9-2023

A Lifetime of Stress: Analysis and Treatment of an Inlaid Chinese Box

Katherine McFarlin
State University of New York College at Buffalo - Buffalo State College, kalmcfarlin@gmail.com

P A T R I C I A H . A N D R I C H A R D E . G A R M A N

A R T C O N S E R V A T I O N D E P A R T M E N T

B U F F A L O S T A T E C O L L E G E

A Lifetime of Stress: Analysis and Treatment of an Inlaid Chinese Box

CNS 695 Master's Project

Katherine McFarlin

May 23, 2022

Advisor(s): Emily Hamilton
Co-Advisor(s): Dr. Rebecca Ploeger, Jiuan Jiuan Chen, and Dr. Aaron Shugar

TABLE OF CONTENTS

ABSTRACT

Inlaid wooden objects are complex and intricate mixed media assemblages that can provide significant challenges to the conservator, as the properties of the individual materials can conflict and complicate treatment options. For example, traditional inlay materials such as ivory and mother-of-pearl are particularly susceptible to shifts in moisture and acidity, and the hygroscopic nature of historic proteinaceous adhesives can exacerbate dimensional changes in the surrounding wood. This paper describes the research and subsequent treatment to stabilize and restore a Qing dynasty wooden tabletop chest inlaid with ivory, mother-of-pearl, and various siliceous minerals. A combination of adhesive failure along multiple joints and significant physical damage to the structure and surfaces had resulted in areas of splitting, checking, separation, and instability. Treatment aimed to restore functionality, as the object will be displayed and used in a private home. Numerous ethical concerns were considered during the course of treatment, such as the invasiveness of certain steps and the need for restoring function versus strictly maintaining form, but the priority for treatment remained the piece's ultimate usability. The object was re-assembled with durability in mind, and a variety of approaches were utilized for securing new joins and filling losses in the wood. Once treatment was complete, the box was stabilized for regular handling and use in a private environment.

Keywords: ivory, mother-of-pearl, wood fills, Qing Dynasty, furniture conservation

1. INTRODUCTION

Described as an "Antique Chinese Jewel Case, Early 20th Century" by the Hawaiian dealer *South Seas,* a *huali guanpixiang* or rosewood seal chest, with five internal drawers, brass hardware, and complex decorative inlays of plants, animals, and figures was brought in to the Patricia H. and Richard E. Garman Art Conservation Department by a private client. In 2012 the client purchased the object in Maui, Hawaii, and the box was shipped from Maui to Western New York during the wintertime in a cardboard box. During transit the piece suffered severe structural damage, likely from a combination of the drastic environmental change and mechanical damage that may have occurred during shipping. One of the structurally critical back joins came apart, most of the interior structure supporting the drawers fell out, and the base platform completely fell apart. Additionally, there were some minor losses to the inlays and missing pieces of brass hardware, including some of the hinge pins holding the front doors in place. The primary goal of treatment for the client was to make the object functional and presentable again for personal use, while still ensuring the safety of both the sensitive wood and delicate inlays.

While similar boxes and chests are popular on antique and auction websites for private collection, little has been written about these objects from either an art historical or conservation perspective. They are rarely collected in a museum context, but the heirloom quality of many of these pieces can provide immense importance to the families they belong to. These boxes are alternately described as jewelry boxes, scholar's cases, and seal chests, all of which hint at the variety of functions these pieces have served or were assumed to have served. Due to their variety and proliferation, this subset of boxes can also be an excellent case study for timelines of wood-working and artisan trends, particularly for joinery techniques and inlay materials.

2. DOCUMENTATION

The box was documented before, during, and after treatment using digital images and written descriptions. The piece arrived with a corrugated-board tray of disassociated pieces, including the drawers, runners and base skirt rails. Overall inventory shots were taken (fig. 1), followed by detail shots of representative pieces from the disassociated components and complete documentation of the main body and lid (Appendix A).

Fig. 1 Overall inventory shots before treatment, showing the rectos of the accessories with the cabinet and lid closed (top), and the versos of the accessories with the cabinet and lid open (bottom)

2.1. *Description*

The object is a 26 x 31 x 22.5 cm box made of wood, with brass hardware and figural inlays in a variety of materials. The piece was described as an "Antique Chinese Jewel Case, Early 20th Century" on the accompanying paper tag provided by the dealer, and was purchased from South Seas, an antiques store located in the Hyatt Regency Resort & Spa in Lahaina, Maui, Hawaii. The inlays across the front doors depict eight children playing while two women observe, the figures split evenly between the two doors. Paired guardian lions watch from above on the front lip of the lid. On the top of the lid, there is a single plant branch with five flower and fruit elements, all made from different inlay materials. Based on the floral shapes, it is likely a pomegranate branch.

The lid opens to reveal a large, shallow upper compartment. The lid rests directly on top of the compartment's walls, slightly overlapping the upper edges of the cabinet doors. These two doors open outward, and the interior cabinet contains three rows of drawers. The top two rows contain two small drawers each, and a single large drawer rests on the bottom shelf.

The lid and the doors are attached to the main body with two rectangular brass hinges each, and are connected to each other with a large, decorative brass clasp. A hemisphere of brass plate on the lid aligns with two quarter-circle elements on the doors, forming a decorative circle backing for the clasp assembly. Two loops protrude from the elements on the doors, functioning as both the catch for the clasp and as slots for any desired locking mechanism, historically a metal, box-shaped padlock. The hardware is mounted into the box using two brass prongs that go through the entire width of the wood and are then bent back on the interior of the box.

The small drawers have fishtail-shaped brass pull-tabs while the large drawer has a leaf-shaped tab, all backed by decorative angled square plates. The prongs of the pull-tabs appear to have been taped more recently, as additional support. Other hardware included brass handles on both side panels, and riveted loops on both the cabinet and lid on the left side. A brass chain connected these two loops, securing the lid and preventing it from opening too far.

The box appears to be made from thin, continuous pieces of wood, likely a species of rosewood based on historical context and the observed color and grain. The box utilizes through-dovetail joints, most notably along the back corners of the main cabinet, on all corners of the lid, and on all corners of the drawers. The floors of each drawer appear to be joined to the walls with rabbets and grooves, in line with the construction techniques found in the base assembly and upper compartment.

In the interior of the cabinet, the runners are suspended between the back wall of the cabinet and a front spacer with hidden mortise and tenons. The side runners are glued to the side panels for extra security, and a line of adhesive residue is visible on the right interior panel where the runners are missing. The spacer itself is secured to the sides of the cabinet with a series of mortise and tenon joints that go all the way through the side walls to form a pinned joint, visible as small squares along the sides of the cabinet towards the front edge.

The skirted base is made of four separate rails that are connected at the corners with mitered dovetail joints. The floor of the box is rabbeted to sit in grooves running along the inside of all four rails. The top edges of the back and side rails also contain one loose tenon joint each, to connect the base assembly with the main cabinet.

2.1.1 *Context and Significance*

Many of the collector-quality versions of these boxes are made from *huanghuali* wood, or yellow flowering pear in Mandarin, Latin name *dalbergia odorifera*, a tree in the rosewood family. Rosewood holds a special place in Chinese culture, and is prized for its grain pattern, golden color, and pleasant scent when freshly harvested (Kaner et al. 2013). Towards the end of the Qing Dynasty, increasing demand drove the tree to a vulnerable conservation status, and by the early 20th century, many furniture makers opted for progressively thinner veneers instead of full planks of the wood due to the rising costs. The client's piece appears to be made of singular, albeit thin planks of wood rather than veneer; thus, if the box is indeed made from *huanghuali,* then it may have been created for a higher-end client that was willing to pay for the full planks. Alternatively, the object could be older than suggested by the antiques dealer, and may have been made when the wood was more readily available. A definitive identification is not possible due to the lack or provenance for the piece, but rosewood in any age or quantity continues to carry strong significance and value in Chinese culture.

In addition to high quality wood, the piece exhibits a wide range of inlay materials, carefully carved in relief to give life-like dimension to the figures. While some synthetic polymers did exist by the early 20th century, traditional materials were still preferred by artisans. Customary inlay materials found in Chinese furniture include shell, ivory, horn, and stones such as jade and agate. Many boxes will only contain one or two of these materials, but others can contain dozens of materials within single vignettes. While this piece does not quite reach the furthest extent of intricacy and detail possible in the craft, the variety of inlays are impressive in their range of colors and textures.

Heirloom items, particularly for the private home, can range significantly in quality and can present a variety of designs with different intentions. In this case, the combination of the figural and floral inlays can be interpreted as a symbolic wish for good luck and fertility for the owner. In Mandarin, the word for "seed" is identical to the word for "son"; thus, pomegranates in particular are often used a metaphor for having many sons and building a robust family, symbolized by the many seeds found within the fruit (Pomegranates 2022). The flowering pomegranate branch on the lid of the box thus reinforces the scene on the cabinet doors of many sons playing together, invoking and wishing for a prosperous family and strong legacy. The guardian lions above the family scene represent prosperity and success, and physically guard the family and their hopes. While the larger design family of these styles of boxes can contain many different symbols from both real and mythical flora, fauna, and filial scenes, the combination of inlay designs on the client's piece strongly highlights the domestic intention of the box.

2.1.2 *Corollary Objects*

Despite the proliferation of visually similar items across auction and antique websites, no exact matches could be found for this particular piece. However, there were consistent trends of identical silhouettes, structures, and individual inlay patterns that appear to have been mixed and matched according to the taste of the craft workshops and clients.

Two common lid shapes emerged, namely the flat square shape seen in the client's piece, and a more complex domed or gabled lid (fig. 2a, 2b). Similarly, the skirted bases were either composed of simple rectangular rails, or featured decorative carving on the front skirt rail.

Fig. 2. Examples of similar objects found on auction sites by searching for *huanghuali* chest. Sub-figure a) has the same silhouette and structure as the piece, but lacks inlays; b) demonstrates what the interior of the piece would look like with the drawers in place; c) is very similar to the piece but has a greater number of inlays and a different subject matter; and finally d) is similar in structure and inlay design on the front doors, but varies slightly in the silhouette of the base and the other inlaid areas. Courtesy of Carter's Price Guide to Antiques.

In terms of overall decoration, the boxes range from plain finished wood, to elaborate carvings, to complex mixed material inlays. Inlay designs cover a breadth of subjects, from flora and fauna to vignette scenes of daily and familial life. Some inlays were two-dimensional and in-plane with the finished wood surface, while others were carved in three-dimensional relief.

The example in figure 3d is the closest correlate based on overall structure and the subject matter of the inlays, but the example still differs significantly from the client's piece. It is entirely possible that workshops rotated through set templates and inlay patterns to create their boxes, with popular motifs repeating frequently throughout various times and regions. While no exact sibling could be found for the client's piece, the motifs and construction techniques present are indeed consistent with known pieces from the late Qing Dynasty and thus the provided identification is entire plausible. However it is always wise to remember that many cultures hold a reverence for their historic crafts, and both the imitations and continuations of traditional crafts exist today as part of lucrative local and tourist trade industries.

2.2. *Advanced Imaging*

Photographs were taken of the box before treatment using normal illumination, axial specular illumination, longwave ultraviolet induced visible fluorescence (UVA fluorescence), reflected UVA photography, infrared luminescence photography, and reflected infrared photography, in order to fully capture and assess the variety of materials present, and their condition. While it was evident in normal illumination that the inlays were carved from multiple distinct materials due to the variety of tones and textures present, subtle differences were highlighted with the above techniques. The most representative technique was UVA fluorescence, and this method was selected as the main reference point during later analysis.

UV fluorescence response can be particularly useful for identifying materials such as ivory and shell, which fluoresce bright white and blue respectively (fig. 3). In some cases, differences in fluorescence were the only way to distinguish inlays that appeared nearly identical in normal illumination. This differential fluorescence can suggest different ratios of components within two iterations of heterogeneous compounds, the presence of impurities, or chemical differences such as hydrate and anhydrate forms of certain inorganic materials (Gleason 1960; Warren et al, 1999). For example, both agate and chalcedony belong to the siliceous quartz family of minerals, and at certain scales can appear identical to the naked eye. However when exposed to longwave UV radiation, the two stones can fluoresce yellow and white respectively (Robbins 1983). These visual indicators are not conclusive on their own as fluorescence is still not entirely understood in some minerals; however, initial visual examination and documentation with UV greatly aids in guiding later analysis, and provides quick visual reference to help differentiate visually similar materials.

The remaining imaging techniques corroborated the information visible in UV, and no further inferences were made.

Fig. 3. Left: Front, before treatment, normal illumination. Right: Front, before treatment, UVA-induced visible fluorescence. Note the vibrant whites, blues, and creams in UVA, particularly the brightness of the boy's pants in the upper right of the right door. While many of the child figures appeared to be carved from different tonal areas of the same material when viewed with the naked eye, they exhibited distinctly separate fluorescent responses in UVA.

2.2.1 *Multi-spectral Imaging*

In order to further highlight the material diversity of the piece and map related materials, the front face of the box was documented with multi-spectral imaging. Using a monochrome Canon T3i camera and wavelength-specific filters, the front of the object was photographed nine times at pre-determined wavelengths of light to collect spectral images. Three representative images from along the spectrum were selected at 400, 700, and 1000nm, where distinct differences between the images were visible. These three monochrome images were opened in Photoshop and assigned to the blue, green, and red channels respectively in a new image, to produce a final false-color image (fig. 4). This false-color image correlates materials with similar spectral responses through shared color. For example, the lower skirts of the two women appear as blue to blue-green in the generated image, and by looking for similar colors we can see that the tails of the guardian lions, the robe of the boy in the lower left of the right door and the tunic of the boy in the upper right of the left door appear to have a similar spectral response. These color-coded areas are thus highly likely to be made of the same material, potentially reducing the number of necessary sampling sites if further analytical testing is pursued. This technique is also helpful for identifying materials that may have looked similar at one or two wavelengths, but varied at another, such as the tunic of the boy in the upper right of the right door, which fluoresced similarly to the other pink and brown inlays in UV, but here clearly stands out as a vibrant red false color.

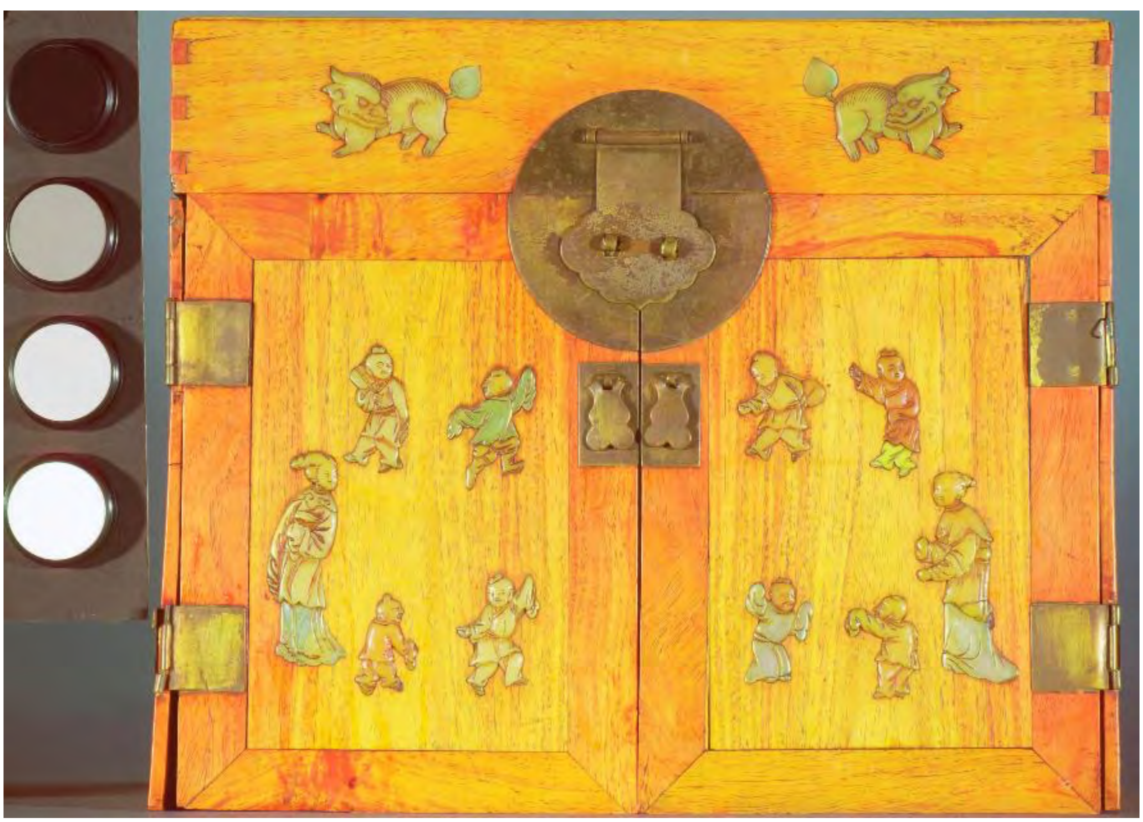


Fig. 4. False-color composite image from multispectral imaging photographs, highlighting the material diversity on the front face of the box. By overlaying the spectral data into a false-color image, materials that have similar spectral responses will display as similar colors and can be quickly identified.

2.2.2 *X-radiography Transmission*

While the object largely employs visible joinery techniques, it is not uncommon to find joints that are supported by internal nails or other hardware. Similarly, inlays can be secured with adhesives, pins or other hardware, or combinations thereof. In order to better assess the fabrication of the piece, an x-radiographic image of the box was recorded (Appendix A). Due to the size of the piece, extreme distortion of the radiograph was unavoidable, but this was deemed acceptable given that the purpose of the radiograph was largely to observe rather than make any quantitative assessments. The x-ray revealed that minimal nails were used in construction, appearing only where strictly necessary to attach hardware such as the back hinges of the lid. All other hardware are held in place with prongs that are riveted smooth to the surface of the hardware, and bent outwards on the other side of the wood, against the interior face. The inlays do not have any additional pins, and appear to be held in position solely with adhesive. However, a dense material was detected in the crevices of some of the inlay carvings, and visual examination confirmed traces of a red material, likely a paint. Based on the density, the pigment seemed likely to be a heavy metal pigment, but more testing was needed to identify further.

2.3. *Condition*

The primary concerns with the object were structural, as many of the glue joins had sprung open. Some of the wood panels were split and appeared warped, some of the brass hardware was missing or damaged, and many of the internal supports were completely detached, including the entire base assembly. There was overall dust and grime on the surfaces of the piece, and areas where the wood finish and inlays had been scratched and abraded. According to the client, the piece was shipped from Hawaii to Central New York in a minimally padded cardboard box during the wintertime, and both the extreme RH shifts that occurred and any physical impacts likely contributed to these damages.

2.3.1 *Structure and Internal Supports*

The back right joint of the main cabinet had completely opened, creating a ¼ in. gap between the side panel and the back panel. Additionally, the floor of the upper compartment partially fell out of its grooves in the back right corner, likely due to the misalignments from the opened joint. On the left side, a major split ran horizontally approximately two-thirds up the panel, widening towards the front roughly in line with the upper door hinge (fig. 5). Adhesive was visible on both connecting faces of the split, but that join attempt had clearly failed. Towards the back of the split, failures in the wood along the wood/adhesive interface were visible as thin splinters connecting across the join, indicating that the issue may have arisen from stresses across the wood rather than pure failure of a weak adhesive. The bottom edge of the panel was forced away a little over a centimeter from the front of the main structure, and this planar disruption appeared to be both aggravated by and contributing to the split. The gap was particularly visible at the lower left tenon of the drawer spacer piece as seen above in figure four, where the tenon had come slightly out of joint.

Fig. 5. Left: upper half of the left panel under UVA-induced visible fluorescence, highlighting the split running horizontally through the panel, and traces of a prior hinge attaching the lid. Right: Interior of the main cabinet, viewed from the underside. Adhesive glue lines from the missing side runners are outlined in green, and the hidden mortises for the runners are outlined in blue. The mortise for the base connection is also visible in the lower middle.

The runners that support the drawers in the middle and right side of the box had completely detached and fallen out. Mortise slots for the missing drawer runners were visible on the back wall and front spacer of the box, with excess glue visible both inside and around the middle slots (fig. 5). Lines of old adhesive were also visible on the right interior side where the runners were originally glued in. Two of the runners remained intact on the left side with adhesive buildup also visible.

