"LAST BUT NOT LEAST" - EXAMINATION AND INTERPRETATION OF COATINGS ON BRASS HARDWARE

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Introduction

It has long been understood that the oxidation of metals can be inhibited by the application of protective coatings made from oils, waxes and resins. These coatings act as barriers which limit the metal's exposure to the environment. Painters' and cabinetmakers' references and guidebooks from the last two centuries document a wide variety of recipes for formulating protective metal coatings. As the titles of many of these recipes suggest, the coatings often had an aesthetic function as well as a practical one. With the addition of various dyes to the formula, a coating applied to a baser metal could enhance its appearance by making it look more like gold.

This paper presents the results of a study undertaken at the SPNEA Conservation Center in an effort to better understand the historic use of metal coatings, how they specifically related to brass furniture hardware, and how the subtle yet distinct appearance of coated hardware fits into an overall decorative scheme. This study was undertaken with three goals in mind:

1. To review existing literature which relates to coatings on metals and compile lists of recipes for comparison.

2. To formulate a series of techniques to help identify fragments of gilded or organic coatings specifically on brass hardware.

3. To set forth a process for cleaning and coating hardware which will protect and preserve historic coating remnants.

The stimulus for this study was a Grecian couch (ca. 1820-1840, attributed to Baltimore cabinetmakers John or Hugh Findlay,) whose presence graced the furniture and upholstery labs at the SPNEA Conservation Center for several months in 1990. The couch's complex finish and upholstery problems were resolved and as the project neared completion the four hairy paw casters needed to be cleaned and lacquered. While cleaning the casters, which were quite tarnished and coated with layers of dirt, varnish, and floor wax, several brilliant gold-colored spots were observed in the recessed areas of the casting. Since the interior surfaces of the casters were also a brilliant, untarnished gold color, it was suggested that they had possibly been fire-gilded or electroplated at one time, and that most of the gold layer had been worn from the exterior surfaces due to use and abrasion, leaving only a few fragments.

To make sure that the gold-colored spots were correctly interpreted, one of the casters was analyzed using the technique of X-ray Fluorescent Elemental Analysis, or XRF.(l) This test is non-destructive and can identify the elements present in a sample by detecting the energy given off when the sample is bombarded with X-rays. Since each element emits its own characteristic fluorescence when subjected to X-rays, it is possible to discern major and minor elemental components of a material such as a metal

or paint pigment. Surprisingly, analysis of the caster using this technique yielded no evidence that gold was present in the areas tested. Since these bright spots on the exterior surfaces also tended to fluoresce slightly under ultraviolet light, we determined that they were more likely remnants of an organic coating, rather than gold. The brilliant interiors of the casters still remained a mystery, as it was not possible for the instrument to obtain a reading from such a confined space. Since then many pieces of brass hardware have been examined with the thought that all that glitters is not necessarily gold.

A survey of historic literature relating to coatings on metal

There are many 18th and early 19th century references and guidebooks available to us which provide information and instructions on how to mix paints and varnishes with the materials available at the time. Of the dozen or so surveyed for this project, virtually everyone which provides recipes for varnish includes one or more recipes for a coating for metal. (See Appendix I for a bibliography of historic texts surveyed and compilation of recipes.) They are referred to by various names, such as "changing varnish", "yellow varnish", "gold lacquer" and "lacker"– the term used in the earlier guidebooks published in England. In general, the term "lacquer" or "lacker" refers to a coating for metal, whereas "varnish" has broader connotations.

The recipes surveyed generally include in their ingredients alcohol (spirits of wine), a resin such as seed-lac, colored resins such as dragon's blood and gamboge, and various dyestuffs including saffron, tumeric and annatto seeds. Two recipes were found which contained a drying oil in addition to other resins.

The numerous coatings for metal had an array of purposes. Some were strictly functional, that is, provided a barrier between the polished metal and the atmosphere, thereby preventing tarnishing. Some coatings included dyes, and could be applied to silver leaf to give it a golden glow or enhance the appearance of a metal of lesser value such as brass, by making it look more like its richer relative, gold. Many recipes had very revealing titles, such as the one from *The Builder's Dictionary* which describes "A Varnish for Brass To Make It Look Like Gold." There are specific recipes for coating watch-cases and keys, and for coating "philosophical instruments." Henry Carey Baird in *The Painter, Gilder, and Varnisher's Companion* (Philadelphia, 1854) notes that "it would be an endless task to enumerate all the various kinds of changing varnishes that can be made…" As a note of interest, Baird may have copied the chapters in his book on changing varnishes and lacquering verbatim from another book, published earlier in London and titled *The Painter's and Varnisher's Pocket Manual*, and he certainly wasn't the only one guilty of rampant plagiarism because *The Painter's and Varnisher's Pocket Manual* in turn may have copied the information contained in the well-known *The Painter and Varnisher's Guide* by P.F. Tingry, published in 1816. Many other authors apparently had no qualms about lifting material from other sources and as there were no laws preventing such actions, the same recipes keep occurring over and over in different sources. As late as 1921, the same recipes were being published for the same purposes, and utilizing the same basic ingredients. (2)

