PART THREE

Historical Materials and Techniques

Form and Polychromy: Two Different Concepts in One Object

Notes on Seventeenth-Century Sculpture Workshop Practices in Bavaria

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In recent years, a number of polychrome sculptures were examined and treated by the author. They belong to the first generation of sculptures in Bavaria to reflect the influence of Italian Mannerism in the province. The relationship to Italian Renaissance sculpture is evident, as is the sculptors' awareness of Italian art via contact with artists in Munich and Augsburg who had visited and trained in Italy. Roots of the development of Baroque ideas can be traced. A general examination revealed obvious differences in the outline of decorative elements between the carved surfaces and the polychromy. Furthermore, eyes, eyebrows, lips, and cheeks were found to have been painted directly on the carved wooden surface, and must have been covered with layers of priming and the authentic polychromy immediately after carving.

Such observations have been made repeatedly, but there is still no accepted explanation for this quite commonly used local coloring in combination with polychromy (Rosenfeld 1990:153).[1] Three sculptural groups have been selected to explain and illustrate these observations in detail.

Case Studies

The sculptural group *The Descent from the Cross* (Fig. 1) is attributed to Christoph Rodt, a sculptor who lived from the end of the sixteenth century until 1643 in Swabia, an area southeast of Ulm (Miller 1989; Mannes 1992). The group is thought to be the centerpiece of a lost altarpiece from the Roggenburg monastery and is now located in the parochial church of Neuburg an der Kammel, Rodt's former village home. The work is dated around 1625. Exact proof of dating and provenance is missing.

Little is known about Rodt. In addition to a number of attributed pieces, there is a monumental altarpiece in Illertissen (a small town near Ulm), which he personally signed in 1604. Moreover, a document written in his own hand has survived. It was found in the head of one of the retable figures. In this document, he introduces his assistants and the painter of the Illertissen retable and gives us his comments on bad beer, expensive corn, and so on (Mannes 1992:106; Becker and Portsteffen 1991).

The Neuburg sculptures were discovered in 1910, stored in boxes in the attic of the castle in Neuburg. Hitherto totally forgotten, this spectacular find led to the first restoration and reconstruction of the group in the arrangement as seen in Figure 1. About 70% of the original polychromy and gilding has survived. The reason for the actual treatment and examination was the poor condition of the polychromy; gilding and

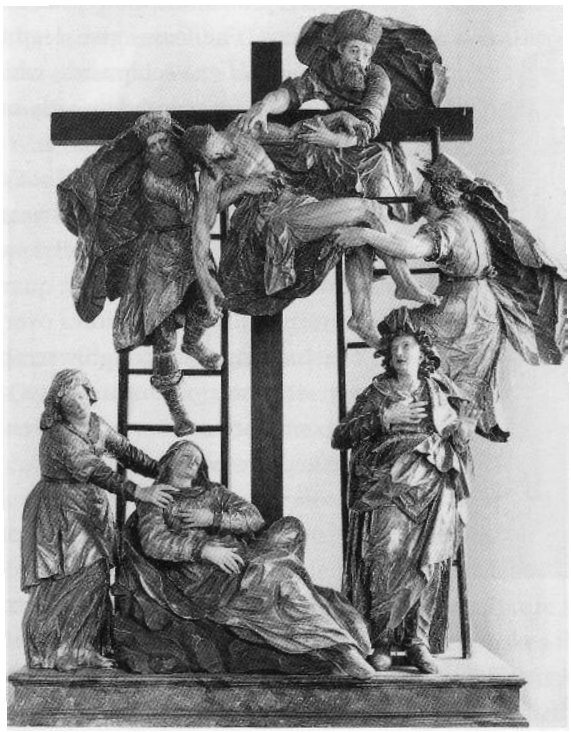

Figure 1
The Descent from the Cross, attributed to Christoph Rodt. First quarter of the seventeenth century. Limewood. H:approx. 250 cm. In the parochial church of Neuburg an der Kammel.

paint layers were flaking due to inadequate environmental conditions. The group was acquired by the Bavarian state from a private owner. Consequently, the group was transferred to the village church of Neuburg.

The original polychromy shows silvered and gilded areas of the drapery, and faces and arms are painted in a very lively manner. Close examination revealed that the painter did not fully comprehend the sculptor's concept. This is supported by four observations:

1. A hole had been prepared for a separately carved button. The planned button had been forgotten, and the painter covered the site in a manner similar to the surrounding area.
2. The painter did not pay careful attention to the borders of inner and outer parts of the robes. After applying silver leaf to large areas of the outer part of the robe, he needed to correct those areas and did so by applying gold leaf over the silver leaf.
3. One leg was painted flesh color; apparently, the painter did not recognize the carved breeches. He later corrected this by adding silver leaf.
4. The carved relief area in the cap of one of the upper sculptures was overlooked; the outline of the carving was not reoutlined in the priming layers.

Figure 2
Bust of *Saint Kunigunde,* attributed to Christoph Rodt. First quarter of the seventeenth century. Large areas of the authentic polychromy are lost. Limewood. H:45.5 cm. In the Collection of Heimatmuseum, Illertissen.

The most important observation made was in the lacunae of the polychromy on the face of Saint John. Beneath the priming and polychromy and directly on the wooden surface, the lips are painted red.

The busts of Saint Kunigunde (Fig. 2) and Saint Heinrich are attributed to the same sculptor. They have survived, although badly damaged, and are now in the Heimatmuseum in Illertissen. These polychrome busts had once been attached to reliquaries, which are now missing. The remaining parts of the polychromy are original and have never been

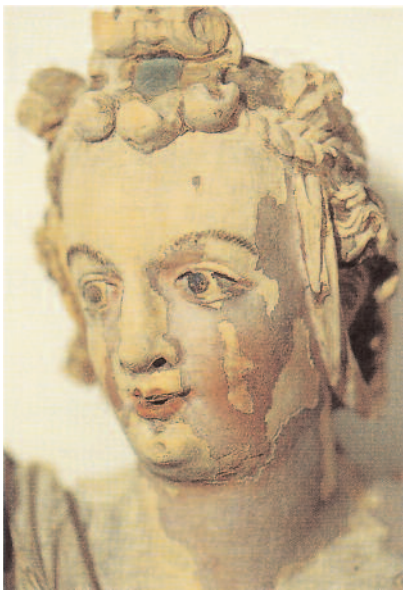

Figure 3
Detail of bust of *Saint Kunigunde* (as in Fig. 2). The system of colored eyes, cheeks, and lips is clearly seen in the lacunae of the polychromy.

Figure 4
The Godfather from *The Coronation of the Virgin Mary,* artist unknown. First quarter of the seventeenth century. Limewood. H:109 cm. In the monastery of Oberschönenfeld.

treated. In spite of the losses, the colorful and very delicate decoration is still apparent. The losses give deep insight into the technique and the elaborate carving of the sculptures, which is covered with thick priming layers. Again the lips are painted directly on the wood surface, as are the cheeks, eyes, and eyebrows (Fig. 3).

The third example is *The Coronation of the Virgin Mary* in the monastery of Oberschönenfeld near Augsburg (Fig. 4). Again, the sculptures are fragments of a lost altarpiece. These sculptures, carved by an unknown artist during the first quarter of the seventeenth century, have been overpainted several times over the years. In the 1960s, some parts of the overpainting were roughly scraped away. Despite this treatment, large areas of original polychromy have survived and were recently restored. Close examination revealed differences between the elaborately carved surface and the polychromy:

- The detailed seam decoration is totally covered by thick priming layers (Figs. 5, 6);
- the geometrically structured surface of the scarf is changed into a flat, floral-painted area (Fig. 7); and
- the decoration of the inner and outer parts of the robe does not adhere exactly to the flow of the carved pleats.

These examples show that the sculptors and painters did not follow the same concepts. The differences seem to prove either the painter's independence in bestowing upon the object his impression of what it should look like or the painter's lack of knowledge of what the sculptor had in mind and a different understanding of quality.

It is obvious that different individuals were involved, that the work was divided into several steps, and that communication between the sculptor and the painter was poor.

All the aforementioned sculptures have lips painted directly on the wood surface, in addition to the overlaying full polychromy. On one piece, colored eyes, eyebrows, and cheeks could be seen on the carved wooden surface due to losses of paint layers. Of course, original paint layers were not removed to determine painted eyes on all the objects, but the discovery of red lips on all of them certainly proves a system of preliminary coloring for details on the carved surface, which must have been covered with priming layers and then polychromy immediately after carving. Who was responsible for these preliminary colorings, and for what purpose?

The discovery of such painted details—along with a finishing layer of tinted brown glaze—on the wood surfaces of sculptures by Riemenschneider and other early Renaissance sculptors led to the theory of the so-called nonpolychromed sculpture or "wooden sculpture with painted details" (Taubert 1983a:73; Rosenfeld 1990; Oellermann 1992).[2] Each new discovery of these colorings is usually considered to support this theory (Westhoff 1993; Meurer 1993). In such cases, the sculptures were planned without polychromy. If polychromy was sometimes added at a later date, this was due to a change in fashion or to a disregard of the artist's concept.

The sculptures studied here have colored details on the wood surfaces along with a polychromy that, without question, was executed immediately following the carving process and the coloring of the details.[3] To find an explanation for this puzzling phenomenon (colored details cov-

ered by polychromy), it is necessary to study the workshop practices at that time, as well as the contract terms according to which the objects were created. Were the carving and the polychromy carried out in the same workshop? Did the sculptor and the painter have separate contracts? Was there any contact or communication between the sculptor and the painter? How did the artists feel about division of work? How much time passed between the making of the sculpture and the application of the polychromy?

Influence of the Guilds

From the Middle Ages to the eighteenth and nineteenth centuries in the German-speaking countries, craftsmen were organized in guilds. Guild rules strictly delineated the different spheres of competence and regulated commercial practice. In general, wood sculptors were not allowed to use colors, and painters were not allowed to carve wood. Several surviving contracts confirm this specialization (Huth 1967:70). This general formula, however, is much too simple to describe the situation. The close relationship between the work of painting and sculpture in altarpieces that combined painting and polychrome sculpture makes the matter even more complicated, and it was a constant cause of quarrels and discussion among the guilds. In 1463 in Basel and in 1475 in Munich, painters were allowed to hire their own sculptors. They could deliver complete polychrome sculptures. This led to angry protests by the sculptors (Baxandall 1980:112).

The fifteenth century saw the development of the practice of commissioning large projects such as altarpieces to only one person, who would act as the general contractor (*Verleger* in German) with various subcontractors. For example, a painter might carry out part of the work in his own workshop and subcontract additional work to other artists and/or artisans. This concept was well known for the *Herlin* and *Syrlin* (carpenters), *Strigel* and *Wohlgemut* (painters), and *Weckmann* and *Lederer* (sculptors), who worked as central contractors to deliver complete altarpieces (Baxandall 1980:118). In such situations, the creative idea of the object was attributed to the artist who controlled, signed, and delivered the work. Generally the whole commission was planned and discussed using a drawing (*Visierung*) that had been approved by the client.

To further complicate this complex system, the different crafts were governed by different rules, just as the same guild in different towns also varied in their rules. In Munich (Huth 1967:73) and Ulm (Weilandt 1993:370), painters and sculptors belonged to the same guild but had to follow different rules. In these two cities and in several others, membership in two different guilds was possible. In addition to the guilds, which

Figure 5
Detail of the seam decoration, as seen in the Godfather (see Fig. 4). The elaborately carved wooden decoration is covered by thick priming layers.

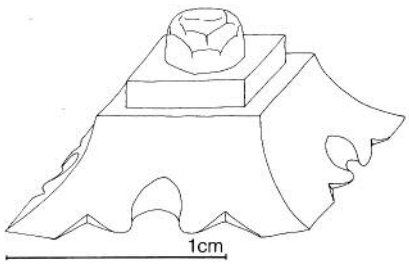

Figure 6
Drawing of reconstruction of the carved seam decoration in the Godfather (see Figs. 4 and 5).

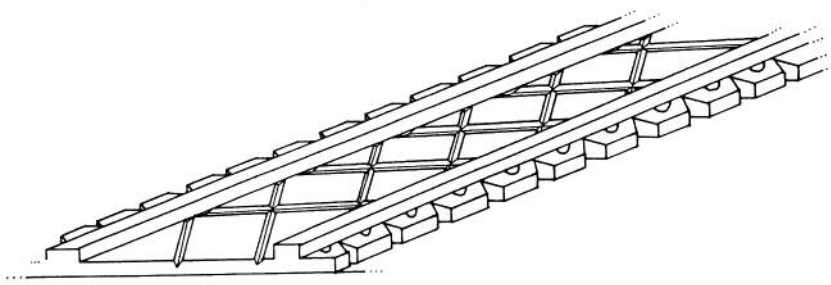

Figure 7
Drawing of reconstruction of the carved structure of the Godfather's scarf, which is changed to a flat, floral-painted design in the polychromy (compare to Fig. 4).

existed only in major cities with a sufficient number of craftsmen, there were four special groups not subject to these guild regulations:

1. Craftsmen in self-governed imperial cities (*Freie Reichstädte*). In the imperial cities, the town council fixed the rules and controlled the conditions governing arts and crafts. In Nuremberg, for example, painting and sculpture were decreed to be free arts and were not regulated by guild rules (Huth 1967:79; Baxandall 1980:106). This was a boon for artists such as Veit Stoss, who worked as painter and sculptor.
2. Artists and craftsmen under the jurisdiction or in the employment of the court and the confraternities (*Hof-und Klosterbefreite*).
3. Non-guild members, the so-called *Pfuscher,* who were more or less tolerated. They could not afford a master's license nor were able to marry a master's widow and therefore had no way to acquire citizenship and membership in a guild (Schindler 1985:265).
4. Finally, those in the guild-free countryside, who could work under various contract conditions (von Tyszka 1908:72; Koller 1982b). Their contracts did not fall under guild rules and were made to fit the needs of the client and the artists. Here, clever negotiations determined the conditions.

It is obvious that such work was created in a certain contract and workshop context that needs to be investigated for each individual piece. Regional differences must be considered as well. Existing contracts provide valuable information, but they cannot, of course, reflect the conditions of day-to-day practice (routine work, votive paintings, sales, etc.). The relatively large number of contracts and rules dating from the fourteenth and fifteenth centuries offer a good picture of the historical background.

In conclusion, one finds, on the one hand, general contracts with one artist who had subcontractors and, on the other hand, separate contracts with individual artists and artisans (Baxandall 1980:104–5). In any case, this means that division of work was customary. Only rarely does one find sculptures that were polychromed by the sculptor himself or by his own workshop.

Seventeenth- and Eighteenth-Century Practices

Separate contracts for separate steps of work appear to be the general practice in the seventeenth and eighteenth centuries. Several authors have studied the conditions reigning at this time. Obviously, regional differences did exist. Again, it would be necessary to investigate every object, which, of course, is not always possible.

In the eighteenth century, the crafts of painters and sculptors were strictly separated, specialized, and self-organized (Koller 1974a:31; Schiessl 1979:10). If the sculptor had a contract for a polychrome piece, he usually had to pass on the finished, carved piece to a painter (Schiessl 1979:10, n. 40). Guild organization still existed and was even more restrictive. It was possible for a painter or a sculptor to provide the idea, sketch, and/or the plan for the work, as well as the polychromy. Several colored designs on paper and small model examples for retables and sculp-

tures have survived. Such pieces were made as a means of furthering discussion among the contract partners and artisans and of helping the future owner to picture the final work (Schiessl 1979:17; Koller 1974a:24). Contracts were then made with each artisan separately (Koller 1974a:33; Volk 1984:189).[4] The growing self-confidence among the different artists led to the practice of signing their work separately (Taubert 1983b). Painters responsible for the polychromy on sculptures and retables were no longer anonymous.

The Procedure

Usually the painter started working immediately after completion of the carving or erection of an altarpiece. But time did not pass as fast as it does today. If the polychrome concept was discussed or contracted during or after erection or carving was completed, it is possible that some time elapsed before the polychromy was applied. There are known instances where years passed after the erection of an altar retable or the carving of a sculpture before the polychromy was applied. This might have been due to lack of funds, a change of mind, or uncertain times. One known case is the Baroque organ in Maihingen (1737), which was never polychromed at all (Walch 1991; Böttger 1991; Scheuch 1991). The rough wood construction and surface of the carvings can still be seen, and blemishes and joints are filled with paste (Fig. 8). This is actually a very rare and astonishing example of an unpainted work in a church with an elaborately polychromed interior. Here, too, we find lips and eyes painted directly on the rough and uneven wood surface, which calls for a finish of priming and polychromy. Another example is the monumental retable in the Church of Überlingen, where the design and the sculpture were contracted to Jörg Zürn in 1613 and the carpentry to Joseph Mutschlenbeck, while the polychromy was commissioned in January 1614 to the painter Wilhelm Baumhauer. During the following half-year, the polychromy order was canceled "for various reasons," as the document says, and it was never executed (von Manteuffel 1969:17, 154, 156).

Figure 8
Organ in Maihingen/Donau-Ries, Johann Martin Baumeister 1737. Detail of the sculpture decoration of the organ. The face of the angel shows repairs in the wood, which calls for priming and polychromy. Eyes and lips are painted. Limewood. In the parochial church of Maihingen.

Other examples of delay in executing the polychromy are the pulpit and high altar of the monastery church of Saint Veit an der Glan, Austria, constructed in 1634 and painted in 1637; the altarpiece in the parochial church in Strasbourg, Austria, constructed in 1747 and painted in 1772 (Koller 1974a:31); and the high altar in the monastery of Disentis, where the polychromy was applied twenty years later (Brachert 1972:161). For the medieval Pietá of Georgenberg, Austria, there is literary proof that it stood in the church after carving for some time before it was polychromed (Koller 1982a; Koller 1993). Other examples have been published (Schiessl 1979:29; Bayerisches Nationalmuseum 1985:264; Württembergisches Landesmuseum Stuttgart 1993:26:447, 27:448).

Conclusion

Conditions such as poor communication, division of labor, and delay in contracting different steps of the work influenced artistic production. A work of art cannot be executed in separate steps by various artists without consequences, especially when there is little or no contact between the persons involved, or when there is a lapse of time between the operations.

Little is known about the relationship between sculptors and painters and how they coped with these circumstances. Literary sources may shed some light. For example, there is a statement by the sculptor Hagenauer, who made the high altar of Köstendorf, Austria, in which he calls for precise priming. "Not to waste the quality of carving," he wanted to be contracted for the priming and the polychromy as well. Apparently he had had some bad experiences with painters (Koller 1974b:118):

> To preserve my pleasure in the clear carving and diversity of facial expression and not, as has often enough happened to me, to find it wasted by poor priming; to the extent that neither the clear contours, the diversity of expressions, nor the difference between the flowers and the other ornaments could be discerned, nor who it was made by and what it was meant to be, therefore I plan to take over not only the carving but the polychromy as well.[5]

This statement may reflect the situation and the feelings of the sculptors who had to pass their work on to a painter, or who were contracted separately. If one presupposes any professional pride, such discontent must have been widespread.[6] From this point of view, the coloring of the eyes, cheeks, lips, and so on, directly on the wood surface might be interpreted as the sculptor's finishing touch: an indication that he wanted to assert his concept of his creation before passing it on to a painter. This interpretation stresses the artist's feelings, which is, of course, a modern interpretation. In any case, the sculptor's own coloring of details confirms that there were strict guild rules and a division of labor.

The concerned artists and artisans probably knew that the polychromy might be executed several years later, or perhaps not at all. In such cases of delayed polychromy, the provisional coloring of the eyes, et cetera, served as a first step toward the polychrome finish of the piece and allowed for immediate use. To describe this phenomenon, the term *temporary* or *provisional coloring* might be useful.

Notes

1 Some of these observations follow:

> (bei) den im Verlauf der Schwanthaler-Restaurierungen untersuchten 67 Figureninkarnaten. . . . finden sich fast stets direkt auf dem Holz schwarze Augen-und rote Lippen- sowie Blut-(z.B. bei Sebastiansfiguren) angaben, die von der Hand des Bildhauers stammen dürften [Examination of 67 polychrome sculptures attributed to members of the Schwanthaler family revealed that most of the sculptures showed black-colored eyes, red lips and blood marks (in the case of sculptures of Saint Sebastian) painted directly onto the wooden surface, probably done by the sculptor] (Koller 1974a:48).

> dunkel eingesetzte Pupillen, die sogar unter Kreidegrundfassungen gefunden worden sind . . . eine Gepflogenheit des bildhauerischen Gestaltungsvorgangs, durch die der Blick festgelegt wurde [colored eyes, found underneath polychromy are part of the customary manner of design, determining the direction of the glance] (Brachert and Kobler 1981:807).

> Denn selbst wenn man eine direkt aufs Holz gemalte Pupille findet, muss es sich nicht immer um ein holzfarbenes Bildwerk handeln, sondern man muss damit rechnen, dass der Bildhauer während seiner Arbeit eine solche Zeichnung als Hilfsmittel benutzt hat, um seinem Werk Lebendigkeit zu verleihen und evt. schnitztechnische Korrekturen vornehmen zu können [The finding of colored eyes on the wooden surface does not always prove that the sculpture is a nonpolychromed one. It is just as possible that the sculptor uses these colored markings to enliven the piece and to control his work] (Westhoff and Haussman 1987:130).

2 See Rosenfeld 1990 for references on this subject.

3 The authenticity of the polychromy is usually determined by the manner of the polychromy, by the presence of visible repair work in the wooden surface that called for a covering by polychromy, by the lack of any patina (soiling) on the wooden surface, and by the evidence of the typical rough surface generally prepared for the better adhesion of the priming layers.

4 The high altar in the monastery church of Fürstenzell near Passau fits as an example for division of work and separate contracts: design of the retable, J. B. Straub; sculpture work, J. B. Straub; carpentry, Jacob Kalchgrueb; carved ornaments, Wolfgang Reittmayr; polychromy and gilding, Andreas Math.

5 Translated by M. Nierhaus from the German:

> Und damit meine Freyd bey reiner Ausarbeitung und verschidtenen Ausdruck der Gesichter mir vollkommen bleibe und nicht so, wie es mir schon oftmals geschehen ist, durch Vergründung verpatzet wird, dass man weder mehr eine reinen Conturn noch verschiedene Gesichtsbildung, weder Unterschied der Blumen noch anderer Auszierung erkennt hat, von wem es gemacht und was es sein oder vorstellen sollte, so gedänke zugleich auch nebst der Bildhauer- auch die Fassarbeit zu Übernehmen.

6 According to some other contracts of that time, the sculptor was required to finish his part with the priming. This is reasonable, because the accuracy of his carving would not then be affected by the influence of the painter (Koller 1976:163).

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Reconstruction and Analysis of Bismuth Painting

Renate Gold

In southern germany and switzerland, an unusual form of painting was developed in the sixteenth century: the technique of bismuth painting. The technique is found mostly on small decorative caskets and beech (*Fagus*) boxes, and occasionally on wooden plates and altars. The lids of the boxes show figurative scenes from the Old and New Testaments with couples dressed in traditional sixteenth-century clothing (Fig. 1). The remaining surface areas are filled with schematic leaf ornamentation or dense designs of flowers, fruits, and symbols of betrothal and marriage (Fig. 2). A number of the boxes that have been examined have inscriptions, and approximately forty are dated. The first boxes appear to have been produced around 1490; however, it was not until 1613 that the governing council of the city of Nuremberg formed an official guild of bismuth painters.

Bismuth has been known as a metal since Agricola (1490–1555) and Paracelsus (1493–1541) and belongs to rare elements found in the cobalt and nickel mines of Saxony, England, and Bolivia, among others. It is a brittle metal, ranging from silver-white to a reddish hue in color. The metal can be pulverized, and its surface remains unchanged in a dry atmosphere but oxidizes under humid conditions. It is found in its oxidized form on the decorated boxes, mostly dark gray and matte in appearance. Very little remains of the warm silvery and blue-red iridescent hue that this metal originally reflected and that made it so fascinating to the viewer.

The technique of bismuth painting may be divided into three categories:

1. A continuous bismuth ground onto which the painted decoration was applied
2. An application of bismuth paint within the painted decoration—as, for example, along borders and collars of clothing (Fig. 3)
3. An application of bismuth for small flowers and stems as part of the background

In short, the term *bismuth paint* may refer to decorative applications, though the technique of a solid bismuth ground is predominant.

Translated by Elisabeth Cornu.

Figure 1
Box, ca. 1560. Painted with bismuth. H:14.5 cm; W:36.5 cm; D:24 cm. From the Germanisches Nationalmuseum, Nuremberg (Inventory no. HG 7865).

Summary of Published Technical Research into Bismuth

The study of bismuth painting was carried out by the author for her doctoral dissertation, titled "Bismuth Painting." As part of the study, historical and contemporary records were researched to compile a sequential record of investigations into the materials and techniques used for bismuth decoration.

First attempt at reconstruction of bismuth by Wibel, 1890

In 1890, Justus Brinckmann, the founding director of the Museum für Kunst und Gewerbe (Museum of Arts and Crafts) in Hamburg, bought a bismuth box dated 1555[1] and asked Ferdinand Wibel, director of the chemical state laboratory, to carry out an examination. In an extensive 1891 essay on the results of his research, Wibel describes a bismuth surface that is visible in the center of the painted box and, after removal of the surface varnish, appears as a matte lead gray area with a red tone. By removing a small sample from the 0.1 mm metal layer with a knife, he confirmed that it is a brittle metal that flakes off in small pieces, revealing an underlying ground of chalk with a glue-like binder (Wibel 1891).

Wibel determined that the paint ground consisted almost exclusively of bismuth with small traces of antimony and arsenic; copper and tin were completely absent (Wibel 1891:5). Deciding that pure bismuth could not possibly be hammered or rolled into a foil, unless the old metal

Figure 2
Writing cabinet, ca. 1650, with bismuth ground. H:31.5 cm; W:41 cm; D:30.5 cm. From the Bayerisches Nationalmuseum, Munich (Inventory no. 60/I 14).

Figure 3
Box, dated 1544. Gold background, with bismuth on the border of the garments. H:17.4 cm; W:45.8 cm; D:29.5 cm. From the Bayerisches Nationalmuseum, Munich (Inventory no. 10/303).

technicians knew a procedure that had since become lost, he concluded that the metal ground resulted not from a foil applied to the ground but from pulverized bismuth applied onto the chalk ground and burnished evenly with a polishing tool or burnishing stone until it achieved an even reflecting surface that resembled metal. He attempted to reproduce the bismuth surface of the sixteenth- and seventeenth-century boxes. For this purpose, he applied a thin slurry of chalk with glue onto the wood surface. After it hardened, he again applied a thin size and sprinkled finely ground bismuth powder onto it. After it was dry, he polished the now-matte gray area lightly with a thin polishing steel and achieved a beautifully reflective metal-like surface (Wibel 1891:7).

Chemical attempts by Buchner, 1908

In his *Hilfsbuch für Metalltechniker* (1923:259–60), Georg Buchner, a Munich chemist, investigated the technique of bismuth painting. Aware of Wibel's attempts to recreate bismuth paint, he sought an easier way to apply bismuth evenly onto a canvas, and first reported his successful efforts in an article, "Ueber Wismutmalerei" (Buchner 1908:121–22).

He produced the surface in the following manner: To 100 g of bismuth subnitrate,[2] he added 200 g of water and continued to add pure hydrochloric acid to the mixture until he achieved a clear solution, then thinned the solution with approximately 1 l of water. He placed a strip of zinc into this bismuth solution and left it for several days. The zinc caused the solution to turn gray and the bismuth to precipitate out in a fine foam, while the zinc went into solution in place of the bismuth. He then removed the remaining zinc strip, decanted the now-clear solution, rinsed it thoroughly, and let the bismuth settle. After forcing the fine metallic bismuth slurry through a glass filter, he immediately applied the bismuth slurry to a wooden surface that had been primed with a chalk ground. His instructions then continued as follows (Buchner 1910:135):

> After drying, a matte, mouse-gray bismuth layer is obtained; this should now be burnished to high gloss with an agate; again, this is an easy procedure to carry out and produces an almost silver-white bismuth surface that can then be painted in the historical manner.

Only in the third, enlarged edition (1923:259–60) of his *Hilfsbuch für Metalltechniker* does Buchner list his recipe almost word for word.

Lippmann and the history of bismuth

In his 1930 article "Die Geschichte des Wismuts zwischen 1400 und 1800," Edmund Oskar von Lippmann discusses a small bismuth-decorated box from the Germanic Museum, dated approximately 1480, to demonstrate the discovery of bismuth, noting "the importance of this metal discovered during the innovation of the book printing process" (1930:362–63). In a 1933 article, Lippmann offers the "postscript to the history of bismuth" by quoting the Nuremberg Bismuth Guild (Lippmann 1933:4). What is interesting about Lippmann's articles is the fact that, although as a chemist he discusses various aspects of bismuth, he does not talk about the difficulty of producing a bismuth ground. Instead, he merely mentions that the ordinarily brittle bismuth, if scattered as a fine powder onto a black chalk

ground, may be burnished into a brilliantly metallic, reflective surface. He published his essays in a multiple volume book in 1953 (Lippmann 1953:86–91).

Reconstructions by Deggeller, Sutter, and Bohring, 1963

These three authors wrote articles on bismuth and their experiences in reproducing a bismuth ground. Deggeller (1963) abbreviated Buchner's 1910 recipe, and Sutter (1963) cited it almost verbatim and added his own results from attempts to reconstruct the chalk ground. Bohring (1963) modified Buchner's techniques by wetting the zinc strip with hydrochloric acid before placing it into the solution of bismuth, which was produced from bismuth subnitrate, water, and hydrochloric acid. He then ground the bismuth slurry on a glass plate, added rabbit-skin glue, and applied the mixture to a chalk ground consisting of a minimum of four layers. Bohring reconstructed the method "in the modern sense" and expressed regrets that the technique of bismuth painting had fallen into oblivion.

Reconstructions by Wehlte, 1967

In 1967, Kurt Wehlte published his groundbreaking *Werkstoffe und Techniken der Malerei,* in which he cited, almost verbatim, Bohring's 1963 reconstruction experiments. He considers this the most successful of the many attempts to reproduce bismuth painting, but adds that "it is possible to reach the goal by using finely ground bismuth metal in its dry form, then adding water and glue and burnishing upon drying. The larger granules of the bismuth powder, in contrast to the bismuth slurry, result in a totally different visual effect" (Wehlte 1967:745–46).

Wehlte points out in his introduction that in his three decades of artistic and technical work, he had often heard of bismuth paint but had never been able to obtain details from art historians nor had he found much useful information in the technical literature (Wehlte 1967:744). Wehlte placed bismuth painting in a chapter on special techniques and, by highlighting it as he did for techniques of wall painting or panel painting, rejuvenated the technique. The popularity of Wehlte's book, which has appeared in numerous editions, has increased knowledge and awareness among experts of this almost forgotten technique.

Differentiation between dry and wet methods by Herrmann

Christian Herrmann (1977) completed a study in which he followed Buchner's recipe in detail and added Sutter's observations, as well as his own amendments. Notably, Herrmann describes the process of obtaining the bismuth slurry as a *wet process,* and characterizes the reconstruction attempts based on mechanical pulverization of the metallic bismuth as a *dry process.* One of the dry methods is the reconstruction process listed by Bohring, first presented by Wehlte, in which pure bismuth powder is ground with a mortar and pestle to a very fine powder and then shaken through a fine copper sieve. Another reconstruction of a dry process was Sutter's recipe, in which the slurry was applied to a chalk ground consisting of four layers that had been finely polished with sandpaper and, after six hours, was burnished with an agate. Bohring had described this process as a dry method.

Practical translation of recipes by Mayr

Katharina Mayr (1977:72–73, 82–84)[3] reported her study in which she reconstructed bismuth ground based on the articles by Wibel, Deggeller, and Sutter, as well as on both Buchner (although he was not mentioned by name) and Bohring. She presented eight reconstruction experiments starting with Wibel's recipe, which she modified in a second experiment by increasing the concentration of the glue layer and thereby binding more of the bismuth powder to obtain a particularly thick reflecting surface. She repeated this method with more-refined bismuth powder, which was passed through a wire sieve, and the finer grain size resulted in a more even surface. In her fourth experiment, she duplicated Bohring's so-called dry process by utilizing a larger bismuth content, stronger glue, and a glass sieve, but also let the bismuth slurry dry before applying it. In summarizing her experiments, she noted that all the bismuth slurries produced a darker color and less reflective surface than was obtained with a pulverized bismuth.

Schiessl's references to fourteenth- and fifteenth-century recipes

In the 1980s, Ulrich Schiessl described reconstruction attempts by Wibel, Buchner, and finally Bohring, though he does not mention proportions of ingredients (Schiessl 1983). In connection with investigations into the etymology of the word *bismuth,* as well as its material scientific explanations, Schiessl also cited studies of Emil Ploss (1959:317–21) and fourteenth- and fifteenth-century recipes, offered as additional reconstruction possibilities.

Summary

All efforts to reconstruct the bismuth painting technique since 1891 were based on the subjective interpretations of each author, and they did not reflect historical analysis or sources. The initiative for technical examination came from art historians and museologists who had rediscovered the bismuth boxes and their unusual decorative technique.

Considerations of the Bismuth Technique by Historians

In an 1876 article, August von Eye became the first cultural historian to concern himself with bismuth-decorated boxes (von Eye 1876:1–3). He believed that the boxes had been neglected because of

> the inconspicuous shape in which they have been passed on to our time. Imbued from the very beginning with very little artistry and created as usable objects that preferably after much handling were tossed aside, these objects were not able to be cleaned or restored due to their technique of manufacture, and therefore were unable to draw the attention of science or collectors.[4]

It is evident from von Eye's comment, that his evaluation placed the boxes in a lower value range, a placement compounded by the fact that the boxes could not be cleaned or restored because knowledge of their manufacturing technique had been lost.

Art historian Jakob Stockbauer makes a value judgment in the article, "The Wooden Boxes in the Bayerischen Gewerbemuseum" (1887), and in a later three-volume work he asks, in reference to bismuth-decorated boxes, whether "the mineral which today we call bismuth should be brought into connection with this art at all" (Stockbauer 1893:243). In the first guide to the Museum für Kunst und Gewerbe in Hamburg, Justus Brinckmann (1893) discusses bismuth paintings and reports on Wibel's reconstruction attempts.

In 1905, Hans Stegmann, an early art historian, wrote, "A thin layer of bismuth powder was applied onto a thick chalk ground, the usual paintings ground, and then burnished by means of a polishing stone until a metal-like reflective surface appeared." Of its quality, he says that "from beginning to end this painting technique cannot lay claim to an art work," and adds, "It is an easy step from this relatively cheap and simple technique to an even cheaper one." He refers to small boxes with applied colored engravings or woodcuts with similar decorative patterns but not bismuth ground (Stegmann 1905:37).[5]

Ernst Darmstaedter (1927) appears to cite Buchner's essays in addition to Wibel's, listing both procedures in abbreviated form in his article. In 1928, art historian Heinrich Kohlhausen writes of bismuth-decorated boxes that the chalk ground merely has bismuth powder sprinkled onto it and then is burnished with a polishing stone (Deneke and Kahsnitz 1978:1126). Hans Lanz (1969) describes the process slightly more extensively: "The metal was applied in powder form onto a glue-like binder on a chalk ground and then burnished with an agate to an evenly smooth silvery reflecting surface."

