Seeing more clearly through opaque surfaces: a review of furniture finishes materials, their use, and ethical considerations related to their preservation

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Abstract

Finishes have been applied to furniture throughout time to enhance it aesthetically and to protect the wood from decay, moisture, dirt and grime. A wide range of materials have been used from when the object was new to later restoration campaigns including waxes, oleo-resinous varnishes, spirit varnishes and later synthetic varnishes. Knowledge of historic materials and techniques is limited by the lack of surviving original surfaces. In addition, treatises listing recipes may misguide our understanding of traditional transparent coatings due to the range of materials listed using unspecific terminology mixed together in countless recipes. Analytical methods can identify materials, and sometimes give a sense of their age, while often leaving us with more questions to pursue.

This paper identifies common traditional coating materials that were used in the furniture trade. In addition the authors review influential historical sources describing finishes applied to pre-industrial wooden surfaces including Theophilus, Stalker and Parker, Watin, Dossie, Roubo, Sheraton, Tingry, Siddon, Tripier-Deveaux and Tolbècque, and a selection of articles and unpublished studies written over the last twenty-five years with a focus on transparent finishes and their preservation.

Five case studies are included to illustrate materials encountered on pre-industrial furniture, applied originally or during restoration campaigns. The two last examples, a French writing table by Bernard van Risenburgh (circa 1755), and an American tall clock by Peter Stretch (1735-1746), will serve as a platform to discuss ethical considerations related to the preservation of furniture finishes.

Introduction

Finishes play a major role in creating furniture as their nature and method of application provide the final touch to the aesthetic intent of the cabinetmaker, while providing a layer of protection from use, moisture, atmosphere, insects, dirt and grime. The appearance of a finish changes over time through natural aging and wear as well as restoration campaigns. The study of historic coatings informs us of the materials that were applied, their methods of application, aging properties and how they were interpreted and cared for at different times in the life of the object. Unfortunately, too few pieces have survived with either their original coating intact or a full history of consecutive layers applied over each other. This lack of material evidence combined with the wide range of materials with different properties makes it extremely difficult to have a clear understanding of what the original finishes were and looked like.[1] Scientific analysis provides more tools to identify coatings and can be used most effectively in the light of period descriptions of recipes, knowledge of restoration techniques, and by comparing a large number of results together.

This paper provides an overview of transparent finishes applied to pre-industrial furniture. It covers materials used to create and restore transparent coatings through time, how they were prepared and applied, recipes found in primary sources as well as discussed in secondary sources, all referenced in the bibliography. Case studies are used as examples and allow the discussion of ethical issues related to the preservation of these coatings.

Materials used in transparent coatings

Each type of finish offers different properties for the maker and consumer. Ideally, woodworkers and finishers desired a finish to be hard, yet flexible, transparent and rendering a certain luster to the surface. In addition a finish needed to be resistant to discoloration, embrittlement, water, alcohol and abrasion. Unfortunately, no finish can fulfill all these criteria. Various finishes have been used through time in attempt to meet the above standards, all with advantages and disadvantages.

Traditional transparent finishes applied to pre-industrial furniture can be put into five general groups. Spirit varnishes, a mixture of a solvent and (a) natural resin(s) that rely on the evaporation of the solvent to form a film. Fixed oil varnishes, a mixture of (a) drying oil(s) and (a) resin(s) that cure through the cross-linking of molecules as well as the evaporation of a solvent (turpentine) to form a film. The constituents of fixed oil varnishes

typically require heat to fully dissolve. Essential oil or oleo-resin varnishes, which include resins and volatile plant oils such as balsam.[2] Waxes, naturally occurring substances such as beeswax typically dissolved in a solvent, often turpentine, applied and buffed. A wax can be applied directly to a wood surface. Drying oils, such as linseed oil are oil coatings without resins that are also applied directly to a wood surface.

There are several noteworthy industrial transparent coatings that came into common use on furniture during the early twentieth century. Alkyd resin varnishes, brought on the market in the 1930s, were valued for their durability and dried faster than fixed oil resins. Alkyds were often modified with oil, anywhere from 35-70%, and contained poly-functional alcohols (glycerol, ethylene glycol) and acid (phthalic acid). The film formation of alkyds relies on the cross-linking of the molecules as well as the loss of solvent. Cellulose nitrate (a cellulose ester) is derived from guncotton and produced as early as the 1840s but not commonly used as a furniture finish until the late 1920s. Polyurethanes, which are synthesized in a two-step process when a polyester or polyether is first reacted with a diisocyanate and then a chain extender, typically a diol or diamine, to make the urethane linkages (Rivers Umney, 2003), became a common coating material in the mid-twentieth century. Other coatings such as phenolic resins (phenol-formaldehydes), and tung oil (also known as China wood oil from the tree *Vernicia fordii*) became popular during the twentieth century by furniture makers and restorers alike.

The traditional transparent coatings that defined the finisher's trade before the modern coatings noted above were created using natural resins, oils and waxes. Natural resins, frequently used as a primary component of transparent coatings materials are all derived from woody plants, except shellac, which is an organic exudation from the *Laccifer lacca* insect found in Asia. Most traditional waxes come from insects (beeswax from bees) and most traditional oils come from plants (linseed oil from flax). The plant resins, a chemical class called terpenoids, constitute one of the major categories of coatings found on western furniture. The most commonly used in furniture finishes include copal, mastic, rosin (colophony), sandarac and shellac. Some are soluble at room temperature in alcohol while others, primarily copals, normally require heat with oil in order to go into solution. All finishes have their advantages and disadvantages as transparent coatings for wood. These primary resins are often used in combination with each other and 'minor resins' such as Venice turpentine, 'gum' benzoin and elemi which were often added as plasticizers. All of these materials are evidence of technology, trade and commerce at the time they were used. For instance, the presence or record of manila copal on a piece of furniture from the eighteenth century indicates that somehow the material was acquired from South-East Asia and probably was made using heat. The following is a list of traditional resins, oils, waxes and colorants from around the globe commonly used on furniture.[3]

Resins and gums

Amber - A fossil resin extracted from an extinct pine tree known to exist in the Tertiary Period. It is a pale yellow and may be transparent to opaque. It is difficult to dissolve but can be heated to go into solution with linseed oil. Amber can be found in the Mediterranean region. It is used in the fabrication of many types of ornamental objects as well as in coatings.

Animé - A resin extracted from the tree *Hymenoea courbaril* that grows in Brazil. It is an orange, sticky resin, insoluble in water and only partially soluble in alcohol. Residues will dissolve in boiling alcohol. Tripier-Deveaux describes its use as an ingredient in spirit varnishes and notes its pleasant odor. He discusses the use of the term animé in period literature, suggesting some confusion about its nature (Tripier-Deveaux, 1845).

Arabic - Also referred to as 'acacia gum' from the Acacia tree. It is granular, white to yellow white in color. Arabic is a true gum that is soluble in water.

Balsam - A general term describing the resins produced by trees in the *Coniferae* family. Balsam may be liquid, semi-liquid or a soft mass. It is yellow-brown in color. Balsam lacks durability but is easily applied to a surface. Examples of balsam include Venice turpentine, Strasbourg turpentine, Canada balsam, Copaiba balsam. It is used primarily as an additive to varnishes to increase flexibility and as a component of oleo-resin varnishes.