In addition to coatings prescribed for baser metals, there are recipes for coatings especially for application to gilded surfaces. There is a reference to a "Gold Lacker Varnish" in a pamphlet titled "Genuine Receipt for making the Famous Vernis Martin, etc.," (published in Paris and Dublin, 1776); the purpose of which was to enhance the gold and give it a "pleasing but magnificent appearance", not unlike a vermeil.

We know that much of the brass hardware that came to America from England in the 18th and 19th centuries was manufactured at factories in the Midlands district, concentrated in and around the city of

Birmingham. A few hardware catalogs survive from a company called W. Walker & Sons in Birmingham, and can be found in the SPNEA archives. They include a numbered drawing for each piece of hardware available, along with an occasional description of the finish, i.e. hinged hooks are "burnish'd and lackerd" and "strong stop butts (hinges) either lacq.d or white".

A book titled *The Resources. Products and Industrial History of Birmingham and the Midland Hardware District*, published in London in 1866 and edited by Samuel Timmins, describes the manufacture of stamped brass hardware and notes that it is always lacquered as the last step in its manufacture. It goes on to describe in great detail the recipes and techniques used for coating the hardware. In this book, and in nearly all the guidebooks surveyed, it is suggested that the metal be heated either before or after the application of the coating to render the coating more transparent and durable. with the application of heat, crosslinking of the resin occurs, making the coating harder and insoluble in most solvents.

Other routine treatments to brass hardware described in Timmins' book were the process of dipping, and "dead dipping". Dipping refers to the process of submerging the hardware in mild acid, which removes any fire scale and tarnish, and prepares the metal for polishing and lacquering. It is common to see unpolished, acid-dipped surfaces on the backs of stamped brasses. Dead dipping was a slightly more complicated process which involved dipping the hardware into acids of different strengths, and had the effect of giving the brass surface a dull, lemony yellow color. This effect was desirable, especially when parts of the same piece were burnished, giving a contrasting mat and burnished look to the metal, similar to that of French gilt bronze mounts applied to furniture. The contrasting of mat and burnished surfaces as a technique to enhance decoration in relief is seen also on gilded frames.

We know that furniture brasses served a dual purpose – they were functional as well as decorative. Brass was an obvious choice over other metals for decorative furniture hardware because it was relatively inexpensive, had good working properties, tarnished more slowly as compared to other metals such as iron and silver, and looked a lot like gold when polished. Just as furniture required periodic refinishing, brasses would also eventually require repolishing. Their factory coatings would eventually degrade over time and with use, allowing air to tarnish the brass underneath. Regimens of brass polishing existed in many households, and involved andirons and door plates, and furniture brasses as well.(3) It is possible that coatings on brass may have been occasionally misunderstood and zealously polished with one of the many abrasive cleaners concocted for polishing other metals, resulting in abrasion and premature removal of the coating.

As noted in the article on "The Care of Period Hardware" by Gregory Landrey and Helen Stetina, the need to occasionally recoat brasses was anticipated, and they cite Thomas Chippendale's shop ledger records in 1765 which bill for "Repair'g & cleaning a Mahogany desk...& new lackering the brasswork..."(4) Since there are indications of hardware being coated at the time of manufacture and also recoated when it was necessary to do so, it is therefore difficult to differentiate between an original coating and a later application. It is important to remember that when examining hardware, that there may be no way to discern between an "original" and an "early" coating.

One will occasionally come across brass hardware that has been fire-gilded. The technique of fire-gilding enabled a baser metal such as brass to be coated with a layer of real gold. An amalgam of gold and mercury was painted on the surface of the brass and the object was heated to the point where the mercury vaporized, leaving the gold behind. (5) Fire-gilded hardware, called "ormoulu" by the French, is often

seen on American Empire-style furniture and furniture influenced by the French taste. Much fire-gilded hardware was imported from France, although occasionally we find gilded high-style hardware from England.

