many different varnish-like mediums and solubility of the aged paint varies considerably.

Its safe removal depends on the difference in solubility between the overpaint and the underlying layers which often include both water and oil gilding. It is generally easier to remove the overpaint from water gilding where non-aqueous solvent systems can be used more safely, than from solvent sensitive oil gilding. Some bronze paints are soluble in aromatic hydrocarbons (e.g. petroleum benzene, xylene), but others require tailored cleaning systems that can include more polar solvents, chelating agents, and surfactants.

6. Conclusions

There are many American frame/painting combinations surviving in collections which provide a standard against which less well-matched combinations can be compared, and they can enable more accurate pairings and reproductions. Original, historic, or otherwise appropriate frames deserve identification and publication, as well as the particular care that conservation can provide.

Acknowledgements

The author is grateful to the many WACC staff members and interns who have shared an interest in the history and conservation of picture frames, with particular gratitude to Michael Heslip.

Notes

1. Pictured at the website of The Old Schwamb Mill: www.oldschwambmill.org
2. Thomas Cole to Asher B. Durand, November 2, 1837. Asher B. Durand Papers, New York Public Library, microfilm Archives of American Art). As noted by Annette Blaugrund.
3. WACC's website: www.williamstownart.org

References

- Adair, W. 1983. *The frame in America, 1700-1900: a survey of fabrication techniques and styles*. Washington, DC: American Institute of Architects.
- Benjamin, A. (1827) 1969. *The American builder's companion*. Reprint. New York: Dover Publications.
- Bessemer, H. 1905. An autobiography. <http://www.history.rochester.edu/ehp-book/shb/hb05.htm> (accessed August, 2006).
- Cennini, C. d'A. 1960. *The craftsman's handbook*. Reprint, New York: Dover Publications
- Edwards, J. D. and T. Wells. 1994. *Historic Louisiana nails: aids to the dating of old buildings*. Louisiana State University.
- Ellis, L., and A. Heginbotham. 2002. An evaluation of four barrier coating and epoxy combinations in the structural repair of wood objects. *Postprints of the Wooden Artifacts Group*. Miami: Wooden Artifacts Specialty Group, AIC. 53-64.
- Englund, J. H. 1978. An outline of the development of wood moulding machinery. *APT* 10 (4). 20-46.
- Fennimore, D. L. 1991. Gilding practices and processes in nineteenth-century American furniture. In *Gilded Wood, History and Conservation*, ed D. Bigelow et al. Madison, CT: Sound View Press. 139-151.
- Ford and Mimmack. 1909. *The art and science of gilding*. Rochester, New York, NY: Ford and Mimmack.
- The Gilder's Manual. (1876) 1991. *Gilder's manual; a practical guide to gilding in all its branches*. Reprint, New York: The Society of Gilders.
- Gill, T. 1996. *One hundred years on the edge: the frame in America 1820 -1920*. Santa Monica, CA. Tatistcheff/Rogers.
- Gill, T. 2003. *The American frame: from origin to originality*. New York, NY: Gill & Lagodich Fine Period Frames.
- Grimm, C. 1981. *The book of picture frames*. New York: Abaris Books.
- Hebrard, M. and S. Small. 1991. Experiments in the use of polyvinyl alcohol as a substitute for animal glues in the conservation of gilded wood. In *Gilded Wood, History and Conservation*, ed. D. Bigelow. Madison, CT: Sound View Press. 277-290.
- Hückel, A. 1991. Picture frames in the nineteenth century. In *Gilded Wood, Conservation and History*, ed D. Bigelow et al. Madison, CT: Sound View Press. 119-126.
- Kamba, N. 1993. Measurement of the dimensional change of wood in a closed case. *ICOM Committee for Conservation preprints*. 10th Triennial Meeting, Washington DC: ICOM. 406-409.
- Katlan, A.W. 1987. *American artists' materials suppliers directory - nineteenth century*. Park Ridge, NJ: Noyes Press.
- Katlan, A.W. 1992. *American artist's materials, vol. 2, a guide to stretchers, panels, millboards, and stencil marks*. Madison, CT: Sound View Press.
- Kaufman, M and E. Wilner. 1995 *Antique American frames: identification and price guide*. New York, NY: Avon Books.
- Koob, S. P. 1985. The use of paraloid B-72 as an adhesive: its application for archeological ceramics and other materials. *Studies in Conservation* 31: 7-14.
- Lewis, P. and G. Darley. 1986. *Dictionary of ornament*. New York: Pantheon Books.
- MacDonald, M. F., P. de Montfort, and N. Thorp. 2003. *The Correspondence of James McNeill Whistler, 1855-1903*. www.whistler.arts.gla.ac.uk/correspondence (accessed 3/30/06).