Benzoin - A resin containing benzoic acid from trees of the genus *Styrax*. It is reddish-brown, hard and brittle in its solid state. Benzoin is soluble in alcohol but not in water. There are a variety of benzoin resins including Siam and Sumatra

benzoin. Siam benzoin contains ethereal oil, benzoic acid, cinnamic acid and vanillin and is about 90% soluble in alcohol. Sumatra benzoin is similar in composition. Benzoin is often added to varnishes as a plasticizer and may have been used as a topcoat on French polished surfaces beginning in the nineteenth century. Records indicate that benzoin has been in use as a spirit varnish since the middle of the sixteenth century.[4]

Colophony - A common resin that is derived from the residue of the distillation process of balsam or crude turpentine. Colophony, also referred to as rosin, has a low melting point (100 to 130 °C), is strongly acidic and is pale in color, rendering a brilliant gloss when freshly applied to wood. It does not wear well and is susceptible to water damage. Colophony is derived from conifers including the Long Leaf Pine (*Pinus palustria*) in North America and Maritime Pine (*Pinus maritima*) in France and the Mediterranean. Colophony is a readily available resin in North America and Europe, making it an easy choice by furniture makers and furniture restorers alike in the pre-industrial era despite its lack of durability. The esterification of colophony with glycerin yields a synthetic resin 'ester gum' which continues to be used in the varnish industry.[5]

Copal - This is a term used to define a class of natural resins including true fossilized resins such as amber and those that have similar properties such as the softer Manila copal which is a non-fossilized resin from South-East Asia. Copals are typically soluble in turpentine and oil under heat and may be reddish, yellow or semi-transparent. The harder copals are virtually insoluble in solvents such as alcohol, turpentine or mineral spirits but do become soluble in turpentine and linseed oil when heated. The soft copals come from the Philippines, the semi-hard to hard copals can be found in Sierra Leone, Kauri, Zanzibar, Congo and Madagascar. Copals are commonly used on furniture and coaches from the 1700s on. Over time they tend to yellow and darken and become soluble in increasingly polar solvents.

Elemi - A term used to describe a variety of tree resins derived from trees of the *Burseraceae* family found in Mauritius (an island near Madagascar), the Philippines, Mexico and Brazil. It is yellow to yellow-brown in color and soluble in alcohol, benzene and turpentine. Elemi's main use is as an additive to varnishes since it tends to be softer than mastic and other primary resins used in furniture resins.

Frankincense - An aromatic resin collected from the various species of the *Boswellia* tree. Frankincense is also referred to as *olibanum*.

Mastic - A plant resin derived from the bark of the tree *Pistacia lentiscus* found in Portugal, Morocco, the Canary Islands and most importantly the Greek island of Chios. It has been known to be used as a traditional picture varnish as well as a component of furniture finishes. It is pale yellow in color, has a relatively low melting point (95 °C) and will become soft when chewed.

Sandarac - A plant resin taken from the North African conifer *Tetraclinis articulatra*. It is yellow to translucent in color and soluble in both alcohol and hot turpentine. Sandarac has a melting point of 135 °C to 145 °C. It makes for a clear and relatively hard varnish but can turn dark and red with age.[6] Venice turpentine and elemi were often added as plasticizers to sandarac-based recipes. The first references to 'Sandarac' in period writings may have been referring to a juniper resin.[7] The term was also used to describe some red pigments.

Sarcocol - A resin derived from the African shrub *Penaea sp*.

Shellac - An animal resin secreted by the insect *Laccifer lacca* (or *Coccus lacca*) onto twigs of a variety of trees in Southern Asia. Shellac is dark brown to light yellow in color and soluble in alcohol. Types of shellac include stick-lac which is as initially collected, seed-lac which is partially refined stick-lac, button, garnet, orange and blonde shellac. Shellac has been used continuously as a transparent coating from the late seventeenth century on (Stalker and Parker, 1688), often as an ingredient in spirit varnishes, then in 'French polish' starting in the nineteenth century. It was rarely used as a finish by itself in America until the early 19th century.[8] Common traditional additives to shellac include sandarac, mastic and copals.

Venice turpentine - A balsam resin exuded by the European larch (*Larix decidua*), produced and exported mainly from Western Austria and Northern Italy. This resin is secreted from the heart of the tree, requiring a deep boring hole.[9] It is yellow to green in color and soluble in most organic solvents. Venice turpentine was used primarily as an ingredient in a varnish recipe rather than by itself. Venice turpentine is known to readily deteriorate and loose its luster.

Oils

Linseed oil - Derived by expressing the seeds of the flax plant (*Linum usitatissimum*). It consists primarily of linolenic, oleic and linoleic fatty acids. Linseed oil is most often processed including cold pressed, and boiled. Driers are typically added such as cobalt, lead and manganese. It is yellow to yellow-brown when fresh but darkens with age as it oxidizes to form linoxyn. Types of linseed oil include blown linseed oil where air is forced through hot linseed oil causing oxidation and polymerization of the oil which results in a harder film. Boiled linseed oil is produced by adding driers to hot linseed oil resulting in an oil film that will more readily polymerize. Boiled linseed oil is typically thicker and will take on a darker hue.[10] Raw linseed oil remains untreated after expression from the seeds. Linseed oil is the most significant oil for the making, use and maintenance of traditional varnishes. It was commonly used in the fabrication of fixed oil varnishes.

Poppy oil - Derived by expressing the seed of the poppy (*Papaver somniferum, P. album and P. nigrum*) from India, Russia, France and Asia Minor. It is pale in color normally, but reddish when hot pressed. Poppy oil is a softer drying oil than linseed oil.

Lavender oil – An essential oil collected from the herb *Lavandula latifolia*. It is also referred to as spike oil.

Walnut oil - Derived by expressing the seeds of the English walnut (*Juglans regia*). It is colorless to pale yellow when made by cold expressing and yields a fairly durable, crack-free surface.[11] Walnut oil has been in use for many centuries or more and may well have been used more traditionally than it is today.

Waxes

Beeswax - An animal wax produced by the honeybee *Apis mellifera*. Beeswax is the most significant wax for traditional transparent furniture finishes being used as both a polish and a coating. It will become soft around 40 oC and has a melting point between 63-65 oC.[12]

Carnauba - A plant wax from the leaf of the tree *Copernicia cerifera* found in Brazil. Carnauba wax is harder than beeswax with a melting point in the range of 83-86 oC.[13] It is often used in combination with beeswax but does not appear in pre-industrial period recipes.

Microcrystalline wax – A mineral wax derived from petroleum. It is usually white in color with a fine crystalline structure consisting of saturated aliphatic and other hydrocarbons. Microcrystalline wax has a melting point of about 90 °C and is chemically inert. It tends to be more common as a modern wax rather than being used historically.

Paraffin wax – A mineral wax derived from the distillation of shale oil, low-grade coal and certain petroleums. It is usually white in color and has a larger crystalline structure than microcrystalline wax with a melting point range between 48-62 °C.[14] Paraffin wax has been historically popular due to its stability.

Solvents

Alcohol - (C_2H_5OH) The term alcohol has been used traditionally by the furniture trade to describe a solvent which has ethyl alcohol as its primary constituent. It is also referred to as 'rectified spirits of wine' or just 'spirits'. Alcohol is miscible in water and most organic solvents and readily absorbs water, which is contrary to maintaining its best working properties with finishes**.** Types of alcohol used with furniture finishes include: Anhydrous alcohol which is 100% water-free ethyl alcohol; denatured alcohol which is ethyl alcohol denatured with methyl alcohol or other additives. Denatured alcohol is poisonous and tends to contain some water. An awareness of alcohol, or distilled spirits, is recorded as early as the twelfth century.[15] It became a common solvent for finish work as spirit varnishes gained popularity.

Mineral spirits – A designation 'mineral spirits' can be applied to a variety of petroleum distillates with boiling ranges between 60 °C to 160 °C. It is produced by petroleum companies in distillation of crude petroleum and has applications in furniture finishes similar to turpentine. In general, most resins are not easily dissolved with mineral spirits. The use of petroleum distillates as solvents was not common until the last few decades of the nineteenth century.[16] Mineral spirits may also be referred to as mineral thinner, petroleum thinner, varnish makers naptha, painter's naptha and rock oil and white spirits.