It is important to recognize fire-gilding as such and not confuse it with other types of coatings. During visual examination one might notice a clue that indicates a fire-gilded surface – drips of gold along the edges which sometimes spillover to the ungilded back side of the hardware. Gold was expensive and there was no point to putting gold on a surface that wouldn't be seen. If, on the other hand, one observes what one thinks is gold on the back of a piece of hardware, it is possible that the hardware has been electroplated. The electroplating process requires that the hardware be dipped into a solution containing the gold ions, so that plating occurs on both the front and back sides of the metal in contrast to fire-gilding, in which only the front sides of hardware were coated. Electroplated coatings also tended to be much thinner – sometimes only molecules thick – and can easily be worn off during unwarranted polishing. To help determine if you have a layer of gold on a metal surface, you can use a spot test for gold. A simple spot testing method is described later.

General Observations and Methods of Examination

Once the hardware has been removed from a piece of furniture for cleaning, it can be more easily examined for remnants of any early coatings. In some situations, however, it is not possible or appropriate to remove the hardware and examination must be conducted in situ. For instance, hardware attached with cotter pins should not be removed because the pins will break if bent; also on rare occasions one will see hardware with no signs of prior removal. In these situations, it is best to leave the hardware attached and examine and clean in place.

The following list of tools and methods for examination and interpretation of hardware coatings suggests a low-tech approach to gathering information. Since the information gained from this type of examination will be of a general nature, it may be necessary to consider more sophisticated techniques of analysis if more specific data is required.

1. If the hardware is particularly grimy, it is best to first remove surface dirt and accumulations of wax using mineral spirits and a brush. Often on the backs of backing plates and escutcheons one can observe the chalky white residue of brass polishes, active corrosion (a bright green powdery surface) and accumulated dirt. Brass polish residue and active corrosion are usually found together because the ammonia contained in most commercial brass polishes induces corrosion. These accretions are usually well-adhered to the surface of the metal and may be difficult to remove.

2. Once the hardware is cleaned of major accretions, it can be examined under a microscope. The most obvious places to find the remains of coatings are in recesses and crevices protected from light and handling, such as areas on backing plates directly underneath bails. A coating will be more readily apparent under the microscope as it has a reflective quality different from that of the bare metal.

3. Examination under ultraviolet light can also be illuminating because any resinous organic coating will fluoresce whereas uncoated metal will not. Often remnants of coatings which fluoresce under UV light will be concentrated around the edges of the piece of hardware. These coatings must be regarded with some suspicion, however, because occasionally in its lifetime a piece of furniture gets a quick coating of shellac or varnish by someone who doesn't bother to take the brasses off, and some of the

varnish will invariably get on the hardware. Also, it is important to remember that synthetic coatings will fluoresce very little or not at all.

4. A simple battery continuity tester from the hardware store will also indicate the presence of a coating by noting the disruption of an electrical current passed through the metal. It is also important to be aware that corrosion products are also non-conductive, as they do not form a regular crystalline matrix in the same way that metal does.(6) The continuity tester is therefore unable to distinguish between an organic coating and a heavy tarnish layer and may give misleading information.

5. Since one may occasionally encounter fire-gilding or gold electroplating, a spot test for gold is available which will not damage the surface of the metal or leave a large area of discoloration. It requires setting up an electrolysis apparatus (See figure 1), and touching a piece of filter paper moistened with a saturated solution of NaCl to the suspected gold layer. If the gold is not pure, and contains copper or some other metal, a slight discoloration of the metal will result at the point of contact with the filter paper. The filter paper is then dipped into a mixture of 20% SnC12/15% HCl, and if gold is present, the filter paper will immediately turn black. Presence of copper or silver ions will not adversely affect the test. The obvious advantage of this type of test compared to other spot tests is that it is only the filter paper which comes into contact with the metal surface, and not a drop of reagent, which can easily spread uncontrolled and damage a larger area.

Another frequent phenomenon is a bright, untarnished surface on the back of a stamped plate or inside a caster. Mistaken by some people for gold, it is more likely an acid-dipped surface which has been in a microclimate created by the attachment of the hardware to either bare wood or a finished wood surface. Because there is less interaction with the atmosphere, the process of oxidation involving these interior surfaces proceeds at a slower rate.

Contextual information is also important to consider. The location of the piece of hardware, its originality, whether it has ever been removed, and whether the finished wood surface surrounding it has been refinished are all significant sources of information about the hardware's history. Brass latches with a remarkably intact early coating were discovered in the interior of a cabinet in the SPNEA collection, where they were protected from light and regular use.