The base support was fully detached from the box and had arrived completely disassembled into its separate components, with the four rails of the skirt separated from each other and from the floor piece. The loose tenons that connected the base assembly to the main cabinet were broken, with fragments of the splines left behind in the mortises of both the cabinet and the individual rails (fig. 6). Small losses were visible in the rabbets of the floor piece, particularly near the corners, but overall the floor piece was complete and stable.

Fig. 6. Left: Upper edges of front and side rails, showing mortises with broken tenons in-situ, Right: Base components arranged in position, with interior grooves exposed

2.3.2 *Drawers*

The drawers were overall stable and in good condition, but the majority of the small drawers had small checks and distortions in the floor panels, perhaps from the same event that damaged the box joins. One small drawer was missing its brass pull-tab and decorative plate, but had a piece of adhesive packing tape on the inside of the drawer directly behind the opening indicating that the tab might have been present at the time of taping. The large drawer and three of the four small drawers had a piece of adhesive tape placed over the interior prongs of the pull-tabs, perhaps intended to keep the tabs in place. The tape was slightly yellow and brittle where it was in contact with the metal components. The fourth drawer had an unknown adhesive securing the tab prongs to the wood, and no signs of tape. A slight concave distortion was visible along the long side edges of ever drawer, cupping inward at the middle from both sides. This may be the result of over clamping during fabrication, particularly if the floors were cut slightly smaller than the finished dimensions of the drawer frame. The stress induced by such over-clamping may have strained the floor pieces, and could have caused or contributed to the checks and splits found in almost all of the drawers.

2.3.3 *Hardware*

Many of the hinges were bent or damaged. On the left door, the upper hinge was in good condition, but the lower hinge was in poor shape with some components bent out of position. The pin in the lower hinge also appeared slightly bent. On the right door, the pin was completely missing from the lower hinge, while the upper hinge was held in place with a modern metal wire acting as the pin (fig. 7). This modern wire was bent into loops at both ends, which stuck out significantly from the hinge assembly. On the lid, the proper left back hinge was missing a rivet in the lower placket, and the pin holding the hinge together was loose and slightly corroded. The other back hinge seemed to be in good working order, though it did not lie perfectly flush and had two extra holes going through it into the back panel, perhaps from an earlier attempt to re-align or re-attach the hinges.

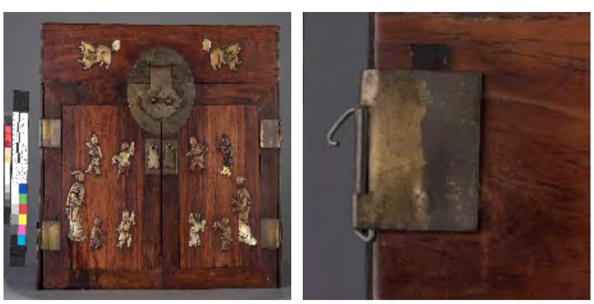


Fig. 7. Left: Lower hinge of left door, with knuckles broken and bent outward, and plate distorted. Right: Modern metal wire acting as a temporary pin for the upper hinge of the right door

The brass handles on both sides of the cabinet were secure and did not show signs of any corrosion or excessive distortion. The brass chain was detached from the upper lid loop and dangled from the lower loop, and an opened chain link was found in storage next to the piece. Aside from the damaged link, the chain was sturdy and in good condition.

The front clasp was in good structural condition, but showed heavy texturing from corrosion. All of the brass tabs exhibited dark brown patination, but had minimal physical damage. All hardware appeared to be coated with an unknown material, and degradation of the coating may have contributed to uneven corrosion of the underlying metal. This uneven corrosion was visible as matte, dark brown areas mottling the expected smooth and shiny surface of the brass in a pattern consistent with wear.

2.3.4 *Exterior*

Both of the front doors were in good condition overall, with minor wear at both top corners where the doors were in contact with the lid. The central panel of the right door was separated slightly from the stiles of the outer frame at the lower left and upper right corners, creating a skewed appearance. The majority of the inlays appeared to be intact and well-adhered, and four of the children's robes contained traces of a heavy metal red pigment in the carving lines, suggesting that the inlays may have been painted at one point in time. The only notable loss in the inlays was from the right foot of the boy in the lower left of the left door. There was also a small horizontal split in the tunic of the woman on the right door, but the crack appeared stable.

The top panel of the lid was overall in poor condition, largely due to a major split running completely through the entire width of the upper lid panel, about an 2.5 cm from the front edge. The front strip was completely separated from the rest of the panel at this split, and appeared to have detached completely from the piece and re-adhered at some point. The front right edge sat slightly proud of the front face of the lid, perhaps from misalignment during this repair. The rest of the top panel had started to detach from the both side walls and had lifted slightly. The rest of the wood was in good condition, with only slight scratches and dust, and a partial split in the wood at the lower right corner of the front of the lid. Most of the inlays were in good condition and all were securely in place. The inlay flower in the upper right had a small abrasions near the center and right, and the lower left branch had a small loss in the distal end.

On the left side panel, aside from the large horizontal split affecting the structure, the surface of the wood was in good condition. There was a visible scratch in the wood finish in the lower left, and a circular discoloration at the upper back edge. This discoloration matched and aligned with similar discolorations on lower edge of the adjacent lid, and another pair was found on the right side, though less intense and less complete. These paired markings may be damage from previous hardware, as the negative space matches the silhouette of a v-shaped hinge known as a lid stay. The markings are visible in normal illumination on close examination, but are particularly visible in ultraviolet induced visible fluorescence (fig. 5). The right and back sides were in good condition with only minor scratches found in the surface finish of the wood.

2.3.5 *Previous Treatment*

There were several signs of at least one previous treatment campaign. Small wax fills were visible along the top edges of the doors, and a small section of unknown fill material was visible on the front left edge of the upper face of the lid. UVA fluorescence photography revealed that a thin layer of adhesive was applied to the interior faces of the structural joints of the box. This adhesive appeared to be an animal skin glue based on the white fluorescence, and while it could be original, Qing craftsman preferred to rely on the mechanical strength of their joinery. This adhesive may have been applied later in life as part of a restoration campaign. The major split on the left side panel of the box also contained a brightly fluorescing adhesive, and was clearly a sign of a failed restoration attempt. Additionally, an unknown coating appeared to have been spray-applied to the lid, and could only be a later application. Regardless of the exact chronographic nuances, it was clear that some prior restoration was done on the box for both structural and aesthetic reasons.

Additionally at some point in the object's history, hinged support stays for the lid were present on both sides of the box, as mentioned previously (2.3.4). The hardware was replaced with the current chain stay on the left side of the box. Inside the drawers, tape and traces of adhesive were visible at the front, perhaps to stabilize the pull tabs for travel. No other major signs of treatment were visible, but given that this object came from an antiques dealer, some cleaning and repairs that were not readily apparent may have occurred in preparation for sale.

3. MATERIAL ANALYSIS

Identifying the materials present on the box was crucial for determining treatment steps, as many natural materials such as ivory and mother-of-pearl are highly sensitive to both aqueous and chemical solvents, and react readily to changes in acidity. High levels of analysis such as species-identification were deemed unnecessary, as broad categorization was sufficient for selecting lower-risk interventions. Fourier Transform Infrared Spectroscopy (FTIR) was the primary form of analysis used for known or suspected organic and inorganic components, utilizing both non-invasive reflectance and microscopically destructive transmission techniques. Select inorganic components were also analyzed with x-ray fluorescence spectroscopy (XRF), and the wood was sampled and microscopically investigated. All analysis and interpretation was conducted with the guidance of Dr. Rebecca Ploeger and Dr. Aaron Shugar. The results of the cumulative material analysis can be found in Appendix E and Appendix F.

3.1. *Fourier Transform Infrared Spectroscopy*

FTIR is a technique where a material is irradiated with a range of mid-infrared wavelengths, and the amount that the material absorbs or transmits is then plotted as a spectrum. Different molecular structures will selectively absorb different wavelengths, producing unique spectral "fingerprints". The unique peaks produced by the unknown material can then be compared to the characteristic peaks of a known material in a published database to determine a potential match.

3.1.1 *Portable Reflectance FTIR*

Reflected FTIR was pursued first, as this technique did not require destructive sampling, and the inlays could be analyzed in-situ. Infrared spectra were collected using a Thermo Scientific Nicolet iS5 FTIR spectrometer with a ConservatIR accessory. Samples were aligned with the collection window with the help of an in-line camera system and laser target, to ensure proper focus and distance to the sample location. The spectra were collected from 500-4000cm^{-1}, and are the average of 64 scans at 4 cm^{-1} spectral resolution. Sample identification was aided by searching a spectral library of common conservation and artists' materials (Infrared and Raman Users Group, http://www.irug.org) using Omnic software (Thermo Scientific).

FTIR confirmed that the inlay material in the women's skirts, the lions' tails, the robe of the boy in the lower left of the right door panel, the tunic of the boy in the upper right of the left door panel, and the pomegranate in the upper left of the lid all are matches for nacre, commonly known as mother-of-pearl (fig. 8). Nacre is a compound of calcium carbonate and aragonite made by many mollusks as an iridescent inner layer, and it has been harvested as a beloved artist's material for thousands of years. The presence of this material was expected, as the colorful iridescence of these inlays are readily recognizable to the naked eye. The other inlay that stood out during initial visual examination was the trouser section of the boy in the upper right of the right door, as it appeared much more opaque and yellow than the surrounding inlays. The generated spectra is a good match for ivory and was compared to African elephant ivory, but exact species identification was not pursued (fig. 9).

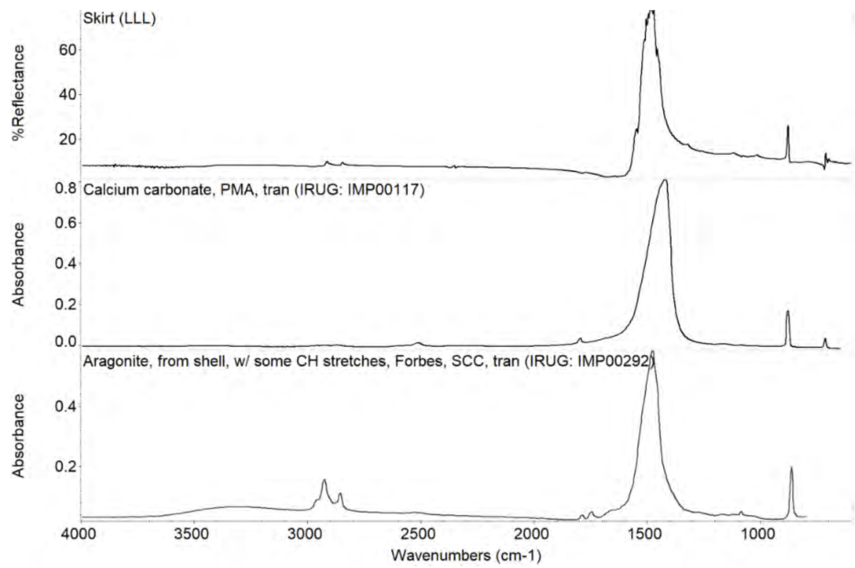


Fig. 8. Reflectance FTIR spectra of the lower left (LLL) woman's skirt, compared to transmission spectra of calcium carbonate, and aragonite from shell

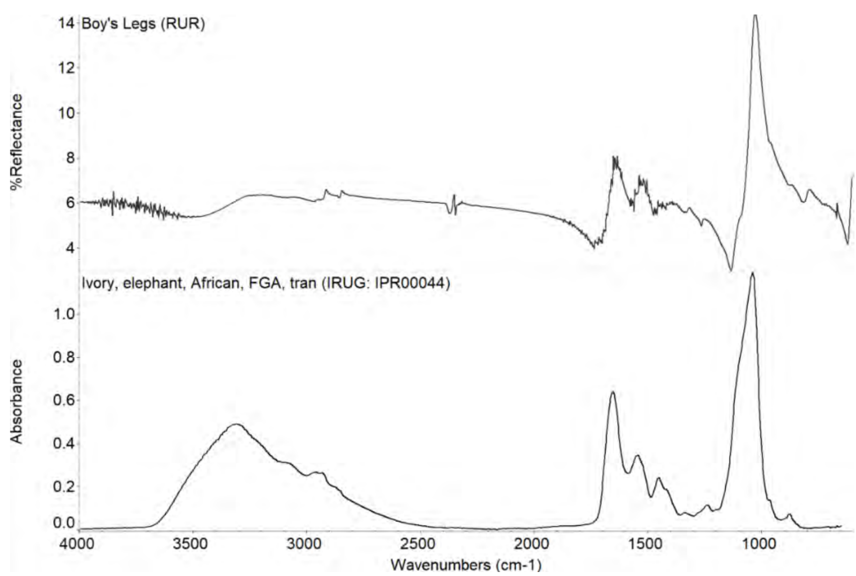


Fig. 9. Reflectance FTIR spectra of the boy's pants in the upper right of the right door (RUR) compared to transmission spectra of African elephant ivory

The results for the remaining inlays were inconclusive, perhaps due to either a lack of an appropriate comparative spectra in the available databases, signal scattering due to the reflectivity of the material, or interference from a potential coating over the inlays on the top of the lid. However, two groups of materials with similar responses were noted. For the majority of the pinkish-brown and brown toned inlays on the front doors, a very strong split peak around 1000cm-1 was observed. This peak correlated to the presence of silica, and the generated peaks were good matches for quartz semi-precious stones. This suggested that these materials may be a similar siliceous mineral such as agate or chalcedony, with difference in UVA fluorescence observed between the two tones explained by the subtle differences in their chemistry. Further testing would have been needed to specifically categorize the material. The other grouping of inlays were the lions' bodies and the spotted pomegranate on the lid, with a strong double peak around 1100-1200 cm-1. No close matches could be found in the comparative databases, but the spectra contained similarities to animal proteins, though the strong double peak in this material was shifted 200cm^{-1} from the double peak typically found on proteinaceous references. However the peak location is similar to the strong silica peak noted in the other mineral materials above, which may indicate that the lions' bodies and the spotted pomegranate are siliceous minerals with some inclusions that were noticeable in FTIR.

The spectra for the remaining inlays on the lid were too noisy to be identifiable, and it is possible that the modern coating used on the wood portion of the lid was also overlapping the inlays. Further testing was deemed unnecessary for treatment, as the positive identification of ivory and shell materials in the composition was sufficient to restrict the majority of aqueous or solvent surface cleaning methods.

3.1.2 *Micro-Transmission FTIR*

In order to identify the adhesives and coatings present throughout the box, small samples were removed under magnification and analyzed with micro-transmission FTIR. Infrared spectra were collected using a Continuum microscope coupled to a Nicolet 6700 FTIR spectrometer (Thermo Scientific). Samples were carefully removed from the object with a tungsten probe, and prepared by flattening them in a diamond compression cell (Thermo Spectra Tech), removing the top diamond window, and analyzing the thin film in transmission mode on the bottom diamond window (2 mm x 2 mm surface area). An approximately 100 µm x 100 µm square microscope aperture was used to isolate the sample area for analysis. The spectra are the average of 64 scans at 4 cm^{-1} spectral resolution. Correction routines were applied as needed to eliminate interference fringes and sloping baselines. Sample identification was aided by searching a spectral library of common conservation and artists' materials (Infrared and Raman Users Group, http://www.irug.org) using Omnic software (Thermo Scientific).

The vast majority of adhesives found on the box are proteinaceous glues, such as historic rabbit skin glues and hide glues (fig. 10). On the interior pins of the right door's upper hinge, an epoxy resin type adhesive was also found, and while no spectrum matched closely enough for a specific identification, based on the good comparative matches in the database it is likely an epoxy-based super glue. This spectrum also showed some minor irregularities consistent with cellulose contamination, indicating that some of the wood may have been pulled up with the adhesive sample.

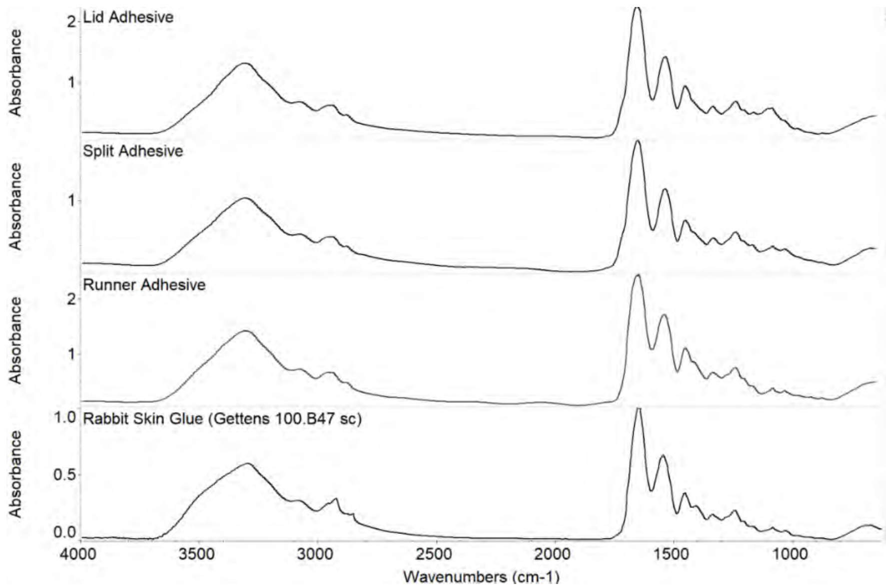


Fig. 10. Micro-transmission FTIR spectra of adhesive samples from the lid, split, and runner, compared to a known spectra for rabbit skin glue

In terms of coatings, the predominant coating present on the main cabinet body appeared to be a natural wax, most likely a beeswax. The dripped residue on the front left door is a petroleum-based wax, most likely a paraffin wax, which would explain the extent of discoloration in the underlying wood. The lid coating that was visible in UVA proved a little more challenging; the best match for comparative spectra in the available databases was a Rustoleum® black spray paint. While the Rustoleum® brand does indeed produce spray-on clear coatings that would be consistent with the observed application marks, a positive identification is not possible without further destructive analysis using another technique such as gas-chromatography mass-spectrometry. Regardless it was clear that this coating was sprayed onto the lid later in the object's history, and is likely an alkyd resin that may have some sort of silica matting agent added.

On the hardware, both the powdery corrosion products adjacent to the door pull-tabs and the textured corrosion on the front clasp were sampled. The powdery corrosion products could not be clearly identified with FTIR, but appeared to have some silica content and likely some copper sulfates. Further testing with XRF was needed. For the front clasp, the textured corrosion seems to be related to an acrylic coating that did not have an exact match in the available databases. However, peaks indicating shorter methyl and ethyl side groups were visible, suggesting that this is a methyl and/or ethyl acrylate co-polymer system. Common examples of these coatings include Incralac and Rhoplex, the latter of which was the closest available match.

3.2. *X-Ray Fluorescence Spectroscopy*

XRF is a non-destructive analytical technique that can be used to identify inorganic elements and their relative ratios. The primary purpose of XRF was to identify the components and composition of the metal hardware, but the technique also aided in identifying inlay materials where the FTIR results were inconclusive.

Spectra for the inorganic unknowns were collected using a Bruker Artax 400 energy dispersive X-ray spectrometer system. The excitation source was a Rhodium (Rh) target X-ray tube with a 0.2 mm thick beryllium (Be) window, operated at 25 kV and 1500 µA current. The X-ray beam was directed at the artifact through a masked aperture of 3 mm in diameter. X-ray signals were detected using Peltier cooled XFlash silicon drift detector (SDD) with a resolution of 146.4eV. Helium purging was used to enhance sensitivity to light elements. Spectra was collected over 60 seconds. Additionally, spectra for the metal hardware were collected over 60 seconds at 50 kV and 400 µA current, in ambient air without the use of Helium (He) purging. Spectral interpretation was performed using the Artax Control software 7.8.

XRF confirmed the presence of high levels of silica in the pink and brown inlay material, alongside an array of minerals that could indicate an agate or similar stone from the quartz family. No significant differences could be found between the different tones of the hardstone, but this is not surprising as only minute differences in elemental compositions are needed to produce visual differences. In the crevices of the inlays however, traces of a red pigment showed high levels of mercury and lead, likely indicated a vermillion or cinnabar pigment (fig. 11). XRF also identified the hardware as a leaded brass, likely a 60:40 composition. This brass is and historically has been one of the most common forms of brass.