Turpentine ($C_{10}H_{16}$) - A solvent derived from the distillation of the oleo-resin obtained from certain conifers. It is a clear liquid with a boiling range of 150-180 °C when properly refined and uncontaminated. The purest of turpentines

should not leave any noticeable residue behind after evaporation. It is miscible with most organic solvents but immiscible with water; turpentine will dissolve, at least in part, some natural resins. Types of turpentine include: pure gum spirits of turpentine, which is made from the gum extract yielding approximately 2 parts turpentine, 7 parts colophony, 1 part water and impurities. This is essentially the type of turpentine used in pre-industrial varnish making.
Steamed-distilled turpentine is obtained by the steam distillation of the wood.

Colorants

Aniline - a synthetic colorant which is a derivative of nitrobenzene from light tar-oil. Most of the coal tar based dyes are not light fast. There are many specific types of aniline dyes. The first aniline dyestuff was mauve developed by William Perkin in England in 1856.

Alkanet root - A plant colorant from the root of the plant *Anchusa tinctoria* commonly found in France, Germany and Asia Minor. It is red when dissolved in oil or alcohol and brown when dissolved in water. The red dye can be extracted from the root with oil or alcohol. Records indicate it was in common use in the eighteenth century.[17]

Archil - A plant colorant derived from various lichen including, *roccella*, *variolaria*, *lecanora*. It is dark red-brown in color and used in the textile trade as well as on wood. Archil is often used in conjunction with other dyes and colorants.

Brazilwood extract – A plant colorant derived from a tree in Brazil (*Caesalpinia echinata*). This dye renders the substrate from a red to crimson color. It is traditionally used as both a dye on wood as well as in the varnish itself.[18]

Cochineal - A plant colorant extracted from the female bodies of an insect (*Coccus cacti*) found in Mexico. The colorant is principally carminic acid and will turn a substrate red. Cochineal is best known as a colorant in the textile industry.

Dragon's blood - A plant colorant from the fruit of an East Asian palm (*Daemonorops draco*). The primary constituents of dragon's blood include dracoalban, dracoresene, draconine and esters.[19] It is a deep red colorant soluble in alcohol and oils. The plant *Daemonorops draco* was once thought to be the source of the blood found in dragons.

Indigo - A plant colorant from various species of the plant *Indigofera*. This dye renders a fairly light-fast blue dye when protected by varnish layers. It is insoluble in water and alcohol. A synthetic Indigo has been in use since 1900.

Logwood extract - A plant colorant from the heartwood of a tree (*Haematoxylon campechianum*) which is found in Central America and the West Indies. It is a light fugitive red dye that produces a variety of reddish colors. Logwood was used widely with traditional finishes in Europe and North America.

Recipes

Recipes for finishes were published in Europe as early as the twelfth century. They range from varnishes applied to paintings, wooden panels, furniture and musical instruments. These texts provide valuable information regarding materials and methods of application used while clarifying the type of surface treatments that were used, which varied according to the nature of the object. This information is most important for conservators studying and treating wooden surfaces. For instance, many eighteenth-century French pieces of furniture have been refinished with a nineteenth-century French polish technique, creating an inaccurately smooth and glossy surface, which does not relate to descriptions in eighteenth-century primary sources. For instance, several sources listed further in this article discuss wax finishes used as the only coating on some types of furniture.

Furniture depicted in portrait or interior paintings from the period is a source for discerning how furniture may have looked during a specific period. While some allowance must be given for artistic license, it is reasonable to conclude from several paintings that the surfaces of some furniture were brought to a certain level of reflectivity and protection. For instance, Rembrandt's 'Music Party' depicts the furniture covered with textiles but the instruments in a polished reflective state suggesting highly glossy coatings. John Singleton Copely's 1771 portrait of Mrs. Ezekiel Goldthwait depicts a table with a reflection so strong that the peaches and lace of her sleeve are seen mirrored in the surface. Already in 1620, De Mayerne, who mainly focuses on paintings, provides a most interesting comment regarding the gloss of wooden surfaces, which tends to confirm what is depicted in paintings: 'The usual varnish on wood is bright as glass and offends the eye.' (Brachert, 1978-79.)

The earliest text known by the authors of this article to have listed a varnish recipe to be applied on wood is *On Diverse Arts*, the treatise of Theophilus, translated from Latin into German in the twelfth century. Theophilus describes the fabrication and use of linseed oil and lists the 'gluten [called] varnish' recipe, which contains linseed oil and a ground resin called 'fornis, which 'looks like very clear frankincense except that when it is broken up it has a higher luster.' There has been much debate around the nature of 'fornis'. Brachert suggests sandarac (Brachert, 1978-79) while Tripier-Deveaux discusses the possibility of copal (Tripier-Deveaux, 1845), along with a discussion on the other possible translations and origins of 'gomme fornis' or 'gummi fornis'. The notes in the English translation of Theophilus from 1963 also include comments on the nature of fornis.

In his article published in 1978-79 on transparent coatings applied to furniture, Thomas Brachert lists a large number of recipes from Italy, Spain, France, Germany or England from Theophilus to the twentieth century, which include spirit varnishes, fixed-oil resin coatings, essential oil varnishes as well as wax. To Brachert's knowledge the first known recipe for a spirit varnish appears in the so-called 'Marciana manuscript', from the early sixteenth century, and lists spirits of wine with benzoin as the only ingredients. Recipes from the sixteenth century, describe fixed-oil resin, essential oil and spirit varnishes, which will continue to be the case in the following centuries, with more and more ingredients included in the recipes, which names depict a taste for exotism. For instance, the so-called 'Paduan manuscript, from the second-half of the seventeenth century, lists a whole row of spirit varnish recipes, which include turpentine, mastic, sandarac, Venice turpentine in spirits of wine, among other recipes for a 'Flemish varnish' (spirits of wine, sandarac, Strasburg turpentine), an 'Indian varnish' (white Arabic resin, mastic, borax) or a 'Chinese varnish' (white amber, shellac, sandarac in spirits of wine).

One of the most influential and the earliest text to have received wide distribution in England is Stalker and Parker's *Treatise on Japanning and Varnishing* (Stalker and Parker, 1688). The authors do not mention any wax finish but they do list two resin recipes: one is a shellac-based spirit varnish 'Shell-Lacc'; the other one is referred to as 'white' varnish, which consists of several resins that appear in guidebooks throughout the next century. The recipe lists: one pound of 'the whitest' sandarac ('Gum Sandrick'), one ounce of 'the whitest Gum Mastic', three ounces of 'the clearest' Venice turpentine, one ounce and a half of copal ('Gum-Capal'), half an ounce of elemi ('Gum-Elemni'), half an ounce of benzoin ('the clearest Gum-Benzoin or Benjamin'), one ounce and a half of anime ('the clearest Gum-Animae'), and half an ounce of white rosin. The authors describe precisely the order in which the resins, here all called 'gums' - a common terminology inaccuracy - must be prepared and mixed together. It is possible that such a complex recipe might reflect more of the period's fascination for alchemy rather than what was actually practiced in the shop. In fact, Brachert refers to these types of recipes as 'kitchen recipes', for they seem to aim to list numerous ingredients rather than being practical. Robert Mussey, in his introduction to the 1987 reprint of the *Cabinet-maker's guide*, emphasizes that some technical handbooks such as Stalker and Parker's treatise were 'written primarily for the edification and amusement of the genteel dilettante, whose hobbies often included practice of various branches of the fine and applied arts.' He specifies that it is unknown how accurately the instructions mirror actual practices of the day.

The Builder's Dictionary, published in 1734 in England, draws from two earlier sources: Mr. Boyle, probably Robert Boyle (Boyle 1664), who focuses on paintings, and Stalker and Parker. Taking from two sources results in some duplication; for instance, there are two recipes for white varnish, one identical to Stalker and Parker, the other being a combination of rosin and amber dissolved in spirits of turpentine. Spirit varnishes recipes prevail, though there is a recipe for a 'common varnish', a type of essential oil varnish made of rosin dissolved in spirits of turpentine. Like in Stalker and Parker, there is no mention of wax finishing.