Treatment of hardware retaining fragments of historic coatings

The routine treatment for hardware at the SPNEA Conservation Center is based on the procedure followed at the Henry Francis duPont winterthur Museum. (8) After examination, the hardware is cleaned of dirt and other unwanted coatings with solvents, dipped in a solution of thiourea and acid to reverse corrosion products, polished with mild abrasives, and coated with a nitrocellulose lacquer made expressly for metals. (see Appendix II - Cleaning Procedure for Brass Hardware)

It is not unusual to see hardware without a trace of any kind of coating. Chippendale-style backing plates and escutcheons have no recessed decoration and their flat, unbroken surfaces invited frequent polishing, so one rarely encounters historic coatings on this style of drawer hardware. Also, reproductions of period hardware have been made over the years, and one prominent manufacturer, Ball and Ball of Exton, PA sells brass hardware with either a polished or "antiqued" surface, neither of which is coated.

If we do find remnants of a coating that we feel are significant, the cleaning procedure can be adjusted to

accommodate them. Since many of the historic coatings are resin-based, they will be sensitive to alcohols, so it is best to substitute other solvents for cleaning. The thiourea dip can still be used when coatings are present, and in some situations rather than dipping the entire piece of hardware into the solution, we will roll a swab soaked in the solution over the tarnished areas. When polishing, we can restrict the abrasive to the tarnished areas of the metal while avoiding the coatings that we feel are significant and worth preserving. Partial polishing may result in uneven coloring, which may not be as noticeable from a slight distance. Allowing the polished brasses to sit exposed to the air for a few weeks before coating will cause the newly-polished surfaces to "mellow" and better blend with the coated surfaces.

Lastly, when it comes to choosing a synthetic coating to seal the newly-cleaned and polished brasses, we might opt for an acrylic resin instead of nitrocellulose lacquer, which contains solvents that could partially dissolve historic resin coatings. Acryloid B-72 forms a coating which is softer than nitrocellulose lacquer, and can be dissolved in toluene, which has only a minimal effect on a resin coating. (9) B-67 in mineral spirits would be an ideal film from the point of view of reactivity with any resinous coating remnants, but it forms an even softer coating which may not be appropriate in a situation where the hardware is handled regularly. An advantage of B-72 is that it can be tinted with chemical dyes such as Ciba-Geigy Orasol Solvent-Soluble Dyes (Ciba-Geigy Corp., Hawthorne, NY) to more resemble the color of a shellac or colored resin coating. The tinted B-72 can then be applied with an airbrush, and sandwiched in between two clear airbrushed coats of B-72.

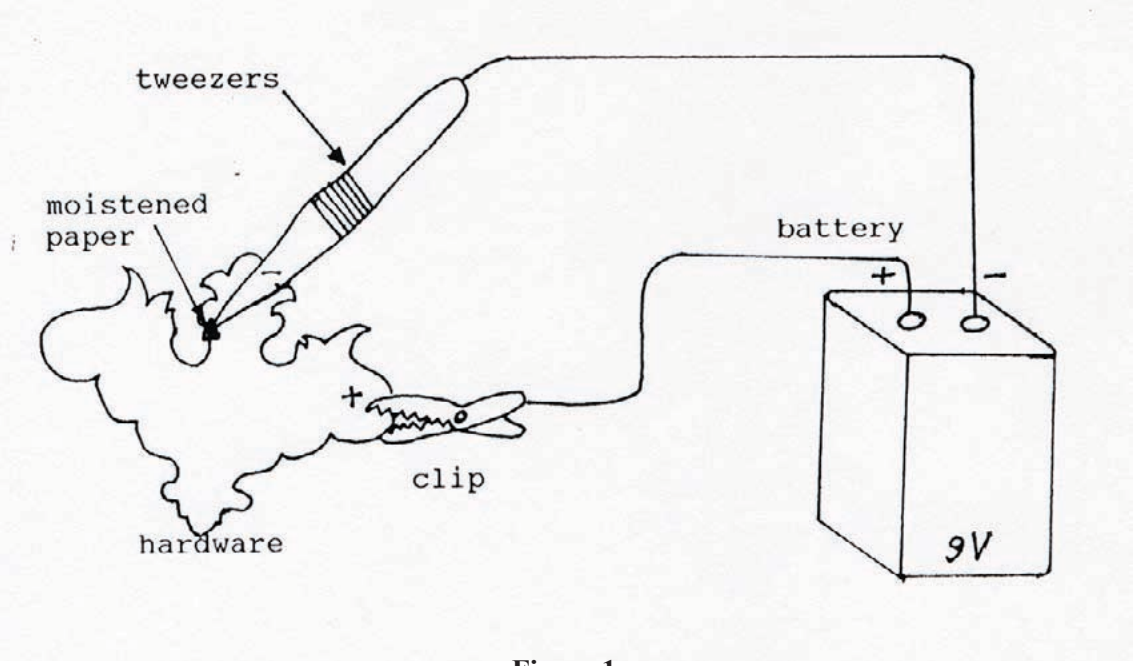

Figure 1

Unfortunately, the natural dyes and colored resins included in historic recipes tended to be very fugitive, and the coating remnants we see today may not bear any resemblance to their original appearance. Through experimentation with early recipes and speculation, may we be able to recreate the dazzling finishes of the originals.