Horst Appuhn, art historian, describes this technique (1986:791), writing that "the ground of multicolored tempera paintings consists of bismuth, a metal that, after being ground, is applied with a binder onto the usual chalk ground and then is polished with an agate." Bernward Deneke, a folk historian, noted in 1969 that "the metal was applied onto the chalk ground in a powder and reflected through the varnish layers" (Deneke 1969:141–42) and, like Kohlhausen, did not mention the binder.

Summary

In reviewing published art historical material concerned with the technology of bismuth painting, it is evident that modern research was initiated in 1890 by Brinckmann; this is not surprising considering the number of objects to which he had access or of which he was aware, although many were difficult to identify. Confirmation of a bismuth ground raised questions about technique from chemists and others, and this eventually led to numerous investigations.[6]

With the article from von Eye and the push by Brinckmann for chemical investigations, museologists moved bismuth boxes into the limelight, although bismuth painting was considered artistically insignificant. The authors of the first articles were especially uncertain about bismuth's value as a material, and even Stockbauer presented bismuth painting as a relatively cheap and simple technique. Cultural historians, by contrast, presented the recipes for producing the bismuth ground in very few sentences but in a schematic fashion, wishing perhaps to convey an idea of the difficulty of this process.

Current Research into Bismuth, Based on Historical Sources and Analytical Methods

Preliminary comments

Traditional bismuth boxes offer a rich spectrum of research hypotheses with regard to makers, purchasers, distributors, and centers and periods of manufacture, which in turn allow for evaluation by art historians and acceptance into museum collections. Other considerations are manufacturing techniques, ornamentation, themes of decoration, and, last but not least, composition of the bismuth ground and the colors used in the decoration.

In the study carried out by the author, the assistance of specialists was needed in order to satisfactorily investigate the various aspects of the bismuth ground and paint, and staff in various museums with bismuth box collections provided support. Technical difficulties were encountered first with the identification of the bismuth ground and then with the interpretation of retouchings and overpainting. Scientists assisted with microscopy and ultraviolet microscopic analysis, but due to cost factors, only limited total reflectance X-ray fluorescence analysis (TRFA) could be carried out.[7]

Evaluation of recipes from the fourteenth to the eighteenth century

Among numerous authoritative handwritten manuscripts from the fourteenth and fifteenth centuries are recipes for inks that optically resemble silver ink but that have bismuth as the base. One of these manuscripts indicates how this ink may be applied to wood. These recipes give rise to the following questions:

1. Are there extant historical artifacts that demonstrate the use of these recipes?
2. Is it possible to duplicate these recipes without the factual knowledge of their manufacture?
3. Is modern bismuth different in appearance from historic bismuth?
4. How closely do the recipes of Wibel, Buchner, and Bohring re-create the original manufacturing techniques?

In order to answer these questions, the various recipes must first be examined in detail.

The earliest recipe for the manufacture of "silver ink" is found in a 1384 manuscript (Library of the Germanischen Nationalmuseum 1384):

> If you want to write so that it looks like silver, take a powder that is called bismuth. Pulverize it on a stone with some egg white or with gum arabic, as a pigment, and then mix it with the same gum arabic to an ink consistency that runs well out of the pen nib. Then rub it with a tooth so that it comes out clear and fine just like good silver.[8]

Most recipes state that they can be used "as a good ink," and only a few indicate the possibility of use as a paint medium. In one fifteenth century manuscript (Library of the Germanischen Nationalmuseum 15th c.:sheet 4v), it is stated that

> if bismuth is being applied to wood with a sponge or by other means, then you have to be careful [this is mentioned explicitly] that the mixture does not

> contain too little gum arabic as there exists the danger of quick drying, or conversely it could become either dry or hard if it contains too much gum arabic. [This is followed by two recipes.]

In this case we are certainly looking at a recipe for a bismuth ground that would have been used for one of the traditional boxes. The recipes for the manufacture of the silver inks and for the paint ground are identical. In all the recipes, gum arabic is the binder for the bismuth; only one author (the one just quoted) deviates, offering a recipe that recommends a binder of "defatted cow's or heifer milk combined with a good clean glue" (author's translation).

Recommendations for producing bismuth powder are to "take bismuth and rub it with a little stone" (Library of the Germanischen Nationalmuseum 15th c.:sheet 4v) or to "take bismuth and pulverize it in a dry manner on a stone" (Historisches Museum 15th c.:202) or, "if you want to temper bismuth, grind it with water" (Bayerische Staatsbibliothek 15th c.:207r). Most mixtures rely on the prepared powder, however, and say little about the size of the granules. These short recipes often give directions on how to store or clean the mixtures.

In addition to these recipes from the fourteenth and fifteenth centuries, books from the sixteenth century mention other mixtures containing bismuth. These books could be considered handbooks for artists, craftsmen, and paint experts, and they have a strong connection to alchemy. In most cases, the purpose of the recipes is to increase the value of an artifact. In this context, one may note that *Argentum musicum* is often included in these handbooks. Recipes direct the working of tin, bismuth, and mercury into a writing medium, with gum arabic in water.

Contrary to earlier recipes for bismuth, those of the sixteenth century always add other elements, such as tin, sulfur, or ammonia, as a base for the mixture.

Analyses and interpretation of historic sources by Mack

As part of this study, and as an attempt to reconstruct bismuth painting technique at the Germanic National Museum, microscopy was used to examine and analyze cross-section samples to learn more about the layer buildup. Electron microprobe analysis of samples from two boxes with differing paint techniques—most likely from different workshops—showed that in both cases the bismuth paint was of high purity. Therefore, sixteenth-century recipes could be excluded as a basis for these boxes, since they would have contained tin, mercury, sulfur, or ammonia in addition to the bismuth. Bismuth painters of the sixteenth and seventeenth centuries would not have used printed recipes but rather handwritten notes passed down from the previous centuries. This process is testimony to the long-term effect of recipes, often relayed and learned repeatedly through practical application.

Wibel's 1890 investigative techniques are unknown; however, his results regarding the bismuth content differ very little from current analyses. He talks of almost pure bismuth, in which only traces of lead, and perhaps antimony and arsenic, are present. It may be, however, that the color layer of the box contaminated the sampled bismuth ground. Accordingly, Oliver Mack of the Germanic National Museum carried out a number of tests on bismuth ground, the results of which are reported in

the following. Microchemical analysis of cross sections from painted beech artifacts shows that the ground was made of glue and chalk, although the number of layers could not be determined. To carry out microchemical analysis of the binder, a cross section was stained for proteins with fast green dye; the chalk ground underneath the bismuth ground stained with equal intensity. A similar analysis of a cross section of a reconstruction produced by the Wibel method showed that the protein stains were uneven. This seems to indicate that Wibel's method does *not* recreate the original technique; in addition, it is difficult to achieve a highly polished surface with his technique, as would have been the case with the traditional box. It was also concluded that the chemical techniques of Buchner and Bohring must be excluded because they are too contemporary, as well.

Reconstruction efforts by Mack

A number of the historical recipes assumed that pulverized bismuth would be used; others listed pulverizing by means of a stone. Following these instructions, Mack attempted to grind bismuth with different types of stone, using bismuth that had been purchased as an alloy. He quickly noticed that small (ideal) particles barely separated from the dry stone, and he found it possible to decant dry bismuth into a vessel in which the various particles could be separated in water and would settle according to their weight. After stirring the solution and waiting for the powder to separate from the larger (undesirable) particles, it was possible to decant the smaller particles floating on top. The point at which the smaller particles could be siphoned off varied with the intended use of the mixture (i.e., ink for a pen requires finer bismuth powder than does the flat appliction of paint layers or ground). The bismuth slurry made in this process shows the same qualities as the chemically made bismuth slurry described by Bohring.

The results raise the question of whether the *dry method,* incorporating Wibel's and Bohring's use of a glass plate and binder, should be renamed *mechanical method,* and whether the *wet method,* using as its base a chemical reaction, should be renamed *chemical method*.

Historical recipes indicate that the binder for bismuth powder is almost exclusively gum arabic. After the bismuth slurry has been combined with the gum arabic, the resulting stable, homogeneous slurry can be applied to a chalk ground—onto a large area on paper or as drawn lines—and polished with an agate. The color differences found in the various tests and described in more recent literature are visible only in the unburnished bismuth and are determined by particle size of the bismuth. The smaller the particles, the darker the color value (and the stronger the amount of binder); the stronger the bismuth foam, the darker the color. It is difficult to discuss objective color differences in burnished layers, probably due, among other factors, to the time difference between the grinding of the bismuth and its application onto the surface. What is noticeable, however, is that a small bismuth surface, approximately 3 cm^2, appears more silvery than a larger one.

Buildup of the paint layers

With few exceptions, the bismuth painters used beech as their substrate. The surface was soaked with glue, then coated with two to four layers of chalk ground, followed by the bismuth layer, which was usually coated with a transparent layer. Paint layers applied above these were generally

coated with a second lacquer or varnish. One or both of these coatings—usually only the lower one—may have been stained, although they could also have discolored with age. There is, however, mention of numerous recipes for a gold-colored lacquer in historical sources, such as a 1596 art technique book by Tobias Scheibell that refers to "a varnish layer of silver which appears like gold" or "a gold color on silver, tin and copper."

The paint may have been applied in one or several layers. Two or more layers are often found if, for example, red or green colors were used; on numerous boxes displaying decorative leaf or garland motifs, the white leaves were first painted and a green lacquer was then applied over them. Indeed, the uneven application by brush of the green paint resulted in a range of different color effects. Mayr (1977:72ff.) mentions an extensive color palette determined on the basis of microscopy and analytical methods, but she does not divulge full details.

Due to cost factors associated with TRFA, samples from only one box[9] could be analyzed in the current study. This analysis confirmed the presence of the following pigments: azurite, vermilion, saturn red, lead white, and copper green. The outer sides of this box have a gilded ground for the decorative painting, whereas the inside has a bismuth ground and, in isolated areas, a silver ground. This box is certainly exceptional in that gold and silver metals are found along with bismuth. The outside of another decorative box, which was executed in the typical method of bismuth painting, also has a gilded ground, painted out partially with bismuth along the borders and on the collars (Fig. 3). Others with grounds of multiple metals may be found, and they will need further investigation.

Bismuth paint in a fifteenth-century manuscript

The considerable number of recipes for inks that, according to historical sources, used bismuth to simulate silver, necessitated a search for historical manuscripts that might contain these inks. Mayr's 1977 study of a fifteenth-century Bible[10] indicated that the metal layers in the colored etchings were made of bismuth. Inquiries to experts at numerous state libraries in Munich unearthed no manuscripts with either decorative painting or writings in ink that contained bismuth. Visual and microscopic examination of the Bible yielded opinions that the dark metallic and reflective areas in the paint might be bismuth, or that it might also be silver or an alloy of tin, zinc, or lead. Electron-dispersive X-ray microscopy (EDX) indicated that the samples contained almost 100% bismuth.[11] This analysis proves the use of bismuth paint on paper in the fifteenth or sixteenth century.

Conclusion

As a result of these studies, for the first time, the author and coworkers have been successful in both reconstructing a bismuth surface following historical recipes and, through analysis of fourteenth- and fifteenth-century manuscripts, pinpointing the technique that most closely follows the old manufacturing techniques.

The examination of bismuth decorative objects indicates that the presence of bismuth, as well as gold and silver, or the combination of gold with bismuth, enhances the appearance of the object, and it also has provided insight into the technical know-how of the bismuth artist. The assumption that bismuth was used as a substitute for silver will need to be reevaluated in this new context.

The study has also confirmed, for the first time, the use of almost pure bismuth for decorative painting on paper in the fifteenth or sixteenth century.

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Notes

1 Housed in the Museum für Kunst und Gewerbe (Museum of Arts and Crafts), Hamburg. Inventory no. 1890 413.

2 This is an old nomenclature for $(BiO)NO_3$ and is approximately 70 g of metallic bismuth.

3 See also Mayr 1984.

4 See also Deneke and Kahsnitz (1978:1119).

5 See also Deneke and Kahsnitz (1978:1137).

6 Brinckmann states in the annual report of the Museum für Kunst und Gewerbe:

> The paint ground of bismuth paintings: this work was initiated by the Administration for the Arts and Applied Arts. Its purpose was to establish the nature of the ground of the so-called "Bismuth paintings." During this investigation, the body of questions grew substantially so that the end result was an extensive publication which seemed very desirable and which therefore appeared in print in the *Jahrbuch der Wissenschaftlichen Anstalten.*

7 This was facilitated by Alexandra Bersch, restorer of paintings and sculptures at the Museum für Kunsthandwerk in Frankfurt.

8 Author's translation is from Old German.

9 In the collection of the Museum für Kunsthandwerk, Frankfurt. Dated 1552 or 1557. Inventory no. 6784.

10 In the collection of the Tiroler Landesmuseum, Innsbruck. Inventory no. F.B. 129.

11 The author took part in this examination, along with restorers Gerdi Maierbacher-Legl (Munich) and Michael Klingler (Innsbruck). Scientific analysis was carried out by Karl Nigge, technician at the Department of Material Science and Technology of Metals at the University of Erlangen/Nuremberg, using a Raster electron microscope equipped with an EDX spectrometer.

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Japanning in Seventeenth- and Eighteenth-Century Europe

A Brief Discussion of Some Materials and Methods

Margaret J. Ballardie

Figure 1
Detail of alligatoring as the result of copal varnish applied to the eighteenth-century shellac varnish surface of a japanned panel.

In art conservation, it is essential to have a thorough knowledge of the original materials and techniques used to decorate the surfaces of the objects that come into the conservator's care; if these materials are not known and a varnish is used in the conservation treatment that is incompatible with the existing varnishes, disastrous results can occur. See Figure 1 for an example of the type of surface that can result from such incompatiblity. For this reason, among others, it is important to understand and to recognize the different techniques used in lacquerwork and japanning.

When one considers the surface finishes that are described under the heading "Japanning," the situation is very confusing. For example, an eighteenth-century box decorated with chinoiserie and coated with a spirit varnish would be described as japanned. A Victorian box with a black oil-based ground and mother-of-pearl decoration would also be described as japanned, as would a tinware box whose black painted surface had been heated in an oven (i.e., *stoved*). To understand what these surfaces have in common, it is necessary to look at the history of the word *japanning.*

The word came into use during the seventeenth century, when lacquerware from China and Japan rose to the height of fashion—black and gold lacquer from Japan becoming the most admired and sought-after. Since that time, the words *lacquer* and *japan* have been used generally and indiscriminately to describe varnishes and paints that produce a glossy surface. In short, japanning is the Western re-creation of Far Eastern lacquerware.

By the end of the seventeenth century, European craftsmen were aware of the techniques and materials used in Far Eastern lacquerware. The following quote from Dossie's *Handmaid to the Arts* (1796:282) makes it clear that *urushi,* the toxic raw material for the lacquer resin, had been brought to Europe but was rejected for safer and more familiar resins.

> The true japan black Lacquer (which is now frequently brought from China) has been sometimes used for the varnishing of snuff boxes, cups, and all such pieces made of paper or saw-dust. But this lacquer, being the concreted juice of the toxicondendron tree, its poisonous qualities are almost constantly fatal to those who work with it for any length of time and sometimes even on very slight contact with it. Such a momentous inconvenience, together with the tediousness of dispatching the work, on account of its great tardiness in drying, being extremely good reasons against its use, it is much more

> advisable to employ the common kind of varnish, which when managed judiciously, may be rendered nearly both as beautiful and durable, without either the danger or the difficulty attending the other.

Dossie incorrectly reports that urushi comes from *Rhus toxicodendron,* a sumac tree, and is fatal; in fact, it is extracted from another sumac, *Rhus verniciflua,* which can induce a serious rash that may require hospital treatment. However, his rejection of urushi for its difficult drying requirements correctly pinpoints why it was not widely adopted. Indeed, craftsmen of the period experimented with familiar materials, such as resins, as well as the more recently imported shellacs from India, in attempts to duplicate the look of oriental lacquerware. Eventually they discovered that by building up layers of clear varnish over a colored ground—or incorporating designs such as Chinese figures, fanciful animals, and flower forms within the layers of varnish (using gold or other metal powders)—they could create surfaces similar in appearance to those of genuine oriental lacquer panels.

In many European countries, publications appeared that described the techniques, materials, and designs used to re-create the fashionable Chinese-influenced decorations of what came to be known as chinoiserie; of these, *A Treatise of Japaning and Varnishing* by John Stalker and George Parker (1688) is probably the best known. Because it was written for amateurs, the instructions are concise, though often buried in flowery asides, as the following example illustrates (Stalker and Parker 1971:16):

> Lay all your Colours and Blacks exquisitely even and smooth; and where ever mole-hills and knobs, asperities and roughness in colours or varnish offer to appear, with your Rush sweep them off, and tell them their room is more acceptable to you than their company. If this ill usage will not terrifie them, or make them avoid your work, give them no better entertainment than you did before, but maintain your former severity, and with your Rush whip them off, as often as they molest you.

White Japan

Stalker and Parker also include a recipe for "White Varnishing or Japan" (1971:21–23), variations of which appear in other literature. The varnish used for white japan is a mixture of resins they called "Best White Varnish." If the recipe is reproduced carefully according to the instructions, the result is very attractive, with the translucent look of ivory. Throughout the process, the secret of success is to allow plenty of drying time between layers and to keep the layers very smooth.

Note that the format of the following recipes[1] and directions (Stalker and Parker 1971:10–11) has been reorganized for clarity.

White Varnishing or Japan

Ingredients

1 oz. [31.1 g] isinglass dissolved in 30 oz. [852.36 ml] water, to produce isinglass size
Flake white (lead white)
Potato starch, cooked in water to thin paste (1 oz. [31.1 g] starch to l pt. [568.26 ml] water)[2]
Best White Varnish (see recipe below)

Application

- Gesso ground: Mix 20 oz. [568.26 ml] isinglass size with whiting to the consistency of light cream. Apply three coats. When dry, rub back the surface until very smooth.
- Flake white layer: Mix remaining 10 oz. [284.12 ml] isinglass size with flake white. Apply at least three coats. When dry, smooth the surface gently.
- Starch layer: Apply two coats.
- Best White Varnish layers: Apply up to twelve coats.[3]

Best White Varnish

Ingredients

Stalker and Parker	Adaptation by the author
1 lb. Gum Sandrick	1 lb. (454 g) sandarac
1 oz. Gum Mastic	1 oz. (28.5 g) mastic
3 oz. Venice Turpentine	3 oz. (87 ml) Venice turpentine
1½ oz. Gum-Capal	1½ oz. (42.5 g) copal
½ oz. Gum-Elemni	½ oz. (14 g) elemi
½ oz. Gum-Benzion or Benjamin	½ oz. (14 g) benzoin
1½ oz. Gum Animae	1 oz. (28.5 g) copal (substituted)
½ oz. White Rosine	½ oz. (14 g) rosin

Preparation

In separate glass containers, dissolve the following groups of resins in the volumes of alcohol indicated:

copal and resin	10 fl. oz. (290 ml) alcohol
benzoin and Venice turpentine	10 fl. oz. (290 ml) alcohol
sandarac and mastic	30 fl. oz. (870 ml) alcohol
elemi	5 fl. oz. (145 ml) alcohol

After the resins have dissolved completely (about twelve hours), filter the solution and mix carefully together.

Note

[a] The author found that six layers proved sufficient.

[b] The original solvent was "spirits of wine."

Two further versions of the white japan recipe may be found in the eighteenth-century literature. Although one—in the *Polygraphic Dictionary* (1735), under the heading "Japan"—is almost identical to that of Stalker and Parker, the second—in Dossie's *Handmaid to the Arts* (1796:314)—shows significant differences. Dossie maintains that the gessoed ground should not be applied because it causes the japanned ground to "crack and fly off in flakes." Applied in its place is a layer of "clear-coat" or a "clear-col," which is a hot size with the addition of a small amount of whiting. When dry, it is rubbed smooth and, although it fills only the pores of the wood, can produce an excellent surface. Following Dossie's directions, the flake white and the starch mentioned in the white japan recipe are mixed together while dry and bound with mastic varnish. Then, what is now virtually a paint is applied in thin layers; once these are absolutely dry, the surface is gently rubbed smooth.

It is important to note that the Best White Varnish was, in fact, not white or colorless; the resulting layers tended to be pale ochre or umber, and they darkened over time. These white japan surfaces were often decorated with designs inspired by Chinese porcelain and were

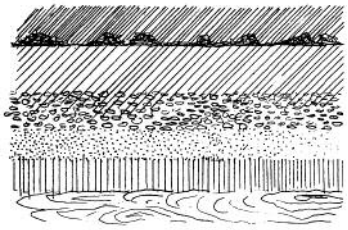

Figure 2
Schematic diagram of white japan layers. Note the watercolor decoration layer (pigments with gum arabic) between the Best White Varnish layer and the top varnish layer.

painted with pigments bound in gum arabic. The surface then would be finished in layers of pale shellac rubbed smooth, and polished with a mixture of oil and rottenstone (Fig. 2).

Blue Japan

Another noteworthy recipe from this period is for blue japan. Various blues are mentioned, including Prussian blue and blue verditer, but one of the most interesting involves the use of smalt (i.e., cobalt-blue glass that has been pulverized). Smalt was produced principally in Holland, although some was also manufactured in London.

Stalker and Parker's recipe for blue japan (1971:23–24) is much like that for white japan, except that blue pigment is mixed with the lead white, and a layer of smalt replaces the starch. Blue japanned surfaces consist of a layer of blue japan, followed by layers of white varnish.

Blue Japan

Ingredients

- Gum-water: Mix 1 oz. [31.1 g] whitest gum arabic with ¾ pt. (15 fl. oz. [426.18 ml]) water. When the gum has dissolved, strain it through muslin.
- Flake white: Grind lead white with the gum-water.
- Smalt is mixed with isinglass size.

Application

Mix the lead white and smalt together (the proportions depend on the depth of blue required) to the consistency of common paint. Apply the mixture to the surface. Wait until the paint layer is perfectly dry, then apply another layer. Repeat three or four times. If a darker blue is required, apply more layers using only smalt and isinglass size. Put aside for two days, then apply seven or eight layers of white varnish. Allow at least a week for drying before polishing the surface (Fig. 3).

As with white japan, recipes for blue japan changed over time. For example, isinglass was used as the binding media for the pigments in Stalker and Parker's 1688 formulation, but by the end of the eighteenth century gum elemi and poppy oil, heated together, were used as a binder, making the preparation closer to that of commercial paint.

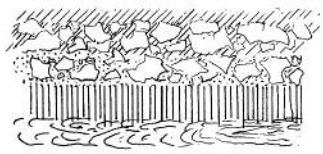

Figure 3
Schematic diagram of blue japan layers, using smalt. Mastic varnish would cause less discoloration, but it is not as durable.

Blue japan may have been covered with a colored varnish, rather than the white varnish in the preceding recipe, to create special color effects. To cite one striking example, the author has seen a long-case clock entirely decorated with smalt that was varnished over with a transparent golden varnish, producing a beautiful translucent green (Fig. 4). Assuming that the gold is the original color of the varnish, not a product of aging, it is important to note that pigment and varnish colors were used in separate layers to produce the desired effect. This is very often the case with japanning techniques, and this possibility must be checked before any varnish is removed during conservation treatment.

Raising Techniques

An essential element of japanned work decorated with chinoiserie is the raising of portions of the decoration so that figures, mountains, buildings, and so on appear in relief. Raised decoration was often gilded with either gold leaf or gold paint.

A number of different recipes for raising techniques have been published, providing a range of different approaches. Stalker and Parker, for example, use gum arabic as the binding medium in their recipe (1971:33), advising that whiting and red bole be ground together with "strong Gum-Arabick-water" until the mixture is "as fine as butter." The resulting paste may be built up slowly in layers to achieve a desired shape, or it may be cut, scraped, and carved. The instructions offer numerous warnings about the care that must be taken with this technique, and the chapter ends with this claim: "With these ingredients, joined to Art and Skill, it is possible to make a paste so hard, so stubborn, that a violent stroak with a hammer can neither break or discompose it" (1971:35).

One later recipe includes whiting and pigment bound in seed lac. Recipes in most modern publications call for gesso, and they usually stipulate that the underlying japanned surface be scored through to the supporting ground.

Sprinkling

Among the many other decorative techniques used in japanning is *sprinkling,* in which metal powders of varying particle size were sprinkled onto the varnish while it was still wet, then sealed with another coat of varnish. Fragments of gold leaf might similarly be applied to the surface and

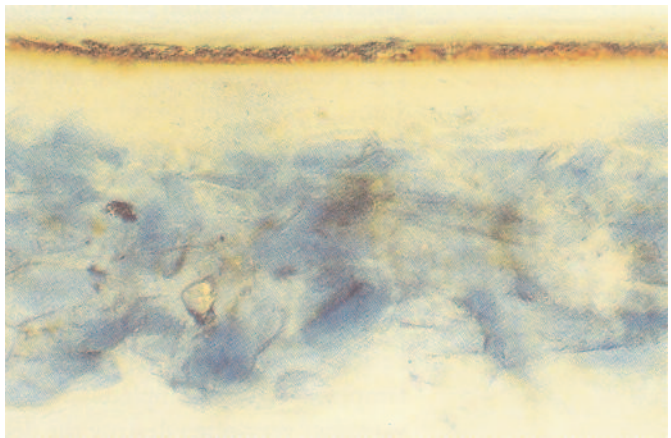

Figure 4
Cross section of a sample taken from a long-case clock (ca. 1730, Canterbury). Smalt is shown in the center, supported by the varnish layer. A section of the gold decoration can be seen in the thin layer at the top.

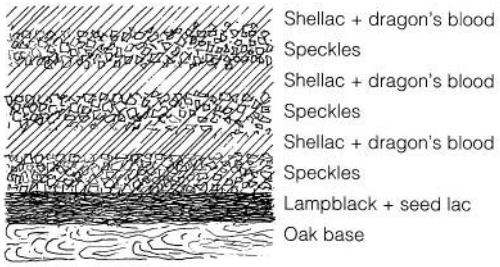

Figure 5
Schematic diagram of aventurine layers. The visual effect is created by holding the speckles between layers of shellac or other varnish.

suspended between layers of varnish. In *A Treatise of Japaning and Varnishing,* this technique is called "Speckles" or "Strewing" (Stalker and Parker 1971:31–32). Strewing refers to the application of gold leaf. When used to create borders of dense speckles, the technique is also known as *aventurine*.

Sprinkling was developed to create a traditional lacquerwork technique, and it involves two categories of metal: (1) *powders*—brass dust, silver dust, green gold, powdered tin, and copper dust; and (2) *speckles*—flaked metal leaf, gold, silver, and copper. There is an endless variety of application techniques for metal leaf and powders. Moreover, the metals behave differently in various mediums (e.g., gum-water, varnishes, and shellacs).

The sprinkles were applied in a variety of ways that range from a single, light sprinkling to a thick layer over a previous layer of bronze powder. Furthermore, three or four layers of speckles may be separated by layers of shellac that had been colored with gamboge or dragon's blood. Indeed, in many early recipes, thirty to forty layers could be applied, including the basic gesso ground, the foundation coats of japan, raised decoration, gilding and watercolors, and the many finishing coats of varnish or shellac. Between all these coats, the surfaces have been smoothed and polished (Fig. 5).

Some Modern Developments

During the nineteenth century, japanning recipes altered dramatically. Oil varnishes and asphaltum began to be used, reflecting the shift to industrial processes in response to increased use of japanned ware during the Victorian period. Commercial paints with descriptive names such as Lacquer, Japlac, or Japan were produced.

Further changes occurred during the 1920s, when chinoiserie achieved renewed vogue in furniture, clothes, and interiors. In Paris, lacquer artisans produced some beautiful pieces utilizing genuine urushi; but generally, commercial paint with a high varnish content was used. In the newspapers, advertisements appeared with headlines such as "Let us Japan your bedroom suite" or "Do not buy new! We can Japan your furniture." Sometimes antique pieces received this colorful treatment, and it is possible nowadays to find an eighteenth-century object with a twentieth-century painted surface that, after seventy years of wear, can become visually confusing.

Conclusion

Conservation of complex examples of all types of japanned surfaces must be approached with the greatest care, as many of these surfaces have been tampered with or completely renewed, and solvents used to remove the varnishes very often destroy the decoration held within those varnishes.

For example, shellac varnishes are often very difficult to treat with solvents, as they readily absorb the solvent, and the result may be that suddenly the entire layer dissolves. Another important consideration is that the seventeenth- and eighteenth-century varnishes were not clear and colorless; although desired, such varnishes were then unobtainable.

Very few articles have been written on conservation of japanned objects. Activities of the ICOM Interim Lacquer Group[3] address Far Eastern lacquer, as well as Western lacquering techniques (i.e., japanning); however, those of us in the group are a small minority in the vast conservation field.

Notes

1 Measurements are given in British imperial units and converted to metric.

2 The author was advised that potato starch was the starch most likely used in seventeenth-century Europe.

3 The Interim Lacquer Group is part of the Furniture and Lacquer Working Group of the ICOM Committee for Conservation.

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Painted Harpsichords

Laurence Libin

In their role as status symbols, musical instruments are prized for their looks as well as their sounds; and of all instruments, keyboard types expose the largest surface for display. For example, pipe organs with monumental architectural facades appeal as much to the eye as to the ear in expressing institutional pride. On a smaller scale, stringed keyboard instruments, such as the harpsichord, clavichord, and piano, have important functions as furniture glorifying their owners' taste through luxurious decoration inside and out (Fig. 1). Such ornamentation reached a peak of elaboration during the late Renaissance and Baroque period, when costly harpsichords, spinets, and virginals were custom painted in distinctive, often meaningful schemes. After 1557 in Antwerp—a leading center of production—the Guild of Saint Luke embraced both harpsichord makers and painters, who were sometimes related by marriage and collaborated side by side in fulfilling commissions (O'Brien 1990:12–14). Owing to a different guild structure, eighteenth-century Parisian harpsichord builders and their customers could rely on independent decorators, such as a particular M. Doublet, who advertised between 1775 and 1783 that "he is known by the particular care which he takes in order that the instruments which one confides to him do not run the dangers to which they are too often

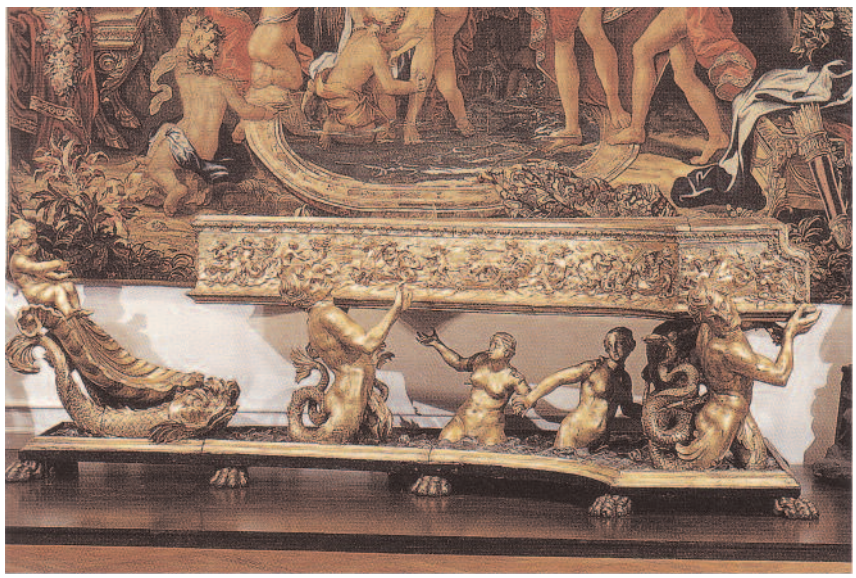

Figure 1
Michele Todini, harpsichord (outer case), ca. 1670, Rome. Length of raised portion, 272 cm. The Metropolitan Museum of Art, Crosby Brown Collection of Musical Instruments, 1889 (89.4.2929).

exposed in other ateliers" (Germann 1980:437).[1] Though often done anonymously, harpsichord painting attracted artists even of the stature of Rubens and Jan Breughel. The tradition continues today in the work of painters who decorate replicas of antique harpsichords by contemporary makers.

In comparison, the standard black concert piano of the past hundred years looks austere; its plain exterior is less costly and distracting than fancy painting would be. Furthermore, the modern piano's internal iron frame renders the surrounding wooden case acoustically inert, whereas the harpsichord's essentially all-wood construction allows the case to vibrate somewhat, contributing to the overall tone quality. Characteristically thin-walled Italian harpsichords, built nearly as lightly as guitars, are usually housed in a separate protective outer case that can bear an extraordinary burden of gesso, gilding, and paint; the lidless, usually plain cypress instrument can be removed from its outer case and placed on a table to enhance its resonance. Only exceptionally are thin-walled Italian instruments (unlike those with an integral, false "outer" case) loaded with any external decor other than elegant moldings and, occasionally, intarsia and ivory buttons.

The Northern European harpsichord, by contrast, is more heavily constructed and so does not have a separate outer case; thus the instrument itself ordinarily is painted. For this discussion, Flemish and French harpsichords represent the decorative mainstreams.[2] These instruments typically display three distinct zones of painting: the case walls (including a separate flap enclosing the keyboard end) and lid exterior; the lid undersurface; and the soundboard (Fig. 2). The exterior usually sports a conventional decor like that seen on contemporary or somewhat earlier furniture, ranging from plain or gold-banded monochrome to marbling, or even fantastic chinoiserie. Complementary designs often appear inside around the keyboard and soundboard areas, as well as on the removable rail that prevents the jacks from rising too high. In order not to weaken the case (which can be constructed of hardwoods and softwoods of various species), any elaborate carving is confined to the stand.

The underside of the lid, revealed when the lid is raised for a performance, can be spectacular. One scene might occupy the entire surface; or the front section, if separately hinged, might have a separate picture facing the player when this section is folded back. Many Flemish lids incorporate a sententious Latin motto on exotic greenish wood grain–printed paper (Mactaggart and Mactaggart 1985). French examples commonly

Figure 2
Hans Ruckers, octave spinet, 1581, Antwerp. W:80.2 cm. Plan view, most strings and jack rail removed. The Metropolitan Museum of Art, Gift of B. H. Homan, 1929 (29.20).