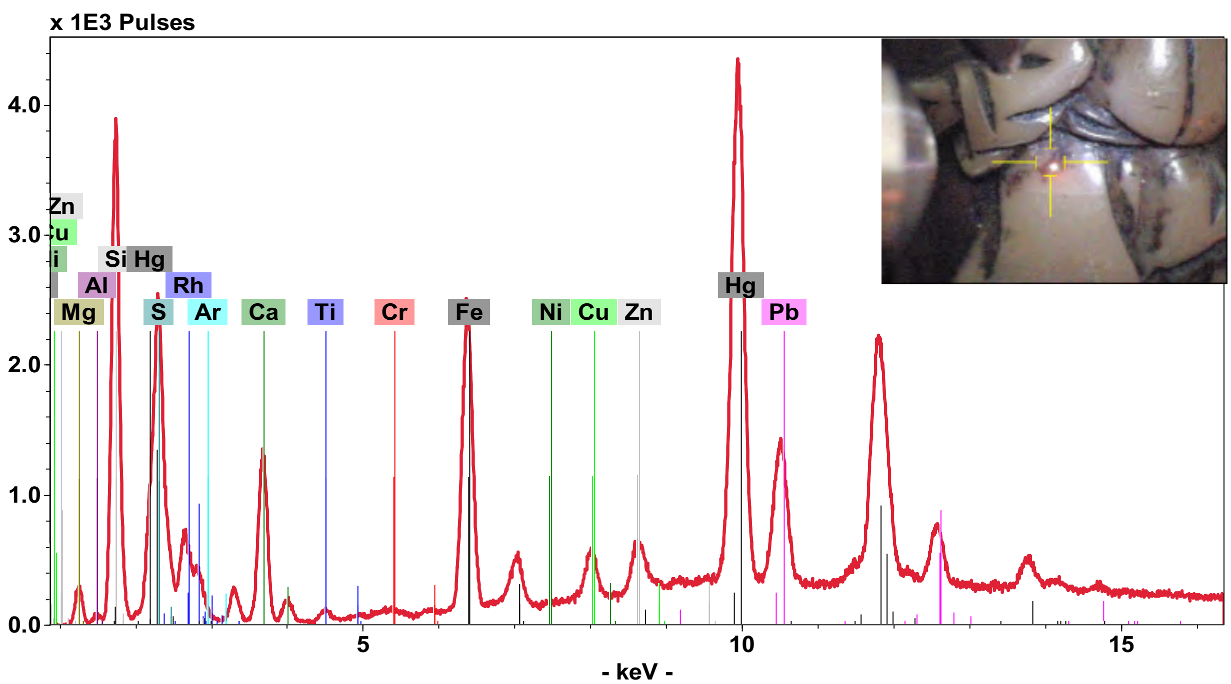


Fig. 11. XRF Spectra for the red pigment found in recessed areas of the inlays, with notable Mercury (Hg) and Lead (Pb) peaks that could indicate vermillion or cinnabar

3.3. *Wood Identification*

While the corollary objects and art historical research suggest that the box should be made primarily from the Chinese rosewood *Dalbergia odorifera*, this piece could have been made from a lower cost or more readily available tropical hardwood, or from some other hardwood stained to imitate rosewood. Portable cabinets such as this piece were sometimes made for the tourist trade or general commercial use, and genuine rosewood may have been reserved for custom pieces or high-end clients. Similarly, the chest may have been made in Hawaii rather than mainland China, and a different tropical wood may have been more accessible for the craft workshop. Additionally, some of the interior wood for the drawers, base floor, and runners appeared to be finished differently or potentially be a different species, and some components were either completely unfinished or potentially re-purposed from scraps or other projects. In order to better understand the woods present on the box, small samples were removed for microscopic analysis and identification.

A 3x5mm sample of wood was cut out from the interior of the cabinet's back panel with a scalpel, from directly above one of the existing blind mortise slots (fig. 12). Small slivers were cut off of the sample with a micro-tome in the tangential, transverse, and radial orientations, and the samples observed under a Zeiss Axio Imager A1m microscope equipped with illuminators for transmitted light microscopy. Images were taken using Zen 2.0 software. Samples were viewed under brightfield illumination. Objective magnifications range between 50x and 400x for transmitted light microscopy. Transmitted light microscopy images were obtained using brightfield condenser filters (fig. 13).

Fig. 12. Interior right back corner of cabinet, showing the sampling location for wood identification, above the lower runner mortise

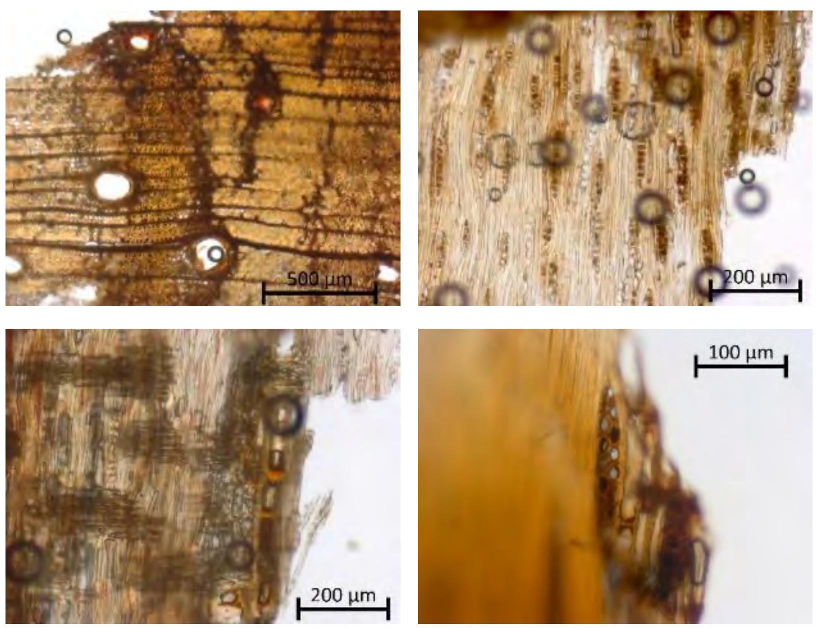


Fig. 13. Clockwise from top left: transverse view, tangential view, and radial view of the wood samples, and a close-up of a biseriate parenchyma in tangential view in the lower right

The transverse view revealed that the wood was a diffuse porous hardwood with banded aliform-confluent parenchyma. The tangential view displayed biseriate transverse rays of 5-8 units arranged in uniform rows. The radial view was poorer quality due to the smaller surface area on this face of the sample, but both ray and axial parenchyma were still visible. Vestured pits and crystals were visible in association with the vessel elements, and some vessel elements also contained resin. Based on these features, the wood used for the visible surfaces of the box is definitively a tropical hardwood, and the results seem consistent with the *Dalbergia* or rosewood genus over other groups of tropical hardwoods (Hoadley 1990). On visual comparison, the sample appeared closer to known samples of *huanghuali D.odorifera* than Indian rosewood *D.oliveri* or Brazilian rosewood *D.nigra;* however, species identification is not possible without further testing (Gasson et al. 2011). It is sufficient to say that the wood used for the main cabinet is likely a rosewood, and is consistent with the expected time period and location of the piece. Once analysis was complete, the sample piece was glued back into its original position with dilute fish glue.

A 3x5mm sample of wood was also cut off from the rabbet on the right back edge of the base floor piece, to determine if other species of wood were used for the non-visible interior features. Small slivers were cut off of the sample with a micro-tome in the tangential, transverse, and radial orientations, and the samples observed under the Zeiss microscope. The features were identical to those observed from the cabinet wall, indicating that at minimum, the floor of the base is also rosewood. Further samples were not taken, as there were no other appropriate locations to take samples from, and further sampling may have been redundant and thus excessively destructive. Based on grain patterning in the drawer wood, it is highly likely that all components of the piece are in fact rosewood, though some of the interior runners were clearly re-purposed off-cuts from other areas of production.

4. TREATMENT

The primary goal of treatment was to make the piece fully functional so that the client could use the piece within their home. The client gave full permission for the use of aggressive or invasive treatment steps as deemed necessary to reach the stated goal. Similarly, the client expressed a desire that this treatment should be a learning opportunity for the author, as private ownership afforded much greater flexibility with treatment options than may be available in an institutional setting with high value or restricted artworks.

Given these stipulations, treatment focused on restoring stability and function to the piece, while minimizing mechanical and solvent damage to the inlays wherever possible. In some instances, it was necessary to separate individual components from the main body to allow for greater access to interior spaces while minimizing unnecessary manipulation and stress. The piece was cleaned with both dry and wet methods, missing components were replaced or filled as needed, the failed glue joints were re-adhered in order to restore structural stability, and supports were added to bolster weakened areas.

4.1. *Cleaning and Disassembly*

4.1.1 Dry Surface Cleaning

All faces of the box were cleaned with a soft brush and a vacuum, to remove the loose surface dirt and debris. While the process did have an effect on the overall appearance of the box, a noticeable amount of stubborn dirt remained in corners and crevices. A second pass was made with a slightly stiffer and denser brush that could reach into the smaller crevices more easily, but the bristles were still soft enough to not damage the wood finish or inlays. After testing a small spot in the back lower right corner of the box to ensure the beeswax finish would not be damaged, the box was dry cleaned further with cosmetic sponges, focusing on areas with noticeable accretions. This phase of cleaning greatly improved the appearance of the surfaces of the lid and drawers. The cosmetic sponges were cut into narrow triangular strips to precisely maneuver around the inlays, and did not cause any noticeable damage to the surfaces under magnification. Through this combination of soft brushes and sponges, the halos of dirt around the inlays became significantly less visually distracting.

Heavy buildups of dirt, cobwebs, and sawdust were cleaned from the interior grooves of the skirt rails with bamboo skewers. A stiff brush was required to remove all of the fluffy, lightweight debris, as the detritus easily snagged on the wood and was difficult to lift out of the grooves with the bamboo skewers alone. The rabbets of the base floor were likewise cleaned, and large chunks of dirt and wax-like buildup were lift from the crevices with a dental pick. The buildup of paraffin wax on the left door was reduced in thin shavings with a scalpel.

4.1.2 Disassembly

In order for any further cleaning to proceed, particularly aqueous or solvent cleanings, the decision was made to separate the lid and doors from the main cabinet. By removing the lid and doors, the moisture-sensitive inlays could be treated separately, and the vibrations and mechanical strain on the pieces and their hinges could be reduced. Removing the doors and hinges also allowed greater access to the interior of the lid, and allowed for the main cabinet to be manipulated in three-dimensional space for more comprehensive repairs.

The right door was removed easily, as the only connection point to the main box was a single steel wire that was serving as a replacement pin for the upper hinge. No pin was present in the lower hinge, and the knuckles separated freely. This unstable connection was another justification for removing the doors, as the right door in particular was subject to twisting and banging against other components any time the box was moved. The steel wire jutted out from the box and had been bent over into tight circles at both ends to prevent slipping. The wire was cut with wire cutters at the top of the hinge, and the two pieces removed from the hinge knuckles. The door was removed and placed in its own tray for the rest of treatment.

The left door posed some difficulty during removal, as one of its hinges had corroded together. The pin on the lower hinge was pushed out with minimal resistance, though the metal also had a solid layer of corrosion over the entire area of the pin. In the upper hinge however, the pin had corroded to the middle knuckle and could not be removed. The hinge was still functional since the fusion was limited to the singular middle knuckle, but the hinge could not be unpinned and removed like the others. The priority was to protect the inlays from both abrasion and unnecessary vibration and manipulation, so the interior prongs securing the hinge plate to the door were unbent in order to separate and isolate the door and its decorations. Unfortunately, the metal was quite brittle and one of the prongs broke at the point of stress during unbending. This piece was saved in a labeled polyethylene bag.

Similar corrosion issues were found in the hinges joining the lid to the cabinet. The back left pin slid out easily, but the back right pin was also corroded and fused to the middle knuckle of the hinge. The lid hinges were joined to the box with rivets, and these rivets could not be safely removed without risking damage to the wood. Instead, the thin outer knuckles were gently bent out with pliers to allow the corroded pin to drop out. The knuckles were monitored for cracking during the process, as the metal was also brittle. While certainly more invasive and damaging than originally intended, manipulating these metal components was necessary for the sake of isolating and protecting the decorations, and ultimately allowed both greater and safer access to interior spaces for later phases of treatment.

4.1.3 *Aqueous Cleaning*

Now that the sensitive inlays on the lid and doors were isolated, the main cabinet could be cleaned more thoroughly. The main cabinet and drawers were wiped down with a microfiber cloth that was lightly dampened with deionized water and then wrung out with a secondary cloth, to minimize the amount of moisture applied. The floor and rails of the base were similarly cleaned, paying extra attention to the top of the rails where there were significant accumulations of dirt and some residual proteinaceous adhesive. These thin streaks of adhesive could be swelled easily with water, and were either wiped away or gently scraped off with a spatula or bamboo skewer.

A large component of aqueous cleaning revolved around reduction of the excess proteinaceous glue found throughout the box. Total removal was not necessary, as animal glues have consistently been remoistened and reused in historic restorations for many generations (Rivers and Umney 2012). Leaving these traces in situ would also maintain some of the historical context and could act as a rudimentary barrier layer for fills or additional adhesive where needed. However, in some areas the old adhesive was at risk of impending uniform contact across the joint interfaces that needed to be re-glued. In these cases, cotton swabs moistened with room temperature deionized water were rolled over the excess glue to swell the adhesive, and then the residue was scraped down in layers using a metal spatula or scalpel (fig. 14). Once only a thin layer remained, the residue could be balled up with a rubber crepe eraser and removed mechanically. This procedure was crucial along the bottom edge of the cabinet walls, on the top rails of the base, and in the interior mortises of the cabinet, where the excess adhesive prevented insertion of the runners.

Fig. 14. Left: Adhesive reduction with a scalpel from an overfilled runner mortise.
Right: before and after adhesive reduction on the bottom edge of the cabinet

Finally, the lid and doors were spot-cleaned only where dirt or other accretions were visible, using small cotton swabs moistened with deionized water. Materials such as mother-of-pearl shell and ivory are particularly sensitive to acidic solutions, so the water was buffered to a neutral 7 pH with a sodium hydroxide solution to minimize the effect of the water should it accidentally come in contact with the inlays. However, the largest factor governing the potential impact of moisture on these materials is dwell time – thus, all efforts were made to reduce how long the buffered water solution remained on the surface of the panels. Before use, the cotton swamps were lightly dampened and then squeezed out, the required area swabbed, and after cleaning an area any moisture left behind was immediately blotted with a cosmetic sponge (fig. 15). This procedure was highly successful, and minimized the risk to the inlays.

Fig. 15. Spot-cleaning of the front door with buffered, deionized water, which was immediately blotted with a cosmetic sponge after swabbing.

4.1.4 *Solvent Cleaning*

As indicated by micro-transmission FTIR analysis, the brass hardware was coated with an acrylic co-polymer system, similar to brand name products such as Incralac and Rhoplex. This coating had partially degraded in areas of high contact, leading to uneven and preferential corrosion. Since the coating was no longer providing adequate protection, and arguably was causing greater damage in its current state, the coating was removed. Working under a Leika stereomicroscope, the coating was solubilized and reduced with acetone on rolled cotton swabs, aided by gentle mechanical removal with a bamboo spatula. A bright green color was visible on the swabs, indicating at least partial removal of some of the built up corrosion products. The coating was visible as milky or light translucent green waxy flakes, particularly when the bamboo was lightly pressed across the surface, and served as a clear visual indicator both for the presence of the coating and when the coating had been fully reduced (fig. 16). The metal was cleaned with a final pass of ethanol. All solvent use was carefully controlled, and care was taken to avoid any contact with the surrounding wood and finishes.

Cleaning revealed the hardware was coated unevenly. The backsides of all pull tabs were uncoated, and a significant amount of corrosion had built up on the backsides of the front door tabs. In these areas, the brown corrosion was powdery and moved readily with gently pressure from a bamboo skewer. Due to the nature of metal corrosion, intensive cleaning was not pursued, as some flaking and delamination was visible near the edges of the fishtail shape and further attempts at cleaning had a high likelihood of damaging the core metal and removing large amounts of the surface.

Overall, cleaning was successful and proceeded without issue. The hardware was not re-coated as any coating would need regular upkeep or renewal to prevent further damage, and such maintenance could not be ensured. Additionally, allowing for natural aging and patination would allow for visual cohesion with the rest of the piece, and would be sympathetic to the intention for the piece. In many East Asian cultures, signs of age are considered to have value, and a natural patination is preferable over any attempts at full polishing or restoration. Natural aging and patination will also provide a slight protective layer for further handling, and will require the least maintenance from the client.

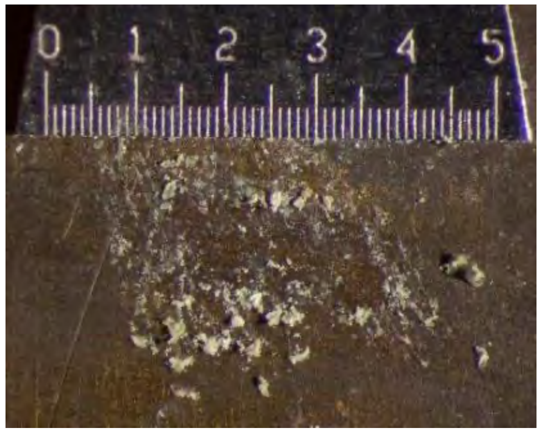


Fig. 16. Macrophotograph showing milky green flakes of solubilized coating during solvent cleaning of the brass hardware. The scale is marked with millimeter increments.

4.1.5 *Tape Removal*

Fiber-reinforced packing tape was adhered to the interior of the front faces on four out of the five interior drawers, including the large bottom drawer. The drawer fronts may have been taped in order to keep the drawer tabs in place for shipping. The areas of adhesive that were exposed to air had crosslinked and become brittle, but the sections that were well-adhered remained tacky. The carrier was mechanically removed by pulling from one edge at a low angle, aided by a spatula to lift the degraded support fibers simultaneously and leave no brittle fragments behind (fig. 17). The bulk of the adhesive residue was removed with a crepe eraser, but solvents were needed to complete reduce the adhesive. Interestingly, the interior wood did not show signs of blanching or any other response to ethanol, suggesting that the drawers were not finished in the same manner as the main cabinet. Thus, the remaining adhesive was safely and efficiently reduced with an ethanol swab.

Fig. 17 - Tape removal from interior front wall of one of the small drawers. The brittle carrier has been removed, revealing the prongs and adhesive residue beneath.

Two of the drawers had an additional layer of pressure-sensitive tape beneath the packing tape. The carrier was mechanically removed, and adhesive residue was reduced as above. It is unclear why the hardware was taped over twice for these two drawers, and not the others. The hardware on the fourth small drawer was secured by an unknown adhesive that did not respond to solvents, likely an epoxy resin. This adhesive was left in place. No traces of the tape adhesives were visible under UV examination after cleaning, indicating that removal was successful. Without the tape impeding movement, the interior prongs were exposed and the tab assemblies could rotate on their axes. There was no evidence that the prongs were secured any further, and this level of movement should not pose any risk during use.

4.2. *Hardware Fabrication*

As noted during examination, one of the smaller interior drawers was missing its brass pull tab from the front. No two pulls were identical across the piece, though the small drawers all shared a similar fishtail shape with subtle differences in size and shape. Of the four drawers, the front panel of two had a subtly different tone, and the drawers were split into pairs accordingly. A pattern for the missing pull was made based on the paired drawer, rather than averaging the tabs from all drawers, and new hardware was cut out from 26 gauge brass sheet (fig. 18). Paper mockups were traced onto the brass sheet, and the shapes cut out with a jeweler's saw. All edges were filed and sanded, and a 2mm strip of brass was crimped and shaped around a metal rod to create the looped connector. The center holes for the decorative plate and the pull tab were drilled out with a rotary tool fitted with a #52 bit, and the hole expanded with a small round file. While the new tab isn't a perfect match for the paired hardware, it is cohesive with the overall aesthetic of the hardware.

New pins for the hinges were also fabricated from new 14g brass wire. The wire was cut into approximately 5-6" pieces, rolled straight, and then beaded at one end with a jeweler's torch. The bead was then hammered into a rivet on a draw plate, and the rivet shaped on a belt sander so that it was proportional. Four pins were selected for their superior shaping, checked for fit, and cut to size for each individual hinge.