- Meyer, F. S. (1957). 1992. *Handbook of ornament*. Reprint. New York: Dover Publications.
- Millar, W. (1897) 1998. *Plastering plain and decorative*. Reprint, Shaftesbury: Donhead.
- Mitchell, P., and L. Roberts. 1996. *Frameworks: form, function & ornament in European portrait frames*. London: Merrell Holberton.
- Mitchell, P., and L. Roberts. 1996. *A history of European picture frames*. London: Merrell Holberton.
- Moyer, C. and G. Hanlon. 1996. Conservation of the Darnault mirror: an acrylic emulsion compensation system. *JAIC* 35: 185–196.
- Moyer, D. 2002. Nails for historical archaeologists. www.digitalpresence.com/histarch/nails.html (accessed 03/10/06).
- Newbery, T., G. Bisacca, and L. Kanter. 1990. *The Italian Renaissance Frame*. New York, NY: Metropolitan Museum of Art.
- The painter, gilder, and varnisher's companion*. 1883. Philadelphia: Henry Carey Baird & Co.
- Phibbs, H. 2002. Sealed frames for preservation. www.pictureframingmagazine.com/pdfs/pres-supp/APR02_SEALED_FRAMES.pdf (accessed 8/25/06).
- Richard M, M. Mecklenburg, and C. Tumosa. 1995. Technical considerations for the transport of panel paintings. *The Structural Conservation of Panel Paintings*. Getty Trust Publications. 525-556.
- Salimnejad, B. 2002. Formulating gesso fills for discrimination by x-radiography. *Postprints of the Wooden Artifacts Group*. Miami: Wooden Artifacts Specialty Group, AIC. 81-83.
- Savory, C. H. ca 1875. *The practical carver and gilder's guide*. Cirencester, UK: Steam Press.
- Sawicki, M. 2002. Research into non-traditional gilding techniques as a substitute for traditional matte water-gilding method. *ICOM Committee for Conservation Preprints*. 13th Triennial Meeting, Rio de Janeiro: ICOM. 2: 524-32.
- Shelton, C. 1996. The use of Aquazol-based gilding preparations. *Postprints of the Wooden Artifacts Group*. Norfolk: Wooden Artifact Specialty Group, AIC.
- Simon, J. 1996. *The art of the picture frame: artists, patrons and the framing of portraits in Britain*. London: National Portrait Gallery.
- Smeaton, S. 1988. *The art of the frame: American frames of the arts and crafts period*. New York: Eli Wilner & Co.
- Sozzani, L. S. G. 1997. An economic design for a microclimate vitrine for paintings using the picture frame as the primary housing. *JAIC* 36 (1997):95-107.
- Stafford, M. and D. Ware. 1975. *An illustrated dictionary of ornament*. New York: St. Martins Press.
- Thornton, J. 1985. Compo: the history and technology of plastic composition. *AIC preprints*, American Institute for Conservation 13th Annual Meeting, Washington, DC: AIC. 113-126.
- Thornton, J. 1991. Minding the gap: filling losses in gilded and decorated surfaces. *Gilding and Surface Decoration*. UKIC Restoration 91. London: UKIC. 12-17.
- Thornton, J. 1991. The use of nontraditional gilding methods and materials in conservation. In *Gilded Wood, History and Conservation*, ed. D. Bigelow et al. Madison, CT: Sound View Press.
- VanThiel, P. J. J. and C. J. deBruyn Kops. 1995. Framing in the golden age: picture and frame in 17th century Holland, trans. A. P. McCormick. Rijksmuseum, Amsterdam.

Wadum, J. 1995. Microclimate boxes for panel paintings. *The Structural Conservation of Panel Paintings*. J. Paul Getty Museum. 497-524.

Wetherall, A. 1991. The history and techniques of composition. *UKIC preprints*, Gilding and Surface Decoration UKIC Restoration 91. 26-29.

Wilner, E., ed. 2000. *The gilded edge: the art of the frame*. San Francisco, CA.: Chronical Books.

Sources of Materials

Compo:

Decorators Supply Corp.
3610 S. Morgan St.
Chicago, IL 60609

J. P. Weaver & Co.
941 Air Way
Glendale, CA 91201-3001

Decco felt:
Testfabrics, Inc.
PO Box 26
West Pittston, PA 18643.

Direct reading caliper:
Veritas Tools, Inc.
1090 Morrison Dr.
Ottawa, Canada K2H 1C2

D-rings (item U711) and hanging hardware:
United Manufacturers Supplies, Inc.
80 Gordon Drive
Syosset, NY 11791

Low viscosity epoxy resin:
West System, Inc.
102 Patterson Ave.
PO Box 665
Bay City, MI 48707-0665

Microballoons:
Conservation Support Systems
924 West Pedregosa St.

Santa Barbara, CA 93101

Prebulk epoxy resin; Woodcast:
Abatron, Inc.
5501 95th Ave.
Kenosha, WI 53144

Rite-Dent vinyl polysiloxane impression material
putty:
International Dental Supply
8205 West 20th Ave.
Miami, FL 33014

RTV silicone rubber encapsulant:
Dow Corning 3110, catalyst #1:
Museum Services Corp.
385 Bridgepoint Drive
South St. Paul, MN 55075-2466

About the Author

HUGH GLOVER is conservator of furniture and wood objects at the Williamstown Art Conservation Center (WACC), where he has been working since 1988. He received diplomas in Antique Furniture Restoration from West Dean College in 1979, and Conservation and Restoration of Wood, Stone, and Polychrome from The City and Guilds of London Art School in 1985. Address: Williamstown Art Conservation Center, 225 South St., Williamstown, Massachusetts, MA 01267. email: hgllover@williamstownart.org