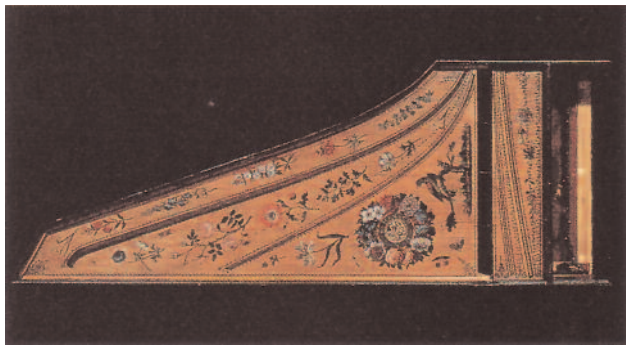

Figure 3
Henry Hemsch, harpsichord, 1736?, Paris. L:238 cm. Plan view with strings, mechanism, and keyboards removed. The soundboard decoration is essentially original. Museum of Fine Arts, The Edward F. Searles Musical Instrument Collection, 1981 (81.747).

exhibit an evocative landscape, *fête galante,* or even a theatrical scene, sometimes done in oil on canvas that is applied to the wood (Libin 1983).

Because of its protected position, the lid interior escapes much of the dirt and wear that endanger the exterior, though the portion nearest the keyboard may be smoked from candles that flanked the music desk or scratched by the lid prop stick. Frequent opening of the lid by dirty hands also may have deposited localized grime. Because eighteenth-century builders often enlarged and redecorated older instruments, lids should be examined for signs of piecing out, especially along the curved side. Complete overpainting sometimes obscures an earlier motto, which may be visible in raking light or through X rays. Stands, too, are sometimes reworked or replaced in conformity with later styles. Vestiges of original decoration, including printed paper in Flemish instruments, can be hidden behind the keyboard end blocks, under jack-rail brackets, and elsewhere. This evidence must be documented and preserved.

The most problematic area for conservators is the soundboard, the instrument's chief acoustical radiator, which—unlike the case and lid—must be painted before the wire strings are installed (Fig. 3). Treatment of this crucial vibrating surface requires an understanding of its complex structure and function. Especially if an antique instrument is to be rendered playable (a very controversial operation), conservation of the soundboard painting should involve the assistance of an experienced harpsichord restorer who can deal with loose components, open cracks, and the unstringing and restringing of the instrument. The following overview of the soundboard is necessarily superficial but is meant to alert conservators to common pitfalls.

A French- or Flemish-style harpsichord soundboard (Fig. 4) typically comprises half a dozen or more separate edge-joined boards, each up to about 15–20 cm wide, of medium- to fine-grained, quartersawn spruce or fir. While still in the rough, individual boards are selected for desirable tonal properties by tapping; resonant ones are preferred. Some old sources recommend wood split from the north-facing side of a trunk, excluding heartwood as too stiff and coarse (Hubbard 1965:201–4, 273–76). Ideally, the grain should be clear and uniform, but considerable variation occurs with no discernible effect on tone. Once glued up, the soundboard is planed and scraped (not sanded) to a graduated thickness of about 2–4 mm, thinnest where maximum flexibility is required—as in the treble and corners—and thicker where structural or acoustical needs dictate greater stiffness—as in the bass. This subtle but tonally vital topography is difficult

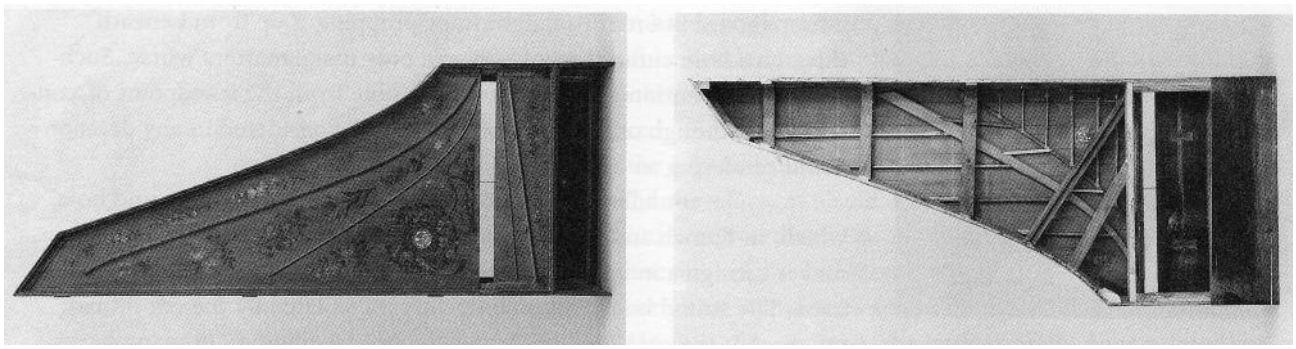

Figure 4
Louis Bellot, harpsichord, 1742, Paris. L:238.7 cm. Plan view with strings, tuning pins, keyboard, mechanism and bottom removed. The Metropolitan Museum of Art, Crosby Brown Collection of Musical Instruments, 1889 (89.4.1218).

Figure 5
Louis Bellot, harpsichord, as in Fig. 4. Bottom view showing soundboard ribbing, transverse cut-off bar, four-foot hitch-pin rail, and traces of previous alterations.

to discern once the soundboard is installed, since the enclosed bottom of the case blocks access for measurement. Removing an intact bottom should be avoided.

Various structures are applied to the soundboard before its installation, commonly in dry winter weather. These include the thin, curved hardwood bridge, which bears the strings and conducts their vibration to the soundboard; and the ribs and transverse cut-off bar, which reinforce the soundboard from beneath and help define its vibrating modes (Fig. 5) (Kottick 1985). The shape, mass, and placement of these elements critically affect the soundboard's elasticity and nodal lines, and hence the instrument's tone. The ribs, which transect the soundboard's grain, must be strong enough to inhibit its tendency to warp and crack yet light and flexible enough not to damp vibration. The heavier, more rigid transverse cut-off bar prevents excessive deformation of the soundboard forward of the bridge and, in so doing, isolates a triangular portion of the soundboard surrounding the sound hole.

To provide tonal and dynamic variety, most harpsichords have two or three sets of strings, commonly including one set roughly half the length of the other(s) and pitched an octave higher. These higher, so-called four-foot strings pass over a separate bridge and hitch onto pins embedded through the soundboard into a stiff rail attached beneath. The four-foot hitch-pin rail acts like the cut-off bar to further define the vibrating area around the bridges. The longer, so-called eight-foot strings hitch to pins in an elevated rail that edges the soundboard along the curved side and angled tail; this hitch-pin rail and corresponding molding along the straight side or spine help secure the soundboard to liners beneath. The front edge of the soundboard fastens to the belly rail, of which the inside top edge may be partly cut away in the extreme treble to afford more vibrating area.

Obviously, correct stringing and string tension are fundamental to tone quality and duration, but these factors leave the maker's control once an instrument is sold. A common defect in harpsichords that have been too heavily strung or pitched too high is wavy distortion of the soundboard caused by its sinking under the bridges and pulling up over the four-foot hitch-pin rail; this action simultaneously exerts excessive compression and tension on different areas of the soundboard. In extreme cases, such distortion causes the four-foot strings to buzz against the soundboard. This defect will not ordinarily correct itself, even if an instrument is properly restrung or even unstrung altogether. Bad as this seems, trying to remove

Figure 6
Henry Hemsch, harpsichord, as in Fig. 3. Detail of maker's insignia in sound hole and surrounding decoration, before restoration.

a soundboard in order to flatten it, or propping it up from beneath through a hole cut in the bottom, can only make matters worse. Such drastic intervention is generally indefensible from the standpoint of conservation, though other factors must also be considered in any decision about rendering an antique instrument playable.

The soundboard's last salient feature is its circular sound hole, which, in French and Flemish harpsichords, typically incorporates the maker's insignia in a cast lead rose (Fig. 6); rarely is any other material used. The sound hole's location in the area isolated by the cut-off bar means that the rose's weight is tonally inconsequential. In many harpsichords, the sound hole is decorative rather than acoustically essential because openings in the belly rail allow equalization of air pressure inside and outside the soundbox. Indeed, in two 1778 spinets by Pascal Taskin (one at Yale University, the other in a New York private collection), the presence of a sound hole is merely suggested by a painted circular ornament incorporating Taskin's monogram.

Holes made by positioning-pins sometimes pierce the soundboard under or alongside the bridges. Finely scribed layout lines may also have aided bridge positioning. Other faint guidelines are sometimes found, especially encircling the sound hole and along borders, scribed to assist the painter. As mentioned earlier, old harpsichords were sometimes enlarged and remodeled; therefore, redundant scribe lines and plugged holes may reveal former bridge and hitch-pin positions. These features should be documented whenever found.

Despite their ribbing and barring, soundboards ordinarily do crack along the grain as a result of environmental changes. Unlike loose bridges and ribs, small cracks are seldom fatal to the sound, but they readily enlarge if not repaired. Larger cracks are often shimmed, but shims can cause further cracking and compression in the neighboring wood. Shimming and other repairs may also require inpainting and overpainting that can obscure the original decoration, as well as alter the character of the original wood surface by exaggerating earlywood and latewood corrugations (Mactaggart and Mactaggart 1977). Very often during enlargement or repair work, ribs will have been moved or replaced and cracks reinforced from beneath through holes cut in the bottom or with the bottom removed. Such procedures represented common practice until quite recently. An opened bottom at least affords opportunities for inspection and measurement, which is necessary for accurate replication of an instrument.

The strings are secured to the tuning pins, which are embedded in a thick hardwood plank. The strings pass over this so-called wrest plank, and then over a stationary bridge, called the *nut*. The wrest plank may be veneered on its top surface with soundboard stock, so that although not resonant, it appears to be an extension of the soundboard and may be painted to match. Scribe lines, redundant holes, and other revealing marks may also be encountered here. Occasionally, string-gauge markings are inked on the nut or, more rarely, on the soundboard bridge, showing where wire diameters and materials changed. Antique harpsichords rarely retain original or even very old strings, but, because gauge patterns may survive string replacement, whatever wire is present should be measured (and kept in order, if removed); and any extraneous fragments, such as broken loops, should be labeled and preserved. If tuning pins must be removed—for example, to clean stains from the wrest plank—these, too, should be kept in order, as their diameters may be graduated. Hand-forged

tuning pins often have rough surfaces, and their flattened tops may be unexpectedly soft or brittle; they must be extracted cautiously with a snugly fitting socket wrench called a *tuning hammer,* which may have to be specially fabricated.

Unlike the exposed surface of a violin, a soundboard is not meant to be handled, and therefore, as a rule, protective varnish does not appear as an original feature of Northern European (excluding English) instruments. Although several eighteenth-century sources describe soundboard varnish, even stating that it improves sound, this idea may be fanciful (Hubbard 1965:216, 219–20). At most, the builder might have primed the upper surface with a light coat of (preferably dewaxed) shellac, gum arabic, gum senegal, or dilute glue before delivering the unstrung instrument to the soundboard painter, who might prefer to size just the areas to be painted in order to keep the colors from bleeding. Due to differential darkening over time, any spot sizing not covered by paint, or old spot varnishing over the design, might now show up as an unintended halo around the decoration. Varnish over an entire soundboard painting is probably a later addition. Varnished bridges are particularly suspect; the coating can grab the strings, making tuning difficult, and can prevent firm string bearing against the bridge and pins. However, the acoustical effects of soundboard varnishing have not received scientific study, and the inherent risks of removal might outweigh potential benefits.

In the traditions under review, soundboard paintings usually involve two kinds of design elements: (1) multicolored flowers, leaves, fruits, and small fauna—such as birds and bugs—painted in flat gouache in a water-soluble binder, such as gum arabic (not in egg tempera, as is often stated [Mactaggart and Mactaggart 1979:60]); and (2) curvilinear blue borders and arabesques, typically somewhat three-dimensional and containing smalt. Borders and arabesques were likely executed first, then an opulent floral ring around the rose, followed by the rest of the design, which might have been laid out first in chalk, with care taken in placement to cover blemishes in the wood. If, as Sheridan Germann suggests, the painter used mussel shells as containers for small quantities of paint, it would have been hard to keep the unused paint wet for long, hence the painter would probably try to use as much of one color as possible at one time with little blending: all the blue first (for borders and arabesques), then all the red, yellow, and so on. In contrast to lid paintings, the soundboard palette was limited and work went quickly (Germann 1980:445, 447).[3]

Individual soundboard painters can often be characterized by their design vocabularies and techniques, as these tend to remain consistent among soundboards from the same painter, who may have worked for several builders over decades. Printed herbals and similar pattern books provided models for certain forms, some of which seem to have been symbolic. Conventional images of resurrection—for example, a moth or a dead trunk sprouting new leaves—are not uncommon, though their significance might be lost on most viewers (Fig. 7). Placement of cherries next to a cherrywood bridge, or of an insect near a woodworm hole, suggests a visual pun. In general, seventeenth-century soundboard paintings look opaque, as though their crowded, rather stiff, self-contained, and flatly rendered flowers were applied as découpage; occasional white underpainting reinforces this effect (Germann 1980:453). Except when imitating this style, as on an enlarged or faked Flemish soundboard, later French soundboard painting typically looks more energetic, integrated,

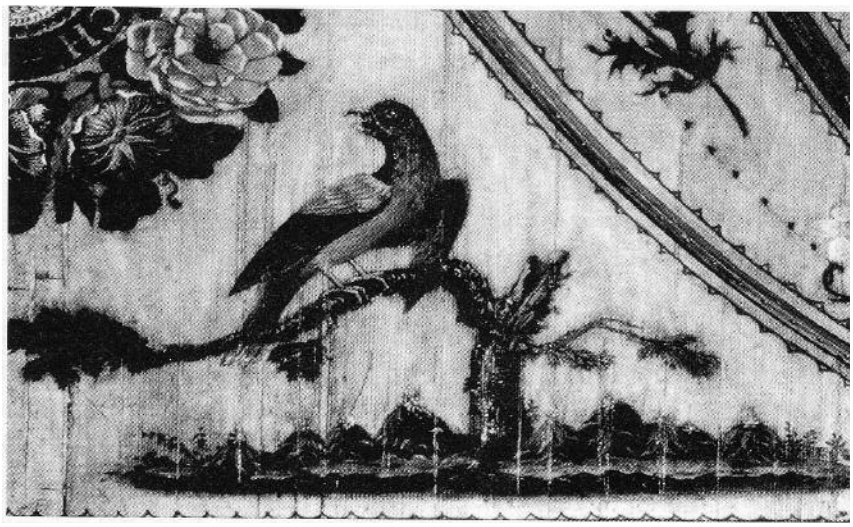

Figure 7
Henry Hemsch, harpsichord, as in Fig. 3. Detail of soundboard painting adjoining bridges and four-foot hitch pins, before restoration.

and transparent—sometimes to the extent of revealing the underlying wood (Germann 1994).

Because of its delicacy and tendency to bleed, such water-based paint preferably might be cleaned by dry methods without much rubbing. Liquids can raise the early growth grain of wood, which has been compressed by scraping, and thus alter the character of the original surface. Solvents can have unanticipated effects on resins in the wood, and the possible acoustical effects of solvent penetration in soundboards have not been studied.

In the past, restorers often overpainted worn areas of decoration and altered the size and location of painted elements to cover soundboard repairs; for example, a leaf or the feathers of a bird might have been elongated to cover a shim. Shims and patches reflect light differently from their surroundings if the grain of the wood is not properly oriented, and sanded wood accepts paint differently from scraped wood. To hide such discrepancies, inexpert soundboard repairs often involve wholesale staining and varnishing, which, like bad overpainting, can be reduced or removed if technically feasible and aesthetically necessary. Any such intervention must be considered in relation to conservation of the whole instrument—whether returning it to its presumed original state or to a later state, to which some past alterations might be integral. The intervention must also be considered in light of the instrument's significance and intended function.[4]

Acknowledgments

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Notes

1 See also Germann 1981.

2 For a historical outline of various schools of harpsichord making and for further explanation of technical terms, see Hubbard 1965.

3 See also Germann and Odell 1978.

4 A fuller discussion of the conservation issues raised in this article can be found in Barclay 1993.

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Floral Painting on Early Eighteenth-Century American Furniture at The Metropolitan Museum of Art

Frances Gruber Safford

The Metropolitan Museum of Art in New York has in its collection of American furniture a particularly strong representation of case pieces from the early decades of the eighteenth century that are ornamented with decorative painting—a total of fifteen examples from New York and New England. In conjunction with research for a collection catalogue of early Colonial furniture, these objects became the focus of a special project to investigate the technical aspects of the painting, an area largely unexplored in the study of such furniture. The author felt that a knowledge of the materials and methods used in the decoration was essential for a better understanding of these pieces. One aim was to determine as closely as possible the original appearance of the painted surfaces, which we see today in a more or less deteriorated and altered state. Another aim was to learn to what extent ornamentation belonging to various distinct stylistic groups differed in the paint and techniques used.

Furniture decorated solely or primarily with ornamental painting, which in most instances featured floral designs, first appeared in America around the turn of the eighteenth century. At that time, pieces with carved or applied decoration in the Mannerist style were being outmoded by furniture in the newer, early Baroque fashion. On seventeenth-century Mannerist furniture, paint formed only part of the decorative scheme; it was applied selectively to distinguish particular elements of the carved or applied ornament. Thus, furniture with floral painting was novel, and it appears to have had great appeal as a colorful, cheaper alternative to high style, early Baroque japanned or veneered pieces.

A Chest of Drawers from the Boston Area

The most elaborate decorative scheme of any piece studied is on a chest of four drawers from the Boston area; this piece combines graining with floral ornamentation that is contained within simulated panels on the drawers (Fig. 1). With its drawer fronts divided by and built up with deep mitered and beveled moldings, this joined chest of drawers is a late example of the Mannerist applied-ornament style as it evolved in and around Boston, after being introduced by London-trained joiners in the 1630s. The late expression of that style is indicated by the incorporation of certain newer design elements, such as the surrounding of the drawer openings with an applied astragal molding—a feature that reflects the influence of early Baroque case furniture, which was first produced in Boston in the late

Figure 1
Chest of drawers, 1700–1720. H:102 cm. Massachusetts, Boston area. The proper right side is partially cleaned. The Metropolitan Museum of Art, Gift of Mrs. J. Insley Blair, 1948 (48.158.11).

1690s. It is the most elaborate example from a group of more than twenty chests of a similar format.[1]

Design

The painted ornamentation appears to have been influenced by early Baroque furniture, with the exception of the undulating vine motif on the shallow drawers, which has a long tradition of usage in the seventeenth century and earlier. A striking feature of this newer style is its expanses of highly figured veneers. The bright graining on the drawer fronts suggests such veneers, although it may be drawing upon an earlier tradition of simulating in paint the exotic woods that were favored on Mannerist furniture at the highest level of production. Dark semicircles painted on the side panels recall the round or oval figure of so-called oyster shell veneer, unknown on American furniture but found on English pieces of the last three decades of the seventeenth century. (Probate inventories indicate that by the mid-1690s, inlaid furniture was present in New England, which means it must have been imported.) This type of veneer—which is often quite light in color, except for its dark figuring—is frequently found on English furniture in conjunction with brightly colored floral marquetry set against a dark ground. The decoration on the chest of drawers was apparently meant to evoke such fashionable furniture both in its designs and in the tones of the backgrounds on the drawers.

The three leaves at the base of the painted sprigs may well represent a misunderstood fleur-de-lis, particularly as they are drawn on the top drawer. Variations in the execution of the sprigs, such as in the shape and number of petals in the flowers, suggest that a basic pattern may have been drawn or scribed to serve as a general guide, but it was not followed carefully in the painting. The left and right sides of each of the two center drawers are mirror images of one another; the vines on these drawers are similar in configuration but vary in decorative detail and color. As these two drawers are structurally interchangeable, both have been in the upper position; the arrangement originally intended is not entirely certain, but

Figure 2
High chest of drawers, 1700–25. H:131.4 cm. Probably Boston, Massachusetts. Detail of drawer fronts. The Metropolitan Museum of Art, Gift of Mrs. Russell Sage, 1909 (10.125.709).

the placement of the drawer with the black vine above the drawer with the white one is probably correct.

While the vines—a traditional motif—must have formed part of the painter's regular repertoire, the sprigs, in all likelihood, were taken directly from a print or drawing, as the manner in which they are depicted certainly suggests copying from a line design. The sprays are entirely outlined in black, and colors are applied within the confines of the lines. Neither this manner of delineation nor a similar spray motif is encountered elsewhere. Flowers generally suggestive of those that terminate these sprigs, in that they have a dark inner portion of the petals surrounded by a light band, can be found in Stalker and Parker's *A Treatise of Japaning and Varnishing* (1960:pl. 13 and others), but the flowers on this chest are more distinctively rendered. The only related flowers known to be painted in a similar manner and whose designs resemble japanning are on a high chest of drawers, also from the Boston area, in the Metropolitan Museum's collection.[2] One of the two types of flowers depicted on the latter piece has inner petals outlined in black, punctuated with dashes of color, and surrounded by a band of solid color that in some instances, as in Figure 2, is filled with dots. What connection there may be between the painting on these two pieces is unknown. There are no other similarities, and the painting is by totally different hands—that on the high chest being much more proficient.

Scientific analysis

The chest of drawers is made of red and white oak (frame, top, and drawers), eastern white pine (side and back panels and certain applied elements), and yellow pine (remaining applied elements). At the time the technical investigation was begun and samples were taken, the painted surfaces were covered with a heavy, discolored coating (as can be seen on the proper left side in Figure 1).[3] Bold lines of graining were partly visible where the coating was worn thin on the drawers, and specks of intense color stood out from the otherwise muted tones in a few small, chipped areas. Such tantalizing evidence had long aroused the author's interest and curiosity, and indeed the scientific analysis of this piece proved to be particularly rewarding. It revealed that the decoration under the coating, and overpaint in several areas, was surprisingly colorful. Cleaning of the painted surfaces was begun in August 1994, and early results can be seen in the photograph. The effect of this painting when new—with its multicolored floral motifs, surrounded by bright orange or green moldings, with all colors strong and fresh—must have been dazzling. The number of different pigments is the greatest found on any one piece in the study. In approximate descending order of the extent of their use, they are carbon black, iron-earth red, yellow ochre, red lead, lead white, copper green, vermilion, and realgar.[4]

Samples taken from the front and rear stiles show that the ground layer of black paint, which contains fine, closely packed particles, is thin.[5] It has flowed into the wood pores and closely follows the contours of the wood surface. The same black appears to have been used to paint the pattern of arcs on the side panels, where the black overlaps and mixes into the red ground layer. The red ground contains an iron-earth pigment. This red may have once covered the top, as well; a red pigment that has not

been analyzed was detected under magnification in some of the wood pores across the entire surface.

On the top and bottom drawers, iron-earth red, which appears to be the same as that on the case sides, forms the ground coat of the panels with the sprig design. It also colors the center plaques holding the escutcheons, and it was used for the graining. Wavy, "trial" brushstrokes of this red appear on an unexposed surface of the bottom drawer. Conceivably, they were made just prior to the application of the red wavy lines of graining on the mitered and beveled strips of the two deep drawers. The ground of those bevels is yellow ochre, and the red of the graining mixes into the yellow background layer. The center plaques on the two middle drawers were also originally yellow ochre, but were later overpainted with red. Trial swirls of yellow ochre were applied to the back of the chest, where they never received a coating. This indicates that this paint was initially lighter and less brown than it now appears on the drawer fronts. Both the yellow ochre and the iron-earth red ground layers are considerably thicker than the black on the frame. Orange applied moldings mediate between the yellow beveled strips and the red panels. The orange consists of red lead mixed with lead white. Because of extensive paint losses, the original brightness of those moldings is hardly discernible in the photograph.

On the two shallow drawers, the ground of the floral decoration is orange—the same red lead and lead white mixture found on the moldings of the deep drawers—and was later overpainted with red. The applied moldings surrounding the orange panels are painted with a copper green, possibly verdigris. A cross section shows blue-green particles in a binder that looks slightly yellow. The green paint—originally strong and bright—has suffered considerable losses and appears almost entirely black. This is due, in part, to the discoloration of the pigment and binder, but is also due to the fact that only a few areas of the deteriorated and discolored coating above the paint had been removed at that point in the treatment.

In the floral elements, green is employed only for buds and flower centers in the sprigs on the top and bottom drawers, and for leaves on the bottom drawer. Prior to cleaning, this green was virtually indistinguishable from black. The dark lines in the sprigs, the dark vine on a shallow drawer, and the dots on the white vine are black paint; it is similar to the black on the frame but applied much more thickly. The red decorative accents in both the sprigs and the vines are vermilion, and the orange ones are realgar. The realgar must have differed in hue and intensity from the orange made from red lead and lead white in order to warrant the use of this noxious pigment.[6]

Conclusion

The artisan who decorated the chest of drawers worked with commercially available pigments at the basic level of a painter-stainer.[7] This person was adept at graining, and had a good sense of color and design, but may not have had much practice in rendering flowers. This individual may or may not have been the joiner who built the piece. The artisan was engaged in a level of production that in an urban context such as Boston, provided a cheaper, more conservative alternative to fashionable veneered, inlaid, or japanned pieces, and in a rural environment might have been the most stylish available.

Five Chests from Connecticut

The ornamentation on the Connecticut chests discussed here differs markedly from that on the chest of drawers detailed previously, both in type of flowers and in painting method. As will be shown, four of the chests, illustrated in Figures 3–7, are recognizably similar in their designs and technique and can be considered the work of a single major school of painting. This appears to have been the principal style of ornamental painting in south-central Connecticut for about three decades and must have encompassed several craftsmen or shops. A fifth Connecticut chest exhibits a different style of floral painting and underscores the fact that the ornamentation on the four other pieces represents a distinct tradition.

A chest dated 1705

Figure 3
Chest with drawer, dated 1705. H:82.9 cm. South-central Connecticut. The Metropolitan Museum of Art, Gift of Mrs. Russell Sage, 1909 (10.125.29).

The chest with drawer inscribed "EL 1705" (Fig. 3) and four related chests with dates ranging from 1704 to 1706 are an early manifestation of the major south-central Connecticut style. What may be the earliest example, a 1704 chest at the Art Institute of Chicago, is partly carved and partly painted.[8] In form and construction, these dated pieces are seventeenth-century joined chests; more specifically, except for a few structural details, they are built like chests from a shop tradition that has been associated with Peter Blin of Wethersfield, Connecticut, which were decorated with applied ornamentation and carving. Such chests typically have carving on the outer front panels, consisting of a central stalk with a large, stylized tulip and leaves, smaller tulips, and sometimes thistles; and some examples of a ring of tulips enclosing initials on the middle panel.[9] The composition of the painted motifs on the front panels of the 1705 chest closely parallels this arrangement.

The chest is made of oak (frame and drawer) and yellow pine (panels). The ground coat is a thin red-brown layer containing iron-earth pigment. With the exception of a few small elements, the floral designs on the facade are all delineated first in a thick coat of lead white, over which the colors—vermilion and copper green—are then applied in a relatively thin layer. The colors either entirely cover the white undercoat, as is the case in the solid green or red leaves on the drawer front, or, more often, are used as detailing that stands out against the white. Varied, lively effects are achieved with this limited palette through numerous parti-color combinations: the longitudinal division of small leaves into two colors on the drawer; thick green veins over red hatching on the leaves flanking the thistles; a diaper pattern in green with dabs of red in the interstices on the thistles; dots on the tulips and within the circular band of the center panel; and on the carnations, green cross-hatching on the lower petals, followed by a tier of petals in a solid, deeper green, and white center petals with red stripes.

The green areas vary in color, and samples indicate that visible differences are due not just to a greater or lesser degree of darkening with age or variations in the thickness of the remaining paint layer or finishes covering it, but are due also to an intentional use of two shades of green. Two distinct green paints were found: one, a deeper blue-green consisting of copper-green pigment particles and binder; the other, a lighter green mixture of copper green and lead white. Some variations in the brightness of the paint on the front panels, particularly the white, are due to a thicker or thinner residue of a glaze layer of uncertain date, which consists of tiny red particles in a medium that has turned to brown. Because the glaze

Figure 4
Chest with drawer, 1705–25. H:48.6 cm. Connecticut, Guilford-Saybrook area. The Metropolitan Museum of Art, Gift of Mrs. Russell Sage, 1909 (10.125.16).

appears to have bound to much of the color detailing, it was left in place when the chest was cleaned in 1991 (Fodera 1991). Only traces of this layer remain on the drawer front, where the detailing is worn and there has been some restoration.

The red and green dots that speckle the framing members of the facade are painted directly on the ground. They were set off by wavy white lines, now mostly lost, that accented the shadow moldings. On the side panels, large leaves and flowers on thick stems issue from mounds indicated only by a short arc. They are executed in lead white, in a broadly brushed, rather gritty, and sometimes barely continuous application.

Two "Guilford-Saybrook" chests

The chests in Figures 4 and 5 form part of a group of eighteen pieces of case furniture with a type of painted ornamentation that has long been associated with the area of the Connecticut shore extending from Guilford to Saybrook. The large range of decorative designs in this group—mainly flowers and birds—is more varied and far richer than that on any other American painted furniture of the period and encompasses the motifs on the front of the 1705 chest. In addition to the forms illustrated by these two pieces, the group includes a high chest of drawers, two joined chests of drawers, and numerous joined chests with drawers. The furniture in this group is made primarily of yellow poplar.

Figure 5
Chest on stand, 1705–25. H:93.7 cm. Connecticut, Guilford-Saybrook area. The Metropolitan Museum of Art, Gift of Mrs. Russell Sage, 1909 (10.125.15).

The principal designs used were firmly rooted in earlier traditions. The facades of the Guilford-Saybrook chests invariably show flowers or vines emerging from a central vase or mound. This device and the types of flowers depicted have a long history and were popular in numerous media throughout the 1600s. Although some of the flowers on these pieces may well have become part of the painters' learned vocabulary, in all probability the original sources of the floral forms and birds were published designs. Beginning in the Renaissance, printed ornament designs adaptable for use in various media were in wide circulation, and flower and bird designs abounded. The bold design on the upper front of the chest on stand (Fig. 5) was undoubtedly taken from a printer's device. It corresponds exactly to chapter headings found in several seventeenth-century English books. Designs incorporating those same motifs appear on numerous Guilford-Saybrook pieces and are exclusive to that group. On all but

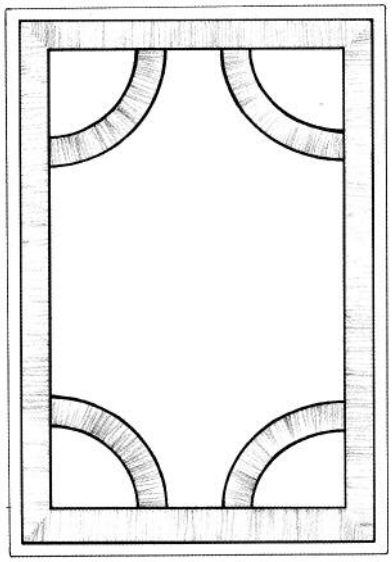

Figure 6
Design on the top of the chest on stand shown in Figure 5.

this chest on stand and a joined chest with drawer at the Henry Ford Museum and Greenfield Village in Dearborn, Michigan, the roses and thistles have been arranged so as to make the composition totally symmetrical.[10] Several variations exist, suggesting the work of more than one artisan and the evolution of the motifs over time.

For the most part, the resemblance of this painted decoration to fashionable marquetry or japanning, which must have accounted for its popularity, lay in its bright colors and not in the motifs used. On the top of the chest, however, a painted border, now only partly visible, defines the perimeter and describes an arc inside each corner (Fig. 6). The border is formed of white dashes between red lines applied directly on the ground, and it resembles crossbanding found on early Baroque veneered furniture.[11]

Several decades ago, a Charles Gillam (or Guillam), who was living in Saybrook perhaps by 1703, was suggested as the maker of this furniture; however, no documentation is known that can definitively link him to the Guilford-Saybrook furniture (Trent 1994). It is likely that he was one of several joiners in the area who must have been interacting, given both the structural relationship between the 1705 chest and related dated chests and some of the Guilford-Saybrook pieces, and the similarities in motifs and painting technique not only between those two groups but also in a further group discussed later and represented by a chest with the initials "MD" (Fig. 7).

The painting technique used on the small board chest with drawer (Fig. 4) and the chest on stand (Fig. 5) is the same as that on the facade of the 1705 chest: designs laid out in white, over which detailing—primarily in red and green—is applied in thinner layers in a stylized, fanciful manner. The chest with drawer (Fig. 4) is made mainly of yellow poplar. Its lively design is painted on a black ground. Like the iron-earth ground of the 1705 chest, this ground seems to have little binder (Fodera 1991, 1992). The layer of lead white that defines the design is thick enough to appear slightly raised above the background. Some of the finer color details are deliber-

Figure 7
Chest with drawer, 1715–35. H:84.5 cm. Connecticut, probably Guilford-Saybrook area. The Metropolitan Museum of Art, Gift of Mrs. J. Insley Blair, 1945 (45.78.4).

ately worked directly on the ground, as is the case in the red dentiled edges of pairs of flowers on the front and in the delicate, feathery tufts on the sides. Green is applied only over white. Visually there are two shades, one bluer and deeper than the other; but because only one sample was analyzed, it is not known whether more than one green paint is involved. The one sample tested, from a bluish area, contained some lead white in addition to copper green. Two distinct red paints were identified: one contains vermilion with the addition of a lead pigment; the other appears to be a lead white with the addition of red lead or an iron-earth pigment.

A sample from the deep yellow center of the middle flower on the proper left side revealed the presence of orpiment;[12] however, no pigment was detected in a sample from an adjacent flower, where the area of yellow lacked clear boundaries. The samples were taken before the chest was cleaned in 1992. The cleaning removed most but not all of the discolored and uneven finish layers that obscured the designs and the brightness of the colors (Fodera 1992). As some of the yellow may still be imparted by yellowed varnish, with the limited sampling done it is difficult to know the extent that orpiment was used. Nevertheless, it seems reasonable to assume that orpiment was employed in the areas of yellow that are clearly demarcated, as in some petals and in the distinct yellow lines within the white fields surrounding the green and red on the tulips.

The floral motifs showed no previous restoration, and although there are some losses, the definition of the major elements by the use of color reads clearly. However, important questions about the original appearance of the decoration remain. Not only is it uncertain if all of the areas that now appear yellow were meant to be that color, but it is also unclear if elements that are currently white—such as some of the stems, small leaves, or edges of petals—were intended to be pure white or whether they have lost color detailing or an original glaze. A more general question that remains unanswered for all of the painted furniture of this period is whether the decorated surfaces were originally coated with a transparent varnish.

In spite of considerable wear and losses, the overall composition of the decoration on the facade of the chest on stand (Fig. 5) makes a strong, bold statement. However, the reversal of colors on identical motifs is no longer readily apparent, as on the upper drawer, where a pair of green inner leaves veined in red alternates with red outer leaves veined in green, or as in a similar reversal of colors on the center and outer crowns. Birds frequently ornament the sides of Guilford-Saybrook pieces, and no two are quite alike. The birds on this chest sport green tail feathers that are veined like leaves, in red.