L'Art du peintre, doreur et vernisseur, by Felix Watin, published in France in 1755, is a most valuable treatise on painting, gilding and varnishing. Watin had worked for years as a manufacturer of varnishes, artists' pigments and gilding supplies. He specifies that wax was commonly used as a furniture finish while varnish was not.[20] He describes three main types of varnishes: clear or spirit varnishes, oil varnishes and spirit of turpentine varnishes. Even though the varnish recipes listed by Watin are mainly intended for other wooden surfaces than furniture, such as paneling, musical instruments

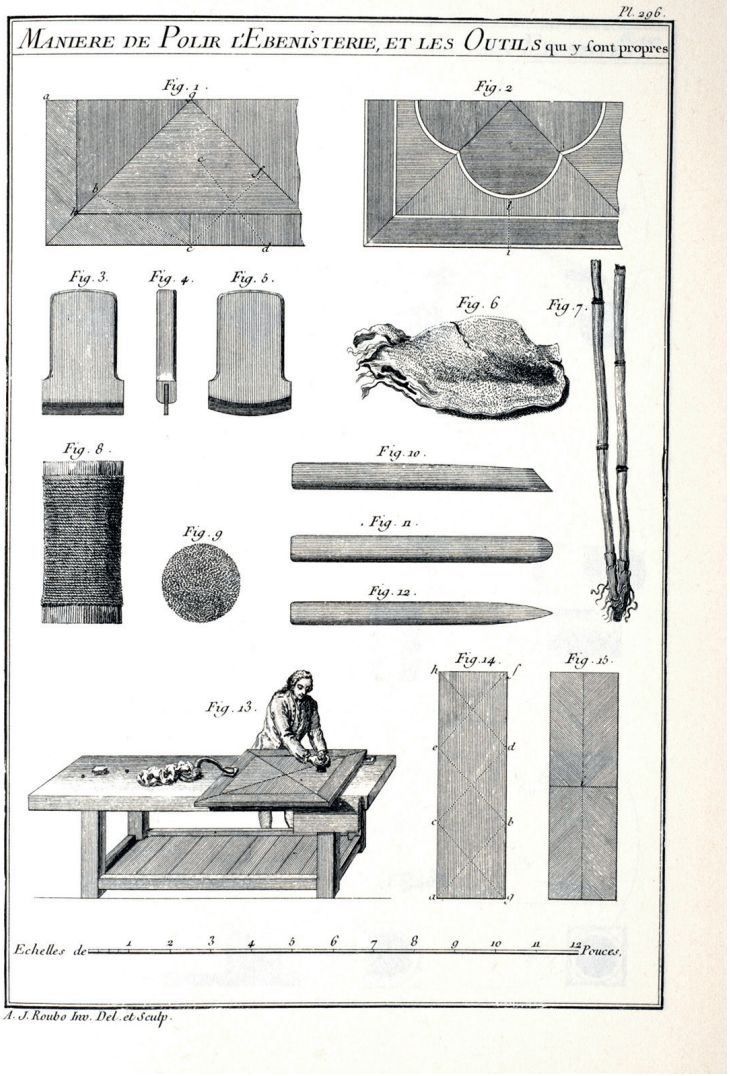


Figure 1 Roubo (André Jacob), *L'Art du Menuisier*. Paris: De l'Imprimerie de L.F. Delatour, 1769-1775. Plate 296: Manière de polir l'ébénisterie et les outils qui y sont propres. Courtesy, The Winterthur Library: Printed Book and Periodical Collection.

or fan boxes, this source is a valuable reference of materials used in the manufacture of resin varnishes. Watin for instance specifies that sandarac was used in all spirit varnishes, except the ones that were made of shellac, which attests to the use of both resins in the eighteenth century in France. He also indicates that wooden surfaces need to be sized with parchment glue before to be varnished, but here again he is not talking about furniture specifically.

In *Handmaid to the Arts*, Robert Dossie (Dossie, 1758) does not specifically address transparent coatings on bare wood; he describes varnishes applied on japanned wooden surfaces as well as on paintings. For varnishes he recommends seedlac in most instances, except for light color grounds or paintings, in which case whiter resins are more appropriate, though far less hard than seedlac. Indeed he justifies his recommendation of seedlac as it brings hardness and tenacity. If these properties are needed with associated brightness, resins can be mixed together. He lists more or less complex recipes for spirit varnishes including sandarac, Venice Turpentine, gum anime, copal (can be replaced by gum sarcocol), mastic, benzoin and white resin (unidentified). He discusses white varnishes to be prepared in oil of turpentine in the context of colored grounds, when light binders might be preferred, which include mastic, sandarac, white resin, sarcocol, anime, copal and olibanum, over heat. He mentions oil varnishes that are 'greatly out of use now'. He does not mention wax finishes, which is understandable as he focuses on painted surfaces.

In *L'Art du menuisier*, published in France between 1769 and 1775, Roubo is the first author to directly focus on furniture finishes. He describes materials, tools and techniques in great length, offering an uncompared source of information. As outlined by Mussey in his introduction of the reprint of *The Cabinet-maker's Guide of 1827* (Mussey, 1987) Roubo had intimate associations with the trade and his information is considered highly reliable. Roubo describes the different finishing techniques for furniture, in relation to the nature of the surface - veneered or solid - also depending of the wood specie or other material used, as well as in regards to the quality of the work. He describes wax as the most commonly used finishing techniques on furniture, with different polishing techniques for a veneered or solid surface; dry when there is veneer, wet for some solid wood. Figure 1 illustrates the tools and techniques used in polishing a surface. To the knowledge of the authors of this paper it is the only publication that addresses veneered surfaces finishes specifically. For the highest quality furniture, he recommends a white varnish recipe made of 2 pounds of spirits of wine, 5 ounces of sandarac, 2 ounces of mastic, 1 ounce of gum elemi and 1 ounce of 'aspic' oil (lavender or spike oil), dissolved over gentle heat in a double boiler. This is to be applied with a brush and then polished very thoroughly, generating a high gloss surface. Roubo does not mention sizing the wood with glue as other authors like Watin did.

The Cabinet Dictionary by Sheraton, published in England in 1803, offers detailed and valuable entries to the words 'polishing' and 'varnishing'. For furniture varnishes, sandarac prevails,

associated with other resins. He lists recipes for both spirit and oil varnishes. For small boxes he recommends mastic and sandarac in spirits of wine, plus Venice turpentine; for larger work: sandarac (main component), seedlac, rosin and Venice turpentine, with the option to increase seedlac content for mahogany, with dragon's blood and alkanet root, all in spirits of wine. He lists a white varnish for delicate surfaces made of sandarac, white rosin and Venice turpentine. Oil varnish recipes are also provided like a copal and linseed oil varnish recommended for paintings and pictures. Sheraton also discusses oil and wax finishes under the 'polishing' entry, where three types of finishing techniques are listed: with oil, soft and hard waxes. Linseed oil and beeswax prevail; beeswax can be associated with spirits of turpentine for a soft wax polish. Colorants can also be added to the wax.

The Painter's and Varnisher's Guide by Professor Tingry, a Geneva chemist, was published in Geneva in 1803 and in England in 1804. Tingry describes in great detail all the ingredients used in the composition of coatings, from resins to oils, waxes and solvents. He describes in depth oil varnishes that seem to have been in common use at that time. He also mentions wax used on common furniture. His work represents an unprecedented effort to understand the chemical nature of materials and processes of varnish making.