Suggestions for further study

This study has barely scratched the surface of this large and interesting subject, but has hopefully provided inspiration to others to pursue related topics. Case studies of specific examples of different coatings should be held up to more sophisticated techniques of analysis, as it might be useful to discern specific components of the coatings in question. Another related topic which was not elaborated upon is that of pickling and chemical patination techniques which were occasionally employed to give a base metal a more interesting color. There is a thorough discussion of this topic in a source titled *Scientific American Handy Book of Facts and Formulae* (Munn & Co, Inc., New York, 1921). In addition, further study and comparison of the colors created by the multitude of recipes for metal coatings would yield information which would allow us to better understand and more accurately represent the craftsman's original intent.

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Notes

1. X-Ray Fluorescent Elemental Analysis of the caster was conducted at the Fogg Art Museum, Cambridge, MA in March, 1990.

2. This very interesting book, *Scientific American Handy Book of Facts and Formulae* (Munn & Co., Inc., New York, 1921), includes over 40 recipes for lacquers for metal, some of which are arranged in chart form according to their ingredients and the color they produce. These are the same formulas that appear in the earlier guidebooks. The technology changed very little over 100 years.

3. *At Home - The American Family 1750 - 1870* by Elizabeth Donaghy Garrett (Abrams & Co., New York, 1990) makes several references to the importance of polishing the brass objects, including the brasses on furniture, as part of routine housekeeping.

4. Article by Gregory Landrey and Helen Stetina, "The Care of Period Hardware," gives a procedure for cleaning and coating brass hardware.

5. The technique of fire-gilding is illustrated in *A Diderot Pictorial Encyclopedia of Trades and Industry*, (Dover Publications, Inc., New York, 1959) Volume 2, plate 421.

6. Schrager, Arthur M. *Elementary Metallurgy and Metallography* (Dover Publications, Inc., New York, 1969).

7. Laver, Marilyn "Spot Tests in Conservation: Metals and Alloys", ICOM Committee for conservation, Zagreb, 1978.

8. Heller, Don "The Coating of Metal Objects At Winterthur", AIC presentation, 1983.

9. Horie, C.V. *Materials for Conservation*, (Butterworth's, London, 1987) gives solubility perameters for shellac, p. 217.

APPENDIX I

The following list of period guidebooks and references surveyed for this study includes representative ingredients for lacquers and metal coatings included in each text.

The Builder's Dictionary or, Architect's Companion. London, 1734

Describes "A Varnish for Brass to make it look like gold", designed to be used on leaf gold or brass.

2 qts. spirit of wine
1 oz. gamboge
2 oz. lake
2 oz. gum mastic

Clarke, Hewson and John Dougall. *The Cabinet of Arts. M'Gowan, London,* 1823

Many, many recipes for varnishes, including one for "Gold - colour varnish, or Lacker".

8 oz. amber
2 oz. lacca
8 oz. drying oil
oil of turpentine, colored with annatto, saffron, and dragon's blood

Genuine Receipt for Making the Famous Vernis Martin. Paris, 1776

This small text (20 pages) includes a recipe for a varnish for gold, to give it a "pleasing but magnificent appearance".

1 lb. gambouge
4 oz. ornotto (annatto?)
4 oz. Venice turpentine
1 pt. turpentine
add some amber varnish, (sometimes an ounce of seedlac is also added)

Hopkins, Albert, ed. *Scientific American Handy Book of Facts and Formulae.* New York: Munn & Co., Inc., 1921

Although this is a much later publication, it is significant in that the changing lacquer recipes and ingredients it contains are virtually identical to the recipes of 100 years earlier. The lacquer for philosophical instruments appears again as do several others. Most interestingly, it has a chart of 19 different recipes, which are arranged according to their ingredients and the color they produce. The colors are described as fine pale, full yellow, gold, deep gold, red, and green for bronze, among others. This book is filled with interesting information on related subjects: there are extensive descriptions of patination processes, and techniques of acid dipping and gilding.

Mackenzie, Colin. *Mackenzie's Five Thousand Receipts, etc.* Philadelphia and Pittsburg: John J. Kay, 1830.

"This varnish is meant to give a gold color to white metals."