The chest on stand is made primarily of yellow poplar. The black ground is similar to that on the small chest with drawer in Figure 4. Only one red (vermilion) and one copper green paint were identified on the chest on stand. The green, which in cross section shows blue-green particles in a medium that appears yellow, looks nearly black in some areas. The narrow red brushstrokes at the very top of the thistle and those in red and green in the tufted flowers on the lower drawer are applied directly on the ground. Cleaning of this chest at the museum in 1980 removed some of the discolored coatings that obscured details of the design; it also removed what appeared to be the deliberate painting out of certain elements, such as the pair of large leaves flanking the center crown. A layer of yellowed varnish of varying thickness remains on the

surface, in some areas going over losses. It is not clear if the varnish is entirely responsible for the variable brown yellow seen over most of the white areas. Analysis of two samples of brown yellow from the upper facade—one from the vine and the other from a small leaf—revealed that they contain mainly arsenic with only a trace of sulfur, far too little for all the arsenic to be present as orpiment. It is uncertain whether this layer is a glaze or a yellowed varnish containing arsenic, and its date is in question. In a sample from the bird on the proper right side, arsenic, a trace of sulfur, and some copper were detected in a brown glazelike layer that appears to be above a clear coating. Arsenic, but no sulfur, was also found in a yellow ochre layer on the chest in Figure 7.

A late "Guilford-Saybrook" example

The shop that produced the board chest with drawer inscribed "MD" (shown in Fig. 7) appears to have been an offshoot of the main Guilford-Saybrook tradition. This chest differs structurally from the Guilford-Saybrook pieces in the use of pine as the primary wood and in the less rudimentary character of the dovetailing of the drawer, but the method of painting is the same. In this instance, the design in lead white with detailing in vermilion and copper green is executed on a yellow ochre ground. Only the upper left side of the chest now has a yellow tone, but yellow pigment was detected under magnification in the wood pores of all main surfaces, including the top, cleats, and moldings. The vines are very obviously formed from crisp compass curves. Virtually all the floral forms on the facade are variations and elaborations on a tripartite motif (be it leaves or a stylized lily) of the type seen next to the tulips on the chest with drawer in Figure 4. The leaves of the trees on the sides are a solid color—red, green, or white—and are uniform in size and shape. This is a more restricted, more formulaic design than the rich variety of motifs seen, for example, on the chests in Figures 4 and 5, suggesting a waning of the Guilford-Saybrook tradition. Several other case pieces with similar decoration on the front and sides are known. Among them is a small board chest with drawer that is inscribed with initials and the year 1730—another indication that the painting on the "MD" chest (Fig. 7) must be relatively late.[13]

A Connecticut chest in another style

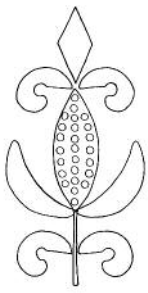

Figure 8
Motif from a chest with drawer, 1720–40. H:92.7 cm. Connecticut, probably Milford area. The Metropolitan Museum of Art, Rogers Fund, 1934 (34.128).

The ornamentation on another pine board chest with drawer in the Metropolitan Museum's collection represents a different style of floral painting produced along the Connecticut shore. The decoration on this chest—which is one of several thought to have originated in the Milford, Connecticut, area—is also based on a conventional lily motif (Fig. 8).[14] The motif could have been abstracted from the floral designs seen on the "MD" chest, but the resemblance is probably purely coincidental, as the Milford chests differ significantly from the Guilford-Saybrook pieces in construction and in the composition and execution of the designs. On the front and sides of the museum's chest, either the full motif (as in Fig. 8) or portions thereof are arranged on vines that tend to meander, and the effect is close to that of an overall pattern. The exact replication of forms indicates use of a template.

Paint losses on the chest are extensive. Only traces of lead white remain on the terminal fleur-de-lis and the pair of leaves at the base of the motif illustrated. The red, which defines the pair of large outer petals, is a

mixture of red lead and lead white applied directly to the ground. The colored dots that decorated the white center petal appear to have been green on the front and red on the sides. The green has not been identified; no copper was detected in the one sample analyzed. The thin, dark ground coat on this piece is a mixture of black and red particles—probably a carbon black with a red-iron pigment and red lead. Whether this type of ground is peculiar to this piece or is characteristic of all the chests with similar decoration remains an open question until the paint on related chests in other collections has been analyzed.

Conclusion

The investigation of the technical aspects of the ornamental painting on the Metropolitan Museum of Art's early eighteenth-century American furniture proved fruitful. As the body of knowledge initiated by this project is enlarged, it should become an increasingly valuable tool in the further study of such furniture. The project achieved two broad goals. First, it identified the pigments used in the painting, making it possible to much more accurately determine the original colors of the decoration on each piece. The analysis of the chest of drawers from the Boston area (Fig. 1) was especially rewarding in this respect. It brought to light a color scheme far more vivid than imagined, for one is accustomed to seeing painted ornamentation that is discolored and muted through age and later coatings. Second, the project demonstrated that individual schools of ornamentation appear to be defined not only by the nature of the designs but also by the technical aspects of the painting.

The floral painting on the aforementioned chest of drawers provides a marked contrast to that on the Connecticut chests, both in the type of flowers represented and in the manner of their delineation. While the type of floral ornament seen on this piece appears to be a unique survival, the flowers in the sprigs do bear some affinity to those seen in japanning. The general influence of professional Boston japanners on the painter-stainers and joiners of the area has yet to be assessed (as little research has been done on painted furniture from eastern Massachusetts), but it does appear to have had some effect on the depiction of flowers in this instance.

In the case of the four Connecticut chests painted in the same distinctive manner, one can speak of a recognizable school of painting, whose shop practices can be clearly differentiated from those that produced the ornament on the fifth Connecticut chest discussed. Although the group of four represents the work of several hands in their construction and ornament, they appear to be diverse expressions of the same or related tradition of painting. However, the exact source of this form of painting and the artisan who actually introduced it to south-central Connecticut are questions that remain to be answered.

Acknowledgments

The author is greatly indebted to present and past members of the Department of Objects Conservation for the scientific investigation of the objects discussed in this article. Thanks go to Antoine M. Wilmering for spearheading the project on the painted surfaces and for supporting it throughout; Mark T. Wypyski for the pigment analyses; Keith Bakker for the macro-examination of the surfaces, the sampling, and the cross-sectional microscopy; and Mark D. Minor for additional helpful observations. The drawings are by Edward Di Farnecio.

Notes

1 For the chest's fielded and painted side panels, see Schwartz (1976:15) and Safford (1980:353, pl. 1). The most ornate of the related chests is one at the Brooklyn Museum, Brooklyn, New York, which has fleurs-de-lis and small birds painted in black on a red or white ground, in addition to graining (Peirce 1976:1292); and one at the Henry Francis du Pont Winterthur Museum, Winterthur, Delaware (acc. no. 56.10.3), which retains only graining.

2 The high chest is also illustrated in Lockwood (1926:fig. 59).

3 For the technical analysis, cross sections were examined microscopically in visible and ultraviolet light, and pigments were identified by energy dispersive X-ray spectrometry. Virtually no identification of binders was undertaken. Conservation reports, including drawings of the cross sections, are in the object files of the Department of American Decorative Arts.

4 Realgar is an orange-red sulfide of arsenic and is poisonous. It is a mineral found in natural deposits and is related to orpiment (see note 12). See Harley (1982:125).

5 The black was not tested for all pieces in the study. Those samples that were analyzed did not give a reading and were assumed to be an organic pigment.

6 See note 4.

7 See Cummings (1971) for painter-stainers and 1684 painter's inventory, and Fairbanks and Trent (1982:449–53) for pigments identified in seventeenth-century Boston portraits.

8 For the dated chests at the Art Institute of Chicago, the Connecticut Historical Society (Hartford, Connecticut), and the Museum of Fine Arts, Boston, see Kirk (1967:nos. 18, 43, 45). The last chest in the group mentioned—at the East Hampton Historical Society (East Hampton, New York)—is illustrated in Graybeal and Kenny (1987:336).

9 For a typical carved chest, see Lockwood (1926:340). Through the years the author has examined all five painted chests and numerous carved ones to establish the structural relationship. This relationship recently has been examined in detail in Willoughby (1994). For an overall view of the Blin group and its attribution, see Schoelwer (1989).

10 For an example of the chapter heading and the chest at the Henry Ford Museum, see Fales (1972:figs. 23, 28).

11 For another chest with banding, see Fales (1972:fig. 27).

12 Orpiment is a yellow sulfide of arsenic. It is a mineral occurring in natural deposits in Europe and Asia and was known since ancient times. It is closely related to realgar and was disliked because of its noxious fumes. See Harley (1982:93–94).

13 The 1730 chest is in a private collection and unpublished.

14 The Metropolitan Museum's chest is unpublished. A chest with closely related decoration, at Historic Deerfield, Inc., in Deerfield, Massachusetts, is in Fales (1976:fig. 382). The attribution of this group to Milford is based on chests with a history in that area of Connecticut. See Kirk (1967:nos. 49, 50).

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Chinese Motifs in the Baroque Art of Minas Gerais, Brazil

Historical and Technical Aspects

Luiz A. C. Souza and Cristina Avila

The occupation of the former Brazilian captaincy of Minas Gerais (General Mines), in the southeast of Brazil (Fig. 1a, b), occurred as a direct result of the gold discoveries and subsequent gold mining in the region. The Portuguese colonization process began at the beginning of the eighteenth century, starting a new period in the history of Brazil and creating influences as far reaching as the Industrial Revolution in England (due to the trade agreements between Portugal and England). According to Eakin (1989:11):

> Portugal covered its constant trade deficit with England with Brazilian gold, and Lisbon, in the end, became simply a way station for American bullion on its way north. Brazilian gold financed the commercial expansion of England in the early eighteenth century, and, in the last half of the century, its industrial expansion.

Due to the search for precious metals and gold mining, the occupation took hold in a very short time. The intense commercial activity and the demands of the new region gave rise to new and very active adminis-

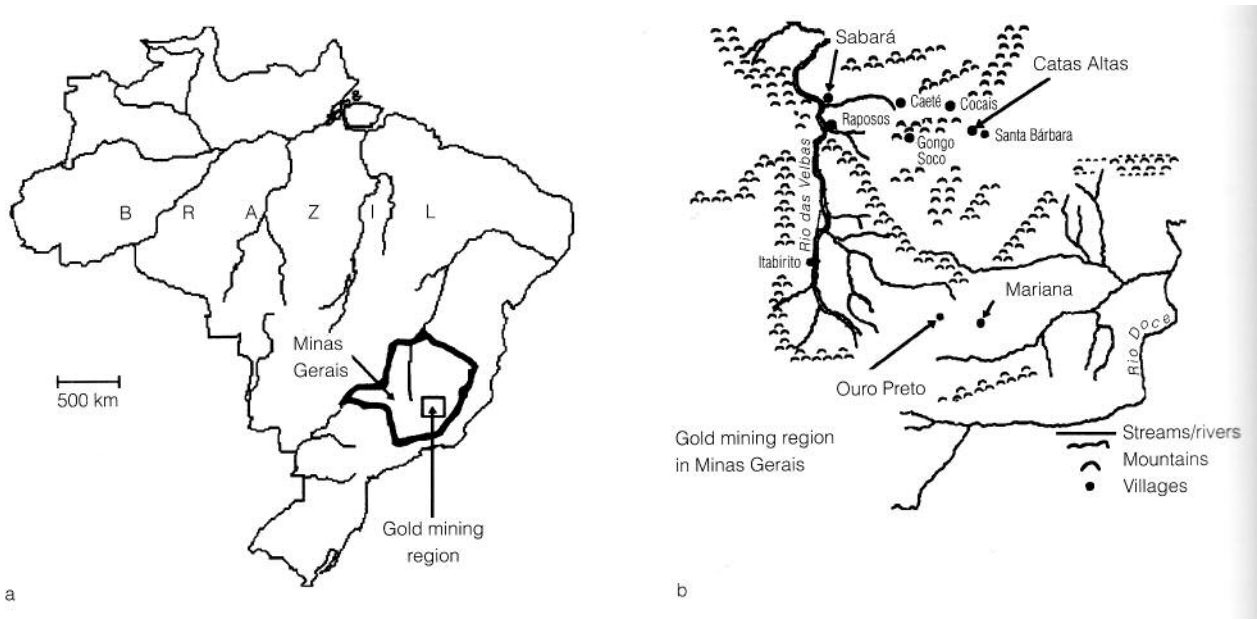


Figure 1a, b
Map of Brazil (a), showing the position of the state of Minas Gerais and the gold mining region. Detail (b) of the gold mining region in Minas Gerais, indicated by a square in the map at left.

trative centers. The political climate in the region was of permanent conflict between the several social groups in Minas and the rigorous and oppressive Portuguese administration.

Even the Catholic religion adapted and became more devoted to its functions as an agent of social integration, virtually ignoring its missionary objectives. Religious practices were directed toward the external manifestations of the faith, as opposed to the understanding of the Catholic doctrine. As a result of these adaptations, most of the religious ceremonies were performed in a much more conspicuous manner, as evident in the processions and pilgrimages and in the decoration of the chapels and Baroque sculptures. Among other measures, the Portuguese efforts to control gold production and traffic resulted in the prohibition of Catholic religious orders, which were in Minas Gerais. This aspect of the town's history is particularly relevant when one observes the astonishing number of churches in small towns such as Ouro Preto (Black Gold)—which has twenty-three churches; and Sabará, which also has several. Each chapel was built by a different fraternity or brotherhood, and this resulted in intensive and competitive building and ornamentation of the numerous religious buildings in the mining regions.

Evolution of the Religious Architecture

At the beginning of the Portuguese occupation of Minas Gerais, religious architecture was very primitive, and consisted only of small chapels with straw-covered roofs and walls built of wattle and daub. These buildings usually consisted of a nave as the main room, with a small altar for the saint of devotion.

In general, one of the biggest problems art historians now face in studying the art history of this region is the lack of documentation on the construction of the churches and on their interior decoration. However, detailed observations of the architectural features of the chapels has allowed scholars such as Avila (1984) to propose a chronology of their stylistic development. The proposed chronology is divided into three phases, following changes in building construction and style. The first phase is from 1700 to 1730, a period characterized by initial settlement and formation of the first villages. The Chapel of Our Lady of O (1717–20) (Fig. 2) and the Chapel of Our Lady of Soledade (1727), both in Sabará, are from this first phase. The second phase, from 1730 to 1755, is characterized by the introduction of regional materials, such as soapstone and quartzite, for structural and decorative uses. The third and last phase, from 1755 to 1785, is characterized by the widespread use of stone as a structural material in the religious and government buildings. Numerous churches were built during this phase, mainly because of the competition between several fraternities and brotherhoods.

Interior Decoration of the Churches

A few chapels are decorated with Asian-style motifs, such as Chinese life scenes, pagodas, birds, elephants, rabbits, and so on. The traditional explanation for these Asian-influenced motifs in Minas Gerais is the Portuguese discovery of the maritime route to the Far East at the end of the fifteenth century, which certainly influenced the styles and techniques of Portuguese artists. On the origin of these motifs, the Brazilian author Andrade (1978) surmises that a Portuguese artisan may have learned the technique in China,

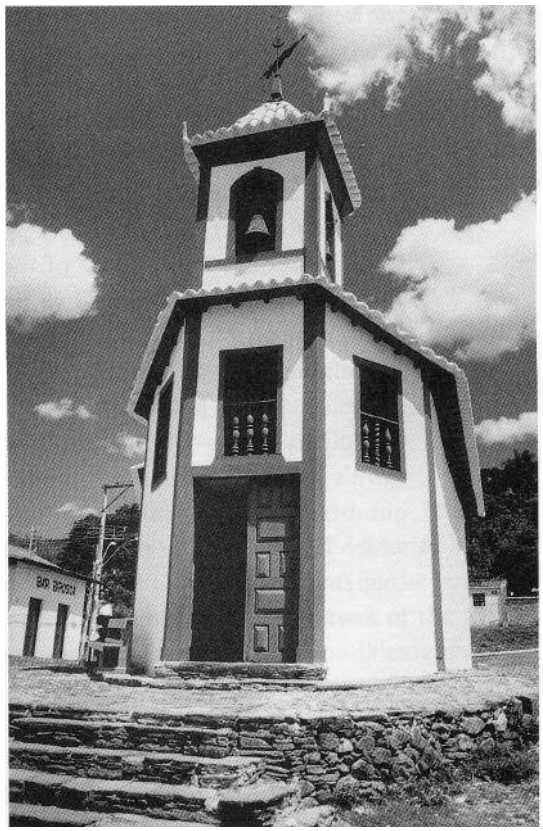


Figure 2
Exterior of the Chapel of Our Lady of O in Sabará, Minas Gerais, 1717–20. Notice the Chinese influence on the tiles at the corners on the upper roof. The interior of this church is particularly rich in panels with Asian painted and gilded motifs (Fig. 3).

Figure 3
Detail of the interior decoration in the Chapel of Our Lady of O.

or even that a Chinese or Indian painter might have traveled to Minas Gerais and painted the motifs directly. Either explanation is historically plausible, as the Portuguese had established a maritime empire in the Far East beginning in the late fifteenth century from the base provided by their earlier exploration of the African coast. Portugal's colonies in the East Indies and Asia included Goa, Ceylon, Malacca, and Macao (Severy 1992).

Technical studies of the Asian-style motifs in Minas Gerais show, however, that the technique is perfectly in accordance with the European technique for chinoiserie, a practice that was already well known in parts of Europe after 1660 and that arrived in Portugal after 1720 (Smith 1962:117–18). The bookshelves at the library of the University of Coimbra, for example, are all painted in chinoiserie. The person who painted these decorations is known to be the Portuguese artist Manuel da Silva, who signed a contract in 1723 to do the paintings.

Asian motifs in the interior decoration of the churches

Decorations with Asian motifs are present in Sabará (Figs. 2, 3), Mariana (Fig. 4), and Catas Altas (Fig. 5), which were very important mining villages during the eighteenth century. None of these cases have documentary evidence regarding the authorship of the motifs. In the church interiors, the motifs appear as bright figures over red or green backgrounds. In addition to the gilding, there is also extensive use of silver leaf, usually to represent human faces or the bodies of birds. The borders of the gilded or silvered parts are well defined with a black line, which is also sometimes used over the gilding to create contouring. In Minas Gerais, sil-

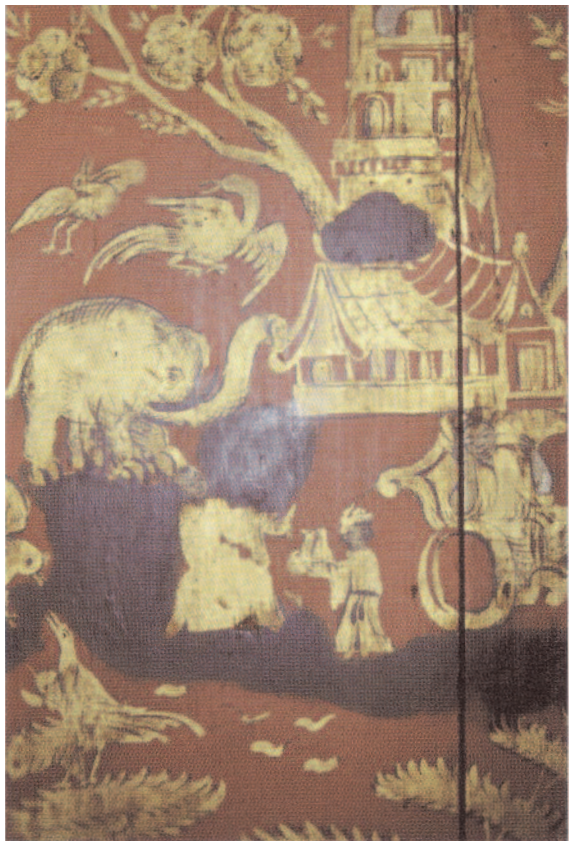


Figure 4
Cathedral of Sé, in Mariana, Minas Gerais. Detail of the decoration on the seats used by the priests. The faces and hands of the human figures in these panels are in silver leaf.

Figure 5
The Altar of Santo Antônio in the Mother Church of Our Lady of Conception, Catas Altas, Minas Gerais. Detail of the painted Asian motif.

ver leaf is not used as widely as gold leaf, the former being a subject that deserves more research, particularly the use of silver leaf on wood polychromed sculptures.

The following is a brief description of the churches and their locations.

Sabará

The Mother Church of Our Lady of Conception. Construction of this church started in 1701. The interior ornamentation is highly characteristic of the first phase of the Baroque style in Minas. Both gilding and carving are generously present throughout the interior. The design pattern is similar to that observed in the north of Portugal, the origin of most of the Portuguese artists who went to Minas Gerais.

The Chapel of Our Lady of O. This particularly small chapel is considered to be one of the most outstanding religious buildings of the colonial period in Minas Gerais (Fig. 2). The lavish interior ornamentation (Fig. 3) is characterized by painted and gilded Asian motifs, such as pagodas, Chinese scenes, and birds.

The Chapel of Our Lady of Soledade. Unfortunately, this chapel no longer exists, but remnants of the carved works and painted ceiling, which were saved by the municipality, are worth mentioning because of the singularity of the painted motifs (Fig. 6). The painted decorations of the ceiling are naive, and they clearly reflect an ingenuous attempt to produce Asian-style motifs. Together with the carved works from this chapel, these artistic expressions reflect popular art production in Minas Gerais that is sometimes found in small country chapels, most likely because of the lack of financial resources or of specialized artists and craftspeople.

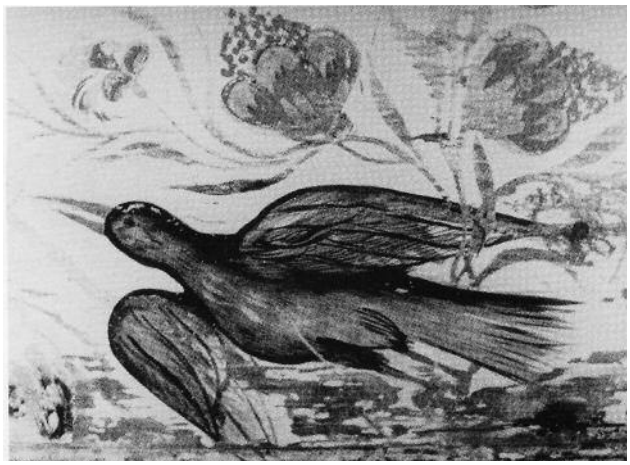


Figure 6
Painted bird on a remnant of the ceiling from the Chapel of Our Lady of Soledade, Sabará, Minas Gerais. The simplified pattern of Asian style is characteristic of this little chapel.

Mariana

The Cathedral of Sé. The ancient Mother Church of Our Lady of Ascension was the first Mother Church of Minas (1705), and in 1745 it became the Cathedral of Sé, the first seat of the archbishop of Minas Gerais. The altars and interior ornamentation of the church are of high quality, featuring polychromed sculptures and gilded altarpieces still in very good condition. The church has an organ dated 1751, which is decorated with Asian motifs similar to those already mentioned. In the main chapel, Asian motifs decorate the seats reserved for the priests (Fig. 4). These motifs include several Chinese-style scenes with birds, flowers, insects, and elephants. Of interest is the fact that the elephants' trunks are not anatomically correct, clear evidence that the painter had never actually seen an elephant.

Catas Altas

The Mother Church of Our Lady of Conception. This church resembles a time capsule for the study of polychromy, gilding, and carving techniques in Minas Gerais. Construction of the church started around 1738 and continued for several years, but the interior decoration was never completely finished. The wood of the altars was polished only, ready to receive a ground. Some elements exist with only ground layer completed; the painting and gilding were never carried out. Yet other parts were completely finished, with painted, gilded, and silvered decoration. The interior decoration has never been restored—a key factor for the study of the original materials. A complete study of the materials and techniques used to decorate this church is the subject of the doctoral thesis of one of the authors (Souza), and some preliminary information from this study has already been published (Souza, Ramos, and Avila 1992). Chemical analysis was performed on samples from the Asian motifs on this church's altar devoted to Santo Antônio (the results are discussed in the following). These motifs are similar to those found in the other churches previously described; they are painted or gilded over a red or green background (Fig. 5).

Other sources of Asian motifs

Finally, many of the figures of birds, flowers, and life scenes in the 1688 book published by Stalker and Parker closely resemble the figures in the

Asian motifs in Minas Gerais. Unfortunately, it is not possible to find lists of source books that may have been used as references by the Brazilian and Portuguese painters and artists working in Brazil, because after the end of the Inconfidência in Minas Gerais, Portugal ordered the destruction of some of the most important book collections. Even in the remaining documents, there is no reference to source books that may have been used by the artists working in Minas during the colonial period. Further research should be carried out in collections such as that at of the National Archives in Rio de Janeiro in an attempt to fill this gap in knowledge.

Analytical Results

The analytical results displayed in Table 1 refer to samples taken from the Asian painted motifs on the Altar of Santo Antônio. The samples were analyzed through microscopy of the cross sections (Fig. 7a–f), after careful examination of the fragments under a binocular microscope. The samples for Fourier-transform infrared (FT-IR) spectrometry and polarized light microscopy (PLM) were selected and prepared from the original paint chips, after careful manipulation of the fragments with a small scalpel under the binocular microscope. Scanning electron microscopy coupled with energy-dispersive X-ray analysis (SEM-EDX) and fluorescence microscopy were employed after the cross sections were analyzed with reflected light under the microscope.

Discussion of the results

The microscopic examination indicated that the structure of the materials, starting from the bottom layer, was as follows: *gesso grosso, gesso sottile,* bole, red layer, mordant, gold leaf or bronze powder, and a varnish. The stratigraphy of these painted motifs in Catas Altas is similar to that of the polychromed sculptures from the colonial period in Minas Gerais. The techniques for the ground layers and the bole are the same (Souza, Ramos, and Avila 1992). The bole was perhaps applied under the red layer to save on the more expensive vermilion, or it may be that bole was applied all over the white ground so some areas could be water gilded. Only some areas would then have the subsequent layers, as described here. There are two techniques that were noticed for the first time in polychromed sculpture in Minas: the use of oil-size gilding and the use of bronze powder as a decorative material. It should be emphasized that the term *bronze powder* is used to indicate the brass microleaves present in a sample (CA082); this is a terminology already in use in the conservation literature (Stodulski and Dorge 1991; Bernstein 1991).

Varnish layer

The use of a varnish layer over the entire painted surface is a very important aspect of the technique because it gives a deep tonality to the red paint and reduces the reflective character of the gold leaf in oil gilding. It was not possible to positively identify the type of resin or mixture of resins used to make this varnish, but there are certain characteristics that should be mentioned. The FT-IR spectrum of a fragment of the varnish is very similar to the spectrum of a particular Brazilian resin that is extracted from trees of the genus *Hymenaea*. In Brazil, the resin is sometimes called *Resina do Jatobá,* but it also has other names throughout the country. Some of the European naturalists who visited Brazil during the beginning of the

Table 1 Summary of the results obtained from analysis of painted Asian-style motifs

	Sample CA083 Red surface covered with varnish	Sample CA084 Matte gilded decorations	Sample CA082 Brown areas in the painting
Microscopy		7 yellowish top varnish	7 yellowish top varnish
		6 gold leaf, covered with black pigmented layer at the borders	6 green-brown with dispersed metallic microleaves (bronze powder)
	5 yellowish top varnish	5 mordant	5 mordant
	4 red layer	4 red layer	4 red layer
	3 bole	3 bole	3 bole
	2 *gesso sottile*	2 *gesso sottile*	2 *gesso sottile*
	1 *gesso grosso*	1 *gesso grosso*	1 *gesso grosso*
PLM		7 pure transparent organic layer, isotropic, RI<1.66	7 pure transparent organic layer, isotropic, RI<1.66
		6 not analyzed	6 transparent greenish isotropic medium, RI<1.66; copper resinate, partially discolored (turned brown)
	5 pure transparent organic layer, isotropic, RI<1.66	5 not analyzed	5 not analyzed
	4 vermilion (very small particles) and red lead	4 vermilion (very small particles) and red lead	4 vermilion (very small particles) and red lead
	3 iron oxides + graphite	3 iron oxides + graphite	3 iron oxides + graphite
	2 gypsum (small particles, very well crystallized)	2 gypsum (small particles, very well crystallized)	2 gypsum (small particles, very well crystallized)
	1 gypsum (particles of heterogeneous sizes)	1 gypsum (particles of heterogeneous sizes)	1 gypsum (particles of heterogeneous sizes)
FM	5 bright yellowish green fluorescence	7 bright yellowish green fluorescence	7 bright yellowish green fluorescence
FT-IR	5 spectrum characteristic of terpenic resins (confirms gypsum in both layers 1 and 2)	7 spectrum characteristic of terpenic resins (confirms gypsum in both layers 1 and 2)	7 spectrum characteristic of terpenic resins (confirms gypsum in both layers 1 and 2)
SEM-EDX	not performed	7 organic, no metallic elements present	7 organic, no metallic elements present
			6 metallic microleaves: brass (Cu with traces of Zn)
			5 clay (Si, Al, Fe), plus lead-containing particles
		1, 2 shows clear differentiation between gessoes in layers 1 and 2	

Numbering refers to the sequence of layers, from bottom to top.

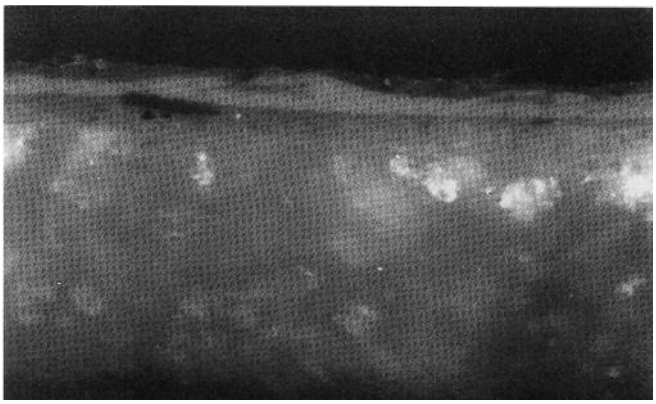
PLM = polarized light microscopy

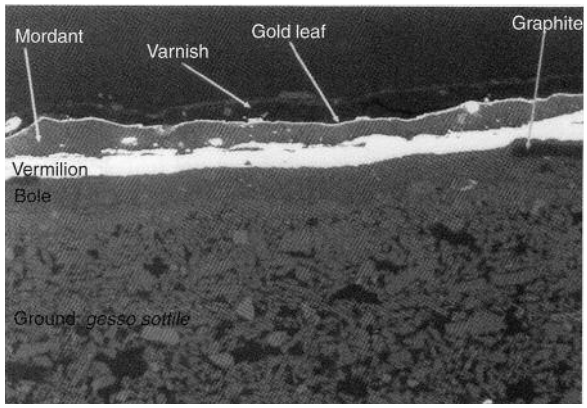
FM = fluorescence microscopy

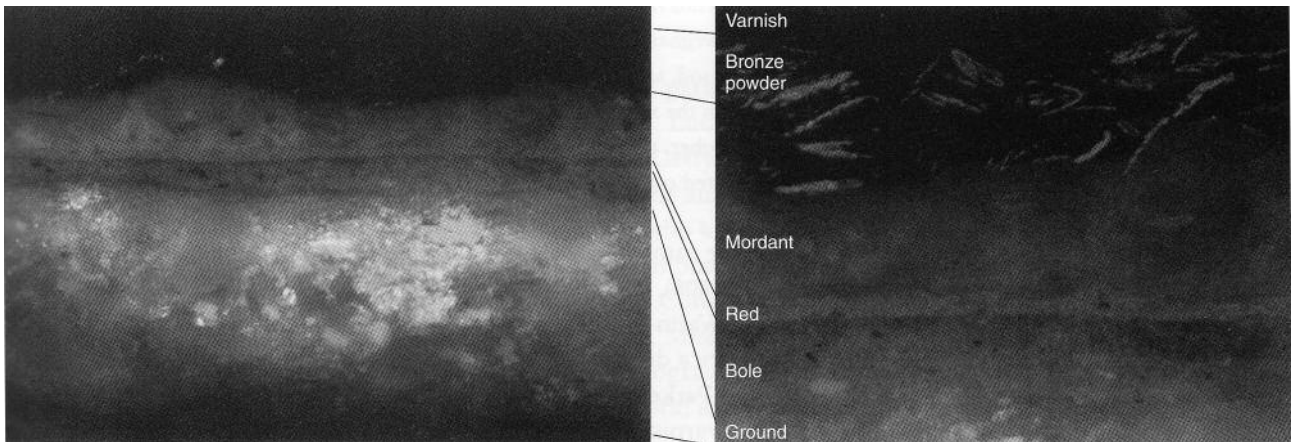
Samples were taken from the Altar of Santo Antônio, Mother Church of Our Lady of Conception, Catas Altas.

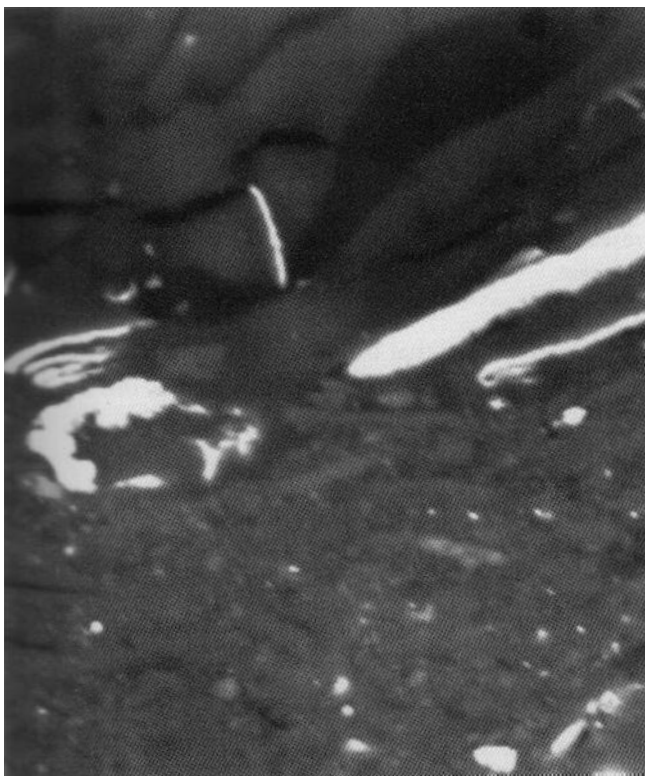
Figure 7a–f

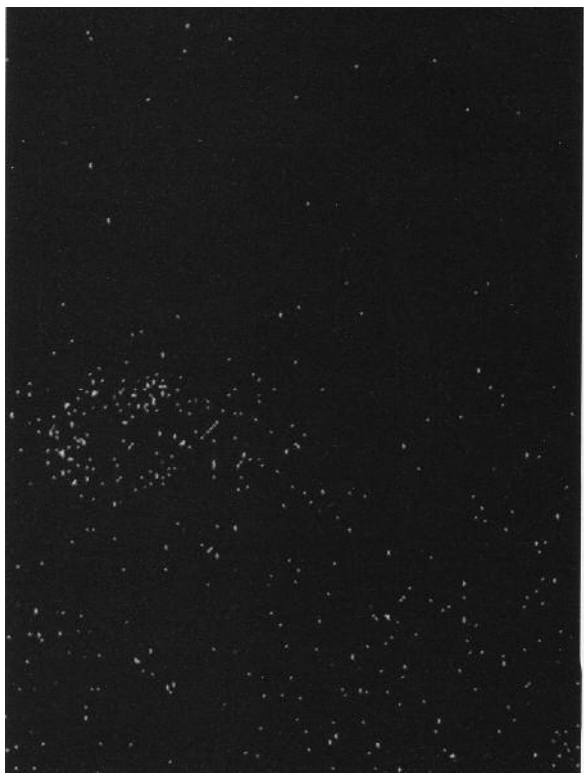
Photomicrographs of the cross sections of samples CA084 and CA082 (described in Table 1), examined under the microscope (a, b, c) and SEM (e, f). Cross section (a) of sample CA084, viewed at ×128 magnification with reflected light; same cross section (b) viewed under the SEM (notice the irregular gold leaf over the mordant layer); cross section (c) of sample CA082, viewed at ×128 magnification; detail (d) of CA082, showing the metallic microleaves; SEM detail (e) of the mordant layer and the bronze powder layer; and mapping (f) of Pb distribution on CA084 (mapped area displayed in "e"), showing the presence of lead on the mordant layer.