The cabinet-maker's guide, which first known edition dates from 1809 in London, was reprinted and augmented several times,[21] including recently in the United States by Robert Mussey (Mussey, 1987) under the title *The first American furniture finisher's manual: a reprint of 'The cabinet-maker's guide' of 1827*. This manual, whose pocket size tends to testify for its daily use in the shop, focuses on furniture specifically. Mussey's research leads him to conclude that it was the first book printed in America to deal exclusively with furniture finishes. Most of the varnish recipes provided fall into the spirit varnishes group, with not surprisingly for the period, the description of French polish. The 1827 edition edited by Mussey states that 'the method of varnishing furniture, by means of *rubbing* it on the surface of the wood, is of comparatively modern date, though '[bees]wax has been used either by itself, or mixed with spirits of turpentine for a very considerable period'. The guidebook also covers wood dyes as well as japanning, gilding and other miscellaneous arts.

An in-depth discussion of French polishing in America is recorded in a trade publication entitled *The Mechanics' Register, or Journal of the Useful Arts, Trades, Manufactures, Science, etc.* published in Philadelphia in 1837. The writer refers to French polishing in Vienna around 1800, and then current practices in Germany and France. This journal includes detailed information about materials, techniques and best timing practices to be used to ensure the most lustrous and durable finish.

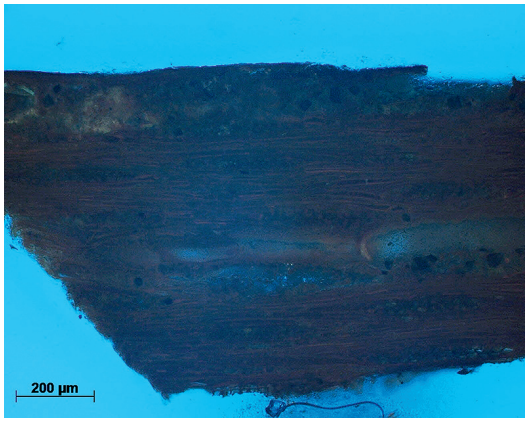
The *Traite théorique et pratique sur l'art de faire les vernis* by Tripier-Deveaux was published in France in 1845. In the same class of treatises as Tingry's work, which he refers to extensively as well as to Watin, the author describes in depth the materials used in varnish making. Tripier-Deveaux was followed by Henri Violette, also a working manufacturer, who published in France in 1866 the *Guide pratique de la fabrication des vernis*.

In 1903, Tolbècque, *in L'Art du luthier*, focuses on finishes applied to musical instruments. Nevertheless, this work provides most valuable information on materials used within varnishes broadly, through an annotated list of recipes ranging from 1550 to the end of the nineteenth century. Sandarac, associated with mastic, is listed in most recipes and shellac only appears towards the end of the eighteenth century. Like Watin, Tolbècque recommends sizing wooden surfaces prior to varnishing. He quotes part of the study of Eugene Mailand (Mailand, 1859) on sizing of musical instruments. Of interest to this study Mailand describes several sizing types he has tested, including fish, Flandres, parchment glues, egg albumin, dextrin or starch, which are all considered appropriate for furniture but not for musical instruments where gum resins soluble in alcohol are preferred.[22]

In the past forty years several authors have studied these primary sources and conducted scientific analysis of transparent coatings as well as experimented with reproduction of pre-industrial techniques to create these surfaces. Thomas Brachert in Germany (1978-79) and Robert Mussey in the United States (1982, 1982, 1987) figure among the best-documented studies on transparent coatings applied to furniture. Theodore Penn has authored another significant source of information on materials used in varnish making through his thesis on decorative and protective finishes from 1750-1850 (Penn,

Figure 2 Chest on Chest, Wilmington, DE, 1790-1810, Swietenia, cedrela, cedar, pine, tulip poplar, brass. Gift of Miss Mary Hoxie Jones in memory of Frances Canby Ferris, 1993.60. Courtesy, Winterthur Museum. Photo by James Schneck.

Figure 3 Cross-section of finish sample from the chest on chest. Left: visible light; right: ultraviolet light. The lack of fluorescence in the wood pores suggests a wax original coating. Photo by Stephanie Auffret.



1984). Regarding wax finishes specifically Joseph Godla has studied in depth wax finishes applied to furniture in America (Godla, 1991). Katharina Walch and Johann Koller, though not focusing on house furniture but on larger woodwork such as church panels and furniture, have offered a scientific approach to the study of transparent coatings on wood (Walch, Koller, 1997) that is most valuable to the field. In 2000, Angie Barth, then student at the Institut Français de Restauration des Oeuvres d'Art (now Institut National du Patrimoine), dedicated her technical study on the 'vernis Roubo' listed above.

Case studies

This selection of case studies illustrates a variety of transparent coatings applied to furniture, either at the time of their creation or during restoration campaigns. The last two featured objects will also provide a stepping-stone to discuss ethical considerations linked to the preservation of transparent coatings.

Chest on chest, Wilmington, DE, 1790-1810. Winterthur Museum, 1993.0060

This chest on chest (figure 2), part of the Winterthur museum collection, dates from the late eighteenth to early nineteenth centuries and was made in the Delaware Valley, on the East coast of the United States. It is veneered with thick figured mahogany. It is of relatively plain design, with discreet moldings and simple brass bail-and-rosette handles, but features a beautiful wooden surface that was most likely originally finished with wax. This wax finish revealed the figure and natural warmth of the wood with a satin luster and an open grain surface. Roubo's description of a wax finish suggests that all waxed surfaces were not left with an open grain though and could have been quite glossy. Roubo describes various levels of polishing that would have left a surface 'as homogeneous and shiny as a mirror'[23]. He recommends the use of shellac powder to be spread over the wax layer to be rubbed with it or, for black woods, colophony powder. This would have filled the pores of the wood while providing color (for the shellac). Cross-sections taken in three different locations of the chest do not show any resin coating (figure 3), confirming analysis done in 1994 by FTIR microanalysis (Report AL 3348. 05/16/1994), which suggested that the sample 'could be of any of several esters of long-chain fatty acids. However the best match was to a reference spectrum of beeswax[...]'

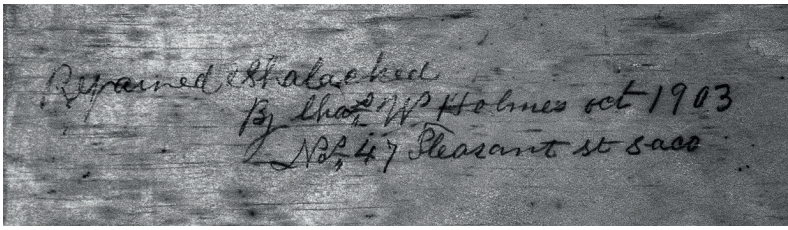
Tambour desk, Boston, MA, 1793-1796, by John Seymour. Winterthur Museum, 1957.0802

This elegant neo-classical tambour desk (figure 4) includes mahogany veneer and light wood inlays. It bears the label of 'John and Thomas Seymour, cabinetmakers, Creek Square, Boston', under the lower drawer bottom (figure 5). The Seymours were amongst the most well-known cabinetmakers in Boston at the time. Near the label is a handwritten pencil note that is of special interest to this study: 'Repaired and Shalacked by Charles W Holmes Oct 1903 Pleasant Street Saco' (figure 6), an indication of a French polish restoration treatment. Cross-sections of the surface show an upper layer of shellac - identified by its characteristic pinkish fluorescence under ultraviolet light - over what appears to be a plant resin, from its bright whitish fluorescence, which penetrates the pores of the wood. Locally an opaque coarse pinkish layer is visible (figure 7). Recent SEM-EDS analysis has identified calcium sulfate with small amounts of iron oxides (Report AL 5961). It is likely that this layer is a preparatory treatment of the wood executed before the application of a natural plant resin. Primary sources describe the polishing of the wood as a first step in varnishing a wooden surface. Tripoli is often cited and though it is silica and not calcium sulfate, one might wonder if period descriptions did not misname this reddish (or yellow) material that has been described as a fine powder, chalky material, by Diderot and D'Alembert[24] for instance. As noted before, the terminology used in primary sources can be misleading. Such a preparatory polishing treatment followed by what appears to be a spirit resin varnish would have provided a highly glossy surface, as seen on several Copley's paintings mentioned earlier. The surface was restored in the early twentieth century with the same desire to produce a mirror-like surface, in this case with a French polish technique.