All hardware was finished with a Sculpt Nouveau Deep Brown Traditional Patina, to match the tone and aging of the existing hardware. The pull tab was threaded between the prongs so that it dangled inside the loop at the end, then the decorative plate threaded over both prongs to lock the tab in place. The prongs were then threaded through the hole in the front of the drawer and bent back in opposite direction to secure the new tab hardware in place. Once in place, the new tab blended with the surrounding hardware. The back of the pull-tab was inscribed with the author's initials to label it as a replacement piece.

Fig. 18. Top: New brass pull-tab and decorative plate during fabrication, next to preparatory drawings and measurements. Bottom: Finished brass hardware.

4.3. *Structural Treatment*

4.3.1 *Lid*

Based on the poor alignment at the front edge of the lid, it appeared that the front fragment had broken off and been re-attached at some point in the object's history. A noticeable shelf could be felt on the front face between the top panel and the front lip at the right edge, and the break edges of the associated split were poorly aligned. In an attempt to correct this misalignment, pH buffered water was carefully wicked into the seam from the interior and exterior, to swell and loosen the hide glue. This procedure was somewhat successful at the edges of the seam, and an attempt was made to gently lift the lid fragment off with the aid of a Casselli spatula. However some damage began to occur as the procedure moved inward, and ultimately the center of the upper edge was too well adhered to remove without causing significant damage to the thin edges of the top panel. The middle section was well aligned, and loosening the edges allowed enough movement in the fragment to gently realign the overhanging edges.

The lid was glued back together in stages with liquid fish glue, with at least 24 hours spent clamped under pressure between each step (fig. 19). First, the front outer edges of the top panel were aligned and glued to the front edge, and the split between the front fragment and the main lid panel closed. However too little adhesive was used during this first attempt, and the front edge did not fully adhere. This join was loosened and the join properly flooded to join the front top edge together. Once dry, the side edges of the top panel were rejoined with the side panels, making sue to properly flood the joins. In these scenarios, the fish glue acted both as an adhesive and a non-aesthetic gap filler, to ensure sufficient points of contact for a strong join. After all joins were dry, any excess fish glue was reduced with lightly damp cotton swabs followed by a dry cosmetic sponge to minimize the dwell time of the water and maximize the mechanical removal of the adhesive bulk without damaging the wood finish.

Fig. 19. Front edge of the lid, before (top) and after (bottom) treatment. The split was successfully rejoined and secured to the side panels, and losses were toned and filled to blend with the surrounding wood.

Small losses along the joins were filled with fish glue bulked with cellulose powder and toned with dry pigments. Fish glue was chosen since it is more reversible and easily cleaned than epoxies, and would not leave a white halo around the fills like PVA-based fillers are prone to do. Bulking the adhesive with cellulose should help make the material more sympathetic with the wood for any seasonal shifts, and weakens the overall cohesiveness of the glue so that it will be more prone to failure within its matrix rather than damaging the wood. While toning the fill material gave an excellent rich color, one disadvantage to this method is that the pigment may be at risk of spreading if it is reversed in the future, though it is still easily controlled within the fish glue binder. Any of the material left behind can be easily moistened and wiped away, as the surrounding surfaces are either protected by the alkyd resin coating that was already present, or by the fish glue used on the join surfaces. Once cured, the fills were in-painted with Golden acrylic paints, to imitate the surrounding wood grain patterns and provide a slight barrier. Finally, the fills and any losses in the coating were finished with a thin layer of clear Butcher's paste wax in a satin finish, buffed with a soft cloth and cosmetic sponges until the appropriate sheen was achieved, and the lid had a cohesive finished appearance.

4.3.2 *Base Reconstruction*

The cleaned floorboard and skirt rails, which will now be referred to collectively as the base, were dry fit together. Remnants of hide glue were visible under UV examination in the groove of the front rail and on only one rabbeted edge of the floor, indicating that these components were glued together at one point. The floor rabbets were slightly warped along the short edge and were difficult to align with the grooves in the rails, but could be fit snugly in with gentle pressure. The rails aligned well at the mitered dovetail corners, and the overall base assembly appeared square when assembled dry; however, a large gap was left between the floor piece and the back rail. The back edge of the floor panel was rabbeted as if to fit into the groove of the back rail, but fell short of the back edge by 1 to 5mm. This difference is too great to solely result from shrinkage of the wood, but it is possible that the floor was intentionally cut short to account for expansion. To corroborate this notion, one common practice with rabbeted floors is to glue only one edge, usually the most visible, and leave the other sides unglued to allow the wood to move over time without breaking the entire structure. As noted above, it appears this technique was used for the base assembly, and the woodworker plausibly could've taken other steps to allow for movement such as cutting the floor panel slightly short. The size of the gap in this case may indicate a slight miscalculation, though a pattern emerges when also taking into account the noted curvature in the side panels of every drawer. Since similar stresses and gaps were noted across most of the components, it is likely that cutting the floor panels slightly small was an intentional technique, though exact reasoning can only be assumed.

4.3.3 *Clearing Cabinet Joins*

With the lid and doors removed from the main body, the cabinet could be safely inverted to access the interior. Turning the cabinet over allowed access to the hidden mortises in the end grain of the side and back panels, which housed the loose tenons that connected the cabinet to the base. The fragments of the loose tenons in the base rails could be removed mechanically with pliers, but the same was not true for the fragments inside the cabinet panels. Quick examination with a UV flashlight revealed that the tenons had been glued into the upper mortises with a similar proteinaceous glue as the rest of the box. Based on how this glue reacted to aqueous cleaning in open areas, it was clear that any attempts to swell the adhesive here would be unsuccessful, as there was not enough space for the water to wick into the mortise. Flooding the mortise would expose the surrounding wood to excessive amounts of moisture that could exacerbate dimensional changes and cause additional damage.

The mortise and tenon joints connecting the cabinet to the base were structurally critical, particularly for proper alignment of the components, so leaving the broken tenons in situ was not an option. The mortises needed to be cleared to allow for new loose tenons to be installed, as attempting to glue the cabinet to the base without the extra support of the tenons would almost certainly provide unsatisfactory or unstable results. Drilling new mortises in the adjacent wood was equally inappropriate, and beyond the skill level of the author. Thus, the decision was made to carefully drill out the tenon fragments with a hand-drill.

Fig. 20. Drilling out the tenon fragments from the mortises on the underside of the cabinet with a hand drill to make room for new tenons, to provide a more structurally sound join during subsequent re-assembly. Courtesy of Lorna Brundrett.

The historic tenons were carefully documented, and the large fragments that could be removed mechanically were stored in a labeled polyethylene bag for reference. A hand crank drill was fit with the smallest available bit, estimated to be a size #58, slightly smaller than the width of the mortise. A maximum depth was marked on the drill bit with a piece of blue painter's tape based on the depth of the empty mortise on the left panel, and the back and right side tenons were drilled out to expose the original mortise slots (fig. 20). Three evenly spaced holes were drilled across the length of the mortise to the measured depth, and the remaining fragments of the tenon removed with tweezers. Sawdust was removed periodically with a vacuum and soft brush, and the surrounding wood frequently checked for damage. Ultimately, the procedure was successful, and the mortises were cleared of the old broken tenons with minimal damage to the wood.

Drilling out the tenons was a much more destructive step than typical conservation measures call for, but it was deemed an acceptable loss for the sake of ensuring a good connection during re-assembly. While it would've been ideal to leave the tenons intact, minimal information was lost since the large fragments from the base rails were saved, including one complete tenon that had not been properly glued into the upper cabinet.

New tenons were custom cut for each mortise slot from pre-fabricated shims, and sanded down to the unique curvatures of each connection. The new tenons were then consolidated with a solution of 10% Butvar in a one to one mixture of acetone and ethanol, to impart some additional flexibility and strength into the tenons. While not strictly necessary, consolidation may delay future failure and provide extra support for the connection in the event of further stresses. With all components prepared, the box was ready for assembly.

4.3.4 Cabinet Re-Assembly

The course of treatment revealed further components that were poorly aligned, out of plane, or otherwise inhibiting proper assembly of the cabinet structure. During examination it appeared that the side panels had warped and were preventing the open back join from coming together, but further examination revealed that the compartment floor had fallen partially out of the grooves in the back and right side panels, causing the floor to sag and preventing the panels from squaring properly into the grooves. With the lid removed, the cabinet could be flipped upside down and the compartment floor gently weighted until it could be realigned. Once the floor was properly positioned, the back joints were successfully dry fit back together.

During this process, the lower left tenon for the drawer spacer was also pushed back into its original position with steady pressure, and the presumed warping in the left side was resolved. The large split going across the panel had allowed the bottom fragment to skew outwards, but fortunately the wood itself was not warped and the tight dovetails in the back restrained the section from further movement. Likewise the supposed warping in the right panel was largely resolved by realigning the compartment floor and fitting the back dovetails back together, though some minor gaps remained in the far edges of the joint, perhaps another example of the intentional short-cutting of the floor panels mentioned previously.

After confirming fit, the back joints were gently eased open again in preparation for re-assembly. One of the dovetails on the lower third of the back left edge broke off prior to arrival along a weakened knot or defect in the wood. The dovetail fragment was rejoined with fish glue; however, the area of the break was degraded and the surface area for adhesive contact was poor. To strengthen the join and reduce the visual disruption of the degraded defect, the gap was filled with a paste of fish glue bulked with cellulose powder and toned to match with dry pigments.

Once all the components were cleaned and treated individually, the box could be reassembled. The main cabinet was placed upside down on a padded surface, to allow better access to the interior. The back dovetail joints were wet with buffered deionized water, to clean any remaining dust and re-activate the historic proteinaceous glue. A thin layer of fish glue was painted on to all interlocking surfaces, and the back joins pressed into approximate position by hand. The joints were then clamped into their final positions and allowed to dry for three days.

The runners were installed following a similar re-wetting and gluing procedure. The side runners could be identified by the adhesive residue along the long edge, and break patterns of the excess glue were used to determine the exact location and position of each piece. The cabinet walls and side runners were re-wet and glued along the old glue lines, and clamped in place. The middle runners were slid into place, and the mortise slots flooded slightly with fish glue to ensure good contact and surface area for the fish glue.

Next, the new consolidated tenons were placed into their respective mortises in the cabinet walls and the exposed edges painted with fish glue (fig. 21). The dry fit base assembly was placed face down over the cabinet with the mortise slots aligned to the tenons, and the assembly gently hammered into position with a rubber mallet. Once in position, glue was brushed onto the mitered dovetails of the base rails and the corners roughly squared by hand. The entire cabinet and base package was then lifted and placed upright onto the working surface and weighted to ensure good contact between the cabinet walls and the tops of the rails. The base assembly was checked for fit at the corners, and clamped square.

After two days of drying, some small gaps still remained between the cabinet and base, likely due to the warping observed in the base assembly. To reinforce the structure and improve appearance, the small gaps were filled with bulked, toned fish glue, and sealed with paste-wax.

Despite realignment of the back joins and main floors, the horizontal split on the left panel remained open even with significant pressure. The decision was made to leave the split open, as trying to force the split closed would simply re-direct the stress and potentially cause greater damage to the side panel and nearby joints. However the split was still visually distracting due to light passing through, and the split could worsen if the box was ever lifted by the brass handles without additional support. To mitigate this, the entire length of the split was lined on the interior with a Tyvek strip adhered with dry wheat starch paste (fig. 22). The Tyvek strip was made from two layers of paper Tyvek that were laminated together with wheat starch paste and toned to blend with the surrounding unfinished wood. The Tyvek ridge can also act as a base for any aesthetic fill materials in the future if desired, so that the fill does not need to be adhered to the wood. Tyvek was chosen over a Japanese paper due to the durability and smoothness of the material, so that the drawers could pass easily over the support with snagging or damaging it.

Small Tyvek bridges were also added along the interior base where the cabinet meets the base assembly, to support the new tenons along the uneven join. The Tyvek bridges will also provide an audible indication of any adhesive failure when the box is picked up, to warn against further movement or lifting until the box can be stabilized. One last Tyvek-wrapped support was made for the back edge of the base floor, made from custom-cut strips of archival acid-free mat-board, which were wrapped with the toned Tyvek. Two Tyvek wings extend from the support, and were adhered to the underside of the floor panel with wheat starch paste. This support piece will support the floor when it is under weight and prevent the center from sagging.

Fig. 21. Interior of the inverted cabinet during treatment, with the back joints and runners glued in place, and the new tenons positioned in the mortises in preparation to receive the base assembly


Fig. 22. Detail of the Tyvek supports in the interior of the cabinet (top) and beneath the base floor (bottom)

With gluing complete, the last step of treatment was to re-pin the hinges and join the doors and lid back to the main piece. The hinges were aligned on the right door and new pins slid into position. Some adjustment of the upper hinge bracket was necessary due to the loss in the upper knuckle, and a slight bend was introduced into the pin to prevent it from slipping down into the middle knuckle and abrading the interior. The pin can pop out of the broken knuckle if the door is opened quickly or pulled away from the main body, but it can be returned to its position by slowly closing the door with gentle upwards pressure. The door opens and closes smoothly, though the lower right corner does catch slightly on the front rail of the base in line with a previous wear mark. On the left door, the lower hinge was re-aligned and a new pin inserted. The prongs of the front bracket were pressed into their corresponding holes on the left door, and the prongs bent outward in line with the original wear marks. Since the top prong was damaged during removal and could not be secured with bending alone, the prong was adhered in its slot with a 50:50 mixture of B48N and B72 in acetone. Finally, the lid was installed by first sliding the corroded pin into the right hinge and then securing the left hinge with a new pin. The knuckles of the right hinge were gently pressed back into shape with pliers to secure the old pin.

The chain was reattached to the loops on the lid and side panel, but the allowed range of motion was not ideal as it allowed the corroded pin to drop slightly out of alignment with the broken right knuckle, which in turn caused additional misalignment and stress on the lid. Thus, a few of the chain links were doubled up and secured to the lower loop to effectively shorten the chain length and limit the opening range of the lid. With these adjustments, the lid and doors could be safely and consistently opened and closed. The drawers were then slid into their proper positions to complete the box.

As a final aesthetic and practical measure, removable lining inserts were made for the upper compartment and drawers. Acid-free archival 4-ply mat board was cut to size, padded on one side with 100% cotton batting, and covered with silk shantung. Red silk was chosen based on corollary objects and historic precedent, and natural cotton batting was selected over standard polyester batting to reduce the presence of any potentially off-gassing materials near the sensitive metals and stones of fine jewelry. For similar reasons, the liners were entirely hand-sewn and no adhesive was used, and the inserts can be removed and re-covered at any time. Cotton batting also has the advantage of being hygroscopic, and can provide a slight humidity buffer for the surrounding wood (Batting 2020), and the high loft of polyester was not needed. Lining the interior of the box provides a cushion for anything stored inside and protects the items from snagging or getting damaged on checks or gaps in the wood, resulting in a visually pleasing and easy-to-use storage chest.

5. DISCUSSION

During the course of treatment, a number of invasive and destructive treatment decisions were made, and while the results were successful in meeting the desires of the client, alternate courses of action can always be rhetorically theorized. In general it is understood that a conservation treatment should not necessitate the removal of original material, but what is the ethical approach when an object is in poor enough condition that some loss is necessary in order to treat and rescue the larger whole? What are the acceptable extents of restoration and repair in order to preserve the presumed original intent of the artist or maker? And finally, how have varying conceptions of these questions affected pieces throughout their history?

5.1. *AIC Code of Ethics*

The Code of Ethics and Guidelines for Practice put forth by the American Institute for Conservation is a framework of professional conduct that outlines the obligations professionals have “to cultural property, to its owners and custodians, to the conservation profession, and to society as a whole” (AIC 2022). To loosely summarize, the principles laid out within the Code direct conservators to carry out their due diligence in all aspects of research and documentation, respect the uniqueness of and advocate for their works, be introspective and honest about their resources and abilities, and to limit damage to original materials through thoughtful treatment and by establishing a long-term continuum of care.

However, the needs of individual pieces or the desires of collectors and private clients can sometimes challenge the ideal application of these standards. A client may desire a greater extent of restoration than what might be necessary or preferred in a museum environment, or the piece has to be prepared for a higher degree of handling and use than if the piece were sitting protected within a vitrine. Regardless of final use or the extent of needs, conservation professionals are expected to honor the intent of the Code, and understand that the quality of work should not be compromised when considering treatment options.

Thus, any time an invasive treatment is pursued, it is crucial to weigh the risks against the benefits of all available options, so that the best possible route can be chosen in a given scenario.

These analyses can be complex and deeply subjective based on the individual conservator's skill level, experiences to date, aces to resources, and of course the time available for the project. No simple framework or checklist can fully encompass the multitudes of potential issues that can be encountered in these situations, but a few questions are particularly useful when considering treatment options for functional objects that will reside in a private home:

- What is, or will be, the intended use of the object?
- How will it be handled and stored?
- Can the environment be controlled, and can other long-term preservation needs be adequately met?

These questions strongly guided decision-making throughout treatment, with a focus on the durability of both the materials and techniques utilized, in anticipation of frequent handling and private use within an unknown environment. When all implications of treatment are carefully considered, extensive intervention measures may be acceptable provided the overall preservation needs of the object are not compromised.

5.2. *Deconstruction and Reconstruction*

The primary concern for the inlaid box was that it was intended for use as a jewelry box. The doors and lid would be opened and closed frequently, the drawers slid in and out, and the box lifted and moved about while carrying additional weight. Treatment thus focused on stabilizing the structure. In the early phases of treatment, there were concerns that the piece would need to undergo a humidification campaign in order to correct the perceived warping of the side panels, which would cause significant damage to the inlays if they could not be properly isolated. The brass hardware would also be damaged if exposed to the quantity of water needed to flatten wood in a controlled fashion (Van Gerven 2016), meaning that the box would have to be disassembled and all hardware removed in order for any treatment to proceed. This route was viewed as a last resort, and mercifully as treatment progressed it became clear that many components could be guided back into plane with gentle pressure alone. Total disassembly was thus not required to stabilize the structure and would have been inappropriate due to the additional stress and harm undoing all the well-adhered joints would have caused.

However, the issue of the damaged hardware still remained, as well as the ability to access interior cavity spaces without damaging the decorations. The door hinges were missing pins and parts of the knuckles, and the doors would not open smoothly or uniformly. The bent hinge plates would need to be hammered to resolve the distortions, and the knuckles could certainly not be re-aligned without significant work, which done in-situ could damage the surrounding wood. For the sake of returning function to the doors alone, it was clear that some deconstruction had to occur. The makeshift wire pin barely holding the right door was temporary at best, and separation of the right door occurred almost as soon as the wire was cut. Next, removing the left door would allow the greatest opportunity to repair the distorted knuckles and restore a safe range of motion. In a similar fashion, removing the lid would allow greater access to the interior of the lid, and would allow the cabinet to be turned upside down for access to the cabinet without putting abrasive pressure on the inlays. While perhaps unconventional in the current standards of conservation practice to partially deconstruct an object prior to beginning treatment, it became a clear choice when weighing the needs and functionality of the piece compared to the potential risks to the decorations if all components were left in place.

Treatment is never as simple as hoped for, and separating the doors and lid was not as straightforward as sliding the pins out from the hinges. Corrosion products had fused two of the pins to the middle hinge knuckles, preventing them from sliding out smoothly. Given the risks of leaving the lid and doors in place, and the extreme restrictions on both time and techniques that this would've imposed, more aggressive options had to be considered. In the case of the left door, this meant unbending the securing prongs of the hinge plate so it could be removed from the door, and prying open the outer knuckles of the lid hinge with pliers so the corroded pin could drop out of the bottom. In both cases, the metal was brittle enough from time and work stress that cracks formed, and small slivers eventually broke off. In another context such damage would've resulted in an immediate halt to treatment, but this was deemed an acceptable risk for the benefits of greater control and correctional ability for all later phases of treatment.

With the inlays isolated, the structural issues of the piece could be addressed – pieces could be returned to proper alignment without vibrating or placing pressure on the decorations, areas of adhesive failure could be cleaned and adhered anew, and broken components could be stabilized and repaired. This was particularly crucial for the connection between the base assembly and the cabinet, where the previous loose tenons had snapped. While the pieces could have been glued together without removing the old tenons, this would've resulted in an uneven and much weaker join given the poor surface area and topography of the thin cabinet walls. The loose tenons were designed for a specific purpose, and ignoring this fact would severely impact the usability of the piece (Rivers and Umney 2012). In an ideal scenario, no original material would have to be removed – but in order to ensure a safe and secure connection that would allow the object to be picked up and handled, removal of a small section of already damaged wood was preferable over drilling completely new mortises.