Mordant
Varnish
Gold leaf
Graphite
Vermilion
Bole
Ground: gesso sottile


Varnish
Bronze powder
Mordant
Red
Bole
Ground





nineteenth century have already provided a description of the resin (Spix and Martius 1981:184; de Saint-Hilaire 1975:177). It is also mentioned by Nieuhoff (1813), a Dutch traveler who was in the north of Brazil during the Dutch occupation of that part of the country in the sixteenth century. According to Spix and Martius (1981:184):

> In the forests we observed many of those trees from which comes the resin *anime* (*Hymenaea courbario* L.). Here they call it *jatoba* or *jataí*. Between the shelf and the wood of this tree, which is similar to our elm, there are relatively few spaces filled with liquid resin; the major portion of resin comes from the axial roots of the tree, when injured, which generally happens when the tree is cut. Behind the old trees it is possible to find some round balls, of clear-yellow, weighing about six to eight pounds, formed by the continuous dripping of the liquid resin. The purity and color of this substance depends mostly on the kind of soil where the balls are formed, because it impregnates the resin with certain soluble substances which don't exist in a dry soil, argillous or sandy. The finest resin is, however, the one which comes from the shell, mostly at the end of the dry season, during September and October; the indigenous people collect the resin by drops, which are then melted over the fire.

The same resin is referred to as *anima* by Watin in his treatise on varnishes (1808). He mentions the *Hymenaea* trees from South America as its source. Watin also affirms that this resin was imported to Europe from South America during the eighteenth century. It is surprising to find that Stalker and Parker (1960:10) also quote this *anima* resin in one of their recipes for varnishes, but without mentioning its source or other common or scientific name. João Manso Pereira, a Brazilian chemist who lived in Rio de Janeiro (ca. 1750–1820) was famous for being able to prepare porcelain, varnish, and lacquering as perfect as the best from India (Santos 1942:490). The main ingredient of the varnish is cited as the resin from *Jatobá* trees, dissolved in very strong *aguardente*—an alcoholic drink popular in Brazil, produced by the fermentation and distillation of sugar-cane juice. To date, there are insufficient analytical results to prove that the *resina do jatobá* was actually used in the formulation of the varnish for the Asian motifs in Catas Altas, but the information collected thus far may be helpful for future researchers addressing this subject.

Mordant layer

Analysis by SEM-EDX clearly shows that there are lead-containing particles in the mordant layer, together with clay and iron oxides; this is a traditional technique for preparing oil size for gilding.

Bronze powder

The SEM-EDX analysis of the resinous medium surrounding the metallic leaves shows the presence of copper in the material, which leads to the conclusion—confirmed by the PLM observations—that there is copper resinate in the resinous medium in which the metallic plates are dispersed. It is not clear, however, whether this copper resinate was originally applied to the surface or if it is there as a degradation product of the brass particles in contact with the resin. The brown superficial aspect of these areas in the painting is certainly due to the discoloration of the copper resinate,

as can be observed through PLM analysis of particles taken from the greenish layer.

Conclusion

Contrary to the general art historical approach for the authorship of the Asian painted motifs in Minas Gerais, the authors conclude that the artists who created these decorations were either Portuguese or Brazilian painters who used the European technique for imitating the Chinese style. These motifs in Minas Gerais can, therefore, be called *chinoiserie* because they are in perfect accordance with the definition of this term (Impey 1977:9) as referring to a European imitation of the Asian style.

The varnish used as a finishing layer on the chinoiserie in Minas Gerais may contain the Brazilian resin previously referred to as *resina do jatobá,* also known as *anima*.

Acknowledgments

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A Short Primer on the White-Painted Furnishings of Eighteenth-Century Philadelphia

Chris A. Shelton

While white paint has been a ubiquitous decoration for exterior and interior architecture, it was also used to decorate some of the highest style furnishings of the eighteenth century. White-painted looking-glass frames, carved wall brackets, and furniture were produced in Philadelphia during the eighteenth century—beginning the decade before the Revolution—but they are quite rare in America's decorative arts collections.[1] At that time, the wealthy patrons of Philadelphia (perhaps the most cosmopolitan colonial city) sought both imported and locally produced carved furnishings and decoration in the latest London fashion. London craftsmen, like their counterparts in other urban centers of Europe, were inspired by the asymmetrical, carved, painted, and gilded decoration of the French Rococo style. This manner of decoration had been popular in the 1750s and 1760s among English cabinetmakers, who produced frames and furniture in this style (Gloag 1968).

White-painted decoration continued to be fashionable in Philadelphia even as the city became the capital of the new republic, and the city's patrons and craftsmen embraced the new Classical taste of London and Paris. The simplicity of Classical designs, many of which were based on motifs from the rediscovery of the ancient Roman cities of Herculaneum and Pompeii, made a compelling new fashion, in direct contrast to the exuberance of curvilinear Rococo design. For example, English architect Robert Adam's frescolike palette with white and gold decoration and symmetrical foliage swags, revived Classicism in English interiors and became synonymous with the English national taste during the last third of the eighteenth century (Fowles and Cornforth 1979:26–27, 32).

Unfortunately, the few surviving white-painted surfaces of furnishings attributed to Philadelphia have been mistakenly gilded or otherwise obliterated and restored with surfaces that do not visually represent this subtle type of decoration. Recent investigations of several of these furnishings have provided an opportunity to reexamine the materials and techniques of this often misunderstood painted decoration. Treatises from this period document techniques for white-painted decoration and can provide insight for reinterpreting these surfaces. These treatises, combined with accurate identification of the constituent paint materials, make it possible to better understand and preserve white-painted objects.

Review of Period Literature

Treatises on painting produced in London and Paris have provided a wealth of information about the materials, techniques, and aesthetics of eighteenth-century workmanship. While many important accounts dealing with gilding and japanning were produced throughout the seventeenth and eighteenth centuries, two major works stand out as resources for understanding period paint technology, and more specifically, white-painted decoration on wood.

The first is the 1773 guidebook, *L'art du peintre, doreur, vernisseur* by Jean Félix Watin (reprinted in 1977). A master gilder who graduated from the Académie de Saint Luc, Watin set up shop in the Bonne-Nouvelle district of Paris, where he became a dealer in prints and also sold colors, gilding supplies, and varnish (Pallot 1989:39). His treatise is one of the most exhaustive examinations of gilding in the eighteenth century and provides an excellent summary of painting practices. In 1803, the English cabinetmaker Thomas Sheraton produced the second important guidebook, *Thomas Sheraton's Cabinet Dictionary* (Sheraton 1970b). In addition to illustrating furnishings and advising on their use and placement, this treatise includes an extensive supplement regarding geometry, perspective, and all types of painting.

Paint is a complex material made of a film-forming binder (such as oils, resins, gums, or hide glue) and a finely divided colorant, the pigment. As Sheraton (1970b:415) observed in 1803, "there are various methods for priming, coating, and giving the finishing lay of plain surfaces . . . in point of durability, cheapness, facility and beauty . . . whether in oil, varnish or water colors (distemper)." The binder chosen to formulate a paint determines many of its working properties and its subsequent durability. For instance, white paints made with drying oils, such as linseed oil, have often been used for exterior architecture because they form durable and largely water-resistant protection for the wood. In interior settings, where weathering is minimal, paints formulated with various animal-hide glues—known today as size or distemper paints—were used. They had the advantage of being fast-drying and not having the turpentine fumes associated with oil-based paints.

Much of the appearance of a paint is determined by the choice of pigment. In addition to color and texture, consideration must be given to the differences in optical and physical properties of pigments. Light is refracted (that is, bent) as it passes through the binder, and it is further refracted, reflected, or transmitted through the pigment particles. These interactions lend varying degrees of opacity to paints. For instance, chalk (a common white pigment) and various drying oils have very similar refractive qualities that result in a very translucent white oil paint. By contrast, lead white, the highly refractive pigment created by grinding the flakes of corrosion product scraped from lead sheet, produces a very opaque white oil paint.[2]

The steps involved in producing a finely painted wood surface are simple. The wood is first sealed with oil or a coat of hide glue and then is coated with a suitable primer to fill the pores and produce a uniform surface. One or two coats of the desired paint are then applied. A more saturated, glossy surface is created by applying a varnish over the paint. Although this practice was used for oil-bound paints, both Sheraton and Watin suggest it is particularly useful for distemper paints, since it provides a layer of protection for the water-sensitive distemper.

White-painted surfaces with a range of surface qualities could be created using just a few pigments, glue or oil, and varnish, depending on how the paint was formulated and layered. Indeed, the character of this painted surface is one of the most important considerations for white-painted decoration.

Matte white surfaces were also popular in the eighteenth century. Watin (1977:83) explains that such a surface could be created using hide glue and a dense lead white pigment that came to be known as "the King's white" because the French king's apartments were painted this matte white color. To prepare the surface, the wood is first sealed with glue size and then primed with gesso (a mixture of a strong glue size and chalk). One or two coats of the paint made with strong glue size and lead white pigment would produce the desired delicate matte appearance. Watin (1977:83) notes that "this white, according to the workers, is friendly to gold; that is to say the gold shines by its beautiful matte quality." Unfortunately, it was easily spoiled by the pigment's darkening or being burnished by wear.

Sheraton, in discussing "the fine dead whites sometimes used in domestic painting," details a similar matte white surface produced with oil paints. For this technique, however, the wood was primed not with gesso but with glue size and lead white pigment. This lead-based primer was then coated with a leanly bound lead white oil paint. Sheraton (1970b:418) explains that "the deadnes of the white will partly depend upon the coats of size given, which, if substantial, partly absorbs the oil colour, and renders it dead." Because it remained unvarnished, this oil-bound, matte white surface would present many of the same problems of discoloring and uneven wear as the glue-bound technique.

A more saturated or glossy white surface is created by applying a varnish. Distemper-painted surfaces were also frequently varnished to increase their durability. Varnished white-painted surfaces are described by both authors as a refined surface for paneling and decoration. Chipolin, a varnished distemper paint, is described by Watin (1977:76) and given very high regard:

> Nothing is so magnificent for a drawing room or a suite of rooms as a superb paneling painted in this manner. One can offer the ostentatious richer, more sumptuous embellishments, but one cannot present to the wise a more noble, more economical, and durable decoration. This paint has the brilliance and freshness of porcelain.

The wood is first sealed with a glue size containing a fungicide, usually garlic and leaf extracts; then the surface is primed with gesso made from strong parchment size and chalk or white clay. The smoothed and primed surface is painted with strong glue size mixed with lead white pigment and clay (with a small amount of indigo or black to counter any yellowish color in the mixture). The painted surface is then sealed with a final wash of glue size and given several coats of clear alcohol-soluble varnish (Watin 1977:79–83).

Although there are many other possible permutations, these three techniques for white-painted decoration reveal the sophistication of the eighteenth-century craftsman. Not only were oil and distemper paints—often containing lead white—used to create these subtle surfaces, but both matte and porcelainlike surfaces were desirable.

White-Painted Decoration from Philadelphia

Three furnishings made in Philadelphia in the eighteenth century have been the subject of recent examination to identify the binders and pigments in the original white-painted decoration. Two powerful techniques—fluorescence microscopy with reactive fluorescent dyes, and scanning electron microscopy (SEM) with energy dispersive X-ray analysis (EDX)—were performed on small cross-sectional samples of painted decoration. In addition to identifying the organic and inorganic constituents of paints, these techniques provide direct observation of the thickness, density, appearance, and condition of each layer. An added benefit is that the same sample can be used for both techniques.

Fluorescence microscopy of cross-sectional samples is one of the most useful methods for examining painted decoration. It was used in this study to chemically characterize the different binders through observation of their fluorescence and reactivity with various fluorescent dyes to mark layers with specific chemical structures.[3] Scanning electron microscopy was used both to image layers and particles according to the mean atomic weight using their backscattered electrons and to analyze the X-ray emissions of individual pigment particles to identify their elemental composition.[4] The results of these examinations compare favorably with the materials and methods of the period identified by Watin and Sheraton.

Many English craftsmen experienced in the Rococo style emigrated to Philadelphia in the 1760s. Some brought the printed Rococo designs of English carvers and cabinetmakers like Thomas Johnson and Thomas Chippendale (Hecksher and Bowman 1992:1–15). These craftsmen produced perhaps the most robust Rococo carving in the colonies, as well as some of the only locally produced, white-painted furnishings. The two earliest objects examined (Figs. 1, 2) are the work of James Reynolds. These objects are important not only because they are attributed to a specific maker, but also because they represent two different contemporary aesthetics for purely white-painted decoration.

Reynolds arrived in Philadelphia in 1766 and soon advertised himself as a "CARVER and Gilder, Just arrived from London . . . UNDERTAKES to execute all the various branches of carving and gilding in the newest . . . taste" (Beckerdite 1984). By the next year, he also undertook paperhanging, and manufactured papier-mâché borders, ceiling ornaments, and brackets. He also imported looking glasses, and marketed materials such as English glue, gold leaf, bronze, quicksilver, tinfoil and white and brown varnish (Prime 1969:225).

Frames and looking glasses were an integral part of the fashionable decoration of the time. Reynolds advertised undertaking "all kinds of frames in carved gold, carved and white, or carved Mahogany Frames" (Garvan 1976:95). John Cadwalader had commissioned four looking glasses from Reynolds, and in 1771 was billed by Reynolds for a fifth looking glass "in a carv'd white frame," which is now owned by Winterthur Museum (Fig. 1) (Duerbeck 1994).

Close inspection of this looking-glass frame reveals that it has been restored with a partially gilded surface that obscures the delicate veining in the carving. Because of its altered surface, this looking glass has frequently been mistaken for a partly gilded looking glass ordered by Cadwalader in 1770.

Several cross-sectional samples were taken from the frame and analyzed using both fluorescence microscopy and SEM to identify the constituent pigments. The samples confirmed that the surfaces have had a

Figure 1
Carved pine (*Pinus*), white-painted looking glass with gilded highlights, 1770–71. Attributed to Philadelphia carver-gilder James Reynolds.

number of later restorations over the original white-painted surface. The decoration was developed in a manner similar to Sheraton's technique for a "dead white" painted surface using an oil-bound paint. The carved frame had been primed with a coarse lead white pigment in a binder that was characterized microscopically as a proteinaceous glue. The entire surface was then painted with a finely ground lead white pigment in an oil binder; no gilding or varnish was evident on the original surfaces (Duerbeck 1994).

James Reynolds is also believed to be the maker of the only attributable carved wall bracket made in Philadelphia (Fig. 2) (Hecksher and Bowman 1992:190). This object has been examined and conserved and provides an important counterpoint to the Reynolds looking glass. Before conservation, some interpreted the dark brown surface as an attempt to paint the pine surface to imitate mahogany. Samples of the surface decoration, taken to develop a conservation plan, revealed a much different original appearance beneath later restorations (Podmaniczky 1994). Observations made under the microscope indicate that, unlike the looking-glass frame, there is an original varnish coating that would have produced a porcelainlike appearance very different from the dead white of the looking glass. Therefore, it is probable that Reynolds produced both matte and glossy white-painted surfaces, depending on the fashion and taste of his patron.

Figure 2
Carved pine, white-painted wall bracket, 1765–75. Attributed to Philadelphia carver-gilder James Reynolds.

White-painted decoration has often been used in concert with gilding, particularly in the later Rococo and Neoclassical decorations. Gilding did find favor in American architectural interiors of wealthy

Figure 3
Neoclassical ash (*Fraxinus* spp.) armchair, with applied composition ornament and white-painted and gilded decoration, 1790–1800, from Philadelphia. (The Bayou Bend Collection, Museum of Fine Arts, Houston. Museum purchase with funds provided by the Theta Charity Antiques Show.)

patrons such as John Cadwalader. Another English-trained carver-gilder, Hercules Courtney, charged Cadwalader for laying twenty-seven books of gold onto a carved cornice, and glazier Anthony de Normandie charged for "laying gold on 786 feet Paper Mache" (Wainwright 1964:29, 46). However, it was only with the fashion of Neoclassical style furniture in an English or French style that gilded furniture became popular in Philadelphia. The sale of the furnishings of Governor Penn's town house in 1787 is an early documented example of gilded Neoclassical furnishings; it included "two setees in burnished gold . . . 12 chair and a fire skreen in burnished gold to suit ditto" (Kimball 1931:378).

The inspired Neoclassical designs for furniture that were collected and published by Thomas Sheraton incorporated many of the same motifs as found in the interiors created by architect Robert Adam, including gold and white decoration. Sheraton's designs spread the London style of Neoclassicism throughout England and to America (Cole and Montgomery 1970:preface). At least one set of armchairs based on Sheraton's gold and white "drawing room" chairs was produced locally in Philadelphia in the 1790s. This set of Neoclassical armchairs with white-painted and water-gilded decoration has been the focus of extensive research and conservation in the past few years (Fig. 3). Seven of these chairs are known today.[5]

Their form corresponds closely with the designs for drawing-room chairs illustrated by Thomas Sheraton in his 1793 *Cabinet Maker's and Upholsterer's Drawingbook* (Sheraton 1970a:367). They are also decorated as Sheraton suggested: "These [drawing room] chairs are finished in white and gold, or the ornaments may be japanned; but the French finish them in mahogany, with gilt moldings" (Sheraton 1970b:387). These chairs also are important because they have molded composition ornament instead of carving for decoration on the seat rails, arms, and crests, and they retain their original upholstery foundations.

Visual inspection reveals that the chairs have been heavily restored with both oil gilding and bronze-powder paint, as well as different types of white paint on several of them. The original surface treatment of these chairs was much more refined. The ash chair frames first were prepared with several layers of a traditional chalk and glue gesso, which filled the pores of the wood and provided a uniform surface for the gilding. Areas of the chairs, including all raised composition ornament and the molded edges of the chair rails, were then coated with red bole in glue and were water gilded.

The next step was application of a denser white paint to the background. Watin (1977:83) explained this process:

> Once the work is finished on the areas to be gilded, the background is painted. . . . When painting close to the gilded areas the color is applied with small very fine brushes, cutting off very cleanly any gold that seems to be running.

On the Philadelphia chairs, a thin coat of lead white distemper paint covered the "running" red bole and gold that lapped onto white portions of the scheme in the background of the seat rails and on the turnings. Surprisingly, samples from many sites on the chairs confirm that the gesso primer served as the final white decoration layer in other areas (Figs. 4–6).

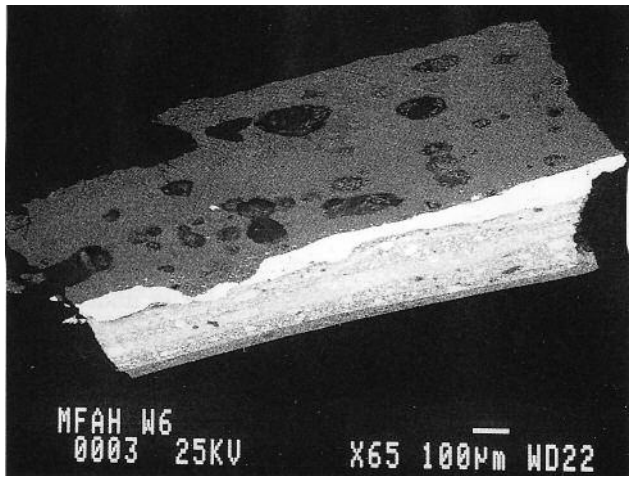

Figure 4
Backscatter SEM image of a cross section of white-painted decoration from the armchair shown in Figure 3. Elements with higher atomic weight appear lighter. The brightest layer contains lead white pigment, while the darkest contains calcium carbonate.

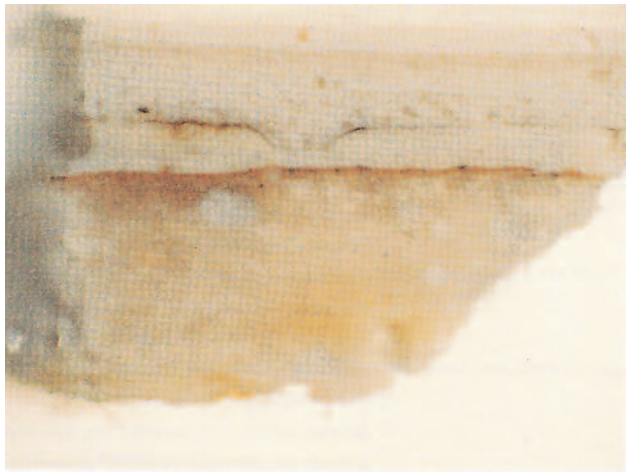

Figure 5
Cross section of white-painted decoration from the armchair shown in Figure 3. Visible light illumination, and ×100 magnification. When the adjacent surfaces were gilded, a thin layer of red bole covered the white ground. A thin layer of dense lead white paint was used by the artisan to cover this excess bole. Two later restoration layers are also visible.

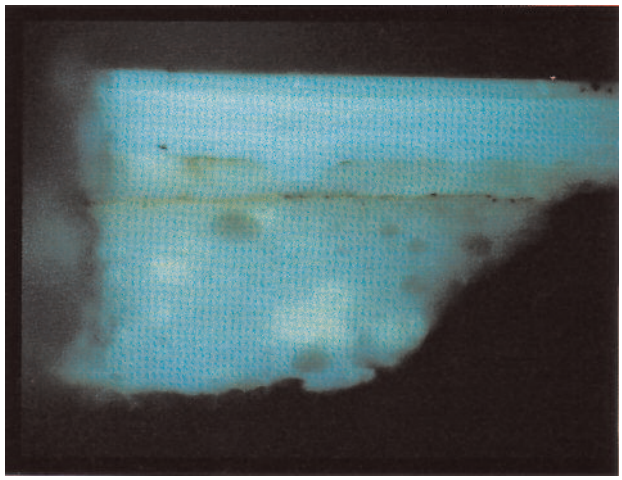

Figure 6
Fluorescence image of the same cross section shown in Figure 5, illuminated with ultraviolet light, ×100 magnification. Note the similarity in the fluorescence of the organic binders between the ground and the paint used to cover the excess bole. These binders were positively characterized with reactive fluorescent stains used to identify proteins, such as hide glue.

The gilded and painted surfaces of these chairs were varnished to produce a uniform, porcelainlike appearance and to provide a necessary layer of protection. Although the chalk ground represents an unusual choice for primary white decoration, the use of an opaque lead white distemper paint to cut off the gold and a clear, unifying, protective varnish are indicative of a high degree of sophistication on the part of the craftsmen.

Conclusion

White-painted decoration was widely used in Europe in the eighteenth century, both in the French inspired Rococo style and later in the Neoclassical style. The treatises of Watin and Sheraton suggest that both oil and distemper paints were acceptable for interior white-painted surfaces. Furthermore, by utilizing varnish coatings, surfaces ranging from matte to porcelainlike could be made. Thorough examinations of white-painted surfaces with cross-sectional microscopy and scanning electron microscopy can allow for characterization of binders and pigments, making it possible to better understand the material and cultural context of these eighteenth-century objects and the original details of their primary surfaces, so that their conservation may be directed.

Notes

1 For a more complete discussion of the Rococo style, see Fiske 1943 and Pallot 1989.

2 The refractive index (n) of a medium is the ratio of the sines of the angles of incidence and refraction of a ray of light passing from one medium (usually air) into the given medium. For linseed oil, the refractive index is $n=1.47$. Chalk has a refractive index of $n=1.51$—very close to linseed oil—while lead white has a refractive index of $n=1.94$.

3 Small samples of the decoration were cast in Bioplastic brand polyester-polystyrene resin. Each sample was ground perpendicular to the outer surface and polished with Stoddard's solvent on 400 and 600 grit wet/dry abrasive papers and with 1 micron alumina powder. Samples were viewed using a Nikon Labophot-pol microscope fitted with fiber-optic lamps and an episcopic-fluorescence attachment, which allows the sample to be exposed to normal white light and ultraviolet (UV) light for examination of the fluorescent characteristics of the sample. The UV light is passed through a series of filters, either (1) in a violet cube block (Nikon V-2B) with the following specifications: excitation, 380–425; dichroic mirror, 430; barrier filter, 450 (Nm); or (2) in a blue cube block (Nikon B-2A) with the following specifications: excitation, 450–490; dichroic mirror, 510; barrier filter, 520. Fluorochrome dyes were used to microchemically characterize specific types of artists' materials. Three fluorescent dyes were applied to each sample and observed under UV illumination: triphenyltetrazolium chloride (TTC) in a 4% solution in ethanol to react with carbohydrates; fluorescein isothiocyanate (FITC) in a 0.2% solution of acetone to react with free amino groups commonly found in proteins and in some modern emulsion paints; Rhodamine B (RHOB) to mark lipid structures, such as in drying oils.

4 Scanning electron microscopy was performed at Exxon Research and Production Facility, Houston, Texas, by Bob Klimentidis. The samples were coated with carbon to provide a conductive surface.

5 In addition to the armchair owned by the Bayou Bend Collection of the Museum of Fine Arts, Houston, six others have been located. Two of the armchairs are owned by the H. F. DuPont Winterthur Museum; see Montgomery (1966:142–44). Another pair is privately owned by Joseph and June Hennage. One chair is owned by George and Linda Kaufman; see Flanigan (1986:130–31). The seventh chair is in the collection of the Yale University Art Gallery.

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The Use of Dyes and Colored Varnishes in Wood Polychromy

Jonathan Thornton

The reported presence of flower pollens in Neanderthal burials indicates that humankind's attraction to brightly colored flowers and plant materials predates Homo sapiens. It is not surprising then, that humans have identified and modified the botanical colorants, among other colored substances, in order to decorate themselves, their clothes, and their surroundings. The quest for dyes has motivated trade and exploration for thousands of years, and descriptions of textile dyes and technologies are found in our earliest literature. Dyes have also been important in the decoration of wood, in ways that are both obvious and unexpected.

The Use of Dyes in Wood Polychromy

The functions that dyes fulfill in the decoration of wood can be broken down into the following five categories:

1. Dyes: When woods are actually soaked or boiled in dye solutions with appropriate fixing chemicals, or *mordants,* as was common practice in the dyeing of textiles, they can be said to function as true dyes. Thin wood veneers were commonly dyed during the periods when pictorial marquetry was fashionable. Such dyed veneers are more or less colored throughout their entire thickness.
2. Stains: A superficial application of a colorant or color-producing reagent to wood is commonly called *staining.* Stains are normally applied to completely assembled furniture and woodwork, and penetrate into the wood a short distance only.
3. Colorants for varnishes and glazes: Soluble extracts of dyestuffs, as well as colored resins, were often completely dissolved in drying oils, spirit varnishes, and oil-resin varnishes. When used in this way, they color the medium but are not distributed as particles, except on a molecular level.
4. Lakes: Dyes can be made into insoluble pigments in a variety of ways, and as such are termed *lakes*. These pigments have particle sizes in the range of other ground pigments. Lakes are generally quite transparent in their media, due to low refractive indexes, and were commonly used in oil-medium glazes and colored varnishes. Modern pigments based on reasonably stable synthetic dyes have acquired a legitimate place in the

production of commercial paints, and a few may even be considered permanent.

5. Adulterants: Dyes have long had a leading role in the adulteration of paints and pigments. They have been used to produce outright fakes of more esteemed and expensive pigments, as well as to brighten the colors of paints that have been extended by the addition of inert white fillers.

The categories of use described above may be combined. Soluble dyes, colored resins, and pigments were often incorporated into varnish and stain recipes, or combined on the object as separate procedures.

Definition, Description, Chemistry, and Terminology

Definition and description

Dyes are organic (carbon-containing) compounds that selectively absorb some wavelengths of visible light. Those wavelengths not absorbed are perceived as color by the viewer. Dyes have always been most important in human technologies as colorants for textiles, and it is from this literature that most of the information regarding them is drawn. In order to be an effective dye, an organic substance must stain or fix well to the substrate, produce a bright color, and retain that color to a reasonable degree. The vast majority of compounds that give rise to color in nature do not satisfy these criteria, and over the centuries the potential plant and animal sources have been winnowed down to relatively few.

Chemistry and terminology

Most dyes are aromatic organic molecules, based on the six-carbon ring structure of benzene. Attached to this benzene ring are the various functional groups that characterize particular dyes. Molecular structures that absorb light and give rise to colors are termed *chromophores,* "color bearers." Typical chromophores for the natural red dyes are aromatic molecules classed as *quinones,* of varied individual structure. Quinonoid compounds are quite stable, and some red dyes—such as *madder,* from the roots of the madder plant, whose major colorant has been identified as alizarin—are as lightfast as a natural dye can be.

By contrast, most yellow dyes are flavinoid compounds, having lesser stability, and natural yellow dyes are notoriously fugitive. The most permanent of these is luteolin, from the stems and leaves of the weld plant. However, one of the most fugitive—quercitrin, from oak (*Quercus*) bark—has been most frequently found in historic textiles, probably because of low cost. Chemists have determined that many natural dyestuffs do not yield a single compound, but are mixtures of several compounds; for example, alizarin, purpurin, and pseudopurpurin are the major chromophoric compounds in natural madder (Mills and White 1994). Because dye compounds have varying degrees of stability, natural dyes that are mixtures will often shift in hue, as well as lose overall intensity, as they fade.

Dyes bind to their substrates in a variety of ways that are classified according to their chemical interactions as being *direct, acid, vat, mordant,* et cetera. Most of these interactions are specific to various textile fibers and are outside the scope of this article, although two, mordant and direct, are sufficiently relevant to be commented on briefly. Most natural dyes are mordant dyes, and these have particular relevance to pigment

production. Mordants (from the Latin verb *mordere,* "to bite") are metal salts, such as alum, which bind with the dye and form an insoluble complex as they are made to precipitate out of solution. This precipitate can be formed on the surface of a fiber (as in textile dyeing) or can be settled out, washed, filtered, and dried to create a pigment. Such dye-based pigments are called *lakes*. Direct (also called *substantive*) dyes are much less common. They bind to polar sites on the substrate without any special treatment. The direct dyes saffron and turmeric, for example, are effective though fugitive dyes for cellulosic fibers such as cotton. They will also dye and stain wood,[1] as it consists mostly of cellulose. *Alkanet* is another direct dye that has been used extensively as a stain (Moore 1882:271).

One dyestuff will often yield different colored complexes when different metallic salts are used as mordants. Such dyes are termed *polygenetic.* Madder, for instance, can be made rust-red with aluminum; violet with iron; orange with tin; maroon with chromium; and yellow with copper. *Cochineal* is another polygenetic dye.

The color afforded by some dyes, such as archil and litmus, both derived from lichens, is pH dependent. The light-absorbing characteristics of the particular chromophore formed will depend on whether the dyebath is alkaline or acidic, and a variety of reds and purples can be made by manipulating the pH of the dyebath.

The natural dyes and tannins present in many woods can be made darker or brighter, or can be altered in shade by the application of various reagents. For lack of a better term, these internally produced colors have been called *chemical stains,* to indicate that the color has been produced by a chemical reaction between the stain and the materials in the object. Examples of such stains include solutions of salts of metals, such as iron and copper. The metal ions react with the phenolic groups of tannins and lignins in the wooden object to form intensely colored complexes. Similar chemistry is involved in an iron and oak-gall stain, prepared separately and applied to wood to "ebonize" it, or in an iron-mordanted logwood (*Haematoxylon campechianum*) extract, used to dye textiles black. In these and other cases, the term *chemical stain* provides a useful distinction between processes but not chemical products. Other chemical stains include oxidants such as nitric acid (aquafortis) (Dossie 1758:509), the chromates, and a base such as ammonia—which is used in the gaseous form to give *fumed oak* (Hayward 1946:15) its characteristic appearance. The oxidants presumably convert phenolic materials in the wood to more intensely colored quinone structures, while the ammonia may catalyze a variety of oxidation and condensation reactions resulting in the formation of chromophores. Other stains in the chemical class include the use of verdigris (basic copper acetate) as a green stain for light-colored woods, bone, and ivory. In this case, probably the only chemistry involved is the binding of the copper ion to the cellulose or protein.

Origins of Relevant Colorants

Natural dyes and colored resins

The naturally occurring dyestuffs are either botanical or animal in origin and are obtained from the roots, stems, flowers, or fruits of plants, or from the exudate (e.g., lac) or actual bodies of insects (e.g., cochineal, kermes). The famous Tyrian Purple that decorated the togas of Roman senators was extracted from *Murex* mollusks of the family Muricidae.

Both natural and synthetic dyes have been used in wood polychromy, but natural dyestuffs have, by far, the longest history of use. Because of this important history, as well as the problems of permanence that have been caused by their use, they are described in greater detail in the appendix at the end of this article. A number of colored resins that were soluble in oils, alcohol, or turpentine were also important in wood polychromy, primarily for the production of clear but colored glazes and varnishes.

Synthetic dyes

Beginning in the mid–nineteenth century, chemists began to explore the chemical constituents and properties of *coal tar,* the black and gooey by-product of the processes of making coke and flammable gas from coal. In 1856, an eighteen-year-old chemistry student, Henry Perkin, was trying to synthesize quinine from one of the component fractions of coal tar (aniline) and inadvertently produced a bright purple-colored material. This synthetic dye, the first to become commercially available, was marketed as Tyrian Purple and Aniline Purple in 1857 (Knecht and Loewenthal 1910:496). Manufacture was subsequently taken up by the French, who called the color Mauveine (Allen 1971:8). Although Perkin's Mauve, as it came to be called, proved to be quite fugitive, more and better dyes soon followed—Magenta in 1858, Rosaniline Blue and Aniline Black in 1860, Methyl Violet in 1861, Aldehyde Green (the first synthetic green) in 1862, and Hoffman's Violet in 1863, to name a few important ones (Cain and Thorpe 1913:202–4).