8 oz. amber
2 oz. gum lac

2 oz. drying linseed oil
16 oz. essence of turpentine
varying quantities of the the following dyestuffs: annatto, terra merita, gum guttae and dragon's blood

The Painter, Gilder, and Varnisher's Companion. 2nd ed., Philadelphia: Henry Carey Baird,1854

The text on metal coatings is identical to that in The Painter's and Varnisher's Pocket Manual, published in 1826. Thfe recipes and text in this book were either taken from the earlier Painter's and varnisher's Pocket Manual, or they both may have borrowed from an even earlier publication by P.F. Tingry, titled The Painter and Varnisher's Guide (1816), which gives the same recipes and techniques for making the lacquers and coating metals. There is a chapter titled "On Lacquering" which includes a lacquer for brass.

6 oz. seed lac
2 oz. amber or copal
40 grains dragon's blood
30 grains extract of red sandal-wood
36 grains oriental saffron
4 oz. pounded glass (to help keep everything in solution)
40 oz. very pure alcohol

The Painter's and Varnisher's Pocket Manual. London, 1826

The text on metal coatings in this book also appears in The Painter and Varnisher's Companion, published in Philadelphia in 1854, as well as in tingry's The Painter and Varnisher's Guide. Along with the recipe for "Lacquer for Brass" already cited under the other title, there is a "Lacquer for Philosophical Instruments" and a "Gold-Coloured Lacquer for Brass Watchcases, Watchkeys, &c. Many recipes in this and many of the other guidebooks suggest that if you don't like the color of the lacquer, you can always adjust the amount of dyestuff. For cleaning brass, they recommend first boiling the brass-work in lye, then putting into a pickle of aquafortis and water.

for Philosophical Instruments:

1 1/2 oz. gamboge
4 oz. gum sandrac
4 oz. gum elemi
2 oz. best dragon's blood
1 1/2 oz. terra merita (Indian dye plant)
4 grains oriental saffron
2 oz. seed-lac
6 oz. pounded glass
40 oz. pure alcohol

for Brass Watchcases, Watchkeys, &c.:

6 oz. seedlac
2 oz. amber
2 oz. gamboge
24 grains extract of red sandal-wood in water
60 grains dragon's blood

36 grains oriental saffron
4 oz. pounded glass
36 oz pure alcohol

Roubo, Andre Jacob. *L'Art du Menuisier.* Paris, 1774

Section 4, paragraph 4: "Description and use of a varnish for gilding copper and other metals." It goes by the name "English Varnish".

1/2 oz. yellow amber (or yellow Kauri)
1/2 oz. crystallized lacquer gum (probably seed-lac)
9 grains of saffron
10 graind dragon's blood
10 oz. spirits of wine

Roubo gives a detailed description of how to make and apply the varnish, and stresses the importance of maintaining clean conditions. He also mentions that to clean a piece that is varnished with this technique, one must never use any abrasive powder out only a clean soft cloth dipped in tepid water.

Stalker, John and George Parker. *A Treatise of Japaning and Varnishing*, etc. 1688. A Tiranti, London, 1971.

There are four different recipes for "lackers" but there is little description of what to do with them. They do give a discussion of lackering burnished silver (leaf) to make it look like gold. All four recipes include spirit of wine, shell-lac or seed-lac, and various dyestuffs, such as turmerick, sangunis draconis, saffron and gambogium. Also a reference to a color called "Ornator". One recipe includes venice turpentine so "you may lacker anything in the open Air."

Timmins, Samuel. *The Resources, Products, and Industrial History of Birmingham and the Midland Hardware District.* London, 1866

This book devotes a whole chapter to the manufacture of brass objects, and discusses lacquering at length along with other techniques for producing decorative finishes on brass hardware. It gives a simple recipe for lacquer, and notes that the lacquer should "present that of pale French brandy…"

seed lac
spirits of wine
turmeric, dragon's blood, and sandal wood for imparting various shades of colour

Tingry, Pierre Francois. *The Painter and Varnisher's Guide.* 2nd ed., London: 1816

The earliest and most likely the original source for three recipes which appear in later texts.
IX For Giving a Gold Tint to Articles of Brass

6 oz. seedlac
2 oz amber or copal
40 grains dragon's blood
30 grains red sandal wood

36 grains hay saffron
4 oz. pounded glass
40 oz. spirits of wine

Two additional varnishes included in this text, one for watchcases and watch keys, and another for Philosophical Instruments, are identical to the ones listed in The painter,Gilder and Varnisher's Companion and The Painter's and Varnisher's Pocket Manual.