The culmination of these issues highlighted that this object was as much a miniature piece of furniture as it was any other kind of object, constructed using many of the same techniques and displaying many similar issues as large scale pieces of furniture. Furniture conservation often relies more heavily on what would now be considered restoration, going well beyond the strict definition of preservation. Yet like this box, these invasive decisions are made for the sake of the stability and function of the piece. Treatment steps thus often can and do utilize historic techniques and materials out of respect for the historicity of the objects and a desire for compatible and sympathetic repairs.

5.3. *Material Selection*

The sixth principle in the Code of Ethics calls for professionals to "strive to select methods and materials that, to the best of current knowledge, do not adversely affect cultural property or its future examination, scientific investigation, treatment or function" (AIC 2022). Selecting ideal materials for repairs and fills was technically challenging, as a number of inherent vices exist within the wood itself that can compromise the long term integrity of treatment. All wood is hygroscopic, meaning that the wood network readily absorbs and desorbs moisture from the surrounding environment, swelling and shrinking with respective changes in relative humidity (Hoadley 1980). Wood is also anisotropic, such that these dimensional changes occur in varying amounts across different axes. Dense tropical hardwoods like rosewood tend to suffer the most from shrinkage, and any restraint such as nails or adhesive can create a point of stress that cause additional damage (Unger et al. 2011). To exacerbate stability issues, rosewood in particular is known for its resinous oils that can cause many adhesives to fail over time (Hayward 1977), and animal glues themselves will similarly swell and react to moisture and lose adhesion as they age (Unger et al. 2011, 381). With these complications and constraints in mind, careful consideration was needed for the selection of materials used throughout treatment.

5.3.1 *Adhesive Systems*

The ideal adhesive for this treatment would be a system that is neutral, inert in fluctuating environments, but flexible enough to respond with the dimensional shifts of the surrounding wood. No such perfect adhesive exists. While one might assume that a solvent-based system would avoid swelling, organic solvents would attack the oils and resins present and cause serious damage to the coatings (Williams 2003). Indeed in terms of the direct chemical effects, solvents such as ethanol and acetone have no distinct advantage over similarly controlled applications of water (Unger et al. 2011, 28). Hardwoods are much less resistant to acids and bases than softwoods, so it is important that any water-based system utilized is a neutral pH, as even a weakly alkaline solution can cause increased swelling. Slight acidity in the solution may not cause sever issues to the wood itself, but when combined with the inherent acidity of the wood it can create an unfavorable environment for the surrounding materials. Finally, one of the main issues with solvent based systems like the epoxy resin Acryloid B-72 is that these systems are magnitudes stronger than the surrounding wood, meaning that any failure of the adhesive would result in substrate failure instead of cohesion failure (Tsetsekou et al. 2018). This is not to say that epoxy resins are never used, but they are typically reserved for special structural applications where the additional compressive strength is necessary. Additionally, using an epoxy system would have necessitated total removal of the existing hide glue and the application of a barrier coating, which in turn may have required a more extensive dismantling and cleaning regimen in order to properly protect the wood. Thus, it was decided that the best system for this particular object would be water-based, as it would not impact the surrounding solvent system inlays and coatings, and are potentially more easily reversed depending on the exact adhesive chosen.

Focusing then on water-based systems, two main groups of adhesive used by conservators are poly-vinyl acetate (PVA) glues and proteinaceous glues. PVA glues, while more stable against environmental fluctuations and less likely to cause substrate failure, can leave white hallowing and other undesirable effects on the wood. Proteinaceous glues such as hide glue have been the historic adhesive of choice for all styles and scales of wood-working, and was prized for its strength, its ability to be re-solubilized and re-used even after significant passage of time, and of course its accessibility (Schellmann 2007; Thornton 2013). However, like epoxies, the strength of traditional hide glue can pose an issue to the wood surface, and a weaker adhesive like liquid fish glue would be better suited for the joins needed in this particular piece. As a cold-set collagen glue, fish glue would be compatible with the existing hide glue, respond sympathetically to dimensional shifts in the wood in a similar fashion to the hide glue, but it is much weaker and slightly more flexible than the hide glue (Tsetsekou et al. 2018). Thus, the fish glue should theoretically have a lower potential for failure than the hide glue, and will not completely restrict the movement of the wood like an epoxy resin system would. Additionally, since the fish glue is a proteinaceous glue, it is not necessary to completely remove the old hide glue before application, as the hide glue can be wetted and re-activated to act as a barrier layer for the new fish glue. This is particularly advantageous for joints that are only partially open, as treatment is possible in these areas without completely dismantling the entire structure (Rivers and Umney 2012). One disadvantage to fish glue is that the adhesive is sensitive to water and environmental shifts; however, this does also allow a greater degree of reversibility than the previous systems for precisely that reason.

The final group of water-based systems is comprised of cellulose ethers such as Klucel-G and methyl cellulose, both of which are used frequently in archaeological conservation. Fish glue was selected over cellulose ethers partially for the sake of maintaining cohesiveness and compatibility across the various materials used throughout the box, but also for the significant reduction in strength of these systems. Given that the majority of joins during treatment were structural and did need a certain degree of strength to withstand regular use, cellulose ethers did not provide the same level of strength across these thin join surfaces as the fish glue.

5.3.2 *Gap-Filling Materials*

Where cellulose ethers might have been useful however was within the gap fills, as the irregularity and damage of some of the wood panels resulted in small but noticeable gaps along the upper edges of the lid and in the join between the base assembly and the cabinet walls. The needs for fills follow the same logic as the needs listed above for adhesives, though issues such as flexibility and sensitivity to humidity are exaggerated given the scale of material present when filling gaps. Epoxies can be used over particularly large gaps where the structure and rigidity are needed, but these systems would be completely inappropriate for our scale as they would be more likely to severely restrict the movement of the wood and create stress points that would expand current splits and damages in the wood (Williams 2011). Commercially produced PVA systems were ruled out due to the potential pale haloing that has been noted in other treatments, though if other options had been exhausted then it is possible to construct custom systems (Fulcher 2017). Fillers made with animal glues have long been used for the conservation of panel paintings (Unger et al. 2001) and fish glue was again a logical choice, although due to its viscosity it must be bulked in order to adequately be sculpted (Wiliams 2011). Barclay and Grattan's paper in the 1987 ICOM Committee for Conservation pre-prints continues to be one of the most comprehensive publications on the range of materials used for aesthetic wood fills, particularly those utilizing micro-balloons. More recent publications such as Kariya et al. (2010) and Fulcher (2017) expand on the use of paper pulp and derivative cellulose products as the bulking agent, noting the low density of the resulting paste and the dimensional compatibility with wood given the similar chemical structures. Given the size of the fills, the existence of hide glue throughout the piece and the use of fish glue for the main joins, and the knowledge that this piece would be used within a private client's home, the fills were made from fish glue bulked with cellulose powder.

The resulting fills were relatively straightforward to work and shape, and some shrinkage was noted after drying. The fills were easily toned with dry pigments, though a high pigment load was needed to achieve the desired richness. The addition of high ratios of inert fill materials strongly impacts the physical and mechanical performance of animal glues, and high pigment concentration notably decreases the amount of intermolecular bonding within the glue, impeding dimensional change (Schellman 2007). Thus while the high pigmentation of the fills can lead to some unfortunate bleeding when the fills are exposed to large quantities of water, the combination of cellulose and pigment in the fills should help mitigate some of the shrinkage concerns of fish glue by itself. To help offset some of the color bleed, particularly for any wet cleaning that may occur in the client's home, the fills were in-painted with acrylics and sealed with a layer of paste wax to both provide a barrier to the original fill and help visually integrate the depth and sheen of the surface. The pigmentation can also be accounted for with adequate planning and control of the quantity and dwell time of the water used for future treatments, and can be swiftly cleaned from the coatings on the surrounding wood with water with minimal impact.

Ultimately however there are concerns that the bulked fish glue is less reversible than other methods, but this system was still desirable for the sake of limiting the number of adhesives cross the piece. Should re-treatment proceed in the future, experimentation with different blends of cellulose ethers and micro-balloons is strongly recommended, as these ultimately may give both a better aesthetic appearance, slightly less reactive behavior, and may be better suited for the non-structural fills at the top of the lid. Applying the fills in layers may aid in reducing shrinking of the fills, and finishing the fills with a layer of methylcellulose and micro-balloons can provide a smoother finish than what is achievable with animal glue and cellulose powder or paper pulp (Kariya et al. 2010).

There remains the question of the large gap on the left side of the object, where a horizontal split running the width of the panel has caused major separation at the front edge. Bulked adhesive is rarely appropriate for gaps of this size due to either the quantity of water and materials needed, or the added dimensional resistance when the wood inevitably shifts. With the Tyvek bridge acting as a dam, a number of fill types could be used, included removable fills molded with paper pulp or tissue paper. Elston (1995) narrates the process of filling deep, non-structural voids with dry paper pulp, followed by a layers of methylcellulose with various fillers to achieve the desired smooth finish, and a similar effect can be achieved with rolled or crumpled pieces of Japanese tissue. Yet sometimes the simplest approach is best, and following in the footsteps of traditional restoration techniques, carved balsawood may have been an appropriate way to fill and secure the split. Balsawood is easy to carve, lightweight and able to compress should the surrounding wood expand, and with acrylic toning it can be matched to the tone and sheen of the main body. Due to time constraints, the skill of the author, and the fact that a fill was not strictly necessary for structural stability and function of the piece, the gap was simply supported with a Tyvek bridge and left as it was; however, if an aesthetic fill is desired in the future then one of the above approaches would be best suited with current technology.

5.4. *Interpretation and Subjectivity*

Ultimately there are many routes and techniques that can lead to a successful treatment, and it is up to the individual conservator's skills, experience, and application of the code of ethics to determine the best possible course for each individual object. A significant amount of subjectivity exists within the field, highlighted particularly within archaeological conservation where resources, time, and knowledge of preservation conditions are often extremely limited. Certain measures are taken in the field out of necessity that would be considered wholly inappropriate when operating within the full capacity of a museum laboratory, but the reality of the situation is that tough decisions must be made for the immediate safety of certain objects (Unruh and Harbeck 2021). If given the choice between a plastic tub from a local dollar store versus open storage or a cardboard box, the plastic tub has the best chance of survivability even though it of course would not be ideal or even good storage in ideal conditions. Indeed even the application of the Code of Ethics has changed significantly as the field has grown, with a more recent focus on collection management and preservation over the more physical interactions that defined prior restoration practices (Ashley-Smith 2009).

The AIC Code of Ethics covers a broad range of possible approaches, ranging from no treatment to extensive intervention, and walking the line between those two is up to the judgement of the conservator and the professionals they consult with. The first extreme of no treatment was certainly an option for this piece, and would have been the likely course of action had the piece belonged to a museum collection where the environment and handling protocols could be controlled. In these regulated spaces, Klucel-G and similar adhesives could have been used instead of fish glue, as the strength of an animal glue wouldn't have been as necessary. Similarly, the old damaged tenons could have been left in-situ, and careful handling instructions included to reduce the likelihood of stress on the weakened join. The Tyvek bridges may not have been included at all, or may have used Japanese tissue, since the drawers would not be manipulated as frequently. Similarly, much of the hardware may have been left as-is since the doors would not be opened frequently, only swapping the wire for a more secure pin. Without removing the lid and doors, stabilizing the lid and re-assembling the cabinet would've been a much more arduous and complicated process, but a process that could be afforded in some institutions. This overall approach would certainly have preserved more of the original material, but would've been vastly less functional and would require a more extensive continuum of care in order to avoid exacerbating the inherent condition issues.

On the other end of the spectrum, treatment could have continued or expanded upon the historic styled of restoration that were evident from previous campaigns. As explained previously, proper alignment and stabilization of the various components may have necessitated a total disassembly. Had the side panels been genuinely warped, one oft-seen approach involves thinning down one side of the wood until it can be bent back into place, or soaking the wood in hot water or steam so it could be bent back into plane. For the base, the loose tenons would definitely have been replaced in this situation, but the irregularity of the cabinet walls would've been unacceptable. For a true restoration, the end grain of the cabinet walls would've been cut or shaved down until the cabinet could sit level on the base. New floors may have been recut for the base given the severity of shrinkage, and additional veneer could be added to the lid to bridge the split. The horizontal split in the left panel may have warranted a new panel, or a craftsman might have cut trapezoids into both sides and used a Dutchman key to connect and hold the split.

Given the multitudes of nuance and alternatives available, treatment of the inlaid box aimed to navigate the space between these two extremes and strived for solutions that would combine the robustness of a traditional approach with the idealized notion of preservation of authenticity that current standards call for. In truth there is rarely one ideal or best approach, which is why the continuum of care and thorough documentation are crucial for ethical practice. Materials and techniques should be chosen that not only meet the goals of treatment in the moment, but allow for future re-treatment as the abilities of the field progress. Few things are truly reversible, and loss of original information cannot be truly restored, but occasionally small losses arguably can be logical and even ethical when those decisions prevent drastic damage or the loss of the piece as a whole.

6. RECOMMENDATIONS FOR DISPLAY

The piece is now in stable condition, and can be safely used as a functional storage piece in the home. The doors and lid can be opened and closed as needed, but should be opened slowly and carefully, to preserve the remaining hinges and prevent any dislocation within the damaged hinges. When moving the box, the entire box should be lifted from the base, rather than from the side handles. Lifting from the side handles for prolonged periods may exacerbate the existing split on the left side, and can strain the join between the main cabinet and the base.

During the course of its lifetime, the box construction and its inlays have already been subjected to probably multiple sudden and drastic shifts in temperature and relative humidity, with the journey from Hawaii to New York being the only known and likely most notable event. Both the wood and the adhesives of the box are hygroscopic, meaning they react to environmental changes by expanding and softening with high temperature and humidity, and by shrinking or becoming brittle in low, dry temperatures (Hoadley 1980). Thus, the drastic changes in environment during shipping had severe effects on these materials, contributing to the failure of the adhesive joints when the piece had to rapidly adjust to the significantly colder and drier air of New York. Now that the piece has spent over a decade in Western New York, the worst damage has already been done and it is reasonable to assume that the box has acclimated to the local environmental cycles for a semi-controlled indoor space typical of the region. Since the treatment was performed with a proteinaceous glue, there is still some risk for expansion or embrittlement if the box returns to an unregulated environment; however, proteinaceous glues are still less likely to cause long term damage precisely because they can respond to environmental changes alongside the wood, rather than creating a point of resistance.

Ideally, the piece will be maintained in a controlled indoor environment around 70°F with relative humidity at 45-55%; however, given that this will be in a private home, such specifications may not be possible at all times. If so, the wider acceptable range is between 60° to 78°F and about 40-65% RH, to prevent mold growth at the high moisture levels and reduce embrittlement of the adhesives when drier. However the main concern is to try to keep the environment relatively stable by minimizing changes of more than ±5°F or ±5% RH over the course of a single day, so that the material has time to adjust slowly as the seasons change. The box can be kept at cooler and drier temperatures during the winter, or vice versa in the summer, provided the environment can be stepped up or down to those conditions in small, 1-5 unit increments per day. A recommended location for the piece would be against an interior wall out of direct sunlight, so that the piece will be buffered from outdoor conditions and the damaging effects of direct UV exposure. Similarly, areas near fireplaces, heaters, A/C vents, open doorways, or other areas where frequent or large variations in the environment are expected should be avoided. However, the piece should not be kept in total darkness, as the absence of light during ten years of storage is likely the reason why the ivory inlay has yellowed so severely, and will only continue to darken if these conditions persist.

Both the proteinaceous adhesives and the wood itself can be attractive to pests, so occasional monitoring and moving of the piece is recommended, to ensure there isn't any new pest damage. While less likely, the silk inserts can be attractive for clothing moths; however, regularly opening and closing the drawers will create a less welcoming environment and a cedar sachet inside the drawers can help deter them. Cedar blocks or sachets should be replaced or refreshed with cedar oil every few months to maintain best efficacy. Regular dusting will also help discourage pests, and is sufficient to keep the piece clean.

Cleaning should be limited to a dry, soft cloth, but if more intensive spot cleaning is needed, then a cotton swab (aka "Q-tip") lightly dampened with pure water may be appropriate. Care should be taken to avoid water contact with the inlays, and any spills onto the surface of the box should be blotted up as quickly as possible. While not immediately damaging, some color transfer may be visible from the fill materials if wet, so water should be avoided in these areas out of caution. Cleaners, soaps, or detergents should not be used at any point, regardless of if they are commercial or home-made, as they can damage the finish and the inlays.

7. CONCLUSIONS

The box was re-assembled and stabilized for regular use in a private home, without loss or damage to the inlaid decorations. While the hardware was not fully restored, the hinges are functional and the lids, doors, and drawers can all be safely opened and closed carefully without cause for concern. The complexity of the piece and the severity of its condition issues resulted in an interesting treatise on ethical practice when considering the form and function of household items and other highly-manipulated pieces of furniture, particularly when considering the adhesives used for repair. The materials during treatment were carefully selected for their durability and compatibility, and can be re-treated if further intervention is needed in the future. The aesthetic inserts can be removed, recovered, or replaced as needed, and the various superficial supports can be replaced in the event of failure or if further support is needed. Overall, the box can now be handled safely and used as desired by the client, and should remain in good condition provided the recommendations for display are honored.

8. ACKNOWLEDGEMENTS

First and foremost, sincere thanks to the clients for bringing in such a beautiful piece and providing input on this wonderful learning project. Many thanks to Emily Hamilton, the advisor for this project, and the many co-advisors including Jiuan-Jiuan Chen, Dr. Aaron Shugar, and Dr. Rebecca Ploeger, for their recommendations and contributions during research and treatment. Thank you also to Aprille Nace for her help with research, Anna Serotta for her feedback and expertise on wood fillers and adhesives, and to Stephen F. Saracino for allowing access to the metals studio in order to fabricate the new hardware.

Many thanks to the entire Art Conservation Department, particularly the Class of 2023 for their support and comradery, and to Meredeth Lavelle and Anne Hoehn for their administrative assistance both within and beyond the Buffalo program. Lastly, sincere thanks to the AIC members who thoughtfully compiled and contributed to the AIC *Code of Ethics and Guidelines for Practice*, as this document is a crucial reference for the entire profession as we navigate our work and the innumerable instances of nuanced, ethical dilemmas that entails.

Funding for the author's education and for this project was generously provided by the Andrew W. Mellon Foundation, the Garman Family Foundation, the Gross Family Foundation, the Hoskins-Smith Family Foundation, the Gerald & Sandra Lippes Fellowship, the Stockman Family Foundation, the National Endowment for the Humanities, the Linton Vincent Tuition Scholarship, and the Buffalo State College Tuition Scholarship.

9. REFERENCES

AIC. 2022. Code of ethics and guidelines for practice. Washington, D.C.; American Institute for Conservation. Revised August, 1994. https://www.culturalheritage.org/about-conservation/code-of-ethics

Ashley-Smith, Jonathon. 2009. The basis of conservation ethics. In *Conservation principles, dilemmas and uncomfortable truths*, ed. A. Richmond. Oxford, UK: Elsevier Butterworth-Heinemann. 6–24.

Barclay Robert L. and David W. Grattan. 1987. "A silicone rubber/microballoon mixture for gap-filling in wooden objects." In *ICOM Committee for Conservation preprints. 6th triennial meeting, Sydney Australia*. Paris: ICOM. Preprints 1, 183-187.

Batting. 2020. CAMEO (Conservation and Art Materials Encyclopedia Online). Museum of Fine Arts, Boston. Accessed July 20, 2022. https://cameo.mfa.org/wiki/Batting

Ecke, Gustav. 1986. *Chinese Domestic Furniture in Photographs and Measured Drawings*. Mineola, NY: Dover Publication.

Elston, Maya. 1995. "Technology and Conservation of a Polychromed Wooden Sarcophagus". In *Conservation in Ancient Egyptian Collections: Papers given at the conference organized by the UKIC, Archaeology Section, and International Academic Projects*. Eds. C.E. Brown, F. Macalister & M.M. Wright. London: Archetype, 13–21.

Fulcher, Kate. 2017. "An investigation of the use of cellulose-based materials to gap-fill wooden objects." In *Studies in Conservation*, 62:4, 210–222. https://doi.org/10.1080/00393630.2015.1109294

Gasson, Peter, Pieter Bass, and Elisabeth Wheeler. 2011. "Wood anatomy of CITES-listed tree species." *International Association of Wood Anatomists Journal* 32 (2): 155-198. DOI:10.1163/22941932-90000050

Gleason, Sterling. 1960. *Ultraviolet Guide to Minerals With Mineral Identification Charts*. New York, NY: D. Van Nostrand Company Incorporated.