In 1865, the benzene ring structure was proposed by August Kekulé (McLaren 1986:15); and, in 1868, the first intentional synthesis of a dye based on this new theoretical understanding produced alizarin, which is one of the most stable and widely used synthetic dyes to this day. Another important class of dyes, the *azo* compounds, began to be synthesized in 1876. By 1910, dye chemistry was well understood and synthetics had replaced all but the most permanent of the natural dyes. The synthetic dye revolution made available new and brighter colors; after the early experimental years, chemists produced synthetic dye colors with far greater permanence than the natural dyes. A few modern synthetic pigments, notably the *pthalocyanine* and *quinacridone* colors, have been placed by Winsor and Newton in their second, "durable" category and may well belong in category one, "extremely permanent" (Thomson 1978:11–12).

History of Use

There is extensive documentary evidence for the use of dyes in a wide variety of the decorative arts, including painted wood. The earliest relevant treatises of a practical nature—such as the *Mappae Clavicula,* a ninth-century compilation (Smith and Hawthorn 1974); and the *Strassburg Manuscript,* attributed to either the fourteenth or fifteenth century (Borradaile 1966)—contain recipes for dye-based colors, but difficulties of translation and interpretation make it hard to say how these recipes were used. Among the dye colors intended for painters mentioned in the *Mappae Clavicula,* parts of which can be traced back to ancient Greek and Roman sources, are indigo, woad, lac, "earth vermilion that grows on the leaves of the turkey-oak" (kermes), and a "broth made from boiling down Murex."

The evidence is discussed in greater detail in the following, according to the categories of use already described.

Dyes and stains

Early treatises rarely distinguish between the use of natural colorants as true penetrating dyes and as superficial stains, and in practice most can be used in either way. The mid–eighteenth century saw an increase in technical treatises describing actual current practice. One of the best of these, Robert Dossie's *Handmaid to the Arts* (1758), contains a lengthy section on stains for wood, including: "tincture of turmeric" (a tincture is an alcoholic solution) and stains based on brazilwood, indigo, madder, fustic, "yellow berries" (buckthorn berries), dragon's blood, and logwood. Another eighteenth-century manual describes a stain made by propping the freshest possible horse manure up on little sticks and collecting the drippings, which would "penetrate [the wood] so as to never fade or vanish" (Smith 1799:267). This, no doubt, had the advantage of a plentiful supply of the raw material.

In 1803, Thomas Sheraton stated that "the art of staining wood was more in use at the time when inlaying was in fashion" and that red and black were the colors currently in use (Sheraton 1970:308). Manuals of the nineteenth century continued to list a wide variety of stain recipes, among the most common of which were those based on barberry and alkanet roots, logwood and brazilwood, indigo, and iron/insect-gall complexes. By the early twentieth century, synthetic dyes replaced natural dyes for all but the most stubbornly traditional artisans. *Coal tar* dyes, as they were still often called, were available in the form of dry crystals that were either water or oil soluble. Water-soluble stains offered a wider range of colors but were somewhat less fast than those soluble in oil (which were usually the highly stable azo dyes).

Colorants for varnishes and glazes

Many dyes are soluble in oils or alcohol and can be used to form bright and transparent media for decorative painting. Most of these early recipes were intended for use over white metal leafs (silver, tin) to give them the appearance of gold. Such *changing varnishes,* as they were sometimes called, are included in many formularies. One from the *Mappae Clavicula* was composed of saffron, gum, linseed oil, and orpiment. Annatto is an oil-soluble dye that was widely used in this way, and in fact its chief modern uses are in the coloring of butter, cheese, and margarine, and in cosmetics. The dyewoods were also commonly included in such recipes. Early craftsmen were often aware of the limitations of dye colorants. Dossie (1758:119) said that annatto was not fast in oil or water media but was fast in "varnish painting." The most common use of dye colorants, however, was in the form of lakes used to produce translucent glazes for fine and decorative painting.

Lakes

Lakes probably originated as the insoluble dye-vat scums and sediments left over from the mordant dyeing of textiles, but they were intentionally made as pigments as early as the Roman period. The name itself came from *lac,* the red dye washed from shellac resin, but was later generalized

to encompass all dye-based pigments. An earlier term for lakes in English was *pinks,* hence the confusing name of *dutch pink* for a yellow lake made from buckthorn berries (Harley 1970:97).

In addition to their attractive, bright colors, the transparency of lakes made them popular with artists for the vehicle-rich paints called *glazes*. Lakes had a solid place in the fine arts but were particularly important in decorative and commercial painting. Such decorative products as japanned "tin" wares (made from tinned sheet iron) and papier-mâché used colored glazes extensively, often over metal leafs and mother-of-pearl inlays. Of the colors listed in one Victorian manual for amateur decorative painters, many are lakes (*Art Recreations* 1866:156, 188). An early twentieth-century writer on paint technology stated that "automobile and carriage painters use lakes extensively for high class work, and decorative artists also use them." Of the colors listed as "decorators' glaze colors," well over half are lakes (Vanderwalker 1924:25, 52). In the painting of wooden vehicles, lakes were traditionally used as glazes over similar colors—carmine over red lead, and yellow lake over ochre, to give two examples (Schriber 1910:24).

With the development of the synthetic dyes, the number of paints based on dyes skyrocketed. An early-twentieth-century authority complained that "there are on the market today a great many unnecessary colors . . . many aniline or dye colors, titled with misleading or alluring names, which mean nothing, but serve only to attract the unsuspecting buyer" (Weber 1923:3).

Adulteration

The confused state of nomenclature alone meant that artists were often unaware of what they were actually using. This was particularly true owing to the widespread adulteration of colors by manufacturers and dealers. An excellent recent article by Leslie Carlisle (1993) on the adulteration of pigments places these practices in the context of a time when even the dealers in foodstuffs thought nothing of faking or "improving" their products with deadly poisons. It seems that merchants of the eighteenth century would have regarded themselves as rubes if they did not engage in the "sophistication" (faking) of their wares.

These shady practices were so prevalent that, in his extensive descriptions of the properties and preparation of pigments, Dossie (1758:43–143) included information on how they were commonly adulterated and how this could be found out by the careful craftsperson. He described three modes of pigment adulteration: dilution with cheaper materials, color enhancement, and outright substitution. He warned that whatever is added to Prussian blue to "sophisticate it" (probably logwood lake) "will always render it more foul and purple." Smalt was added to ultramarine. Even a cheap pigment such as ochre didn't escape having its brightness boosted up by the addition of fugitive dutch pink. Indigo, verditer, chalk, "and other cheap substances" were substituted for bice; and fugitive logwood lakes were sold as the expensive carmine made from cochineal.

Adulteration and substitution continued to be common enough in this century for various writers to issue warnings. Among them were F. W. Weber in his book *Artists' Pigments* (1923:18, 26, 78). He lists "American vermilion . . . with many fanciful synonyms" as consisting of red lead and

the highly fugitive synthetic dye eosin. The already fugitive "brown pink" (formerly made from buckthorn berries) consisted of the still more fugitive quercitron, but only if "genuine." While the cheaper lakes were often used to adulterate other pigments, they themselves were extended by the addition of starch.

When the synthetics were well established, it became standard practice to use them in paint manufacture. Weber (1923:45) stated, "When some of the more permanent lake pigments . . . are used in admixture . . . they can not be looked upon as adulterants but are safe combinations producing a more colorful pigment." This view was apparently not universally accepted. Maximilian Toch, in his *Materials for Permanent Painting* (1911:87), along with other warnings against synthetics, said that alizarin greens were made from coal-tar dyes that "readily decompose when mixed with iron oxide colors." It was generally accepted, however, that cheap and potentially fugitive colors had their place. Ralph Mayer (1940:92) argued that "nobody expects the paints used in ordinary wall decoration to last fifteen years," and a wagon painter said that "on cheap work *munich lake* is substituted for *carmine* and few can tell the difference" (Schriber 1910:49). The *Painting and Decorating Craftsman's Manual and Textbook* (1949:31) listed rose lake as sufficiently permanent for interior work, tinting, glazing, and stains. Thus we see that the paints used on much of our material heritage may be either less permanent than intended or not intended to be permanent.

Aging and Permanence of Dyes

Technical discussion

Dye chemistry is highly complex, and the mechanisms of degradation vary with molecular structure. A few generally agreed-upon statements can be made, however.

Dyes fade in direct proportion to the total light energy they receive. They will not be protected from damage by the maintenance of low light levels but only damaged more slowly. The reciprocity law tells us that decreasing total illuminance by half will cut the rate of damage by half. It is also true that halving the time of exposure under the full level of illuminance will cut the damage by half. The rate of fading, however, has an exponential relationship to exposure, with the most damage happening initially and decreasing in rate over time (Thomson 1978:22).

For most materials, the damage caused by light increases as wavelength decreases. The blue and violet end of the spectrum is more damaging than the red because more photochemistry is initiated by these higher energy photons. In the museum display of sensitive objects, it is both practical and advantageous to exclude damaging ultraviolet light because it contributes nothing to illumination, but the visible light is equally damaging to many dyes and cannot be removed except by colored filters, which are aesthetically unacceptable. Highly light-sensitive dyes are damaged most by the wavelengths they absorb most strongly (McLaren 1956), and it is precisely this selective absorption that makes them colored.

While light is the primary factor in the degradation of dyes, it is not the only one. The chemical mechanisms of fading are many and varied and are not prone to generalization. The longevity of most dyes can be prolonged by a reduction in humidity level. Reduction of oxygen concentration will reduce the fading of most but not all pigments and dyes (Arney, Jacobs, and Newman 1979). Prussian blue, to cite just one

example, fades rapidly in a vacuum but not in air. Gaseous pollutants, such as ozone (Cass et al. 1989), nitric acid (Salmon and Cass 1993), and nitrogen dioxide (Whitmore and Cass 1989), have also been identified as agents of deterioration.

The degradation of dyes depends on the molecular structure of the chromophore. Flavins, which account for most natural yellow dyes, are far more fugitive than quinones, such as cochineal and other reds, but the rate and type of alteration that dyes undergo is very much dependent on other components of the total system, such as mordant and substrate. Most research has been done on textile dyes, but the findings demonstrate the complexity of these considerations. Many textile dyes are more stable with a chrome mordant. Madder is more stable on cotton than on wool, while just the opposite is true of indigo (Padfield and Landi 1966). Dyes that have simply been dissolved in a medium are likely to be more fugitive than those that are present in the form of lakes.

The author carried out informal fading tests on a variety of organic lakes based on annatto, turmeric, brazilwood, logwood, cochineal, and buckthorn berries, made according to historic recipes taken mostly from Dossie. The lakes were painted onto white tiles in linseed oil, animal-glue size (distemper), and shellac (Behlen Brothers' Super Blonde). They were set on a windowsill and exposed to direct sunlight for six months, the tiles half-covered with foil. The results can be summarized as follows: All of the colors were markedly faded, with the greatest color loss shown by the annatto and the turmeric (the latter virtually disappeared), followed by the logwood and brazilwood colors. All colors were least fast in glue size, but were faded to roughly the same degree in oil and shellac, with the exception of cochineal, which showed somewhat greater permanence in the oil glaze. The presence of tin chloride in one brazilwood lake recipe appears to have rendered the color less permanent than a similar brazilwood lake on an aluminum hydroxide substrate alone (Fig. 1).

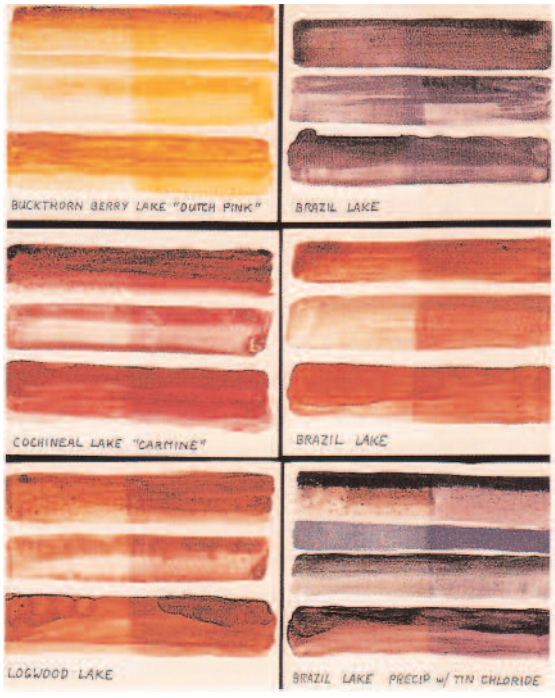

Figure 1
Organic lakes after six months of fading in sunlight with the right side of each test tile covered with foil. The media are, from top to bottom on each tile, linseed oil, animal-glue size, and shellac. The colors are, top left, buckthorn berry "dutch pink"; top right, brazilwood purple; middle left, cochineal "carmine"; middle right, brazilwood red; bottom left, logwood red; bottom right, brazilwood purple with tin chloride.

Similar fading tests were carried out on mixtures of some of the colored resins and shellac and showed the following results: accroides showed no discernible alteration; gamboge was also quite fast, showing only a slight brightening of the yellow hue as an original brown tone was lost; aloes lost its original greenish brown cast and became a darker amber color; and dragon's blood was almost entirely bleached out.

Historical discussion

The fact that dyes fade in light has been appreciated for centuries and has been the subject of scientific investigation since the early eighteenth century. Dossie (1758:102, 60) warned that "all colors formed of vegetables are very uncertain with respect to their standing" and that "some will fly in a degree that makes the use of it destructive to any painting." The best of the natural dyes, such as indigo and madder, were still liable to fade in time, and Toch (1911:24) recommended that indigo be excluded from the palette. His views did not control the market, however, as he complained that "there are about 215 tube colors for sale today . . . and out of this entire amount there are not over twelve that may have any possible use." After the introduction of synthetic dyes, consumers' enthusiasm for certain colors kept those colors in production even after scientists knew them to be impermanent. In 1901, a scientist wrote, "Pigments produced from artificial colourings [except alizarins, azos, and naphthols] are not fast to exposure to light, air, and moisture; some are much faster than others, but the most fugitive are usually the most brilliant and give the most pleasing shades; hence they are largely in demand" (Jennison 1901:108). Some were particularly popular and eventually notorious. Toch (1911:126) said that, from the 1870s on, eosin dye had been used to create a great many popular and brilliant lakes; he went on to say that eosin begins to bleach in only twenty-four hours (Fig. 2).

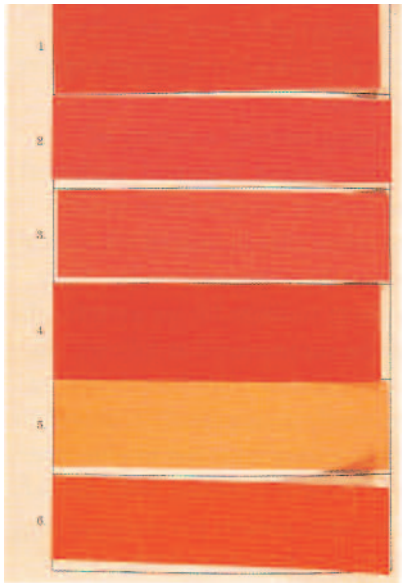

Figure 2
Paint samples made from synthetic lakes, based on eosin dye, that have been protected from light since manufacture and so are probably little altered (from Jennison 1901:70, pl. 3).

The extreme instability of some early synthetic dyes gave rise to the mistaken notion that natural dyes were more stable and tended to only "mellow" rather than fade. In fact, all of the natural dyes are less fast than the best modern synthetics. None of the natural yellow dyes can be regarded as fast by current standards. Two of the most fugitive natural dyes—logwood and quercitron—are the most likely to have been used as adulterants or replacements for more expensive colorants, due to their low cost.

Traditional practice often dictated ways in which the life of organic colorants could be prolonged. Toch (1911:189) said that "painters as a rule know that no earth color or metallic color should be mixed with a lake," but that they could be used as glazes over thoroughly dry colors. This tendency for lakes to be discolored by admixtures of many metal-compound pigments was noted by other writers. Dossie (1758:174) even recommended the use of a horn palette knife to take lakes off the grinding stone, so as not to "greatly injure the color." An early-nineteenth-century guide stated that fading was caused by "not using anything but simply the infusion of coloring materials, without adding anything to set [mordant] the color as we have recommended" (*Cabinet Makers Guide* 1825). Among other miscellaneous instructions for sound practice was the recommendation that gamboge be enhanced in permanence in an oil paint by the addition of copal resin or wax (Weber 1923:57), and that dutch pink was suitable for watercolors, but should not be worked in oils (Dossie 1758:101).

Identification

The conclusive identification of dyes is complicated in both theory and practice, and has been briefly summarized by Mills and White (1994:129). In some cases no method has yet been developed for unequivocal identification. Success is dependent not only on choosing the appropriate method but also on considerable skill and experience in carrying out the analyses, as well as interpreting the results. The techniques most often used include chromatographic techniques that separate the sample into its component parts, such as thin-layer chromatography (TLC) and high-pressure liquid chromatography (HPLC), as well as spectrophotometric techniques that rely on comparing the spectral absorption, reflectance, or fluorescence of an unknown with reference samples of known composition and structure. These include ultraviolet-visible spectroscopy (UV/Vis) and Fourier-transform infrared (FT-IR) spectroscopy (Gillard et al. 1992).

Recent experience at the Conservation Department of Buffalo State College indicates that TLC offers an excellent and reasonably simple and inexpensive method of identifying dye colorants, even in extremely small samples. Best results have been achieved with polyamide TLC plates examined after development under ultraviolet light. This technique gives distinctive "fingerprints" of unknowns. Simple visual comparison of known substances treated in the same way will usually identify the unknown colorant, but results can be confused by the presence of degradation products or other materials extracted into a coating film from the underlying wood.

In a few instances, there are even simpler identification techniques. Some dyes fluoresce strongly and distinctively in ultraviolet light. Lac fluoresces orange; madder, orange-red; and dutch pink, yellow. Microchemical tests are available for many dyes. Dye analysis has been extensively discussed in the literature, most notably in the work of Helmut Schweppe (1963:12; 1977; 1987) and Judith Hofenk de Graaff (1969; 1974:54; Hofenk de Graaff and Roelofs 1978).

Conclusion

Organic dyes have long been important components in colored coating systems such as paints, glazes, and colored varnishes, which differ from one another only in binder-to-colorant ratios. The artists' preoccupation with immediate effect, as opposed to permanence, is nothing new. Painters have used dye-based colorants for their often stunning brilliance, as well as for the broader palette and the transparent effects they offer. This disregard for permanence was especially true in the so-called decorative arts, due to the lower status accorded to these objects in Western culture, whereas the products of fine artists were expected to last. The inclusion of dye-based colorants, however, was often outside the artist's or artisan's control, due to the common practices of dilution, adulteration, and outright fakery carried on by manufacturers and merchants.

Most of the natural dyestuffs are so fugitive that the historic literature is a better guide to actual practice than the present appearance of the objects themselves. The original appearance of many historic painted surfaces can only be surmised, but the knowledge that the current appearance is likely to be a muted shadow of the original, and that fugitive materials may be present on the most unexpected objects, can add greatly to our understanding of period taste and practice. This understanding should inform our decisions with regard to preservation, conservation, and restoration.

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Appendix

Tables 1 and 2 list common natural materials known from the literature to have been used in stains, paints, and glazes. It is likely that many more have had a limited and local use in the decoration of wood than are listed here because thousands of plants have been used to make colorants. This list concentrates on those that were widely traded or propagated worldwide. Most of these would have been available from apothecary shops and were sometimes called *dyer's drugs.* The most common name for the dyestuff is given first, followed by a few synonyms (including the names of lakes made from it), and then the source (seed, root, etc.) and taxonomy. Many of the popular names are drawn from Gettens and Stout (1942), and Mayer (1940).

The currently accepted botanical name is shown in boldface, and the authority given. Superseded names are listed in parentheses. Where no authority can be found the name may still be listed (but not in boldface) as a cross reference and may be either a superseded synonym or a valid name that could not be confirmed from the sources consulted (Bailey and Bailey 1972; Stafleu 1972; Uphof 1968; Willis 1973). More complete treatises on natural dyes have been published, but these works contain obsolete or unconfirmed botanical nomenclature (Liles 1990; Hofenk de Graaff 1969; Perkin and Everest 1918). Because of the polygenetic nature of many of these dyes, the color classification is somewhat arbitrary.

Table 1 Natural dyes

Common name	Synonyms	Source
Yellows and Browns		
annatto	arnato roucou orange lake	Seeds, or pod surrounding seeds, of ***Bixa orellana* L.**
barberry		Bark, stems, and root wood of ***Berberis vulgaris* L.**
buckthorn berries	yellow carmine avignon berries yellow berries french berries	Berries from various species of the *Rhamnus* (buckthorn) genus, such as *R. amygdalinus, R. oleoides, R. **saxatilis* Jacq.**, *R. **cartharticus* L.**, *R. **alaternus* L.**, and *R. **infectoria* L.** ("Persian berries"). The berries were used to make the lakes known as *dutch pink* (also called "brown pink" and "Italian pink"), and to make *Stil de Grain*.
fustic	old fustic dyer's mulberry yellow wood cuba wood	Wood of ***Clorophora tinctoria* L. Gaudich.**
galls	gall nuts	Abnormal growths caused by insects on various oaks (*Quercus* spp.), such as *Quercus infectoria*.
madder	brown madder burnt carmine Rubens madder	Made by partially charring madder lake (see madder under "Reds and Purples").
onions		Outer husks of onion bulbs, ***Allium cepa* L.**

Common name	Synonyms	Source
Yellows and Browns (continued)		
osage orange		Wood of *Maclura pomifera* (**Raf**) **C. K. Schneid.**
quercitron	quercitron lake flavine lake	Bark of *Quercus citrinia,* ***Quercus velutina*** **Lam.**, (*Quercus tinctoria* Bartr.).
saffron		Flower stiles of ***Crocus sativus*** **L.**
sumac		Wood of *Rhus cotinus* L., ***Cotinus coggygria*** **Scop.** (Venetian sumac called *Zante* or *Young Fustic*), ***Rhus coriaria*** **L.** (Sicilian sumac), **R. typhina L.** (American "staghorn" sumac).
turmeric		Rhizomes of ***Curcuma*** **domestica Val.** (*C. longa* L.), *C. tinctoria, C. veridiflora* Roxb.
walnut		Bark, leaves, and nut husks of ***Juglans nigra*** **L.** (American black walnut), ***J. regia*** **L.** (English walnut), and ***J. cineria*** **L.** (butternut, or "white walnut").
weld	arzica dyer's broom dyer's weed	Leaves and stems of ***Reseda luteola*** **L.** The term *Dyer's Broom* is also used for ***Genista tinctoria*** **L.** (*G. spartium* Roth.), which does not yield as bright a color as weld.
Reds and Purples		
alkanet	bugloss violet carmine	Roots of ***Anchusa officinalis*** **L.** (*A. tinctoria* Lamm.).
archil	archal french purple litmus lacmus cudbear	Numerous lichen species of the *Evernia, Rocella, Ramalina,* and *Usnea* genera, including ***Evernia prunastri*** **(L.) Ach.**, ***Roccella*** **phycopsis Ach.** (identified as "archil"), and ***Ramalina scopulorum*** **Ach.** *Turnsole,* another lichen dye, is from *Crozophora tinctoria*.
brazilwood	rose pink hypernic wood	Wood from various tree species of the genus *Caesalpinia,* such as ***C. braziliensis*** **Sw.** ("brazilwood," "bahia wood," "Brazilian redwood"); ***C. crista*** **L.** ("pernambuco wood," "braziletto"); ***C. sappan*** **L.** ("sapan wood"); ***C. echinata Lam.*** ("peach wood," "Nicaragua wood"); and *C. vesicaria* ("Jamaica redwood"). ***C. sappan*** **L.** was known and traded from the Far East long before the discovery of the New World. It was the discovery of these valuable dyewoods in modern Brazil that named the country and not as is often supposed, the country that gave its name to the wood (Mills and White 1994:122).
cochineal	carmine nacarat venice lake	From the bodies of the scale insect ***Dactylopius coccus*** **Costa.** (*Coccus cacti* L.), living on various nopal cacti, such as ***Opuntia coccinillifera*** **(L.) Mill.**
henna		From the leaves of ***Lawsonia alba*** **Lam.**
kermes	crimson grain	From the scale insect ***Kermes vermilio*** **Planch,** found in southern Europe, North Africa, the Near East, and some Greek islands, living on the kermes oak, *Quercus coccifera* L. Less commonly used red dyes were extracted from the Northern European scale insect ***Porphyrophorus polonicus*** **L.** ("Polish red," "St. John's blood"); *Coccus fragiariae* and *C. uvae ursi* from Russia; and *Porphyrophora hamelii* from Armenia.
lac	lac lake indian lake	Dye washed out of the secretions of the scale insect ***Laccifer lacca*** **Kerr.** (*Coccus laccae* L.), living on various species of the genus *Ficus.*
logwood	campeachy wood peachy wood	Wood of ***Haematoxylon campechianum*** **L.**
madder	alizarin *Garance* (Fr.)	Outer portion of the roots of various species of the *Rubia* genus, primarily ***Rubia tinctorum*** **L.**, cultivated worldwide, but also ***R. peregrina*** **L.** ("levant madder"), cultivated in Persia and the Mediterranean area, and ***R. cordifolia*** **L.** (*R. mungista* [*munjeet,* in Hindi], is probably a synonym) from India.
safflower	dyer's saffron *carthame* (Fr.)	Flowers of ***Carthamus tinctorius*** **L.**
Blues		
indigo		From the leaves and stems of various plant species that bear the active principal *Indigotin,* principally ***Indigofera tinctoria*** **L.,** originally from India. A European plant

Common name	Synonyms	Source
Blues (continued)		
		yielding indigo was *Woad* (***Isatis tinctoria* L.**). The indigo-yielding plant ***Polygonum tinctoria* Ait.** was used in Korea and Japan.
Greens		
Most greens were made by combining blue and yellow dyes.		
chinese green indigo		Berries of ***Rhamnus chlorophora* Decne.**
sap green		Juice from unripe buckthorn berries (see "Persian berries"), particularly ***Rhamnus cathartica* L.**, used primarily in watercolor painting as a lake pigment, or as a concentrated extract.

Table 2 Colored resins and resinous woods

Colored Resins		
accroides		Red resin from various species of the grass tree genus *Xanthorrhoea,* such as ***X. hastilis* R. Br.** native to Australia.
aloes		Yellow-brown resin from various members of the *Aloe* genus, such as ***A. vera* L.**, ***A. ferox* Mill.** ("cape aloes," "Hepatic aloes"), and ***A. perryi* Baker** ("Socotran aloes").
dragon's blood		Red resins from various species of the genus *Dracaena* in the Liliaceae family were probably first used in Europe as "dragon's blood." These included ***D. draco* L.** ("dragon's blood," "Sanguis Draconis"); ***D. cinnabari* Balf. f.** ("Socotra dragon's blood") from the island of Socotra; and ***D. schizantha* Baker** ("Arabian dragon's blood," "Socotra dragon's blood"). More recently it has been derived from various species of the *Daemonorops* genus in the Palmae family, such as ***Daemonorops draco* Blume** (*D. propinquus* may be a synonym).
gamboge	gummigut	Yellow resin from ***Garcinia hanburyi* Hook. f.**
seedlac		Raw product of the lac insects, still often brightly colored after an initial washing to remove most of the dye. Other grades of "shellac" and "button lac" may also be brightly colored, due in part to natural colorants but also to the common addition of cinnabar or orpiment in India.
Resinous woods		
Some dyewoods are termed *insoluble* because the colored resins are not water soluble. They have been used primarily to color lacquers and varnishes.		
camwood	camewood kambe wood	Wood of ***Baphia nitida* Lodd.** "Barwood" is probably a synonym for camwood, for it, too, has been identified as ***B. nitida.***
eagle wood	agal wood calambac aloes wood	Wood from ***Aquilaria agallocha* Roxb.** (*Aloepaticum citrinum* may be another name).
red sandalwood	red saunders wood sanders wood padauk	Wood of ***Pterocarpus santalinus* L. f.** Related woods containing brightly colored resins are ***P. draco* L.** ("West Indian dragon's blood") and ***P. soyauxii* Taub.** ("African padauk").

Note

1 For the dyeing and staining of wood with saffron and with turmeric, see Baird (1886:393) and Dossie (1758:508), respectively.

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Verte Antique Decoration on American Furniture

History, Materials, Techniques, Technical Investigations

Robert D. Mussey Jr.

The term *verte antique,* or *antique verte,* is commonly used today to describe a diverse set of faux painting and gilding techniques intended to make wood, plaster, or metal appear like naturally patinated or corroded bronze castings. James Pilkington described the intent in his 1841 publication, *The Artist's Guide and Mechanic's Own Book* (1856:99), as follows: "Bronze of good quality acquired, by oxidation, a fine green tint, called patina antiqua. Corinthian brass received in this way, a beautiful clear green color. This appearance is imitated by an artificial process called bronzing."[1] While the term *verte antique* is found in late-eighteenth- and early-nineteenth-century documents, it appears that it was not the most commonly used term in the period. Other names such as *bronzing, bronzing in gold* or *copper, sea green,* and *patina antiqua* are found in printed and manuscript sources of the period. *Verte antique* does not appear to have been adopted as a term until much later in the nineteenth century, but it is the name most frequently used today and therefore will be used throughout this study.

It is commonly assumed that verte antique techniques were first developed in France, and later adapted in England and the United States, paralleling an increased interest in the Neoclassical. A search of late-eighteenth-century French sources revealed no references to the actual term *verte antique*. Jean-Félix Watin (1776) does not use the term in his influential volume, *L'art du peintre, doreur et vernisseur,* but he does describe *bronzage,* or *bronzing,* on brass and steel, which was the use of a tinted, baked varnish to make baser metals appear like gold. André Jacob Roubo, writing in 1769–75, does not mention the term *verte antique* in his definitive encyclopedic review of the French woodworking trades of the 1760s and 1770s, *L'art du menuisier* (1977:pt. 3, sect. 3).

Transmission of Techniques to America

The vast majority of American furniture with verte antique decoration can be documented or reasonably attributed to Philadelphia or New York. Isolated examples have been attributed to Providence, Rhode Island, and Charleston, South Carolina, as will be seen in cases discussed later; but Philadelphia and New York also were the principal cities to which French-born and trained artisans immigrated. The consensus among furniture historians is that most had fled the excesses of the French Revolution and the Directorate. Prominent among these craftspersons were Charles Honoré

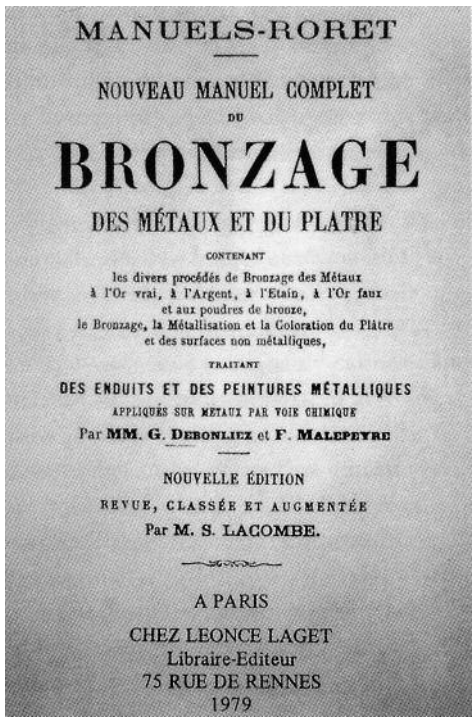
Lannuier,[2] Michel Bouvier, Joseph Brauwers, John Greuz, and Antoine (later Anthony) Quervelle.[3]

New York and Philadelphia became fertile ground for expression of the new Classical ideals that artisans such as Lannuier and Quervelle could supply to an expanding style-conscious and wealthy merchant class. As early as 1795, Anthony Rénaud Jr. advertised his services in New York as "Painter Gilder and Varnisher from Paris," and a Monsieur Pascal called himself "French Upholsterer" (Garrett 1992). However, examination of relevant post–Revolutionary War records for Boston provided no positive identification of any French furniture craftsmen who moved there during the period 1785–1810 (Talbot 1974). A recent study by the author documented that only one cabinetmaker born outside Boston, John Cogswell, moved there and became successful as a local furniture craftsman between 1760 and 1785 (Mussey and Haley 1984).

It appears likely that the artisans themselves were the primary vectors for transmission of the verte antique traditions to the United States. Whether Lannuier, Bouvier, Quervelle, and other cabinetmakers actually did their own gilding and verte work seems questionable, since they were trained in a craft environment with severely defined specializations. Further research may shed more light on who actually did the decoration, but this article will refer to the verte antique of Lannuier and Quervelle.

Documentary Sources for Materials and Techniques

The techniques used to create various forms of verte antique are described in a variety of nineteenth-century French, British, and American sources, growing in frequency with time. The 1837 French guidebook, *Nouveau manuel complet du bronzage des métaux et du plâtre* (Fig. 1), deals largely with formulas for chemical patination of bronze, copper, and brass, but also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NOUVEAU MANUEL COMPLET
DU
BRONZAGE
DES MÉTAUX ET DU PLATRE

CONTENANT
les divers procédés de Bronzage des Métaux
à l'Or vrai, à l'Argent, à l'Etain, à l'Or faux
et aux poudres de bronze,
le Bronzage, la Métallisation et la Coloration du Plâtre
et des surfaces non métalliques,

TRAITANT
DES ENDUITS ET DES PEINTURES MÉTALLIQUES
APPLIQUÉS SUR MÉTAUX PAR VOIE CHIMIQUE
Par MM. G. DEBONLIEZ et F. MALEPEYRE

NOUVELLE ÉDITION
REVUE, CLASSÉE ET AUGMENTÉE
Par M. S. LACOMBE.

A PARIS
CHEZ LEONCE LAGET
Libraire-Editeur
75 RUE DE RENNES
1979

Figure 1
This manual includes important historical formulations and precise descriptions of bronze patination colors of the period.

with faux-bronze decorating techniques for metal, plaster, and wood.[4] The forward includes a detailed and important history of the craft (Debonliez and Malepeyre 1887:1–2):

> Bronzing, which forms today one of the bronze manufacturing branches, . . . has only existed as a specialty for forty years, and was not as widespread then as it is today. . . . Up until 1825 only one tint of bronzing was known, which was vert antique or *vert à l'eau* [author's translation: sea green], which . . . sought to imitate, as closely as possible, bronze exposed to corrosion of the weather . . . or again like Florentine bronzes, in which the color was altered by time or interior vapors.