Willich, A.F.M. The Domestic Encyclopedia, etc. Philadelphia, 1821

Contains a recipe for a "Gold-colour varnish, or lacker":

8 oz. amber 2 oz. lacca
8 oz. drying oil
oil of turpentine colored with gamboge, anotta, saffron, and dragon's blood, "according to the tinge you want".

A yellow varnish, chiefly employed for imparting a gold colour to brass or iron...can also be applied to leather which has been adorned with tin-foil.

2 oz. pure gum-lac
1 oz. dragon's blood
48 oz. alcohol
5 grains tincture of turmeric (yellow wood)

APPENDIX II

CLEANING PROCEDURE FOR BRASS HARDWARE

1. There are often accumulations of polish residue, buffing compounds, wax and/or finish combined with corrosion products on the backs of brass hardware. It is helpful to remove these first with a plexiglas or plastic scraper before soaking them in solvent. More stubborn residues can be removed with the aid of an air abrasive unit and glass beads. Never use glass beads on the fronts, as it is too agressive and will leave a peened surface.

2. Tie a long undyed cotton or flax string to each piece wherever possible to make for easier handling when dipping. ID labels can also be attached at this time. If it is not possible to attach a string to the hardware, an alternate method would be to use wooden tongs to dip and clean each piece in a set order. The use of wire or metal hooks is not a good idea since the metal will react in the solutions. This will help reduce the effectiveness of the solutions or at worst the metal of the hooks may react with the metal of the hardware.

3. Soak each piece of hardware in lacquer thinner or a 50/50 solution of acetone and ethanol for as long as it takes to begin to loosen residues, then scrub with a soft natural bristle brush. This will remove most coatings and some other types of residues (i.e. waxes and finishes). Any discoloration remaining will be patination and/or corrosion products. Coatings and residues can also be removed with methylene chloride paint stripper but please note that it is more toxic than either lacquer thinner or acetone/ ethanol.

4. Dip each piece of hardware in a bath of thiourea and sulfuric acid for 5-15 seconds. This procedure will remove most tarnishes and will turn sulfide corrosion products from greenish to brown. Watch closely while dipping. If a stream of small bubbles is observed then remove the metal from the acid and immediately rinse in distilled water. The sulfuric acid will react with the metal and release hydrogen sulfide gas and sulfur dioxide at the expense of the metal if left in too long. Please note that corrosion products often remain on the surface of the metal after this procedure is completed but that they are not as well-adhered to the surface as before the procedure and will in most cases be removed during the polishing process.

Acid/thiourea dip	Recipe for 1 gallon
8% wt. thiourea	320 gm. thiourea
5% wt. acid	360 ml. sulfuric acid
87% distilled water	4000 ml. dist. water
.5% volume surfactant	100 ml. Triton X-100

Cleaning reaction:

$$Cu_2S + H_2SO_4 + 2nCS(NH_2)_2 \longrightarrow 2Cu[CS(NH_2)_2]n\ SO_4 + H_2S$$

This entire procedure, including the initial cleaning of the brasses in solvent, should be done in the fume hood with the glass door lowered as much as possible. It is also recommended that a respirator be worn that is fitted with an “acid gas” cartridge. The organic vapor cartridges which are customarily used in our respirators are not effective against acid gases. The hydrogen sulfide gas that is released during the dipping process is toxic and will quickly deaden the sense of smell so that it cannot be

detected. Also be aware of the dangers of the thiourea/acid solution. Contact with skin will cause burns and irritation.

Also it is important to remember that the solution will eventually become exhausted with use and will no longer be effective. This is indicated when metal dipped in the solution will emerge with a blackish film - evidence that the cleaning reaction is no longer continuing to completion and that replating of the metal is occurring.

5. After dipping the metal in the thiourea/ acid solution, rinse copiously in a volume of fresh de-ionized water. It is a good idea to change the water after every 5-6 hours of cleaning or whenever the rinse water appears "soapy". Use one to two gallons in the rinse tank.

6. Rinse with acetone. Acetone will help to dry the metal by taking the remaining water molecules with it when it evaporates.

7. Examine the metal closely. There may be a slightly greenish shine to the piece or even some irridesence. This is okay as it will be removed during the polishing process. If there are significant amounts of corrosion still remaining on the piece, the dipping and rinsing process may be repeated.

8. To help remove any remaining green carbonates or black sulfides still remaining, a 10% formic acid solution can be applied with a cotton swab. The formic acid solution can be increased to 20% strength for more stubborn areas of corrosion. Rinse first in water then in acetone.

9. NEVER use ammonia to clean brass as the vapors will corrode any metal object in the lab and there is the possibility that ammonia residues regardless of rinsing will remain in the intergrain boundaries and corrode further.