Figure 4 Tambour desk by John Seymour, Boston, MA, 1793-1796, Mahogany, ash, Eastern white pine. Bequest of Henry Francis du Pont, 1957.802. Courtesy, Winterthur Museum. Photo by James Schneck.

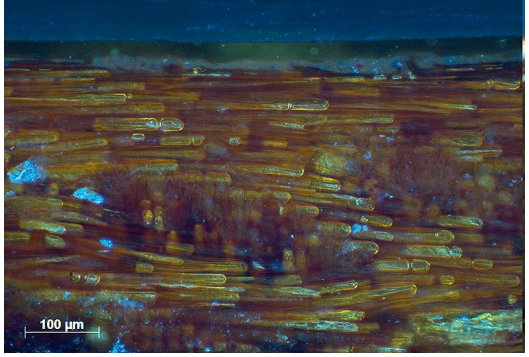
Figure 5 Label of 'John and Thomas Seymour, cabinetmakers, Creek Square, Boston', attached under the lower drawer bottom of the tambour desk. Courtesy, Winterthur Museum. Photo by James Schneck.

Figure 6 Handwritten pencil note near the label stating: 'Repaired and Shalacked by Charles W Holmes Oct 1903 Pleasant Street Saco.' Courtesy, Winterthur Museum. Photo by James Schneck.



Dressing bureau, Philadelphia, PA, 1830, by Walter Pennery, Winterthur Museum, 1980.0116

This Empire dressing bureau (figure 8) was made in 1830 by Walter Pennery, a Philadelphia cabinetmaker. An inscription in pencil on the underside of the drawer in the second row, center, reads: 'The year of our lord one thousand eight hundred/and thirty/Philadelphia June 10th 1830/ Walter Pennery'. Dated 1830, this refined piece of furniture was most likely French polished with shellac, a technique in common use at that time. The trade journal mentioned previously published in Philadelphia in 1837 noted that 'We were the



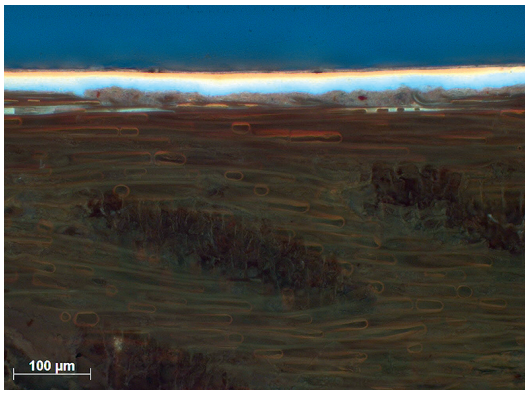
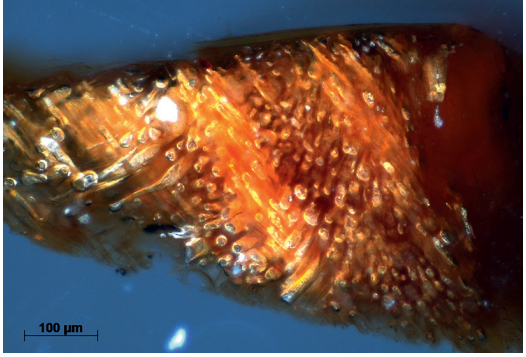


Figure 7 Cross-section of finish sample from the tambour desk. Left: visible light; right: ultraviolet light. Photo by Stephanie Auffret.



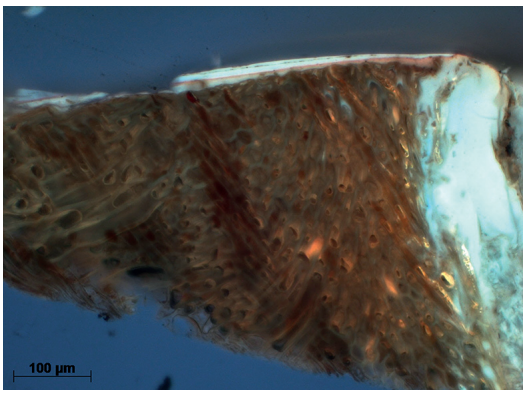


Figure 9 Cross-section of finish sample from the dressing bureau. Left: visible light; right: ultraviolet light. Photo by Stephanie Auffret.

Figure 8 Dressing bureau by Walter Pennery, Philadelphia, PA, 1830, Museum purchase with funds provided by the Special Fund for Collection Objects, 1980.116. Courtesy, Winterthur Museum. Photo by James Schneck.

first to publish any accurate information on the *French Polish* for wood, now become so universally employed.'[25] Indeed, cross-sections of the finish show a first layer of what appears to be shellac, from its pinkish fluorescence. Two subsequent layers are observed on this cross-section, taken in an area protected by the proper right small upper drawer (figure 9). They are most likely a natural resin with grime in between them, suggesting separate campaigns of restoration. Staining of an earlier cross-section (Wolbers, Landrey, 1987) with a .25% Rhodamine B solution in ethanol revealed a bright red fluorescence in the area of the finish/wood interface, indicative of the presence of a fatty-acid material such as would be found in an oil. It is known that coating the wood with an oil prior to the application of a resinous finish was done in the period this piece was made. The bleeding of this material into the porous structures of the wood and the lower finish layer clearly illustrates the unique interaction of individual finishing components revealing a rather complex coating structure. The saturation of the finish into the microstructure of the wood suggests that this surface coating is the first one applied to the object. The fine layering of the finish visible in cross-section would be consistent with a French polishing system. The faint red orange fluorescence may indicate the use of oil

Figure 10 Detail of the dressing bureau surface: area protected under a drawer edge compared to an adjacent area exposed to light illustrating the damaging effect of light on a varnished surface. Photo by James Schneck.

Figure 11 Writing table by Bernard II van Risenburgh, Paris, circa 1755. The Metropolitan Museum of Art. Gift of Mr. and Mrs. Charles Wrightsman 1976 (1979.155.100). Image ©The Metropolitan Museum of Art.

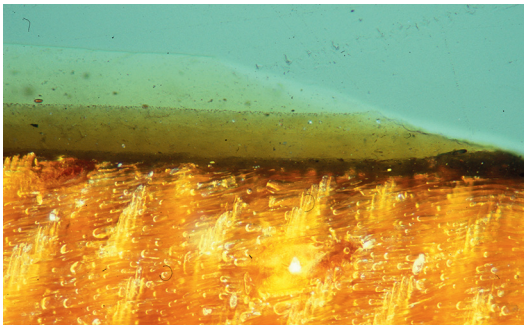
as a lubricant in the padding process. Additionally, it is most interesting to look at a protected area (under a drawer edge) and an adjacent area exposed to light to witness the damaging effect of light on a varnished surface: the protected area is smooth and glossy, typical of a French polished surface, while the exposed area is crazed (figure 10).