Hayward, Charles H., 1977. *The Complete Book of Woodworking Joints*. Toronto: Coles Publishing Co. Ltd

Hoadley, R. Bruce. 1980. *Understanding Wood: A Craftsman's Guide to Wood Technology*. Newtown, CT: Taunton Press.

Hoadley, R. Bruce. 1990. *Identifying Wood: Accurate Results With Simple Tools*. Newtown, CT: Taunton Press.

Kaner, Jake, L. Jiufang, X. Yongji, and F. Ioras. 2013. "A Reevaluation of Woods Used in Chinese Historic Furniture. No. 1". Bulletin of the *Transilvania* 6 (55): 9-18.

Kariya, H., Bruno, L., Godfrey, J. & March, T. 2010. "Treatment of a Dynasty 18 Painted Coffin, 37.47E a-e (Abbott Collection 405A)". In *Decorated Surfaces on Ancient Egyptian Objects: Technology, Deterioration and Conservation* eds. J. Dawson, C. Rozeik, & M.M. Wright. London: Archetype in association with the Fitzwilliam Museum and Icon Archaeology Group, 97–105

McGiffin, Robert F. Jr. 1983. *Furniture Care and Conservation*. Nashville, TN: The American Association for State and Local History.

Pomegranates. 2022. The Metropolitan Museum of Art. Accessed February 22, 2022. https://www.metmuseum.org/art/collection/search/44149.

Rivers, Shayne, and Nick Umney. 2012. *Conservation of Furniture*. 1st edition. London and New York: Routledge.

Robbins, Manuel. 1983. *The Collector's Book of Fluorescent Minerals*. New York, NY: Van Nostrand Reinhold Co.

Schellmann, Nanke. C. 2007. "Animal glues: A review of their key properties relevant to conservation." In *Studies in Conservation* 52:sup1, 55–66. https://doi.org/10.1179/sic.2007.52.Supplement-1.55

Thornton, Jonathan. 2013. "A Brief History and Review of the Early Practice and Materials of Gap-Filling In the West." In *Journal of the American Institute for Conservation* 37:1, 3-22. https://doi.org/10.1179/019713698806082921

Tsetsekou, E., A. Platanianaki, and A. Pournou. 2018. "Assessing wood adhesives used in conservation by testing their bond strength and ageing behavior." Proceedings from *1st International Conference of the Greek Society of Experimental Mechanics of Materials*. In *Procedia Structural Integrity* 10: 227-234.

Unger, Achim, Arno P. Schniewind, and Wibke Unger. 2001. *Conservation of Wood Artifacts: A Handbook*. Eds. Bernd Herrmann and Gunther A. Wagner. Berlin: Springer Science & Business Media.

Unruh, Julie and Cricket Harbeck. 2021. "Conservation decision-making in the field: a case study." In *Journal of the Institute of Conservation* 44:1, 3-24.

Van Gerven, Gert, Bart Ankersmit, Paul H.J.C. van Duin, André Jorissen, and Henk Schellen. 2016. "A controlled method to flatten warped wooden panels". In *Studies in Conservation* 61:3, 125-135. DOI: 10.1179/2047058414Y.0000000161

Warren, Thomas S., Sterling Gleason, Richard C. Bostwick, and Earl R. Verbeek. 1999. *Ultraviolet Light and Fluorescent Minerals: Understanding, Collecting, and Displaying Fluorescent Minerals*. Upland, CA: Gem Guides Book Company.

Williams, Donald C. 2003. "Museum Conservation Institute Preserving and Restoring Furniture Coatings." Accessed December 15, 2021. https://www.si.edu/mci/english/learn_more/taking_care/coatings.html.

Williams, Donald C. 2011. "Some Experiences with Flexible Gap-Filling Adhesives for the Conservation of Wood Objects." In *Facing the Challenges of Panel Paintings Conservation: Trends, Treatments, and Training: Proceedings from the Symposium* eds. Alan Phenix and Sue Ann Chui. Los Angeles, CA: Getty Conservation Institute. 113-124. https://www.getty.edu/conservation/publications_resources/pdf_publications/facing.html

10. Sources of Materials

Butcher's Bowling Alley Wax
Butcher Polish Company
67 Forest Street
Marlborough, MA 01752
Available from the BWC Company
https://store.bwccompany.com/

Butvar B-98N
TALAS
330 Morgan Avenue
Brooklyn, NY 11211
(212) 219-0770
https://www.talasonline.com/

Deep Brown Traditional Patina
Sculpt Nouveau
1155 Industrial Avenue
Escondido, CA 92029
(760) 432-8242
https://sculptnouveau.com/

Dry Pigments
Conservation Materials Ltd.
1165 Marietta Way, PO Box 2884
Sparks, Nevada 89413
Available from Conservation Suppliers

High Tack Fish Glue
Lee Valley Tools
6777 Morrison Street
Niagara Falls, ON L2E 2G5, Canada
1(800) 871-8158
https://www.leevalley.com/en-us

Golden acrylic emulsion paint
Golden Artists Colors, Inc.
188 Bell Road
New Berlin, NY 13411
(607) 847–6154
www.goldenartistcolors.com
Available from conservation suppliers and art supply stores

100% Natural Cotton Batting
Pellon
4801 Ulmerton Road
Clearwater, FL 33762 USA
1(800) 223-5275
https://www.pellonprojects.com/
Available from craft supply stores

Paraloids B-48 N and B-72
Conservation Resources
7350-A Lockport Place
Lorton, VA 22079
(800) 634-6932
https://www.conservationresources.com/
Available from conservation suppliers

Silk Shantung
High Fashion Fabrics
3101 Louisiana Street
Houston, TX 77006
(713) 528-7299
https://www.highfashionfabrics.com/
Available from fabric retailers

Tyvek® Styles 1059B and 1073B
Du Pont
71 Southgate Boulevard
New Castle, DE 19720
1-800-448-9835
https://www.dupont.com/
Available from conservation suppliers

11. Autobiographical Statement

Katherine McFarlin (they/them/theirs) received a B.A. with Honors in Near Eastern Languages and Civilizations from the University of Chicago, specializing in Egyptology. Before starting their graduate studies in Art Conservation at SUNY Buffalo State College, Katherine spent two years as an objects conservation intern at the Museum of Fine Arts, Houston. They also worked as a conservation assistant at the Mansueto Library Preservation Lab in Chicago, and completed multiple workshops on archaeological Greek pottery at the Balkan Heritage Field School in Sozopol, Bulgaria. Katherine spent their first graduate summer interning at the Cleveland Museum of Art in textiles conservation, and will spend their third year interning in objects conservation at the Brooklyn Museum.

12. List of Figures

126904_A1N

126904_A2N

126904_A3N

126904_A5N

126904_A4N

126904_A6N

126904_A8UVA

126904_A10UVA

126904_A9UVA

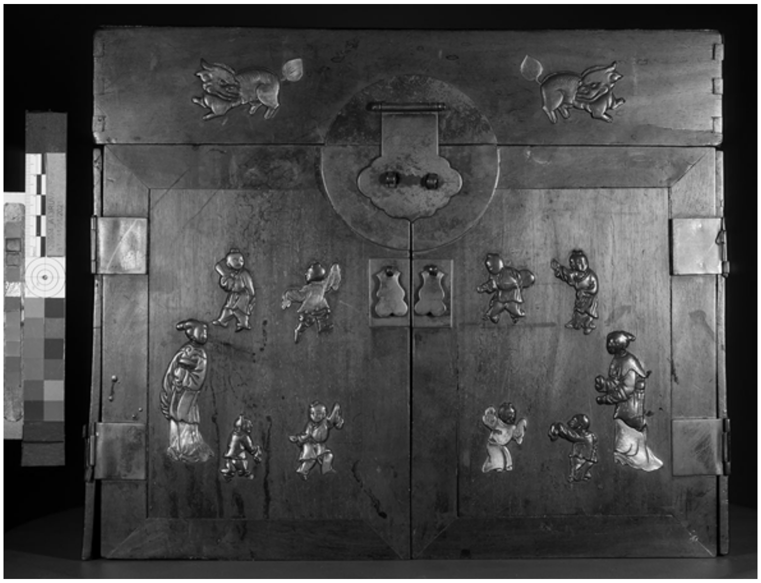
126904_A11UVA

126904_A7N

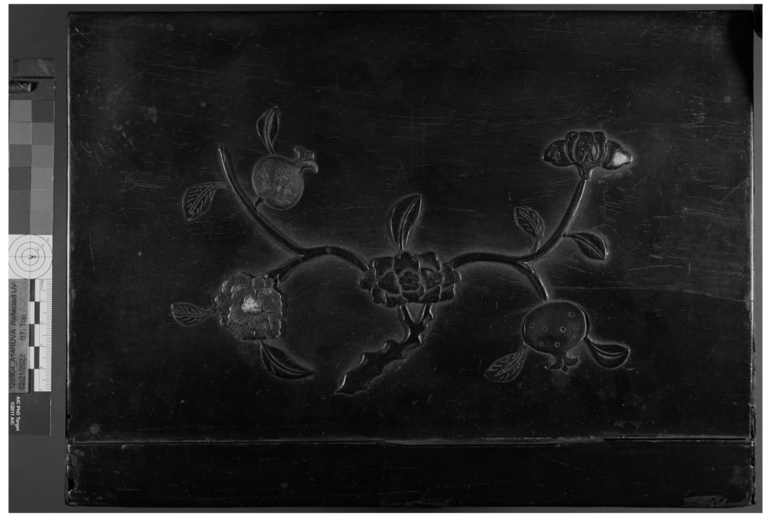
126904_A12UVA

126904_A21N

126904_A22N



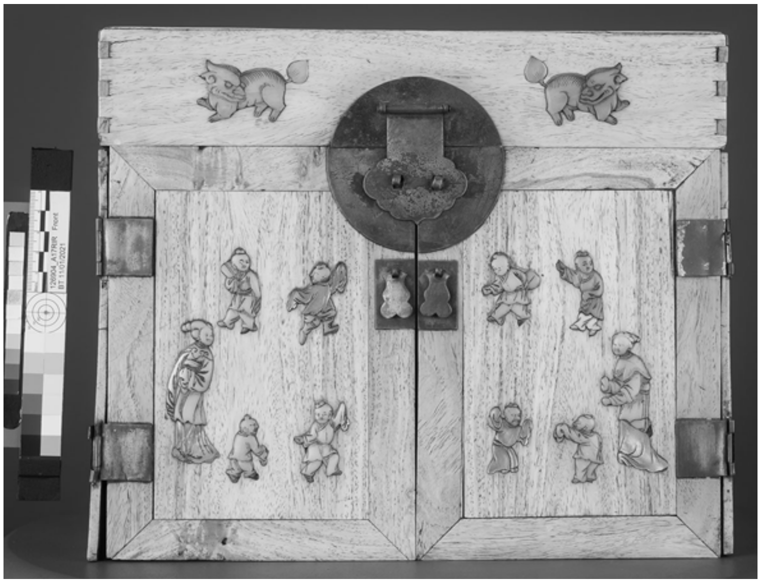
126904_A13RUVA



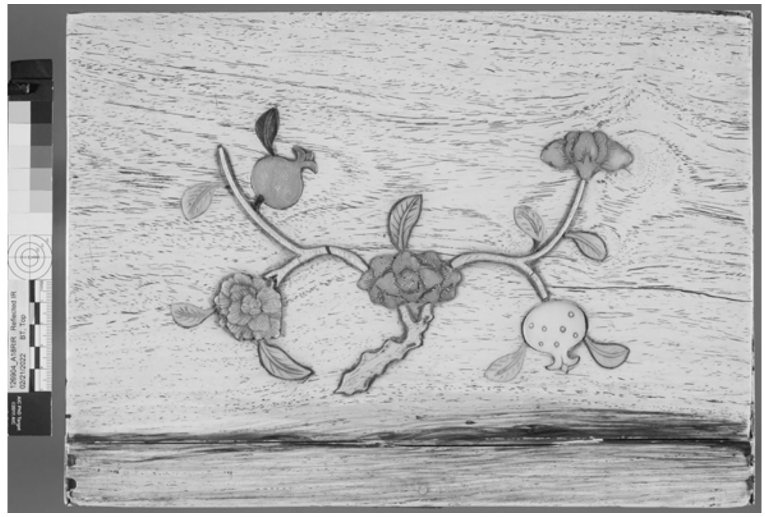
126904_A14RUVA

126904_A15IRLUM

126904_A16IRLUM



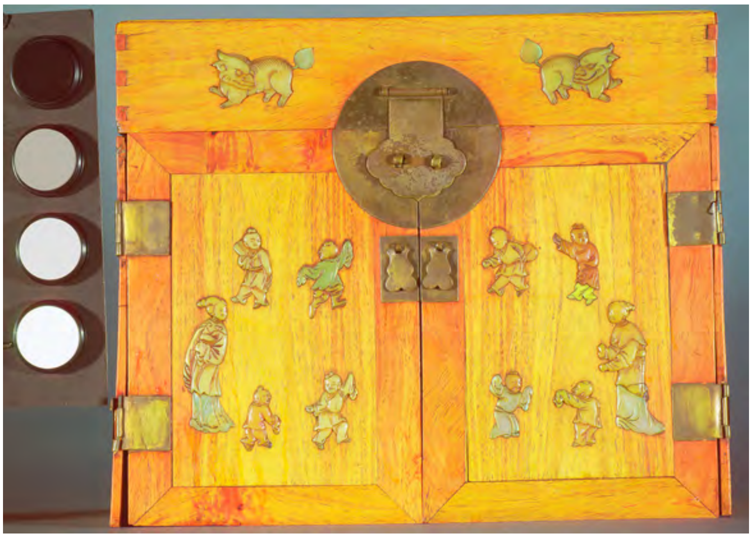
126904_A17RIR



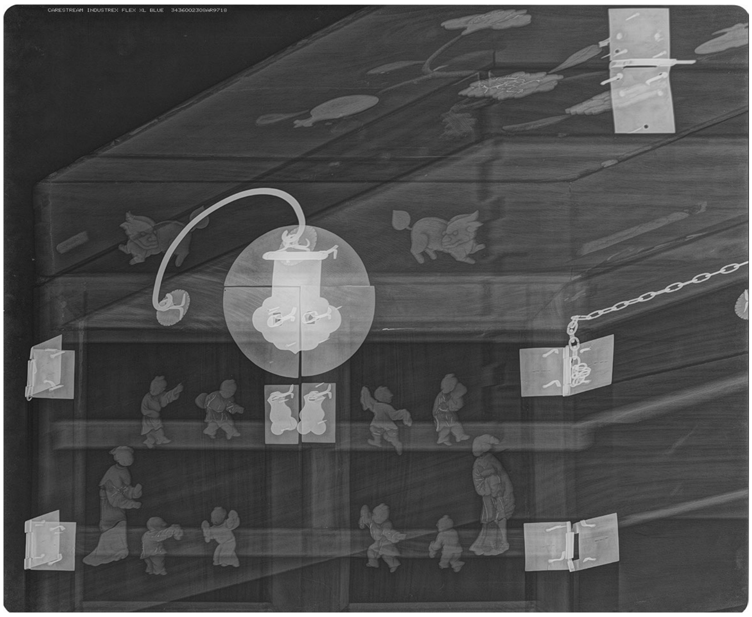
126904_A18RIR

126904_A19SP

126904_A20SP



126904_A23FCMSI



126904_A24XR_edgefilter

PATRICIA H. *and* RICHARD E. GARMAN
ART CONSERVATION DEPARTMENT
BUFFALO STATE • The State University of New York

1300 Elmwood Avenue
Rockwell Hall 230
Buffalo, NY 14222-1095
P: 716-878-5025 F: 716-878-5039
artconservation.buffalostate.edu
artcon@buffalostate.edu

OBJECTS EXAMINATION REPORT **CNS 126904**

OWNER/AGENT	[redacted]
DATE RECEIVED	May 18, 2012
EXAMINER	Katherine McFarlin
FACULTY SUPERVISOR(S)	Emily Hamilton
DATE OF REPORT	October 21, 2021

ARTIST/MAKER (Owner Attribution)	Unknown
TITLE (“”) or DESCRIPTION	Chinese Jewel Case
DATE	Early 20th Century
STRUCTURE	Wood with brass hardware and unknown polymer inlay
DIMENSIONS (H x W x D)	10 ¼ x 12 ¼ x 8 ¾ in (26 x 31 x 22.5 cm)
ACCESSORIES	Includes 5 drawers and 6 slats
LABELS/DISTINGUISHING MARKS	

I. DESCRIPTION

- **THE OBJECT**

The object is a 10 ¼ x 12 ¼ x 8 ¾ in (26 x 31 x 22.5 cm) Chinese box made of wood, with brass hardware and figural inlays in a variety of materials. The piece is described as an “Antique Chinese Jewel Case, Early 20th Century” by the accompanying paper tag, provided by a dealer called *South Seas* located in the Hyatt Regency Resort & Spa in Lahaina, Maui, Hawaii. The inlays on the front doors depict eight children playing while two women observe, the figures split evenly between the two doors. Paired guardian lions watch from above on the front lip of the lid. On the top of the lid, there is a single plant branch with two pomegranate fruits and three flowers, all made from different inlay materials.

The lid of the box opens to reveal a shallow single compartment approximately 1-1/8 in deep. The lid is 2 ¼ in deep and sits directly on top of the compartment, slightly overlapping the doors of the lower section. The lower section of the box has two doors that open outward, and the interior cabinet contains three rows for drawer compartments. Four small drawers measuring 1 ¾ x 5 ½ x 8 ¼ in (4.4 x 14.1 x 20.8 cm) fill the top two rows, and a single large drawer measuring 1 ¾ x 11 ¾ x 8 ¼ in (4.4 x 30 x 20.8 cm) rests on the bottom row. A 3/16 in (0.5cm) thick wooden board acts as the floor of the cabinet, and connects the cabinet to the 3/8 in (1 cm) thick skirted base.

The lid and each of the doors are attached to the main body with two rectangular brass hinges each. The front doors have brass decorative pull tabs about two-thirds up the inner edge, with a brass quarter-circle element directly above them, aligned with the upper corner of each door. Small loops of brass protruding from these elements serve as the catches for the large decorative clasp above them on the lid. The catches can also function as slots for any desired locking mechanism, historically a metal box-shaped padlock. The quarter-circle elements then align with a half-circle of brass above it on the lid, to form a complete circle when the latch is closed. The small drawers have fishtail-shaped brass pull-tabs while the large drawer has a leaf-shaped tab, all backed by decorative square plates. Other hardware included brass handles on both side panels, and riveted loops on both the cabinet and lid panels on the left side. A brass chain connected these two loops, securing the lid and preventing it from opening too far.

• HISTORICAL CONTEXT AND SIGNIFIGANCE

While these items are popular on antique and auction websites for private collection, little has been written about these objects from either an art historical or conservation perspective. They are rarely collected in a museum context. However, due to their more domestic existence, the heirloom qualities of these piece can provide immense importance to the families they belong to. These boxes have been described as jewelry boxes, scholar's cases, and seal chests, all of which hint at the variety of ways these objects could be used. These pieces can also be an excellent case study in wood-working and artisan trends and timelines, particularly for joinery and inlay materials.

Many of the collector-quality versions of these boxes are made from *huanghuali* wood, translated as yellow flowering pear, latin name *dalbergia odorifera*, a tree in the rosewood family. Rosewood holds a special place in Chinese culture, and is prized for its grain pattern, golden color, and pleasant scent when freshly harvested (Kaner 2013). Common inlay materials in Chinese furniture included shell, ivory, horn, and stones such as jade, agate, and chalcedony.

Heirloom items, particularly for the private home, can range significantly in quality and can contain a huge variety of designs with different intentions. The combination of the figural and floral inlays on this piece can be interpreted as a symbolic wish for good luck and fertility for the owner. In Chinese, the word for "seed" is identical to the word for "son"; thus, pomegranates in particular are often used a symbol for having many sons and building a robust family, due to the many seeds found within the fruit ("Pomegranates" 2022). The pomegranates on the lid of the box then reinforce the scene on the cabinet doors of many sons playing together, invoking and wishing for a strong legacy. The guardian lions mirrored above the family scene reinforce the notion of prosperity and success, as well as physically guarding the family and the represented wish. While the larger family of boxes can contain many different symbols - from flora and fauna, both real and mythical, to these filial scenes - the combination of inlay designs on this object strongly highlights the domestic intention of the box.