The authors then relate a succession of vogues for chemical patination colors for bronze that followed each other rapidly. These include one they called a "brown green. . . . [T]his color was made more or less green or brown according to the desires of the worker." Other stylish colors are said to be "Lafleur's Florentine bronze, a fumed Florentine tint, of a softer and more elegant color." Then an *artistic verte* predominated, the color of pale green ashes, followed by *bronze medaille,* a later greenish color with yellowish highlights. Still later, blacks with more-or-less reddish highlights were favored, using bronze powder in spirit varnish, followed by a surface dusting of a soft greenish bronze powder that gave the look of the iridescent throat of pigeon.

Work done in blacks and browns then became popular, also a color called *bronzed iron,* which consisted of a black foundation relieved with pewter powder in imitation of the armor of warriors. The authors describe others including a so-called *waxed bronze,* a *leather bronze,* and a *fly-wing bronze.* This last had a black base with highlights of copper powder, with rosy glazes of hematite (Debonliez and Malepeyre 1887:2–5). The descriptions imply that these vogues followed rapidly one after the other, but they may well have overlapped.

They also discuss a method of "bronzing" wood, porcelain, glass, and metal. This consisted of the application of fine bronzing powders of different colors in a 30% solution of an extremely glossy tree resin from an unidentified source, prepared with potassium or potassium silicate (Debonliez and Malepeyre 1887:136):[5]

> After the objects are coated with a thin uniform coating of this glassy solution applied with a small brush, the bronzing powder is dispersed on the objects with a sifter. One allows them to dry completely at a medium temperature of light reheated air, and one then removes the bronze powder with a large soft brush which has not been absorbed by the varnish vehicle. The layer of bronze powder adheres tenaciously to the glassy resin, so that it cannot be removed either by washing with alcohol, ether or water. It lends itself to being polished with a burnisher of agate or steel.

It is unfortunate that the description is not more detailed about specific materials.

It is especially important to note that this guidebook documents that the preference of artists and artisans for faux-patination colors apparently changed radically over time in the intense competition among Paris artisans. This poses great difficulty for conservators and curators in deter-

mining exactly what colors were intended and, by extension, what British and American artisans sought to imitate. Problems with accurate color interpretation are compounded by the difficulty of translating the subtlety of color described in published sources and the change over intervening centuries in the meaning of words used to describe colors.

In the earliest published American reference located in this study, James Cutbush wrote in *The American Artist's Manual* (1814:22):

> Bronze color, in imitation of the metal, is much used by the colourmen of Paris, who prepare two sorts of it, namely the red bronze and the yellow, or golden. The latter is made solely of the finest and brightest copper dust, the former is prepared of the same material, by adding a small portion of well pulverized red ochre. Both are applied with varnishes, to the outside of substances, as gold leaves are in gilding. But to prevent it from turning green, the bronzed work should, as soon as laid on, be carefully dried over a chafing dish.

By this time, there was a several-centuries-long tradition of varnishing metals with tinted "changeing lackers" (usually based on shellac) and baking them at high temperature, primarily to change their appearance to that of a more noble metal. Cutbush's methods clearly derive from this tradition.

An important London book, Nathaniel Whittock's *The Decorative Painters' and Glaziers' Guide* (1827:57), described a technique for imitating antique verte that is actually a marbleizing technique using paint to imitate a superb green marble. Traditional techniques are described for creating a figured ground using variegated white and black pigments in oil or distemper, with varied overglazes of Prussian blue, raw sienna, and lead white pigments in oil. Alternate glazes in distemper (animal-glue medium) are described. Both were to be followed by second glazes of whiting ground in milk, and dark veins in Prussian blue.

Whittock's ensuing discussion of the mineral green pigments then commercially available is important for this study (Whittock 1827:12):

> All the mineral greens [verdigris and other copper greens] are worked with great difficulty in oil, as they are not opaque colors, and require to be mixed with white lead to give them body. The minerals in both of these oppose each other, and in a short time destroy the work [i.e., react chemically, darken, discolor, and degrade]. Greens both in oil or water colours are therefore best formed of mixtures of yellow and blue that agree together in their bases [are chemically compatible].

For this reason, we probably cannot expect to identify mineral green pigments in work by experienced artisans.

Pilkington gives a similar set of directions for creating a simple painted imitation of "patina antique" on wood (1856:21). "For bronzing sculptures of wood, plaster figures and C. [etc.] a composition of Yellow Ochre, Prussian Blue, and Lamp Black, dissolved in glue water, is employed."

The most important and complete American source located to date is *The Painter, Gilder, and Varnisher's Companion* (1836:121), based on earlier London editions. The editor and publisher, William Jackson, in discussing "bronzing," stated:

> Bronzing in wood may be effected by a process of mixing Prussian Blue, Pale Yellow, Raw Umber, Lamp Black, and Pipe Clay ground separately in water on stone and as much of them as will make a good color put into a small vessel three-quarters full of size, not quite so strong as clean size. This mixture is bound to succeed best on using about half as much more pipe clay as any other ingredients, the wood being previously cleaned and smoothed and coated with a mixture of clean size and lamp black, receives a new coat of the above twice successively. Afterwards, the bronze powder is laid on with a pencil [small brush] and the whole is burnished or cleaned anew observing to repair parts injured by this operation. Next, the work must be coated with a thin layer of Castille soap to remove the glare of the burnishing and afterwards rubbed with a soft woolen cloth.

Copal varnish is then to be used as a protective coating. Note the similarity of the pigmented ground coating to gilder's bole, and the use of burnishing to create a smooth, metal-like surface. This set of techniques clearly derives from gilders' traditions.

The author of this text described in detail the making and preparation of gold, copper, and bronze powders. Less familiar to conservators today than these powders is *Aurum Mosaicum* powder. The author states that (1836:75–76):

> Aurum Mosaicum [mosaic gold] is used for inferior articles; it is prepared in the following manner; a pound of tin is melted in a crucible and a half pound of purified quicksilver [mercury] is added to it. When this mixture is cold it is reduced to a powder and ground with half a pound of sal ammoniac and seven ounces flower of sulpher till the whole is thoroughly mixed, they are then calcined in a matrass [a specially shaped glass reaction vessel of the period for mixing chemicals]; and the sublimation of the other ingredients leaves the tin converted into the Aurum Mosaicum, which is found at the bottom of the glass like a mass of bright flaky gold powder.

The above documentary sources are diverse in origin. The increasing frequency of publication of instructions and formulas as the nineteenth century progressed makes it clear that verte antique and faux bronzing in different media gained widespread popularity as a decorative technique for imitating true chemical patination on metals. These formulations and materials appear to derive from at least three well-developed artisan traditions: the metal lacquering trade, with baked-on, tinted varnishes; gilding traditions, which used gesso, pigmented animal glue–based bole, gold and metal powders, and burnishing; and faux graining and marbleizing traditions, with many thin layers of variably pigmented paints and glazes.

Interpretation of Historic Verte Antique Coatings

Curators, conservators, collectors, and students familiar with the materials described here will understand why relatively few original verte antique coatings remain, and even fewer remain in good condition and with a reasonable resemblance to original appearance. Although current interest in the techniques has led to increasing discoveries of extant original materials, such finds are relatively rare, which is a primary reason so little research and only one publication to date have focused on the subject.[6]

The principal cause of degradation of most coatings is the unstable nature of the materials themselves; many are inherently fragile or

chemically unstable, either alone or in interaction with each other. The organic pigments used, such as indigo and yellow lakes, may be inherently fugitive and unstable. Bronze- and copper-based pigments tarnish and darken, even when bound in a pigmented or clear coating. Varnish resin and animal-glue binders darken and become brittle. Also, coatings with an animal-glue binder are especially vulnerable to any exposure to water. These forms of degradation and associated losses are often obscured by old restoration attempts, few of them sensitive to original materials or appearance. Restorers frequently overpainted original gold powders with cheap bronze pigment "radiator paint," black-pigmented shellac, or applied oil gilding to cover underlying damage to more fragile water-gilded surfaces. As original materials darkened with age, each generation of collectors and restorers assumed ever darkening misconceptions of original intent. They darkened their restoration coatings accordingly—partly to match their mistaken assumptions, partly to help disguise losses and surface defects.

Gaining a better sense of original surface intent requires intensive examination of a variety of decorated surfaces that retain some portion of their original coatings, technical examination to understand the complex materials and layering used by the artisan in each case, and extrapolation from current darkened, degraded surfaces back to probable original appearance. Some educated guesswork is inevitably required in this process.

Technical Investigations

The following case histories will illustrate that the variety of techniques and materials found relate closely to the historical literature cited. Examination and analysis included intensive visual examination; solvent testing; fluorescence and visible-light microscopy of finish samples; use of fluorescent indicator stains, where appropriate; and, in one case, technical pigment identification. No technical testing was carried out to differentiate true gold from copper or tin alloy–based ("bronzing") metal powder pigments. Spirit varnishes were identified by their characteristic white or off-white autofluorescence and rapid solubility in ethyl alcohol, both in areas on the object itself and in samples on the microscope stage. Many of the resin layers were confirmed with a fluorescent indicator stain. Additional technical analyses to identify specific resins, resin mixtures, or other binders were performed in one case only.

The layering sequences in the following cases are indicated, with "a" as the lowest layer.

Figure 2
One of a pair of tables labeled by Charles Honoré Lannuier, New York, 1805–15 (private collection).

Case 1

A pair of Classical Revival card tables, both with a label of Charles Honoré Lannuier, was selected for examination, as many of the verte antique surfaces appeared to be relatively undisturbed, except for some restoration on the gilding (Fig. 2). The tables were passed down to the descendents of the original owner. The caryatid figures combine water and oil gilding, with verte antique decoration on the claw feet, ankles, and tapering caryatid body.

Original verte antique layers

a. Gesso (rabbit-skin glue based)
b. Oil-based paints of varying dark green, brown, and black colors, applied simply by padding on irregularly with a textured

rag. (The texture is plainly visible without magnification. No gold or metal powders were used.)
c. Natural resin spirit varnish as a sealing coat. (The resin or resin mixture was not identified.)

No further analysis was carried out.

These specific techniques and materials have been found by the author only on this pair of tables by Lannuier, although others may exist.[7]

Conclusion

Lannuier's relatively simple technique of ragging thinly pigmented varicolored oil paints onto a gesso ground seems to fall into the faux painting tradition best illustrated in Whittock (1827).

Case 2

A series of finish samples were studied from a Classical Revival sofa with feet carved into dragons' heads, then decorated with verte antique and gilding. Other elements of the sofa include gilt stenciling and carving. Long attributed on the basis of family descent to prominent Providence cabinetmakers Joseph Rawson and Son, its secondary woods, carving, and finish suggest it was more likely to have been made in Philadelphia (ca. 1815–25). The sofa was selected as a superb example of verte antique in apparently original condition, although the surface is markedly darkened. Based on unaided visual inspection, decoration consists of green base paint; gold or bronze powder on protruding highlight portions of the carving; and final transparent, lightly pigmented overglazes. The dragons' mouths and ears are painted red.

Original verte antique layers on dragons' heads, based on ultraviolet (UV) microscopy of eight samples

a. Clear spirit varnish sealer[8]
b. Spirit varnish–based pigmented coating (blue, yellow, green, umber, deep red)
c. Spirit varnish size
d. Scattered, discontinuous gold (or bronze) powders laid directly on the sealer-size. (It was found only on highlight portions of the carvings. In some areas it appears more uniformly dense and very thin with metal flakes closely overlapping, as though the powder had been burnished after application and drying.)
e. One or two layers of lightly pigmented spirit varnish, tinted with brown, dark red, and black pigments. (It was not analyzed further. The pigmented tinting glazes are discontinuous, with considerable variation in thickness and number of coats from location to location. This probably indicates the artisan was dabbing on variably colored layers of thin varnish-glaze to give a patinated appearance and to tone down the reflectivity of the burnished metal powder.)
f. Sealer coat of clear resin spirit varnish

Layers in a dragon's mouth, based on microscopy of two samples

a. Clear spirit varnish sealer coat

Figure 3
Pier table attributed to Anthony Quervelle, Philadelphia, ca. 1815–25 (collection of Randall Scrimsher). Verte antique was re-created based on extensive microscopy of samples of remaining original finish on this and the second of the pair at the Winterthur Museum.

b. Green-pigmented spirit varnish paint
c. Clear spirit varnish sealer
d. Deep red–pigmented spirit varnish, with extensive metallic powder mixed randomly throughout the entire thickness of the layer
e. Clear spirit varnish sealer

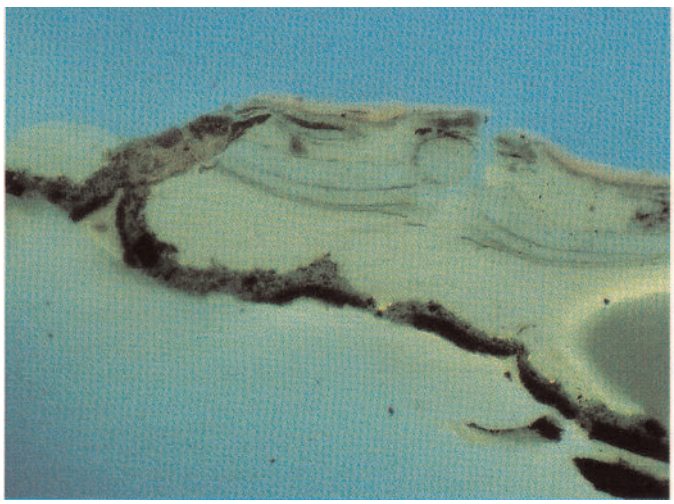
Conclusion
The spirit-soluble resins used in every layer meant that the artisan could work quickly, since each layer dried rapidly. The materials and techniques are quite similar to Philadelphia work of the period analyzed by the author; and the design, carving, and secondary woods strongly suggest it is a Philadelphia-made sofa, despite the attribution to the Rawsons. The use of metal powder mixed with other pigments in the red paint is singular in the author's experience, but may represent a common period technique. It was probably intended to give sparkle and additional golden brilliance. Future researchers should look for its presence in other examples.

Case 3

A Classical Revival pier table from a private collection was examined and treated by the author (Fig. 3). This elaborately decorated piece is attributed to Quervelle, based on stylistic similarities to labeled and documented examples of his work. The other table of the pair in the collection of the Winterthur Museum has identical decorative motifs.[9]

Before treatment by the author in 1991, the verte antique portions of the dolphin supports and the pilasters generally were extremely dark, with black-pigmented coatings over gilded highlights. Extensive preliminary investigation revealed that the dolphins and leafage had been entirely stripped of original finishes, and only the feet retained their original verte antique decoration essentially intact (Fig. 4).[10] Microscopy of a second series of samples from the feet revealed the strata and character of the original coatings, which compared very closely to samples of undisturbed original finish on the other table.

Figure 4
A typical finish sample cross section of original verte antique coatings from a foot of the pier table in Figure 3. The magnification is ×200 on an ultraviolet microscope. From the bottom up: two-layer base coating of green pigmented paint in natural resin binder; scattered flakes of gold powder directly on the upper paint surface; thick, white-fluorescing midzone, composed of five to seven thin layers of natural resin varnish-glaze, with thin pigmentation on some upper layer boundaries; discontinuous dark pigmented restoration overpaint; and clear shellac coating, fluorescing light orange.



Original verte antique materials, based on UV microscopy of forty samples

a. Two layers of green-pigmented paint in a spirit varnish vehicle. (The darker green bottom layer was applied evenly, and lighter green applied in varying thickness over it.)
b. Clear spirit varnish size
c. Gold powder on highlights only. (It was discontinuous and irregular, applied directly to the surface of the underlying spirit varnish. This was not found in recesses or background areas.)
d. One to five layers of thinly pigmented glaze in a spirit varnish vehicle (dark red, umber, blue, and yellow pigmentation), applied irregularly
e. Clear spirit varnish sealer

Conclusion

The variegated and mottled green base coats with gold powder dusted irregularly on the surface, sometimes burnished on high points to create smoother, glossier gold highlights, would have more accurately simulated natural wear on bronze statuary. This is the most sophisticated and complicated decorative scheme analyzed in the study, but it appears to be typical of Philadelphia work in the exclusive use of spirit-soluble coatings. The actual original appearance of the mottled green base coats was dramatically lighter and more intense in chroma than is visible in the degraded coatings on the other table in the pair.

Case 4

Other historical techniques are represented on a Grecian sofa made in New York (ca. 1815–25). It is an example of the finest work of the period, featuring carved paw feet and legs with verte antique decoration, gold stenciling, and water and oil gilding.[11] Examination of the sofa indicated that all gilded and paint-decorated surfaces were covered with a thick layer of restoration bronze-pigmented paint that had discolored and considerably darkened. UV microscopy revealed that original verte antique and gilt layers were surprisingly intact under these restoration coatings.

Extant original materials

a. Gesso, with a protein binder (probably rabbit-skin glue)
b. Base paint, water soluble, with black and green pigments (probably including considerable clay content)
c. Gold powder
d. Clear spirit varnish, probably original

Conclusion

The verte antique decoration is simpler than the Quervelle example above. The overall techniques and materials derive from gilders' traditions and are most similar to those described in *The Painter, Gilder, and Varnisher's Companion* (1836), and they are most frequently found in the work of New York artisans.

Case 5

Variations on bole-type verte antique are illustrated by a drop-leaf sofa table attributed to Charles Honoré Lannuier, in the collection of the White

House, Washington, D.C. The design incorporates two gilded-winged caryatid supports with verte antique bodies, legs, and paw feet, with scrolled leafage on the legs and gilded monopodium terminals. Examination revealed that all surfaces had extensive restoration painting and gilding with diverse materials that obscured the varied and sophisticated original coatings. Extensive initial microscopy confirmed that the legs and feet had lost most of their original verte antique coatings; however, enough remained to allow accurate characterization of the decoration.

Original materials, based on UV microscopy of twenty-eight samples

a. Gesso, animal glue based
b. Two to three layers of water-soluble distemper paint (probably with extensive clay inclusions); dark green on the body, black-brown with green on legs and feet. (Colorants on the body identified were indigo, orpiment—a yellow arsenic trisulfide—and possibly a yellow lake. Original surfaces were too damaged to establish whether the surface had originally been burnished.)
c. Gold powder, sparsely applied
d. Clear spirit varnish sealer

Conclusion

The layers again represent gilders' techniques for creating verte antique through the use of a modified, pigmented gilders' bole and gold powder. Originally, they probably were selectively burnished to further define the surface. Lannuier's use of two different colors of bole (dark green for the body, black for the legs), coupled with traditional water and oil gilding and pierced metal inlay, is reflective of his familiarity with French prototypes.

Case 6

A worktable with both a brand and a label of Samuel Carter, New York, in the collection of the White House, represents possibly the simplest verte antique treatment found to date. The overall original surface decoration includes highly refined and developed metal powder stenciling on various surfaces, including the turned central support shaft and colonnettes that support the case top. Original verte antique decoration remains on the legs and carved paw feet.

Examination revealed that considerable flaking and loss of layers had occurred on the legs. To hide the losses, the entire table base had been varnished with a black-pigmented coating, probably shellac. Although not totally opaque, the coating largely obscured the delicate stenciling and faux-bronze decoration.

Original materials, based on UV microscopy of ten samples and on solvent tests

a. Clear spirit varnish (not covering all surfaces)
b. Green paint in a spirit varnish medium
c. Clear spirit varnish sealer. (This layer is uneven and does not cover all areas of the green base paint.)
d. Gold powder applied sparsely and unevenly only on the highlights of the legs, feet, and claws
e. Thinly pigmented spirit varnish glaze
f. Clear spirit varnish sealer

Gilded stenciled areas were created with similar materials, except that the green underpaint was omitted, and two to three different colored metal powders were used to create depth and a modeled definition of the pattern.

Conclusion

This example, the latest in origin of all the pieces examined, suggests that by 1830 artisans in New York had simplified verte antique techniques and materials to permit economy of production.

Conclusion

Interest in connoisseurship, documentary history, and intensive technical study of verte antique is a relatively recent trend. The historical sources and the cited case studies clearly indicate that verte antique, or *bronzage,* is not one technique or set of materials but derives from many different artisans' traditions. It differed widely among artisans and regions, often involving a complex buildup of many layers of different materials. This complexity is further compounded by later restorations, as most original verte antique decorative surfaces have restoration overpaints or coatings (Fig. 5).

Conservators, curators, and collectors will understand that we have achieved merely an initial understanding of the variety of historic verte antique techniques. Tremendous variations in techniques and materials seem to have been the rule. Each case presents a new discovery of technique or material, or a variation on those already known; therefore, each must be studied in depth before conservation treatment can begin. It is hoped that this study will form a brief framework for examining other examples of verte antique decoration, and that it will be expanded and deepened by future researchers in order to broaden our understanding of these stunning historical decorative techniques.

Acknowledgments

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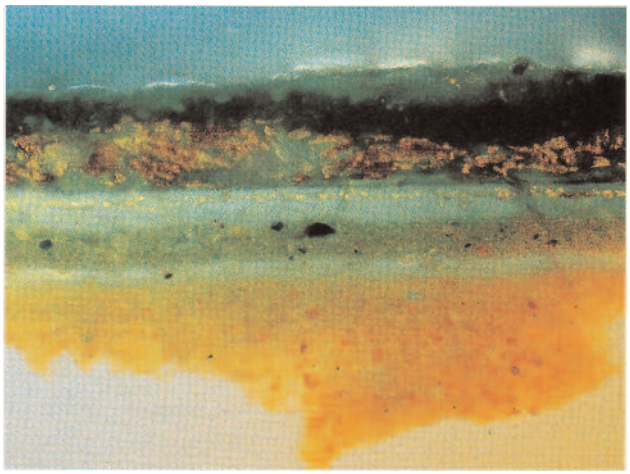

Figure 5
A cross section from a Classical Revival card table with a carved and verte antique decorated eagle base. Attributed to Charleston, South Carolina, ca. 1820–30 (Collection of Randall Scrimsher). In this sample, original coatings include, from the bottom up, yellowish grain filler/ground coat, composed of a drying oil with coarsely ground silica sand; thin layer of natural resin varnish-sealer with light bluish white fluorescence; green paint, composed of yellow, blue, and dark red pigments in a natural resin vehicle; two-zone layer of natural resin varnish size, again fluorescing bluish white, with gold powder in the center. Later restoration coatings follow: extremely thick coating of bronze pigment overpaint; two-zone layer of green paint.

Allman, Michael Flanigan, Randall Scrimsher, Brian Considine, Alfonso Narvaez, Stuart Feld, and Wendy Cooper. Librarians at the following institutions gave invaluable assistance: the Fine Arts Library at Harvard University; the Dibner Library of the Smithsonian Institution; and the Rare Books and Manuscripts Library at the Winterthur Museum.

Notes

1 While Pilkington refers to a chemical patination produced by natural processes, his imitative techniques employed pigments, varnishes, and metal powders.

2 There is extensive but scattered literature on Lannuier. An upcoming (1998) exhibition and catalogue at the Metropolitan Museum of Art in New York will focus on this important craftsman.

3 Quervelle's work is summarized in Smith (1973; 1974a; 1974b).

4 Augmented editions were also published, including the 1887 edition cited here. (The author's translations of this text are used throughout.) A reprint of this title was published by Leonce Laget (Paris) in 1979.

5 "M. Bottger" is said to be the authors' source.

6 There is only one recent publication in the conservation or art historical literature (Loescher 1994).

7 The author has examined approximately three dozen pieces to date.

8 Most spirit varnish recipes of the period called for a mixture of spirit-soluble resins, including shellac in various forms, copal, dammar, mastic, animé, and sandarac. The term *spirit varnish* is used in this generic sense (a resin mixture), without further attempt to identify the specific resin or resins used. For a complex history of spirit varnish formulations, see Mussey 1987.

9 The author extends special thanks to the owner, Randall Scrimsher, and to Michael Flanigan. Gregory Landrey of the Winterthur Museum generously shared his insights and written report on microscopic examination of the museum table and provided finish samples for further microscopy by the author. Both tables are illustrated in Cooper (1993:150–51).

10 During examination, a scrap of newspaper with the date 1973 was found hidden on the rear of one leaf bracket. Restoration was probably done just prior to the table's publication on the cover of the magazine *Antiques* May 1973, 103(5) .

11 This sofa is in the collection of the Baltimore Museum of Art (Acc. #BMA 1991.147), and is illustrated and discussed in Cooper (1993:124–25). It was examined and conserved by Christine Thomson and Susan Buck at the Society for the Preservation of New England Antiquities, Waltham, Massachusetts. Comments in the text are based on their generous sharing of records.

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An Investigation of the Nature of Paint on Wood Objects in the Indigenous Southwest of North America

Nancy N. Odegaard

The southwest of north america is a region of great environmental diversity and vast distances. In general terms, its boundaries approximate the present-day states of Arizona and New Mexico in the United States, and Sonora and Chihuahua in Mexico. Environmental variability produced varying cultural responses, and the diverse forms of material culture associated with a great number of cultural subdivisions are representative of cultural adaptations to particular geographic features and ecologies found within the region. A critical environmental characteristic is precipitation, which comes mostly in the later summer months. The brief but intense thunderstorms and heavy runoffs of water are vital to life in this region. A cultural concern with water that is bound to the origin, history, and future of the people is also reflected in the raw materials and technologies used in painted wood objects.

Anthropologically, this part of the continent is well known. There are both an extensive archaeological record of the inhabitants that predates the time of European contact in the sixteenth century (Fig. 1) and an equally rich ethnological knowledge of the distinctive cultures

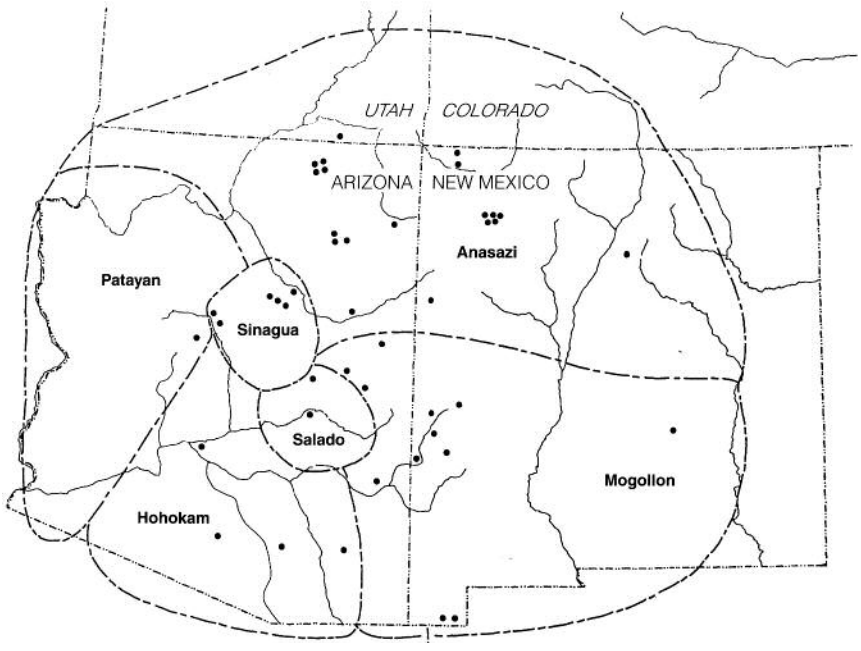

Figure 1
Prehistoric cultures and archaeological sites where specimens of painted wood have been recovered in the Southwest.

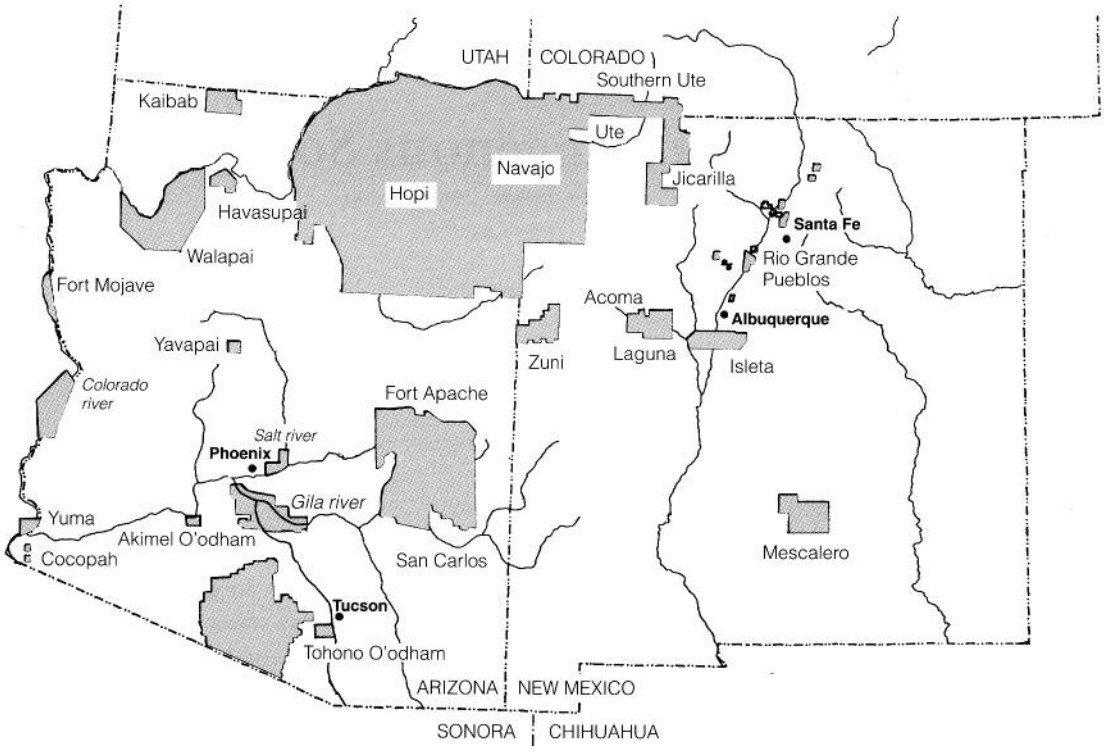

Figure 2
Indian reservations and villages of the Southwest.

that survived through Euro-American contact times to the present (Fig. 2). Comprehensive conservation studies of material culture from the Southwest region generally require the consideration of both archaeology and ethnology regardless of the designation or provenance of the object.

A Tradition of Painting

Evidence exists for a long-standing and highly skilled tradition of paint making in the Southwest. Archaeologists have recovered quantities of prepared mineral pigment and have observed paint associated with surface decoration on rock art, ceramics, textiles, basketry, and wood. However, much of the processing and application technology for early paint remains unknown. The typical tools recovered for paint grinding or mixing include stone palettes, mortars, mullers, and other flat grinding stones, in addition to pebbles, sticks, and pieces of actual mineral pigment. While any flat-surfaced stone may have been used as a palette, formal studies focusing on the ground stone artifacts related to pigment/paint manufacture from this region are relatively recent and few in number. Such studies may clarify pigment processing and binder and vehicle technologies, in addition to expanding further on our knowledge of paint application methods.

Preservation of a wide range of organic artifact materials is possible in the Southwest because of the extreme aridity found in dry caves and rock shelters. Organic-based prehistoric artifacts, such as painted wood, fall under a material class often referred to as *perishables* by archaeologists. Examples of preserved organic remains in the region date from around 9000 B.C.E. onward. Numerous complete and fragmentary examples of painted wood objects have been systematically recovered from archaeological sites throughout the Southwest region. Also obtained through archaeology are organic-based tools used in applying paint, including dauber fragments of textile and fur, twisted grass and yucca or agave leaf brushes, and worked sticks. In general, however, archaeologists working in

the Southwest have not carried out extensive studies of organic materials because of inadequate recovery tools, techniques, and conservation expertise that would prevent object loss during the excavation process.

Cultural Issues and Ethics

When considering the nature of paints, it is clear that the relationship between any surface coating and its substrate is extremely important. Obviously, the physical requirements of paint that is formulated for application to wood is different from that for other substrates, such as rock, animal skin, or ceramic. Conservators should remember that while the use of certain pigments and binders may be associated with a culture, they may or may not be associated with use on wood. Trader Mark Bahti (1993) has observed that there seems to be a cultural logic in indigenous painting that follows a "like with like" in the manufacture of objects. From this perspective, an animal-based binder media would not harmonize with a wood substrate.

There are also cultural differences in the method of paint application, the way in which the paint cures, the preparation of the substrate, and the conditions of object use. For example, Hartman Lomawaima (1994), a Hopi scholar, has noted that some Pueblo objects are specifically painted more carefully, using finer materials and techniques, and that these objects are given special care that ensures their preservation. For this reason, many religious objects are said to remain in "perfect" condition after several centuries of use.

Another consideration is that some objects that are made to be "used up" do not share these same permanent paint characteristics. For instance, gifts such as kachina dolls given to Pueblo children are traditionally used in play and therefore experience a use wear that is foreseen and expected. The loss of the paint may even hold spiritual meaning; for example, the flaking of blue paint in some cultures symbolized the falling of rain (Lomawaima 1994). In earlier times, it was not uncommon for such items to be collected and repainted after they had worn out or been discarded (Sekaquaptewa 1993). Also, kachina dolls and other painted gifts of the Kachinas may be taken from a child secretly, freshened up, and then returned. This process helps remind the child that the Kachinas are always with them (Lomawaima 1994).

There are meanings and restricted uses for the natural materials that make up cultural objects; these differ depending on the context in a particular culture or in a particular activity. In the manufacture of painted wood objects, there are many examples where the artist's ability or memory, convenience, and materials at hand have resulted in aspects of technological change (Dockstader 1985). It would seem that cultural traditions may be respected and at the same time be flexible.

With greater attention from scientific investigators and collectors around the turn of the century, Indian groups in the Southwest were encouraged to increase the quantity and change the quality of their manufactures. Many ethnologists requested that legitimate duplicates or replicas be made of worn-out, obsolete, or unavailable specimen types; this practice created objects that were not made for their original purpose. Instead, more emphasis was placed on aesthetic appeal and salability (Dockstader 1985). Today, the creation of many forms of painted wood specifically for commercial use allows many Native American men and women to make a living.

A Continuous Record of Painted Wood

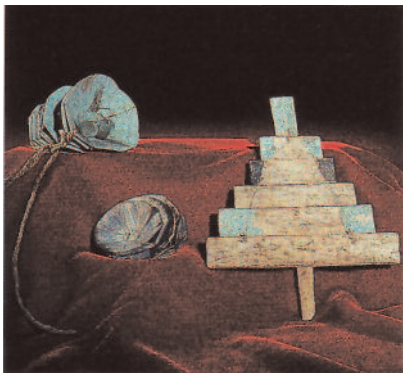

Figure 3
Painted wood flowers and terraced object from the Bonita Creek cave site, Arizona. Arizona State Museum.