Writing table by BVRB II (Bernard II van Risenburgh), Paris, circa 1755. Metropolitan Museum of Art 1976.155.100

This writing table (figure 11) is veneered with tulipwood, mother-of-pearl, stained horn (green, red and blue) and kingwood (Kisluk-Grosheide et al. 2006). The whole surface of the table was once refinished with a thick layer of nitrocellulose varnish that has deteriorated, become extremely brittle and yellowed over time. Prior to treatment in 2005 the finish exhibited numerous craquelures all over the surface and was lifting in many locations (figure 12). From all the cross-sections of varnish samples only one contained what could be the original finish and showed a complete stratigraphy - identified by attenuated total reflection-fourier transform infrared spectroscopy - as two different layers of natural resin and oil (figure 13, layers 2, 3), a thick layer of shellac (layers 4, 5) and two layers of nitrocellulose (layers 6, 7). The other samples either showed only nitrocellulose or shellac and nitrocellulose layers. From Roubo's publication it can be assumed that a table of that nature and quality would have been finished with a 'white' spirit varnish. Unfortunately the two first layers of resin could not be identified at the time of the analysis; the presence of oil, much higher in layer 3 than 2 (according to fluorescence) could come from a polishing process when the table was refinished

Figure 12 Detail of side writing surface exhibiting craquelures and lifted cellulose nitrate varnish. Photo by Stephanie Auffret.

Figure 13 Cross-section of finish sample from the BVRB writing table. Left: visible light; right: ultraviolet light. Layers: 1: wood; 2 and 3: two different layers of natural resin and oil; 4 and 5: shellac; 6 and 7: cellulose nitrate. Photo by Stephanie Auffret.



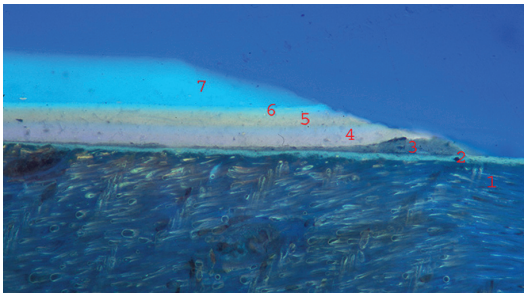


Figure 14 Tall Case Clock, Philadelphia, PA, 1735-1746, Winterthur Museum, 2004.0051. Clock works by Peter Stretch. Mahogany, tulip poplar, iron, brass, textile. Museum purchase with funds provided by The Henry Francis du Pont Collectors Circle, Winterthur Centenary Fund, Mrs. C. Lalor Burdick, Mr. and Mrs. Richard L. Chilton, Jr., Mrs. Robert N. Downs III, Mr. William K. du Pont, Mr. and Mrs. Frederick C. Fiechter III, Mr. and Mrs. John A Herdeg, The Hofmann Foundation, Family of Mr. and Mrs. Walter M. Jeffords, Jr., Kaufman Americana Foundation, Mrs. George M. Kaufman, Mr. and Mrs. Barron U. Kidd, Charles Pollak, Peter A. Pollak, Suzanne W. Pollak, Mr. and Mrs. P. Coleman Townsend, anonymous donors (2), and numerous friends, 2004.51. Courtesy, Winterthur Museum. Photo by Laszlo Bodo.

Figure 15 Detail of the finish of the clock illustrating the degraded finish. Photo by James Schneck.

with shellac. Such an object illustrates well how an object may have been refinished several times in his life, with materials and techniques contemporary to the time of the restoration campaign, and how these interventions erase traces of original finish, compromising the study of early finishes. Approaching the treatment of this table raised the question of what would best preserve the authenticity of the table: leaving the actual finish, accepting it as part of the history of the piece? Removing it and reconstructing a finish closer to the original one? In this case, what materials to use: the same as originally used or synthetic ones that could not interact and be confused with remnants of the original ones? In 2005 it was decided to pursue an intermediate solution: stabilize the condition of the table while reducing the thickness and shininess of the nitrocellulose finish. More research in terms of materials and techniques used by BVRB as well as further analysis of the samples could allow for future treatment.

Tall Case Clock, Philadelphia, PA, 1735-1746, Winterthur Museum, 2004.0051. Clock works by Peter Stretch (figure 14)

Unlike the BVRB table this clock represents a rare example of furniture retaining most of its finish history. The study conducted by Catherine Coueignoux in 2006, as well as additional research, provided evidence of remnants of the original finish (natural resin-based, most likely a spirit varnish) under several subsequent layers of finishes (Coueignoux 2007, 29-38). Unfortunately, the later layers, containing a pine derived resin, probably rosin, and oil, have extensively deteriorated, resulting in numerous losses, darkening and brittleness of the finish (figure 15). Accumulation of soot, dirt and wax has further obscured the surface. Here the finish materials accumulated over the years, and the object history has been mostly preserved to the detriment of the original appearance of the clock. It is clear from the unusual flamboyant mahogany used for the door and base panel that the cabinetmaker intended to create an impressive visual effect, which has been obscured by the degradation of the finish. This begged the question as to what treatment option would best preserve the authenticity of the clock case. Would it be best to keep the surface 'untouched' in order to preserve the authenticity of the object's history and materials as well as a source of information on history of restoration? Should the degraded upper layers be removed to return the clock case to an appearance closer to the original? Or

should an intermediate solution such as filling the losses and/or reducing the later layers of the finish be considered? After much thought and extensive cleaning tests Winterthur conservators and curators decided to carefully clean the surface (from dirt and grime only), allowing to preserve the history of the finish while enhancing the visual effect of the wood. The surface was finally waxed, giving it a satisfying level of saturation while remaining reversible.

Ethical considerations

Through the history of restoration, furniture finishes have often been considered as secondary, serving mainly to enhance the general aesthetic of the object. As such, like on paintings, they were often replaced. This perception has changed recently with more emphasis on preserving furniture finishes.

As conservators charged with treating furniture surfaces it is important to reflect on the intent of past restorers as well as today's practitioners. Going back in the eighteenth century, cabinetmakers such as Riesener documented refinishing furniture they had created several years before. Period written records such as the *Journal du Garde Meuble de la Couronne* (Archives Nationales, Paris) or cabinetmakers' account books reveal that surfaces were scraped and refinished to provide a pristine and saturated surface. Later on, as we can observe directly on objects, surfaces were either striped and refinished, as with the BVRB table discussed earlier, or varnished over previous layers of resins to increase saturation, like with the Stretch clock. Surfaces have often been refinished in the name of being faithful to the intent of the artist, and to do so, by pretending to go back to the supposedly 'original condition' of the object. Consequently many objects have lost a major part of their history, of the marks left by time and use as well as physical documentation of past restoration campaigns. It can be regretted as past interventions are important to study and document, and in some cases to preserve, as they inform us on restoration techniques and materials used at different time periods as well as the appreciation and interpretation that was made of an object.

The second half of the nineteenth century marks a major step in the history of conservation philosophy through the manifestation of opposite attitudes towards the restoration of our cultural heritage. In 1854, in France, Viollet-le-Duc defined restoration a 'means to reestablish [a building] to a finished state, which may in fact never have actually

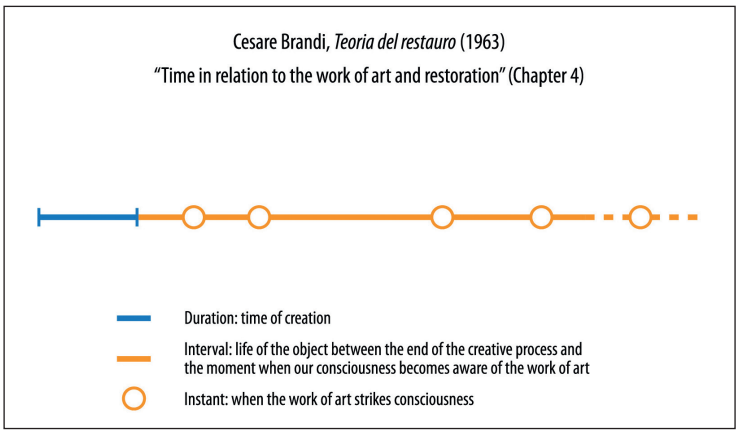


Figure 16 Interpretation of Brandi's approach of 'time in relation to the work of art and restoration'. Design by Stephanie and Gilles Auffret.