• FABRICATION

The box is made from thin planks of an unknown wood, expected to be a species of rosewood based on corollary objects. The box mostly utilizes through dovetail joints throughout its construction, most notably along the back corners of the main cabinet, on all corners of the lid, and on all corners of the drawers. The floors of each drawer appear to be joined to the sides with rabbets and grooves. Some adhesive is visible in the main joints of the cabinet, where the joints have come apart.

In the interior of the cabinet, the runners for the drawers are suspended between the back wall of the cabinet and a front spacer piece with hidden mortise and tenon joints. The side runners are glued to the sides of the cabinet as well, while the middle runner is only glued into the mortises. The front spacer is secured to the sides of the cabinet with multiple through tenons that go all the way through the side walls, creating a pinned joint, visible as small squares along the sides of the cabinet at the front edges.

The base assembly is made of four separate bars that are connected at the corners with hidden mitered mortise and tenon joints, forming a skirt. The floor of the base is rabbeted to sit in grooves running along the inside of all four bars, creating a smooth top surface. This surface acts as the floor of the cabinet as well. The top edges of the back and side bars of the skirt connect to the main box with loose tenons, and the slots for the thin rectangular splines that form the joint are visible on both connecting surfaces.

The hardware is mounted into the box using two brass pins that go through the entire width of the wood and are then bent back on the interior of the box. The brackets for the pull tabs on the front doors appear to have an adhesive holding them in place in addition to the pins. At a later point, additional adhesive measures appear to have been added to some of the pins and joints for further support.

II. CONDITION

❖ **Summary:** The primary concerns with the object are structural, as many of the joints have sprung due to extreme RH shifts weakening the adhesive bonds when the object was shipped from Hawaii to Upstate New York during the wintertime. Some of the wood panels have split and warped, some of the brass hardware is missing or bent out of shape, and some of the internal supports have fallen out. There is overall dust and grime on the surfaces of the piece, and areas where the wood finish and inlays are abraded.

- **Structure and Internal Supports**

The back right joint has completely opened, and is warped about ¼ in away from the back panel. The left side has curved away from the main structure about a ½ in at the bottom of the panel, in conjunction with a major horizontal split along the left side. Adhesive is visible on both edges of the split, but the join has failed. The base support is completely detached, both from the box and from itself. The object was received with the base of the chest completely disassembled. The four bars of the skirt are separated from each other and from the floor piece. The loose tenons connecting the base to the main box are broken in half, with the fragments of the splines left behind in both the base pieces and the main box. The drawer runners in the middle and on the right side of the box have completely detached and fallen out. Mortise slots for the missing drawer runners are visible on the back wall and front spacer of the box, with small fragments broken off inside. Lines of built up adhesive are also visible on the right interior side from where the runners were originally glued in. Two of the runners are intact on the left side, but may need reinforcement. The spacer has slightly come out of its joint at the lower left, in conjunction with the major split and warping noted in the left side of the body.

- **Box Exterior**

Both of the front doors are in good condition overall, with minor wear at both top corners. The central panel of the right door has partially split along the connection with stiles of the outer frame at the lower left and upper right corners, creating a skewed appearance. The majority of the inlays appear to be intact and well-adhered, and four of the children's robes contain traces of a heavy metal red pigment in the carving lines, suggesting that the inlays may have been painted at one point in time. The only notable loss in the inlays is from the right foot of the boy in the lower left of the left door. There is also a small horizontal split in the tunic of the woman on the right door, but the crack seems stable.

The top panel of the lid is overall in poor condition, largely due to a major split running completely through the entire width of the upper lid panel, about an inch from the front edge. The front section of the top panel is completely separated from the rest of the panel at this split, and appears to have detached completely from the lid and been re-adhered at some point. The front edge sits slightly proud of the front face of the lid due to misalignment during this repair. The rest of the top panel has started to detach from the side walls of the lid at both sides, and is lifted slightly. The rest of the wood is in good condition, with only slight scratches and dust, and a partial split in the wood at the lower right corner of the front of the lid. Most of the inlays are in good condition, and all are securely in place. The inlay flower in the upper right has a 0.5 cm square of abrasion in its furthest right petal, with some accompanying smaller abrasion near the center of the flower. The branch has a small complete loss in the lower left near the associated flower.

On the left side panel, aside from the large horizontal split affecting the structure, the surface of the wood is in good condition. There is a visible discolored scratch in the wood finish in the lower left, and circular discolorations at the upper left edge. These discolorations on the top of the side panel and lower edge of the lid match the silhouette of a v-shaped hinge, and may be damage from old hardware. The right side panel has similar circular discolorations from the connection points of the hinge, but the discoloration is less intense and less complete. The rest of the wood on the right side is in good condition.

The back panel is in good condition overall with no major damage to the surface finish of the wood.

- **Hardware**

Many of the hinges are bent or damaged. On the left door, the upper hinge is in good condition, while the lower hinge is bent out of shape and components are bent almost fully away from the piece. The pin in this hinge also appears to be bent slightly. On the right door, the pin is completely missing from the lower hinge, and the upper hinge has a modern metal wire acting as the pin. This modern wire has bent loops on both ends and sticks out significantly from the hinge assembly. On the lid, the proper left back hinge is missing a rivet in the lower placket, and the pin holding the hinge together is loose and slightly corroded. The other back hinge seems to be in good working order, though it does not lie perfectly flush and has two extraneous holes in it going into the back panel, perhaps from an earlier attempt to re-align or re-attach the hinges.

On both side panels there are paired circular scratches or indents in the wood on the side panel and directly above it on the side of the lid, suggesting that a hinge or other hardware used to be present. Both side panels have looped brass handles about two thirds up the height of the cabinet. The left side also has two riveted loops, one on the side panel and one on the lid. A brass chain dangles from the lower loop, and would have been attached to the upper loop to limit how wide the lid could open.

The front clasp is in good structural condition, but shows heavy texturing from corrosion. All hardware is coated with an unknown material, and all areas show signs of degradation of the coating and/or corrosion of the underlying metal. The shiny smooth brass is mottled with matte, dark brown areas, and the areas of damage seem consistent with wear.

- **Drawers**

Though a couple of the small drawers do have small checks and distortions in the bottom panels, the drawers are overall in good condition and stable. Three of the four small drawers have a piece of adhesive tape placed over the prongs of the hardware on the interior front wall, perhaps to keep the tabs in place. One small drawer is missing its brass pull-tab and decorative plate, though there is an adhesive tape on the inside of the drawer directly behind the opening, indicating that this hardware may have been present at the time of taping. The tape has become slightly yellow and brittle directly around the metal components. The tab prongs on the fourth drawer are held in place with an unknown adhesive.

III. PREVIOUS TREATMENT

There are several signs of at least one previous treatment campaign. UVA Imaging highlights an adhesive that was used in the structural joints of the box, most visible on the joints that have sprung open. This adhesive could be either a historic animal skin glue or a more modern PVA glue, as both fluoresce light white. The major split on the left side panel of the box also contains a brightly fluorescing adhesive, and is clearly a sign of a restoration attempt. Additionally, an unknown coating was applied only to the lid, and seems to be a later addition. This coating also fluoresces white, which could indicate a similar family of polymers as the other adhesives, or a bleached shellac. Regardless, it is clear that some restoration was done on the box previously for both structural and aesthetic reason.

It is also clear that at some point in the object's history, hinges for the lid were removed from the piece given the silhouetted discoloration of the wood. At some point, the pull tabs for the drawers may have come loose or needed stabilization for travel, prompting the use of adhesive and tape on the interiors of the drawers. No other major signs of treatment are visible, but given that this object came from an antiques dealer, some cleaning and repairs may have happened in preparation for sale.

PATRICIA H. and RICHARD E. GARMAN
ART CONSERVATION DEPARTMENT
BUFFALO STATE • The State University of New York

1300 Elmwood Avenue
Rockwell Hall 230
Buffalo, NY 14222-1095
P: 716-878-5025 F: 716-878-5039
artconservation.buffalostate.edu
artcon@buffalostate.edu

EXAMINATION REPORT—Analysis & Photography/Imaging CNS 126904

PRE-TREATMENT PHOTOGRAPHS

No.	DESCRIPTION	TECHNICAL NOTES	COMMENTS
A1N	Inventory, Normal Illumination	Lighting approximates standard viewing conditions.	Overall shot showing the tops and interiors of the drawers and accessories, and the exterior of the box with the lid and doors closed.
A2N	Inventory, Normal Illumination	Lighting approximates standard viewing conditions.	Overall shot showing the bottoms of the drawers and accessories, and the interior of the box with the lid and doors open. Note the lack of a base – the accessories to the left are the separated components that form the base.
A3N	Front, Normal Illumination	Lighting approximates standard viewing conditions. Camera Filtration: Modified D810 with X-nite CC1	Note the variety and discoloration of the inlays, and the misalignment of the hinges. Traces of red pigment are on some of the figures' robes.
A4N	Left, Normal Illumination	Lighting approximates standard viewing conditions. Camera Filtration: Modified D810 with X-nite CC1	The circular indents in the veneer from the previous hinge are visible. The chain is detached from the upper loop.
A5N	Back, Normal Illumination	Lighting approximates standard viewing conditions. Camera Filtration: Modified D810 with X-nite CC1	Note how much the right back join (on the left in this image) has sprung horizontally from the structure. Some joint failure is also visible in the lower corner of the left back join. The right hinge appears to have been reattached, as evidenced by the empty extra holes for pins.
A6N	Right, Normal Illumination	Lighting approximates standard viewing conditions. Camera Filtration: Modified D810 with X-nite CC1	The damaged pin hinge is particularly visible, as well as the circular indents from the previous hinge that are mirrored on the other side.
A7N	Top, Normal Illumination	Lighting approximates standard viewing conditions. Camera Filtration: Modified D700 with X-nite CC	Note the abrasion in the flower petal in the upper right of the image, as well as slight scratches on the center of the lower left flower. Traces of a red paint are visible in the crevices of the central flower.
A8UVA	Front, longwave ultraviolet (UVA) induced visible fluorescence.	The subject was photographed in a darkened room while irradiated by a long wave ultraviolet lamp (blacklight). The ultraviolet radiation causes some materials in the subject to fluoresce (emit light). Camera Filtration: Modified D810 with X-nite CC1 + Peca 918 + Kodak 2E	The inlays fluoresce in tones of blue, white, and beige, highlighting the mixture of materials present.
A9UVA	Left, longwave ultraviolet (UVA) induced visible fluorescence.	The subject was photographed in a darkened room while irradiated by a long wave ultraviolet lamp (blacklight). The ultraviolet radiation causes some materials in the subject to fluoresce (emit light). Camera Filtration: D810 with X-nite CC1 + Peca 918 + Kodak 2E	The unusual fluorescence along the upper lid may be an adhesive or consolidant from a previous restoration campaign. Additional indentations and discoloration from the old hinge are now visible. The bright fluorescence along the crack and back joint may be a PVA adhesive.
A10UVA	Back, longwave ultraviolet (UVA) induced visible fluorescence.	The subject was photographed in a darkened room while irradiated by a long wave ultraviolet lamp (blacklight). The ultraviolet radiation causes some materials in the subject to fluoresce (emit light). Camera Filtration: D810 with X-nite CC1 + Peca 918 + Kodak 2E	The bright fluorescence along the upper lid and in the back joints are likely an adhesive from a previous restoration campaign.
A11UVA	Right, longwave ultraviolet (UVA) induced visible fluorescence.	The subject was photographed in a darkened room while irradiated by a long wave ultraviolet lamp (blacklight). The ultraviolet radiation causes some materials in the subject to fluoresce (emit light). Camera Filtration: D810 with X-nite CC1 + Peca 918 + Kodak 2E	The bright fluorescence along the upper lid and in the back joints are likely an adhesive from a previous restoration campaign.
A12UVA	Top, longwave ultraviolet (UVA) induced visible fluorescence.	The subject was photographed in a darkened room while irradiated by a long wave ultraviolet lamp (blacklight). The ultraviolet radiation causes some materials in the subject to fluoresce (emit light).	Note the white hazy fluorescence across the entire surface. This may be a coating, and is visible on the sides of the lid in A9UVA, A10UVA, A11UVA, and only partially in A8UVA. Also note the mixture of

		Filtration: D700 with X-nite CC1+Peca 918+Kodak 2E	fluorescence in the inlay materials, particularly the brighter fluorescence of the lower right fruit.
A13RUVA	Front, reflected longwave ultraviolet	The subject was placed in front of a long wave ultraviolet lamp (blacklight). A camera with sensitivity to the invisible ultraviolet radiation was used to record how the ultraviolet was absorbed (area appears dark) or reflected (area appears light) by materials in the subject. This image can aid in differentiation or characterization of materials. Because the ultraviolet penetrates little beyond the surface, the visibility of anomalies in surface can also be enhanced. Camera Filtration: D810 w/ X-nite CC1 + B+W 403	Streaks of an unknown liquid are visible on the lower left door, and the different reflective properties of the inlay materials are highlighted – some absorb significantly more and appear darker.
A14RUVA	Top, reflected longwave ultraviolet	The subject was placed in front of a long wave ultraviolet lamp (blacklight). A camera with sensitivity to the invisible ultraviolet radiation was used to record how the ultraviolet was absorbed (area appears dark) or reflected (area appears light) by materials in the subject. This image can aid in differentiation or characterization of materials. Because the ultraviolet penetrates little beyond the surface, the visibility of anomalies in surface can also be enhanced. Camera Filtration: D700 w/ X-nite CC1 + B+W 403	Note how the inlays here are much darker than the front, and do not reflect UVA strongly. The bright spots on the upper right and lower left flowers highlight areas of abrasion, as these areas scatter and reflect more of the emitted light.
A15IRLUM	Front, infrared luminescence	The subject was illuminated with an infrared free visible light source. The visible light energy is absorbed by some materials in the subject and released as invisible near infrared luminescence. The luminescence is photographed using a special camera filtered to record only infrared radiation. Illumination source and filtration: White Light LED covered with BG38 filter Camera filtration: D810 with Kodak Wratten 88A	The brass hardware does not emit IR and thus appears very dark – however the luminescent properties of the inlays are still visible.
A16IRLUM	Top, infrared luminescence	The subject was illuminated with an infrared free visible light source. The visible light energy is absorbed by some materials in the subject and released as invisible near infrared luminescence. The luminescence is photographed using a special camera filtered to record only infrared radiation. Illumination source and filtration: White Light LED covered with BG38 filter Camera filtration: D700 with X-Nite 715	Note how most of the inalys do not emit IR, particularly the branch. However the lower right fruit and some of the leaves do luminesce slightly.
A17RIR	Front, reflected near infrared photograph	The subject was illuminated with incandescent lamps. A special camera, sensitive to the invisible near infrared radiation emitted by the bulb was used to record how the radiation penetrated the subject, or was absorbed or reflected by the materials in the subject. Infrared radiation may penetrate overlying layers to reveal underlying information or may help to characterize materials or to distinguish different materials that are similar in appearance. Illumination source and filtration: White Light LED covered with BG38 filter Camera filtration: D810 with Kodak Wratten 88A	Surface damage on the metal components are particularly visible, as well as the grain of the wood. Some opalescence is visible from the material in the bottom skirts of the women.
A18RIR	Top, reflected near infrared photograph	The subject was illuminated with incandescent lamps. A special camera, sensitive to the invisible near infrared radiation emitted by the bulb was used to record how the radiation penetrated the subject, or was absorbed or reflected by the materials in the subject. Infrared radiation may penetrate overlying layers to reveal underlying information or may help to characterize materials or to distinguish different materials that are similar in appearance. Illumination source and filtration: White Light LED covered with BG38 filter Camera filtration: D700 with X-Nite 1000	The grain of the wood is particularly visible, including in the inlaid branch design. While there is significant variation in how the inlays reflect IR, it is interesting how strongly the leaf in the upper left does NOT reflect IR, appearing quite dark. The surface textures and abrasions on the inlays are particularly visible.

A19SP	Front, axial specular illumination	The light was positioned adjacent to the camera to create specular reflections on the surface. These reflections provide information about surface characteristics (e.g., matte v glossy) as well as information about surface topography (dents, bulges, cracks, etc.)	Specular illumination higlights the topography of the piece, showing how finely carved these relief inlays are. Some surface sheen irregularities in the veneer's finish are visible as well.
A20SP	Top, axial specular illumination	The light was positioned adjacent to the camera to create specular reflections on the surface. These reflections provide information about surface characteristics (e.g., matte v glossy) as well as information about surface topography (dents, bulges, cracks, etc.) Camera Filtration: D700 with X-Nite CC-1	The sheen of the coating on the lid is visible, as well as the highly reflective, opalescent quality of the upper left fruit. The topography of the inlays is also highlighted.
A21N	Drawer Interiors, Normal Illumination	Lighting approximates standard viewing conditions. Camera Filtration: Modified D700 with X-nite CC	The attachment methods for the brass pull-tabs are visible. On the right, a drawer with the original tab system intact, albeit aided by adhesive underneath the prongs on the interior. On the left, a drawer whose pull-tab had been supported by an unknown adhesive tape, but subsequently had fallen out. The drawers, unlike the main box, seem to have stayed in good structural condition, as the corner and floor joins are still relatively flush and secure.
A22N	Base Attachement Edges, Normal Illumination	Lighting approximates standard viewing conditions. Camera Filtration: Modified D700 with X-nite CC	Note the residues and broken biscuit joints along the top edges of the bottom rails, where the base was attached to the main cabinet.
A23MSI	Front, false color composite image from multispectral imaging (MSI) photographs	A new image is created via Adobe Photoshop. Three selected MSI photographs are inserted into the red, green, blue channels of the new image respectively. These false colors presented in the new image can be used to assist in identifying materials or in distinguishing different materials that are similar in appearance under visible light. *Selected MSI image and color channel placement:* *Red: (MSI at 1000nm)* *Green: (MSI at 700nm)* *Blue: (MSI at 400 nm)* *Original MSI photographes were taken with a monochrome DSLR camera with band passing filters in front of the camera allowing only particular wavelength to be recorded. See A1MSI_400, A1MSI_700, and A1MSI_1000.*	False color highlights the variety of materials present in the inlays, and helps identify like materials. For example, both the bases of the women's skirts are colored blue, indicating they may be the same material.
A24XR	X-radiograph, before treatment	The subject was penetrated by a beam of x-rays and the extent of x-ray penetration was recorded on film (or a digital imaging plate). Areas of the subject that are denser, thicker, and/or composed of materials that contain elements of higher atomic weight absorb more x-rays, diminishing penetration. They thus appear lighter in tone in the radiograph	Extreme distortion of the radiograph was unavoidable due to the size of the object. However the purpose of the radiograph was to observe the connection of the hardware – the small nails connecting hinges are clearly visible. There does not seem to be any metal attaching the inlays.

PATRICIA H. and RICHARD E. GARMAN
ART CONSERVATION DEPARTMENT
BUFFALO STATE • The State University of New York

1300 Elmwood Avenue
Rockwell Hall 230
Buffalo, NY 14222-1095
P: 716-878-5025 F: 716-878-5039
artconservation.buffalostate.edu
artcon@buffalostate.edu

OBJECTS TREATMENT PROPOSAL — CNS 126904

OWNER/AGENT	[redacted]
DATE RECEIVED	May 18, 2012
EXAMINER	Katherine McFarlin
FACULTY SUPERVISOR(S)	Emily Hamilton
DATE OF REPORT	March 9, 2022
ARTIST/MAKER (Owner Attribution)	Unknown
TITLE (“”) or DESCRIPTION	Chinese Jewel Case
DATE	Early 20th Century

1. Create written and photographic documentation of the object before, during, and after treatment.
2. Perform analysis on the inlays to identify rough composition, as the presence of certain proteinaceous materials will limit aqueous and solvent treatment options.
3. Remove surface dust and debris from all surfaces with a soft brush and HEPA vaccum.
4. Dismantle the hinges and separate the lid and doors, to isolate the panels containing sensitive inlays and allow greater access to the interior.
5. Clean adhesive from the horizontal break on the left panel, and from back joints.
6. Re-align and re-join the horizontal split and back joints of the box, using mechanical pressure and adhesive.
7. Once the separated componenets are treated according to the steps outlined below; re-attach hardware and re-assemble the box.