An argument for continuity of a painted wood tradition in the Southwest is supported by discussion of painted wood objects in archaeological reports, by references to painting in the early Spanish documents of the seventeenth and eighteenth centuries, and by Euro-American ethnographic studies made since the late nineteenth century. Parallels between precontact trade traditions and the oral histories of various indigenous groups have also been used to propose links of common history and common material culture between the prehistoric and historic peoples of the region. Evidence for a record of continuous use of paint on dance and ceremonial masks, prayer sticks, and altar paraphernalia exists throughout much of this region.

Most of the archaeological examples of painted wood in museum collections are fragmentary and require extensive comparative studies to adequately classify form and function. Some of the earliest examples of painted wood objects include miniature bows and arrows, painted wood tablets, baskets, flutes, reed dice, carvings, and bull-roarers. Slender painted sticks (sometimes called *pahos*), in particular, are fairly common in Southwestern sites. Composite forms, such as wooden staffs, bird shapes, terraced objects, wands, and flowers are later examples, but references to them exist widely in both the archaeological and ethnographic records. A survey of ethnological painted wood object types includes drums, sticks, wands, bull-roarers, kachina dolls, masks, baskets, figures, noisemakers, headdresses, gaming pieces, violins, flutes, and bows and arrows.

There are a number of similarities and differences in painted wood technology in the various culture areas defined within the Southwest region. The following review summarizes the consistencies and variability. The greatest number of archaeological painted wood specimens comes from the Mogollon culture area. Most of the preserved specimens have been recovered from dry caves found along the mountainous drainages of the Gila River and its tributaries in southeastern Arizona and southwestern New Mexico. The artifacts are typically constructed of thin laths cut and smoothed from the dry bloom stalk of agave, yucca, or sotol plants (Fig. 3). Examples of Mogollon painted wood generally postdate 700 C.E. The flat laths may be modified with cut holes or slots, notches, or tapers and may be decorated on one or both sides. Composite objects are usually constructed of laths stitched together with sinew or fiber to form terraced objects, flowers, feathers, or bird wings. Masked human effigy forms are also reported. The use of adhesives and binders such as mesquite gum and an unidentified reddish pitch has been reported with specimen descriptions (Cosgrove 1947:24, 2; Wasley 1962; Hough 1914).

Since the 1500s, the prehistoric Mogollon region has been the home of the Chiricahua, Western, and Mescalero Apache peoples of the Athapaskan language family. Traditional Apache objects of painted wood include basketry, puberty canes, arrows, crown masks, and wands. The upright sections of the crown masks and wands were usually constructed of thin slats of yucca or sotol bloom stalk, secured with fiber ties. A variety of paints and binders were used. Pinyon pitch is reported to have been used along with paint on arrows and in the coating of baskets; the juice from yucca leaves has been used with charcoal, and the juice of roasted agave with red pigment (Opler 1965; Tanner 1982).

Artifacts of painted wood from the Anasazi or Ancestral Pueblo area were often carved and smoothed from thin boards or slabs of soft woods, such as pinyon pine, Douglas-fir, or cottonwood. Reported artifacts

generally date from the Pueblo III period (1100–1300 C.E.). The flat carved surfaces may be decorated on one or both sides; and effigy forms, including birds, dragonflies, and human faces, are recognizable by the use of paint color and outline. Composite forms are usually joined with fiber ties or sinew. Vivian observes that "the concept of assembling flat carved pieces to produce three-dimensional representations of life forms and other symbols appears to be a successful adjustment to the material, rather then a limitation imposed by it" (Vivian, Dodgen, and Hartman 1978:17). Paints appear to have been primarily applied after construction or assembly of pieces in composite forms. Pinyon pitch and mesquite gum are the reported adhesives; while a range of binder sources has been surmised, only pinyon resin has actually been identified in archaeological materials (Vivian, Dodgen, and Hartman 1978; Kidder and Guernsey 1919; Bandelier 1892).

When the Spanish entered the area of northern Arizona and New Mexico in the sixteenth century, they found farmers who lived in multiroom structures, or pueblos. The Pueblo peoples include the Hopi, Zuni, and Acoma, as well as several groups to the east, often referred to collectively as the Rio Grande Pueblos. Extensive ethnographic, linguistic, and material culture studies have been carried out with these groups since the end of the last century. The tradition of paint on wood is extremely rich among these people. Painted wood objects are represented by many forms, including headdresses, effigies, ceremonial altars, wands, prayer sticks, and dolls. Larger items are usually made of cottonwood root (*Populus fremontii*) or red cedar (*Juniperus communis*), and prayer sticks have been derived from a wide variety of woody plants. Slats may be cut from yucca (*Yucca* sp.) or sotol (*Dasylirion wheeleri*) flower stalk and are often assembled with fiber ties. Many painted wood objects have a white ground layer (kaolin) below the pigmented layer, and the paint has a characteristic matte appearance. The reported adhesive, varnish, and binder media used with painted wood include yucca leaf juice (*Yucca angustissima*), yucca syrup (*Yucca baccata*), pinyon resin (*Pinus edulis*), and masticated seeds (Cucurbitaceae) (Hough 1902; Parsons 1939; Stephen 1898; Stephen 1936; Stevenson 1904; Stevenson 1915).

Few painted wood specimens have been recovered from sites in the Hohokam prehistoric culture area. A notable exception is a group of six wooden artifacts found in central Arizona and believed to date from a Salado occupation before 1400 C.E. (Haury 1945). The well-preserved and nearly complete figures include four effigy *pahos* made of agave stalk and one masked effigy carved of cottonwood. Many archaeologists believe that a tradition of painting on wood among the Hohokam may be inferred because of the abundant amount of pigments and palettes recovered (Haury 1976).

The Tohono O'Odham and Akimal O'Odham presently inhabit the lower desert area of the Southwest region. Painted wood traditions include basketry, bows and arrows, masks, bull-roarers, calendar sticks, effigies, wands, prayer sticks, and bowls. Reported wood sources include saguaro ribs (*Carnegiea gigantea*), gourd (Cucurbitaceae), pine (*Pinus* spp.), ocotillo (*Fouquieria splendens*), and greasewood (*Sarcobatus vermiculatus*). The adhesives and binders traditionally used include mesquite gum (*Prosopis juliflora*) and an insect lac (*Tachardiella larrea*) that is found on the creosote bush (*Larrea tridentata*) (Castetter and Underhill 1935; Ebling 1986; Lumholtz 1976; Sutton 1990).

Examples of painted wood from the prehistoric Sinagua culture area include carved and painted sticks, thin pieces of shaped wood, and bows and arrows. The reported examples generally date from the Pueblo II period (900–1100 C.E.). The colors and designs appear to be similar to examples from the Gila region of the Mogollon area. Characteristic of some composite forms is the use of dowels for attachments. While an absence of binder use is inferred with some pigments (Barnett 1974), insect lac (*Tachardiella larrea* or *T. fulgens*) is identified with the mixing of pigment (McGregor 1943; Sutton 1990).

Unfortunately, few prehistoric Patayan (or Upland Hakatayan) sites provide information relative to the study of paint on wood. Generally, only pieces of pigment alone or small fragments of decorated wood are reported in the archaeological literature. Likewise, there is equally little documentation for the painted wood manufactures of the Yuman language speakers who currently reside in the delta, river, and upland semidesert areas associated with the Colorado River. Bows, arrows, war clubs, and baskets were the wood objects traditionally painted. Pinyon pitch, mesquite gum, and sunflower seeds are referenced in association with the paint technology of several groups (Kniffen et al. 1935:42; Cushing 1965; Sayles and Sayles 1948).

Pigments and Colorants for Wood

The archaeological and ethnographic literature suggests that until the end of the nineteenth century, most painting done by the indigenous cultures in the Southwest was and is associated with religious ceremony. In many of these cultures, color selection is of critical importance, and its use on objects is guided by specific references to the points of direction. In general, paint appears to be the most important form of surface embellishment used to decorate wood. Parsons (1939) explains that for many Indians there is power in paint and that the use of pigments has the effect of completing or "making sacred." Some of the more common characteristics of painted surfaces from this region include color areas that tend to be separated by definite lines; colors that are not blended or mixed; and paints that are usually applied in uniform thickness.

It appears that most paints are made with ground inorganic mineral pigments, but may also be used as natural fragments or may be processed into a stick or pebble-like form. Unfortunately, archaeological and ethnographic sources that discuss painted wood objects are rarely based on actual chemical or analytical identification of the pigments. More often, object descriptions include a visual reference to color and presumed pigment identification (Table 1). Further research is required to identify the pigments on specimens and to determine which pigments are ground with specialized tools, which are pulverized and washed with water, and which are soft enough to be used in their natural state.

At times, mixtures of inorganic and organic materials may also be used to produce paint. Some examples include gray-blue—charcoal with white clay; and blue—indigo mixed with a fine-grained sandstone or sandy chalk rock.

Binders

To make paint, some pigments and organic colorants can simply be rubbed down on a grinding stone with a little water. Others require the use of a binding media or nonvolatile film-forming material that will hold

Table 1 Commonly referenced inorganic pigments and organic colorant sources

Inorganic Pigments

Color	Source
red	hematite (anhydrous ferric oxide) cinnabar, vermilion (mercuric sulfide)
green	malachite (basic copper carbonate) chrysocolla (copper silicate)
blue	azurite (basic copper carbonate)
yellow	limonite (hydrous ferric oxide)
white	kaolin (hydrated alumina silicate) gypsum (calcium sulfate dihydrate) chalk, caliche, whiting, lime (calcium carbonate)
black	magnetite (ferric oxide) pyrolusite (hydrated oxide of manganese) lignite coal
iridescent agents	quartz (silicon dioxide) sphalerite (zinc sulfide) galena (lead sulfide) specular hematite (micaceous iron oxide)

Common Organic Colorant Sources

Color	Source
black	charcoal, mesquite bark, corn smut, burnt corn, Rocky Mountain beeweed, coffee
brown	walnut juice, pinyon gum
yellow	flower petals, corn meal, bean meal, cattail, pollen
red	mountain mahogany root, purple corn water with sumac berries and potato clay

the pigment particles together for application as a paint. One of the problems associated with trying to understand the nature of indigenous paint in the Southwest is that, typically, few details about the quality of paint and painting technique are reported. The fact that chemical and analytical identifications of organic binder materials are difficult may partially explain why most archaeologists and ethnologists working in this region over the past hundred years have carried out relatively little analysis of painted wood objects. The terminology used is generally inconsistent and reflects the popular language used at the time a study was made. For example, use of the terms *pitch, gum, resin, rosin, sap,* and *lac* are somewhat interchangeable in much of the literature. An understanding of the physical condition of a given painted object is facilitated by a general knowledge of the classification of the binder.

Pinyon exudate is widely reported in the archaeological and ethnographic literature for use as a coating for waterproofing, as an adhesive for mosaic inlay and repairs, as an ingredient in the preparation of certain dyes, and as a binding medium used with pigments for paint. As a binder, pinyon exudate is most commonly referenced with the copper ore pigments. It is usually indicated by a dark brown color and lustrous surface. Though commonly called *pinyon gum,* the exudate is actually a resin (that is, it is insoluble in water and it is capable of melting when heated). Four species of pines may be called *pinyon.* However, most commonly, the

resin is obtained at the natural wounds in the *Pinus edulis* tree, where it appears as a white, opaque, sticky, crystalline mass or as darker pelletlike drippings exuding from the wounds. The exudate or resin consists of volatile oils (sesquiterpenes) and rosin (solid material). The tree grows at intermediate elevations of 1800–2100 m.

The traditional use of pinyon is noted by numerous ethnologists. A process for using pinyon with pigment at Hopi has been described by Stephen (1936:1191–93).

> The piñon gum is gathered from the woods, and heated on a fire. Water is added and the mixture stirred as it comes to a boil. After the gum has melted and boiled for eight minutes it is poured over a sieve. Horse tail hair lays over the sieve (prior to horsehair, sheep's wool was used and prior to that fine yucca fiber was used). The gum strains through the hair and coagulates in the water below. Pieces of green copper carbonate are beaten and rubbed with a rubbing stone into a pulp. Some gum/water is added and mixed together. The liquid is sponged up and pressed out in a small basin. The stiff but pliable gum is kneaded between the hands like stiff putty, it is pulled and twisted and pulled until it becomes a soft glistening whiteness. It is dipped into the gum water and then placed in a new pot of water over a fire. As the water heats, the gum softens and melts. The ground pigmented pulp is added before the water boils. The mixture is stirred as it comes to a boil. The longer the mixture boils the darker and thicker the sediment gets. After cooking, the jar is removed from the fire, the water is poured off and fresh water is poured in to cool the pulp/sediment. Working the hands in cold water, a cake is formed.

Also useful from the perspective of cultural context, is Stephen's note (1936) that it would be evil to use a substance that had been boiled for prayer sticks, indicating that this paint would not be used for this purpose.

Another important tree exudate is mesquite gum, which has been reported as a media binder and adhesive in the archaeological and ethnographic literature. As a binder it is most often associated with a black paint obtained by processing the gum with pieces of bark and sometimes with iron oxide. Mesquite gum is the neutral salt of a complex acidic polysaccharide exudate collected from wounds in the trunk of the mesquite tree (*Prosopis juliflora*), which is a leguminous shrub that grows at elevations below 1200 m. The lumps of clear secretion are gathered and dried. The gum characteristically dissolves slowly in warm water to form a viscous solution, and with heat it chars and decomposes without melting. The preparation of black paint from mesquite involves peeling slivers of gum-saturated bark from the trunk of the tree and boiling them in water until thickened. The black paint may be applied alone or mixed with iron oxide (Teiwes 1988; Lumholtz 1976).

The use of masticated seeds, primarily from the Cucurbitaceae (squash) family, in paint production has been observed and reported by several archaeologists and ethnologists working with the Pueblo cultures in northern Arizona and New Mexico (Bourke 1884; Parsons 1939; Smith 1952; Stephen 1936; Whiting 1939). The use of seeds as a paint binder in the Southwest has not been studied extensively; however, based on existing information, it can be suggested that the oily substance from seeds (such as squash, pumpkin, melon, sunflower, cotton, pinyon, cottonwood) mixed with saliva could be applied as paint on a range of artifacts.

Stephen's (1936) description of several processes of squash seed preparation indicates that after a small number of seeds have been chewed and then spat into a shallow metate, some pigment is rubbed down, then a little water is added to make a paint. When discussing the mixture of bright blue copper carbonate with squash seeds, it was observed that if too many squash seeds were used, the pigment became too dark; if none were used, it became drab or off-color. Smith (1952:31) quotes a Hopi who said that "saliva arising from seed-chewing causes the pigments mixed with it to adhere to the painted object and this practice has the purport of a votive offering."

Yucca extracts are referred to widely in the ethnographic literature as a source for binding media, varnish, or adhesive (Bunzel 1932; Opler 1965; Robbins, Peabody, and Freire-Marreco 1916; Tschopik 1941). These media produce a glossy effect and may originate from a syrup prepared from the fruit of *Yucca baccata,* a juice from the leaves of *Yucca glauca,* or possibly from a soapy extract in the roots. The juice that pools in the agave plant, after the leaves are removed to expose the heart, is very potent and could possibly be a binding material (Madsen 1994). Various yucca plants grow throughout the region at a wide range of elevations, from sea level to more than 2400 m.

In her study at Zuni, Stevenson (1904) reported the use of a paste made by mixing water (that had yucca syrup added) with pigments ground in stone mortars. Yucca syrup was made from the fruit and involved a lengthy process of chewing the fruit, cooking it without water, forming and working the mass into pats, and storing until firm (Stevenson 1915).

Honey and lac are insect-based substances sometimes linked with indigenous paint technology. A clear reddish secretion of insects (*Tachardiella larrea*) that infest the creosote plant (*Larrea tridentata*) is reported as an adhesive and in a mixture with specular iron pigment (McGregor 1943; Sutton 1990). The sticky material is collected when the insects encrust the stems in compact masses. The use of honey is also mentioned as a fixative with pigments (Parsons 1939) and as a possible binder (Bahti 1993; Lomawaima 1994; Tenakhongva 1993).

The use of animal-based binding media in the Southwest is mentioned in the ethnographic literature, but primarily in reference to body paint or to coloring on hide-based articles. Deer grease, mutton fat, human mother's milk, cow's milk, and eagle eggs are specific examples of ingredients used, but they are normally not referenced with painted wood artifacts (Bahti 1993; Russell 1975; Spier 1970; White 1932).

Impact of Trade and Euro-American Contact

During the period of Spanish influence, 1540–1848, many new dyes, tools, and ideas were introduced in the Southwest. Trade invoices of the 1600s record the importation of indigo dye from Mexico (Kent 1982), and pigment analysis of several churches in the Southwest indicate the use of nonindigenous paints, such as vermilion and Prussian blue (Gettens and Turner 1951). By 1880, the Denver and Rio Grande and the Atchison, Topeka, and Santa Fe Railroads had entered the Southwest, and commercial paints and aniline dyes were becoming available to indigenous peoples (Kent 1982). By the turn of this century, many explorers, ethnologists, archaeologists, religious missionaries, and government agents had made ink, bluing, watercolors, tempera paints, and house paints available to the

Figure 4
Hopi kachina dolls representing an evolution of form in the twentieth century. Arizona State Museum.

Indian people. New tools, such as hammers, axes, and knives, were given to parents in exchange for government school attendance by Indian children (Kent 1982). An interest by many established East Coast museums also stimulated a demand for more artifacts.

The Indian Arts and Crafts Movement, or "Santa Fe Movement," of the 1920s and the Museum of Northern Arizona Craftsman Shows that began in 1930 encouraged a commercial market for Indian artisans and established an increase in public awareness and in the quality in the crafts (Dunn 1968; Colton 1938). Within the twentieth century, commercialization has taken some painted wood objects from their original cultural context and reclassified them as tourist souvenirs, then as crafts, and finally as fine art sculpture (Fig. 4).

Conclusion

While archaeological reports and ethnological accounts of cultural materials in the Southwest provide valuable insights into the particular preparations and uses of paints, these reports make it equally apparent that efforts to technologically improve their suitability or durability may have resulted in a fairly wide range of paint system developments and refinements.
The conservation of indigenous objects of painted wood is not straightforward. This is due, in large part, to a traditional lack of communication in the Southwest between archaeologists or ethnographers and the conservation field, an absence of Native American involvement in the discussion of preservation, and a record of inappropriate conservation measures. Sensitivity to the nature and the importance of issues of cultural context clarifies some of the limitations, reliability, and biases of the reported information. However, an understanding of the nature of paint on wood in the indigenous Southwest requires careful consideration of a wide range of tangible and intangible issues.

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The Painted Furniture and Wooden Decorative Arts of Lucia and Arthur Mathews

Mark A. Harpainter and Christopher C. Augerson

Imagine the creative energy required to rebuild a large metropolis from scratch. Following the disaster of the earthquake and fire of 1906 in San Francisco, which virtually leveled the city, this monumental task confronted its citizens.

As a leader in the civic arts community, Arthur Mathews applied himself to facilitating the reconstruction of the city according to the high artistic and aesthetic standards of the prevailing Arts and Crafts movement. Arthur and his wife, Lucia, founded the small Philopolis Press and used its periodical, *Philopolis* (love of the city), to disseminate these ideas. With partner John Zeile, they established a shop to construct furniture for homes and businesses destroyed by the quake, manifesting their ideals of interior design and incorporating their artistic training and talents. Following the evolution of the furniture and decorative arts created in this shop and the Mathewses' elevation of applied arts to fine art status, we see the emergence of a new and unique expression of the Arts and Crafts movement, referred to as the "California Decorative Style" (Jones 1985:32).

Born in a family of talented architects in Wisconsin, Arthur Mathews distinguished himself in his teens by winning national architectural competitions while still an apprentice in his father's San Francisco architectural firm. Turning from architecture to fine arts, he became an illustrator and, at age twenty-five, entered the Académie Julian in Paris for formal training, where he received the Grand Gold Medal for distinction. The artistic environment in Paris offered him influences ranging from new trends in French Neoclassical art, as practiced by muralist Puvis de Chavannes, to Japanese woodblock prints with their flat color planes and different use of perspective. Arthur returned to San Francisco in 1889 and taught art at the California School of Design, where he soon became director.

Lucia Kleinhans Mathews, a native of San Francisco, attended the city's public schools, which, at that time in California, "were strongly committed to manual arts education, teaching students the principal tenets of the Arts and Crafts movement, particularly the belief that the union of hand, head and heart in handicraft yielded therapeutic value" (Trapp 1993:9). After briefly attending Mills College, she enrolled at the Mark Hopkins Institute of Art. Her artistic talents rapidly won her recognition, not only in the school, but with her instructor Arthur Mathews. She married Arthur in 1894 and traveled with him to Europe in 1899, studying painting in Paris under James McNeill Whistler at his Académie-Carmen.

On returning to California the Mathewses resumed working, Arthur as a prominent muralist and Lucia as a painter, as they developed their artistic partnership. Arthur was concerned with the structured compositional aspects of architecture, Classical motifs, and mural painting. Lucia, after exposure to his teaching, adopted these and various Parisian influences, to form her own distinct and personal artistic identity. Her technique evolved as a looser, more "painterly" style, eventually gravitating to a preference for the immediacy and spontaneity of watercolor in the early 1900s (Jones 1985:79).

The Furniture Shop

Perhaps if the great earthquake had not occurred, the abrupt change in the Mathewses' artistic careers to making furniture might never have happened. The pivotal disaster provided an immediate need and market, and their friendship with the wealthy art enthusiast John Zeile provided the site, capital, and business expertise for the new venture. Arthur Mathews designed a craftsman-style brown-shingle building to house studios for himself and the artist William Keith, as well as separate shops for Zeile's Beach Robinson Furniture Company and the Mathewses' own Furniture Shop.

The new workshops were set up to produce limited-production, custom-designed furniture. They were equipped with electric machinery (Giberti 1980:19), and it is estimated that thirty to fifty employees worked on some architectural interior projects, although regular employees were fewer in number (Jones 1985:83).

The division of labor in the Furniture Shop between Arthur and Lucia likely resulted from their respective training. Arthur generally employed skills he gained as an architectural draftsman to design the main structural forms. Lucia was usually in charge of carving and executing the painted decoration. Although she often did the carving herself, particularly on the more decorative pieces, she had assistant wood-carvers working with her. These carvers were usually European trained and frequently had to be retrained to properly execute the low-relief carving favored by the Mathewses (Jones 1985:88). Such low-relief decoration was used essentially as embellishment; it seldom modified the basic form. Lucia also created many of the tabletop pieces, sometimes made as gifts for friends or family, and she continued to produce such personalized works after the closure of the Furniture Shop in 1920. Some of these objects bear her signature.

Patrons of the Furniture Shop included both private and corporate clients. Due to a need for immediate replacement of furnishings after the quake, corporations such as insurance companies and banks became the Furniture Shop's first clients. For these institutions, the Furniture Shop produced suites of furniture in sober styles sympathetic to the business-oriented architectural surroundings of their clients. On seeing the work the Mathewses did for corporations, individuals who were rebuilding their residences in the city became the private clientele of the Furniture Shop. Such clients were proabably exposed to the Mathewses' furniture in offices and boardrooms, but often the connections may have been social. Many businessmen would have been acquainted with Arthur Mathews and John Zeile through private organizations. Arthur was a member of the Bohemian Club, and Zeile was a member of the Pacific Union Club (Giberti 1980:25–26).

The early furniture was simple, strongly constructed, and minimally decorated—if at all—usually with carving. Like those who acquired

them, the pieces were conservative in style. As principal designer, Arthur used a vocabulary for this furniture that drew on well-accepted classical prototypes (e.g., klismos chairs for Pacific Title Insurance) and English Baroque forms (e.g., William and Mary chairs for the First National Bank), as well as American Empire styles (Giberti 1980:28).

With the transition from corporate to private clientele, the furniture evolved from heavier Renaissance forms to a more eclectic style. The pieces began to incorporate elements from Neoclassical, Asian, Gothic, and contemporary European styles, while employing a more creative use of carving and paint. Some pieces exhibit a clear influence from Chinese furniture, and perhaps the shallow relief carving the Mathewses favored was informed by similar carving on Chinese furniture. San Francisco's Chinatown in 1909, rebuilt after the earthquake, contained "the most magnificent Oriental bazaars in the Occidental world" (Steele 1909:96), full of inspiration for a furniture maker. Little of the Mathewses' work has survived, and the primary record of it is in an original catalogue of photographs—referred to as the "Furniture Shop sample book"—which is now in the collection of the Oakland Museum.

Furniture as Artwork

True to the aspirations of William Morris, the Furniture Shop produced not only "workaday" tables and chairs, but also what Morris called "state" furniture, created, he wrote, "as much for beauty's sake as for use: we need not spare ornament on these, but may make them as elegant as we can. . . . [T]hese are the blossoms of the art of furniture" (Anscome 1991:29). These individual works displayed a more personal involvement by the Mathewses and were decorated with careful artistic devotion. Unlike the plainer limited-production furniture they designed, these pieces command individual attention as art objects.

In 1908, the Mathewses created an individual and elaborately painted suite of furniture for their partner, John Zeile. Included in this suite were pieces that trace their roots directly to English Arts and Crafts works and their English prototypes. A drop-front desk resembles the "Backgammon Players" cabinet made by Morris and Co. in 1861. The Morris piece, like the Mathewses', was also designed by an architect (Philip Webb), and decorated separately by a painter (Edward Burne-Jones). The Mathewses rearranged the form to create a writing desk, and extensively carved and decorated the surface. Incorporating a miniature of Arthur's full-size painting *The Wave* in the interior, the desk acts, in a sense, as a frame for the painting.

Part of the same suite for Zeile, a chest or sideboard (Fig. 1), is reminiscent of Burne-Jones's 1860 painted cabinet, "Good and Bad Animals," now in the Victoria and Albert Museum. Similar in form, both works use painted decoration of romantic figurative scenes on the primary surfaces.

A later drop-front desk by the Mathewses (Fig. 2) is of the same form as the one made for Zeile. Like the earlier desk, it traces its roots through Morris to the Gothic form of an English court cupboard. Relying more on color and painted decoration than the exotic veneer on their earlier piece, it covers every visible surface with paint. Decorative devices such as low-relief painted Classical motifs and carved figures on the supports are repeated. The Arcadian scene on the outside face of the drop front is typical of their work.

Figure 1
Chest, ca. 1906–20. H:117 cm; W:206 cm; D:66 cm. Pair of cylindrical candlesticks, n.d. H:74 cm; W:18 cm. Jar with lid, ca. 1906–20. H:28 cm; W:28 cm. *Portrait of Lucia K. Mathews,* painting by Arthur Mathews, ca. 1899. H:63.5 cm; W:58.4 cm. The Oakland Museum of California, gift of the Concours d'Antiques, the Art Guild.

The Harmonious Environment

Both Arthur and Lucia were influenced by J. M. Whistler's emphasis on close color harmonies and use of certain dominant hues to unify his compositions. In the Mathewses' works, the warm, atmospheric light of coastal California and its landscape is captured with ochres, golden browns, and greens (Fig. 2). Like Whistler and the artists of the English Aesthetic movement, the Mathewses sought to create complete interiors with unified decorative schemes. As their painted decoration flowed from the canvas onto the frame and finally over the furniture, they dissolved the border between the artwork and the living space or domestic world. Their carved and painted frames coordinate not only with the paintings they contain but also with the surrounding furniture and decorative tabletop items (Figs. 1, 3).

Figure 2
Desk, Arthur and Lucia Mathews, ca. 1910–12. Carved and painted wood. H:150 cm; W:122 cm; D:51 cm. The Oakland Museum of California, gift of Mrs. Margaret R. Kleinhans.

Figure 3
Portrait of Miss Louise Schwamm, painting by Arthur Mathews, 1899. H:99 cm; W:89 cm. The Oakland Museum of California, gift of the Concours d'Antiques, the Art Guild.

Some Furniture Shop commissions, such as that for the San Francisco Masonic Temple, included complete interiors: furniture and decorative arts in harmony with architectural elements, murals, and rugs, all designed by the Mathewses. Unlike the complete interiors of Frank Lloyd Wright, which incorporated relatively abstract and geometric decoration, the Mathewses' designs appear more "organic," perhaps closer in spirit to the California architects and furniture makers Charles and Henry Greene.

On the West Coast, a primary bond with nature and the influence of Asia set an aesthetic tone for the Arts and Crafts movement. A folding screen decorated by Lucia Mathews, circa 1910–15 (Fig. 4), shows direct observation of nature and inspiration from Japanese decorative work.

With the proliferation of the California bungalow, porches and gardens became an important part of the domestic scene. "Outdoor" rooms served as transitional spaces between the domestic interior and the landscape, while California's mild climate enabled people to spend time outdoors year-round. William Morris had suggested that even small residential city lots could incorporate gardens in their design. As a gardener, Lucia Mathews likely derived as much inspiration from her garden and the coastal landscape as from the floral patterns and decorative designs published widely by Arts and Crafts advocates like Morris. Her painted carvings, like that on the small hexagonal box shown in Figure 5, bring the flora of the California garden onto articles of domestic utility, creating a continuum between indoors and outdoors.

Techniques and Media

To create the rich and colorful decorative effects on their painted furniture, the Mathewses employed a diverse range of traditional paint and finishing media, often using elaborate, complicated, and probably rather experimental techniques. Areas of paint are juxtaposed with areas of gilding, or stained or transparent finishes, and opaque and transparent media are layered and interleaved to achieve subtle tonalities and surface effects.

Figure 4
Four-panel screen, Arthur and Lucia Mathews, ca. 1910–15. H:183 cm; W:203 cm. The Oakland Museum of California, gift of the Art Guild.

Figure 5
Hexagonal box, Arthur and Lucia Mathews, n.d. Carved and painted wood. H:28 cm; W:18 cm. The Oakland Museum of California, gift of the Concours d'Antiques, the Art Guild.

Figure 6
Clock, Lucia Mathews, ca. 1906–15. Painted and gilded wood, metal, enameled face, and glass clockwork. H:37.5 cm; W:15.2 cm; D:10.1 cm. The Oakland Museum of California, gift of the Art Guild.

During an NEA-funded conservation project, approximately seventeen of the Mathewses' painted and decorated wood objects in the collection of the Oakland Museum were examined and treated. These ranged from decorated frames for paintings to small decorative art objects to large furniture pieces. Cross-section paint samples were taken from most of the decorative art pieces and examined, using visible-light, fluorescence, and FT-IR microscopy.[1] In general, these microscopic analyses revealed few signs of later alteration or reworking, and it seems that most of the surfaces are likely the work of Lucia Mathews. Staining the samples viewed in ultraviolet light[2] revealed the presence of oil in both paint and varnish layers. Staining for protein showed its presence not only in discrete layers or thinly dispersed between layers but also in some of the oil-containing layers. FT-IR analysis confirmed the presence of some of these media, primarily resin-oil mixtures and protein layers. The resin spectra most closely matched those of copal and sandarac. Other individual components were difficult to identify. Some of the cross-section samples had curious structures (e.g., with different media twisted in and out of adjacent layers; bleeding from one layer to another; or lean oil mixtures over richer ones to produce craquelure).

The two cross sections of finish from the hexagonal box (Fig. 5) revealed up to nine layers of different media. From the lowest layer, these include a ground layer, which tested negative for protein; oil-resin paint and varnish layers; another ground, which tested positive for protein; then another succession of oil-resin paint and varnish layers, some of which contained protein. This suggests a major adjustment or change of the artist's mind, as none of the layers seemed separated by a clear layer of dirt or use. Unfortunately, the sampling was limited by budget and time constraints. More sampling and analysis is clearly needed to unravel such complicated and idiosyncratic surface structures, but a general pattern of painterly approach and experimentation in the decoration of the surfaces seems clear.

Perhaps the most interesting and challenging phenomenon found on the Mathewses' painted works is the wide variety of darkening and crazing or craquelure from varnishes and glazes, which reveals a probable intent in creating the aged and timeworn effects and tonalities these artists valued. These cracked surfaces range from transparent amber or yellow varnish with very slight crazing to dark molasses-colored finishes that have pulled up into discrete islands on the surface of the paint layer—with many shades and variations in between. These surfaces are particularly visible on many of the smaller decorative objects, such as the jar shown in Figure 1 and the clock in Figure 6. The painted decoration of one jar was almost completely obscured by darkened varnish. Difficult decisions were faced as to how the jar might be returned to exhibitable condition without intruding into what seemed to be an orginal, or at least not fully understood, surface structure. It was decided that microabrasives under magnification would be used to reduce the varnish. This allowed the underlying painted scene to be read without altering the varnish craquelure pattern. Microabrasives were also used for a pair of urns, on areas of varnish that previously had been damaged by water. All other treatments of the Oakland Museum pieces involved only simple surface cleaning and the filling and inpainting of losses, using standard techniques and materials.[3]

Considering the wide variety of influences Arthur and Lucia Mathews combined in creating their furniture, it is interesting and thought provoking to speculate on just what the rich surfaces looked like when these artists stood back to admire their work as it dried (or cracked!). Today, we can only speculate as to their artistic intent. Exactly how much of the mellowed surface patina and tone is the result of their hand, and how much has time contributed to it? A local newspaper critic (Garnett 1912:35) visited the Furniture Shop one September day in 1912 and, after examining a recently completed desk (possibly the one illustrated in Figure 2), provided a unique contemporary perspective of the newly completed work:

> A desk was designed by Mr. Mathews and some of the ornamentation is also his work. The piece also contains a number of panels in inlay and carving, the work of Mrs. Mathews. It is, as a whole, and in detail most charming, and has a character that is quite its own. Indeed, the Mathews are producing a type of furniture so distinctive that one can readily imagine the collector of the future classing it as the California School of the early 20th century.

Clearly, the extraordinary collaboration of Arthur and Lucia Mathews imbued their painted furniture with a unique, personal style and vital spirit. The fact that these pieces are true masterpieces of American decorative art was as apparent then as it is now.

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Notes

1 Analytical work was performed by Tracy Power and Christopher Augerson at the M. H. de Young Memorial Museum in San Francisco, California, and by Michele Derrick and John Landrey at the Getty Conservation Institute in Marina del Rey, California.

2 For the fluorescence microscopy, fluorochrome Rhodamine B was used to test for oil, and the fluorochrome FT-IC and the stain Amido Black for protein.

3 Mechanical abrasion was carried out with fine grit diamond files, followed by Micro-mesh abrasive. Surfaces were cleaned using either saliva or isooctane on cotton swabs. Flaking paint and varnish layers were consolidated with either sturgeon or rabbit-skin glue. Loss compensation was carried out with an epoxy putty or acrylic gesso. Magna acrylics were used for inpainting of paint layers, and Soluvar matte or gloss varnish—sometimes with dry pigments—was used for varnish layers.

Materials and Suppliers

Magna acrylics, Bocour Artist Colors, Inc., Garnersville, NY 10923.

Micro-mesh abrasive, Micro-Surface Finishing Products, Inc., Box 818, Wilton, IA 52778.

Soluvar varnish, Conservation Materials Ltd., 100 Standing Rock Circle, Reno, NV 89511.

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