10. Use of an ultrasonic bath is not desirable for two reasons. First of all, its use is suspected to further increase any stress corrosion cracking which may already exist, and secondly, the peening effect that the water molecules have on the surface of the brass may cause work hardening and embrittlement.

BRASS HARDWARE POLISHING PROCEDURE

1. At present we are using Micro-alumina (1 micron) in a slurry of reagent ethanol or isopropanol as the polishing agent. The mixture is applied to the brass and can be worked with a cotton swab or a piece of cotton fabric - wooden tools and dental floss are helpful for polishing hard to reach areas. The metal is then buffed with a soft cotton cloth.

There are two commercial products available to the conservator which can be used to achieve the same goals as the above-described procedure. One of the products, "Met-Pol", can be obtained from Conservation Materials and consists of micro-alumina particles imbedded in cotton wadding with a carrier of oil and naphtha. Another commercial product, "Nevr-dull", is similar to Met-Pol in that it consists of a polishing agent imbedded in cotton wadding but the abrasive material is a silicate of varying diameter. Some of the particles we estimate to be as large as ten microns in diameter, and there is the possibility that the larger diameter particles could scratch the brass and remove original material. Another negative aspect to Nevr-dull is that there is wax in the carrier which could cause adhesion problems if not removed completely before the brass is coated with lacquer. The main advantage to the Micro-alumina slurry method is that all the ingredients are of known quantity and particle size. with commercial products, we

are uncertain of their exact composition and there is the possibility that the manufacturers could change the composition of the products at any time without us being aware of it. Both Met-Pol and Nevr-dull work well, however, and can be used with discretion.

Calcium carbonate can also be used as a polishing agent but its particle size tends to vary and there is the possibility that larger particles could further scratch the brass surface.

2. Often after the polishing procedure a white powder residue remains in cracks and crevices in the brass surface. This can be removed by soaking in ethanol or acetone, and blowing off the surface with compressed air at 80-100 psi. In situations where the residue is more stubborn and the brass hardware is in good condition and has no evidence of stress corrosion cracking, we have on occasion utilized the ultrasonic bath. The bath is filled with deionized water, and the piece of hardware is submerged for no longer than 5 seconds. Lastly it is dipped in acetone and dried with a soft cotton cloth.

BRASS HARDWARE COATING PROCEDURE

1. Agateen Lacquer 2-B is currently used to coat our polished brass hardware to protect it and keep it from tarnishing. Two coats of lacquer are applied to metal surfaces usually by spraying with a spray gun or airbrush. Some hardware can be dipped in thinned lacquer and when dipped only requires one coat. In situations where it is not possible to remove the hardware from the piece of furniture, the cleaning, polishing and coating procedures can be performed in situ and a coat of lacquer can be applied with a brush.

2. Before coating, hardware should be degreased to remove any fingerprints or other contamination which will inhibit the lacquer's ability to adhere to the metal surface. This can be done easily by dipping each piece in lacquer thinner for several seconds and wiping it off with a clean cloth. It helps to wear cotton gloves while degreasing to prevent further contamination.

3. The brasses can be mounted on a board and manipulated with tongs to facilitate the spraying operation. As mentioned above, Agateen can also be brushed onto the hardware or the hardware can be dipped into thinned lacquer when spraying is not appropriate.

4. Agateen lacquer can be tinted with powdered pigments, Orasol dyes or interference pigments (from Mearle Corp.) if it is necessary to impart any color to the coating. Interference pigments can be used to imitate the look of fire gilding or gold plating. Adding too much of the interference pigments to the lacquer, however, will detrimentally affect their ability to reflect. Numerous thin coats will therefore have better reflectivity than one opaque thick coat.

5. Remember to clean and coat the heads of all screws and fasteners.

6. Acryloid B-72 and Acryloid B-48N can also be used to coat brass and other metals although they are not as durable as Agateen.

MATERIALS

Glass beads

S.S. White #9 from Checker Industries, 1280 Renton st., Pittsburgh, PA 15239 (800)243-2537

Micro-alumina

Buehler Micro-Polishes II from Alumina Powders, 41 Waukegan Rd., Lake Bluff, IL 60044 (312)295-6500

Interference Pigments

Mearle Corporation, 41 East 42nd st., New York, NY 10017

Met-Pol

Conservation Materials, 1165 Marietta Way, Sparks, NV 89431 (702)331-0582

Agateen 2-B Lacquer

Agate Lacquer Mfg. Co. Inc., 11-13 43rd Road, Long Island City, NY 11101 (718)784-0660

Chemicals

Aldrich Chemical Co., Milwaukee, WI
Fisher Scientific, Fair Lawn, NJ