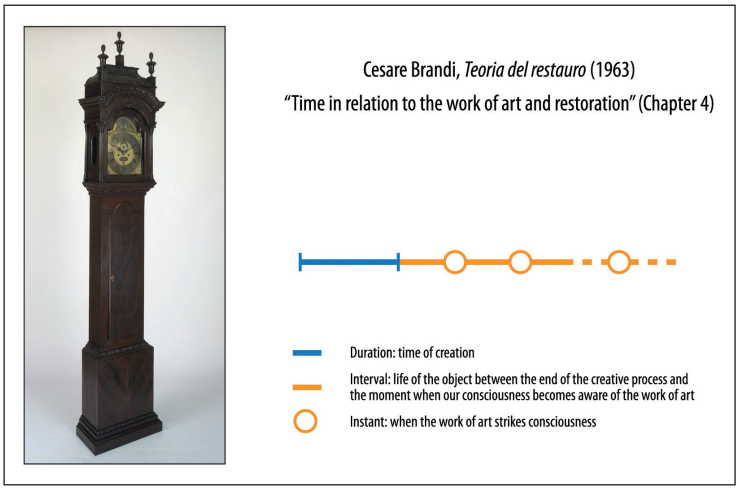
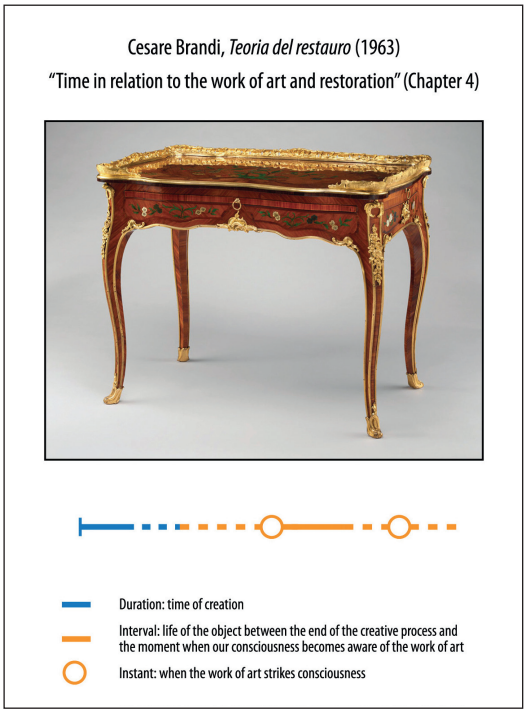


Figure 17 Interpretation of Brandi's approach applied to the Stretch clock. Design by Stephanie and Gilles Auffret.

Figure 18 Interpretation of Brandi's approach applied to the BVRB writing table. Design by Stephanie and Gilles Auffret.



existed at any given time.' (Viollet-le-Duc, 1854). The type of restoration employed by Viollet-le-Duc, named in its English form 'Victorian restoration', was decried by Ruskin as 'a destruction out of which no remnants can be gathered: a destruction accompanied with false description of the thing destroyed.' (Ruskin, 1880.)
Even though Viollet-le-Duc and Ruskin were mainly involved with architecture, their thoughts are applicable to any types of artefacts, up to surfaces. Indeed, when refinishing an aged wooden surface, worn and oxidized, especially with materials and techniques that may not correspond to the original ones - would we know them - are not we creating a state that has never existed before, while erasing testimonies of the object's past life as well as material evidence left on the object?

Cesare Brandi, in his *History of Restoration* (Brandi, 1964), offers an insightful perspective on the place of a restoration campaign within the life of an artwork, emphasizing its impact on the future interpretation of the piece. In the chapter entitled 'Time and restoration' he identifies three times in the life of an object: the *duration* or time of creation, which ends on the day the work is completed by its creator; the *interval* or time from the end of the creation to today, continuing into the future; and finally the *instant*, which corresponds to the moment where the artwork 'strikes an individual consciousness', meaning when the artwork is experienced by an individual. Many *instants* are perpetuated during the *interval*. A restoration campaign can be seen as an *instant* since it happens during the interval, from an individual perspective, but it bears significant consequences on future *instants* to come as it impacts what next viewers will experience. There are two very important related concepts that Brandi develops in his *Theory of Restoration*: first that a restorer should never attempt to go back into the *duration* time, which is over; secondly that we only restore the material (versus the idea). Figure 16 illustrates Brandi's theory while figures 17 and 18 apply it to the Stretch clock and BVRB table discussed before.

In the case of the Stretch clock the restoration campaigns have added materials to a degraded surface but have, to a large extent, preserved traces of the object's life. The object is not experienced today as it was created but there was no attempt to go back into the time of creation, and the preservation of past materials allows for their future study. With the BVRB table, the situation is very different as the object was stripped from its prior finish to create a surface different from the original one through the use of other materials, while erasing traces of age. Viollet-le-Duc's statement easily comes to mind in such a situation where clearly the restorer has created a state that had never existed before. Without judging the success of such an intervention, it has undoubtedly strongly impacted the future interpretation of the object.

Conclusion

Finishes on furniture play a major role in how a wooden object is perceived and valued. Understanding the nature of finishing materials and how they were created, applied, aged and cared for over time is essential knowledge for the conservator and curator alike. The case studies discussed above represent the importance of engaging in informed discussions about ethical issues related to the preservation and interpretation of traditional transparent coatings on furniture.

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Notes

[1] In his article on transparent finishes in New England (1700-1820), published in 1980, Robert Mussey (Mussey 1980) lists ten points outlining the difficulty to study furniture coatings as well as historic sources that provides information on materials used in finishes, such as published recipes, account books etc.
[2] G.G. Hawley, *The Condensed Chemical Dictionary*, 10th edition, New York: Van Nostrand Reinhold Co., 1981, p. 758.
[3] See the Kress Technical Art History website for additional information on pigments and related painting materials: http://www.artcons.udel.edu/about/kress.
[4] R.J. Gettens and G.L. Stout, *Painting Materials, A Short Encyclopedia*, New York: Dover Publications, 1966, p. 14.
[5] Gettens and Stout, p. 14.
[6] Gettens and Stout, p. 34.

[7] R. Mussey, ed. *The First American Finisher's Manual, A Reprint of 'The cabinet-maker's guide'*, New York: Dover, 1987, p. xxiv.
[8] Ibidem.
[9] Gettens, p. 74.
[10] Hawley, 1981, p. 618.
[11] Gettens and Stout, p. 77.
[12] N. Umney and S. Rivers, *Conservation of Furniture*. Burlington: Elsevier, 2003, p. 166.
[13] Ibidem.
[14] Ibidem, p. 167.
[15] Gettens and Stout, p. 186.
[16] Gettens and Stout, p. 198.
[17] Theodore Zuk Penn, *Decorative and Protective Finishes, 1750-1850: Materials, Process and Craft*, Master's thesis, University of Delaware, 1966, p. 2.
[18] Penn, p. 8.
[19] Hawley, p. 393.
[20] 'On ne vernit guère les bois d'ébénisterie; on se contente de les finir à la cire', Watin, 1828, p. 341. English translation: « one rarely varnishes cabinetmaking woods; one settles for wax finishing ».
[21] Mussey reports fourteen known editions and seventy-plus pirated texts.
[22] «...ces encollages, très convenables pour l'ébénisterie, ont tous, pour la lutherie, les défauts graves » (Mailand, 1859).
[23] 'L'ouvrage doit ainsi être aussi uni et luisant qu'une glace', Roubo, 1769-1775.
[24] D. Diderot, J. Le Rond d'Alembert, P. Mouchon. *Encyclopédie; ou Dictionnaire raisonné des sciences, des arts et des métiers*. Paris: Briasson, 1751-1772. Volume 24, Part 2, pp. 444-445.
[25] *The Mechanics' Register, or Journal of the Useful Arts, Trades, Manufactures, Science, etc.*, Philadelphia: Moore and Waterhouse, February 22, 1837, p. 28.

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