<u>Lid</u>

8. Sample and identify the coating on the lid.
9. Sample and identify adhesive from break edges of the large split, and perform solubility testing.
10. Reduce the adhesive from the inside using mechanical methods and solvent as needed, and separate the broken front edge.
11. Join the top panel of the lid with the sides to stabilize the splits along the outer edges.
12. Clean remaining solvent from break edges of the lid fragment, and re-adhere in proper alignment.
13. Fill and tone the loss in the branch inlay.
14. Create a partial fill to cover the abrasion in the lotus inlay.

<u>Doors</u>

15. Unbend interior pins and remove hinge and clasp hardware, and clean any residual corrosion products from the surface of the piece.
16. On the left door, perform solubility testing on the unknown residue at the lower left, and reduce as much as possible without damaging the wood finish.
17. On the right door, consolidate and fill the splits around the central panel.
18. Clean any stubborn residues near the inlays with a cotton swab lightly dampened with pH neutral distilled water.

Drawers and Supports

19. Remove the tape from the interiors of the drawers, and perform solubility testing on the remaining adhesive.
20. Mechanically reduce the adhesive, and reduce the remaining residue with solvents as needed.
21. Assess and stabilize the pull-tab hardware.
22. Clean hardware and create a template from one of the tabs.
23. Mechanically remove and reduce debris from the mortises on the interior of the box.
24. Check the fit on the drawer runners, and reconstruct any damage tenons to ensure a snug fit.

Hardware

25. Sample and analyze the coating from the hinges, and perform solubility testing.
26. Reduce the coating on the external hardware and clean the metal.
27. Reshape and realign the hinge brackets.
28. Custom cut and fabricate new pins for all hinges. Apply an anti-corrosion coating.
29. Fabricate a new pull-tab for interior drawer based on the template and existing tabs.

Base

30. Mechanically remove and reduce debris from interior grooves, saving larger pieces for reconstruction.
31. Reattach broken fragments of the rabbet to the main floor.
32. Reconstruct broken areas of the rabbets and body of the main floor.
33. Create L-shaped wooden bracket for the underside of the base, to support the reconstructed area.
34. Remove the broken loose tenons from the top edges of the base and bottom edges of the cabinet; use fragments to create templates for new loose tenon joints.
35. Clean any residues from joints of the skirt and the rabbets of the floor.
36. Re-assemble entire base package.
37. Secure bracket support to underside of base assembly.

FACTORS INFLUENCING TREATMENT

The client intends to actively use the object as a jewelry case; thus, the structural stability of the box and the durability of the repairs are paramount. A fairly invasive approach may be needed in order to adequately support the numerous structural issues caused by the distorted wood and damaged hardware.

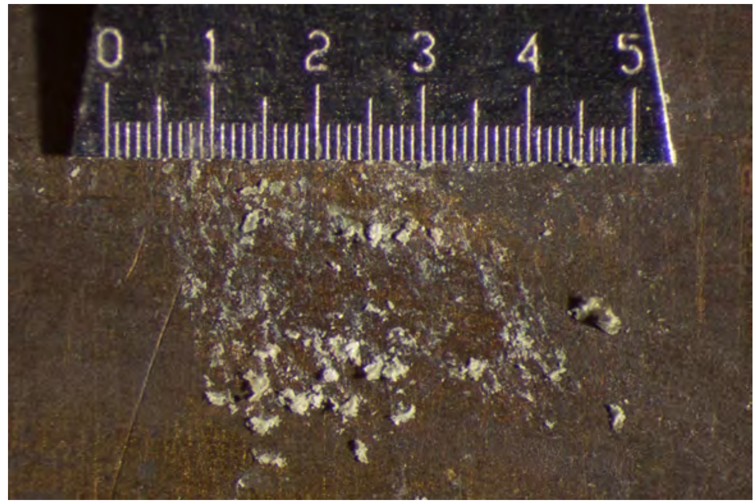
Aqueous and solvent steps may be limited both by the nature of the wood and the presence of proteinaceous inlays such as ivory and shell. Introduction of water and solvents should be kept to a minimum to reduce the risks of further dimensional changes and potential staining, as such materials are porous and sensitive to moisture. Due to the sensitivity of the materials, some dust and dirt may be left in situ in order to reduce overall risk to the material. Likewise, existing coatings may remain in place if they cannot be adequately reduced without damaging the object.

Many of the joints of the piece are damaged, and may need additional support or recosntrution in order to adequately align and bear weight. If these measures are insufficient, new supports may need to be fabricated. The left panel may not be able to re-align with mechanical action alone, and humidfication may be necessary in order to straighten the warping in the lower half of the panel. If humidification is needed, all remaining hardware will need to be removed prior to humdification and the humidficiation chamber should be localized if possible, either through disassembly to isolate the left panel, or via physical barriers with the panel left in-situ in the cabinet construction.

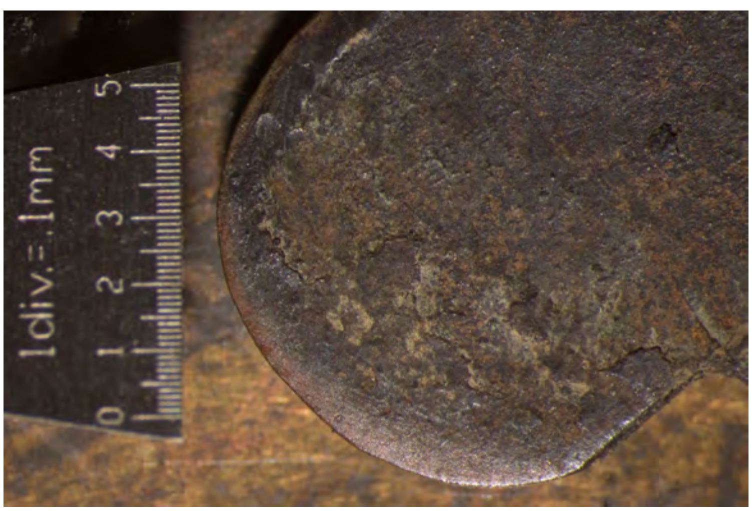
ANTICIPATED RESULTS OF TREATMENT

The box will be stable enough to be functional for active use in the client's home. All joints will be fully closed and secure, the base reassembled and sturdy enough to support weight, and splits in the wood stabilized. The brass hardware will be realigned, and new hardware fabricated where needed.

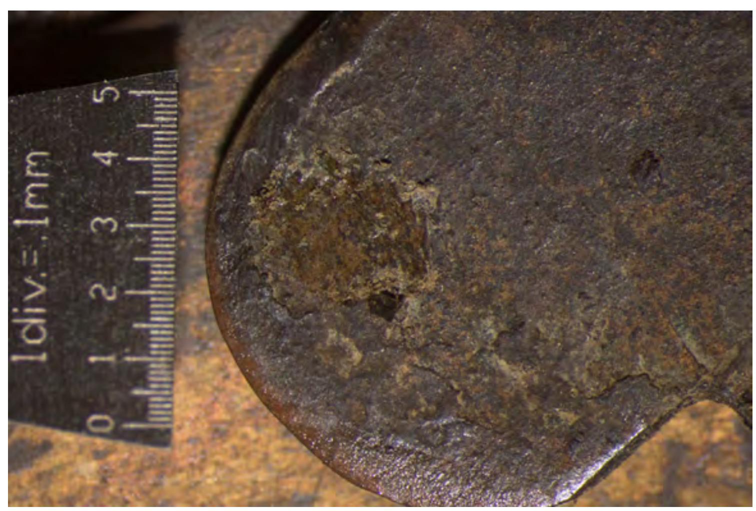
126904_B4DET



126904_B7DET



126904_B5DET



126904_B6DET

126904_B1N

126904_B3N

126904_B2N

126904_D1N

126904_D3N

126904_D5N

126904_D4N

126904_D6N

126904_D9UVA

126904_D11UVA

126904_D10UVA

126904_D12UVA

126904_D7N

126904_D13UVA

126904_D8N

126904_D2N

PATRICIA H. *and* RICHARD E. GARMAN
ART CONSERVATION DEPARTMENT
BUFFALO STATE • The State University of New York

1300 Elmwood Avenue
Rockwell Hall 230
Buffalo, NY 14222-1095
P: 716-878-5025 F: 716-878-5039
artconservation.buffalostate.edu
artcon@buffalostate.edu

OBJECTS TREATMENT REPORT — CNS 126904

OWNER/AGENT	[redacted]
DATE RECEIVED	May 18, 2012
EXAMINER	Katherine McFarlin
FACULTY SUPERVISOR(S)	Emily Hamilton
DATE OF REPORT	July 29, 2022

ARTIST/MAKER (Owner Attribution)	Unknown
TITLE (“”) or DESCRIPTION	Inlaid Chinese Box, “Antique Chinese Jewel Case”
DATE	Early 20th Century
DIMENSIONS (H x W x D)	11 ¾ x 12 ½ x 9 ¼ in (29.8 x 31.8 x 23.5 cm)

I. TREATMENT PERFORMED

1) Recorded the condition of the piece before, during, and after treatment using digital images and written documentation.
2) Removed surface dust from all surfaces with soft brushes and a HEPA vacuum. Where visible debris remained, another pass was made with a cosmetic sponge[i] to loosen and lift areas of stubborn grime.
3) Analyzed the inlays, coatings, metal components, and wood in order to characterize the materials present. Please refer to Analysis & Imaging for techniques and results.
4) To protect the delicate inlays and reduce excess movement and vibration during later stages of treatment, the hinges of the piece were disassembled and the doors and lid removed.
   a) Removed the chain on the left side by gently opening the connecting links with needle nose pliers.
   b) Cut the steel wire serving as a pin in the upper hinge of the right door with wire cutters and removed it from the hinge. No other connection remained, and the hinge separated easily to remove the right door.
   c) Pushed the pin on the lower hinge out from the bottom with a probe, but the pin of the upper pin had corroded and fused with the middle knuckle and could not be similarly removed. The interior prongs of the hinge plate were unbent and slipped out to separate the entire hinge assembly from the door instead.
   d) On the lid, pushed the left hinge pin out with a probe, but the right hinge pin was corroded to the middle knuckle and could not be moved. To isolate the lid, the outer knuckles of the right hinge were unbent with pliers until the pin could drop out.
5) Cleaned the components without inlays with a microfiber cloth that was lightly dampened with deionized water and then wrung out, to minimize the amount of moisture and dwell time.
6) Spot-cleaned the lid and doors only in areas of visible accretions using small cotton swabs lightly dampened with deionized water that had been buffered to a neutral 7 pH with sodium hydroxide. To reduce dwell time further, blotted the area with a cosmetic sponge immediately after the swab was removed.
7) Reduced historic proteinaceous glue residues on join surfaces by swelling the residue with a cotton swab moistened with deionized water, and scraping the excess with a bamboo skewer or metal spatula. Thin layers were reduced further with a crepe eraser in areas where a tight join was needed, but complete removal was not necessary and thus not pursued.

8) Solubilized and removed the degraded coating on the brass hardware with acetone[ii], working with cotton swabs and bamboo skewers under a stereomicroscope. The bare metal was then cleaned with ethanol[iii], and the hardware was not re-coated.

9) Reduced the buildup of paraffin wax on the left door in thin shavings with a scalpel.

10) Both fiber-reinforced packing tape and pressure-sensitive tape were found on the interior fronts of the drawers, holding the pull-tab prongs in position.
   a) Mechanically removed the carriers by pulling from one corner at a low angle, aided by a metal spatula.
   b) Reduced the bulk of the adhesive residue with a rubber crepe eraser, and reduced the remaining residue with ethanol and cotton swabs.

11) New hardware was fabricated to replace the missing pins and pull-tab component
   a) 14 gauge brass wire was cut into 5-6" pieces, beaded at one end with a jeweler's torch, hammered and sanded into a flat rivet, and the shaft rolled straight between two steel blocks. The final pins were then custom cut for their associated hinge.
   b) Patterns were made from the existing drawer tabs, and a new tab and backing plate were cut out from 26 gauge brass sheet with a jeweler's coping saw.
   c) Based on the existing drawer tabs, patterned and cut a new tab and backing plate from 26 gauge brass sheet with a jeweler's coping saw. For the connection, drilled center holes into both pieces using a rotary tool fitted with a #52 bit, and expanded the hole with a small round file. Crimped and shaped a 2mm strip of the brass sheet for the connecting looped prong.
   d) Filed and sanded the edges of all new components, and applied a patina[iv] to match the existing hardware. Inscribed "KM '22" on the back of the pull-tab to indicate that it is a new component dated from 2022.
   e) Assembled the completed pull-tab, inserted the prongs into the hole in the incomplete drawer, and bent the prongs back against the interior face of the drawer front to secure the tab.

12) On the lid, re-attached the front lip fragment to the upper panel, and then secured the upper panel to the sides and front of the lid.
   a) Since a noticeable shelf could be felt on the front edge of the lip, initially attempted to remove and realign the front fragment by wicking pH buffered deionized water into the front seam to soften the older proteinaceous glue, and lifting and separating the upper panel from the front panel with a spatula. However, some damage began to occur as progress moved towards the center, and the process was halted.
   b) The front outer edges of the fragment were aligned with the front face of the lid and adhered to the associated rabbet shelf with liquid fish glue[v]. Applied glue to the break edge between the fragment and the upper panel, and clamped the lid to put pressure on both joins. Rare-earth magnets wrapped in tissue were used across the break edge to ensure both sides remained in plane while under pressure.
   c) The lid was left clamped for 24 hours, a second round of adhesive applied where the fragment was still lifting, and clamped again for 24 hours.
   d) The side edges of the upper panel were then glued to the sides of the lid, and clamped for 24 hours.
   e) Excess fish glue was reduced with lightly damp cotton swaps and dry cosmetic sponges.
   f) Losses along the joins were filled with fish glue bulked with cellulose powder and toned with dry pigments[vi], to reduce the visual and physical disruption along the edges of the lid. Fills were in-painted with Golden acrylic paints[vii] to imitate the surrounding wood grain.
   g) Applied a thin layer of clear, satin-finish Butcher's wax[viii] with a soft cloth to the fills and along the joins, and buffed the areas until a cohesive sheen was achieved with the surrounding areas.

13) Removed the broken tenons from the tops of the skirt rails and the bottom of the cabinet walls, and fabricated new tenons based on the remaining fragments.
   a) The tenons had been glued into the mortises of the cabinet walls, and removing these fragments was critical for secure re-attachment of the base assembly. The tight connection meant that aqueous swelling could not be used without risking the wood, so the tenon fragments were drilled out with a hand-drill.
   b) Documented the historic tenons, and removed any loose large fragments mechanically. The glued fragments were drilled in three places with a size #58 bit to a pre-determined depth based on the cleared,

un-glued mortises. Sawdust was vacuumed away as needed, and the drilled fragments loosened and removed with tweezers.

c) Custom cut and sanded new tenons for each mortise from pre-fabricated softwood shims. The new tenons were consolidated with 10% Butvar B-98N[ix] in 1:1 acetone:ethanol for added flexibility and strength.

14) Aligned, assembled, and glued all components of the cabinet with liquid fish glue.
   a) Re-assembled the floorboard and skirt rails. Glued the floorboard into the front rail in accordance with the residues found on those components.
   b) Aligned the floor of the upper compartment, glued the broken dovetail back into position, and dry-fit the back dovetail joints together. With the joints closed, the lower left tenon of the drawer spacer could also be pushed back into place. The interior faces of the back joints were moistened with a damp cotton swab to activate the existing hide glue, and adhered together with fish glue. The joints were clamped and allowed to dry for three days.
   c) Glued the interior runners back into position based on the associated adhesive residue and build-up, following a similar process of re-wetting and re-activating the existing hide glue, aided by a fresh layer of fish glue.
   d) With the cabinet upside down, the new tenons were glued into their respective mortises, and the base assembly placed face-down on top, aligned with the tenons. Applied glue to the end-grain of the cabinet walls, and gently taped the base assembly down with a mallet until it was snugly connected to the cabinet.
   e) With the base aligned on the tenons, the entire box was lifted and placed upright. The corners of the base were wet, glued, squared and clamped for two days.
   f) Small gaps remained along the join edges due to irregularities and distortions in the wood. These gaps were filled with the bulked and toned fish glue, to ensure good strong connections throughout and reduce the aesthetic disruption of light streaming between the walls and various components.

15) Supports were made out of 2-ply Tyvek[x] laminated with wheat starch paste and toned with acrylic paints, and adhered to potential weak spots inside the cabinet. These Tyvek bridges can provide some resistance against separation and provide an audible clue of when the joins may start to fail if put under heavy weight.
   a) Since the large horizontal spit on the left cabinet panel could not be rejoined mechanically and was too large to safely fill with an adhesive system, the entire split was lined with a Tyvek strip adhered with wheat starch paste.
   b) Added three Tyvek strips along the interior join between the cabinet and base to support the new tenons.
   c) Cut strips of archival 4-ply mat board and glued them into a block, then wrapped the block in the Tyvek to form a support for the loose-hanging back edge of the base floorboard. Wings extending from the support block were glued to the underside of the floor with dilute fish glue, and dried under weight.

16) Re-attached the lid and doors, and pinned the hinges back into position. Minor curvature adjustments were made to the new pins to ensure they fit securely in the damaged hinges and did not slip out of place
   a) During removal at the beginning of treatment, one prong of the hinge bracket on the left door was brittle and snapped off at the point of stress. Since the prong could not be re-secured like the others, it was adhered into its slot with a 50:50 mixture of B48N[xi] and B72[xii] in acetone.

17) Re-attached the chain to the loops on the lid and side panel, and adjusted the range of motion by looping the chain on itself at the side, shortening the usable length of the chain.

18) Created custom-fit, hand-sewn, removable liners for the upper compartment and drawers. Inserts are fabric-covered boards made from archival 4-ply mat board, padded with 100% cotton batting[xiii], and covered with red silk shantung[xiv].

MATERIALS

---

[i] Polyurethane cosmetic sponges; non-latex soft polyurethane cosmetic sponges; CVS Pharmacy, Inc. Woonsocket, RI 02895.

[ii] Acetone, Fisher Scientific Company, Pittsburgh, PA 15219.

[iii]Ethanol, Fisher Scientific Company, Pittsburgh, PA 15219.

[iv] Deep Brown Traditional Patina, Sculpt Nouveau, Escondido, CA 92029.

[v] High Tack Fish Glue, Lee Valley Tools, Niagara Falls, ON L2E 2G5, Canada

[vi] Dry Pigments; Conservation Materials Ltd.; 1165 Marietta Way, PO Box 2884 Sparks, Nevada 89413

[vii] Golden Fluid Acrylics, (100% acrylic emulsion artist paints), Golden Artist Colors, Inc., 188 Bell Rd, New Berlin, NY 13411.

[viii]Butcher's Bowling Alley Wax; Butcher Polish Co.; Marlborough, MA 01752.

[ix] Butvar B-98N, thermoplastic polyvinyl butyral resin, Talas, 20 West 20th Street, 5th Floor, New York, NY 10011 Telephone: 212-219-0770

[x] Tyvek® Styles 1059B and 1073B: Du Pont; 71 Southgate Boulevard, New Castle, DE 19720; 1-800-448-9835.

[xi] A copolymer of methyl methacrylate; Conservator's Emporium; 100 Standing Rock Cir., Reno, NV 89511; (775) 852-0404 · FAX (775) 852-3737.

[xii] A copolymer of ethyl methacrylate methylacrylate; Conservator's Emporium; 100 Standing Rock Cir., Reno, NV 89511; (775) 852-0404 · FAX (775) 852-3737.

[xiii] 100% Natural Cotton Batting, Pellon, 4801 Ulmerton Road, Clearwater, FL 33762 USA: 800 – 223-5275

[xiv] Silk Shantung, High Fashion Fabrics, 3101 Louisiana St, Houston, TX 77006: (713) 528-7299

PATRICIA H. and RICHARD E. GARMAN
ART CONSERVATION DEPARTMENT
BUFFALO STATE • The State University of New York

1300 Elmwood Avenue
Rockwell Hall 230
Buffalo, NY 14222-1095
P: 716-878-5025 F: 716-878-5039
artconservation.buffalostate.edu
artcon@buffalostate.edu

TREATMENT PHOTOGRAPHS

No.	DESCRIPTION	TECHNICAL NOTES	COMMENTS
B1N	Overall, Normal Illumination, During Treatment	Lighting approximates standard viewing conditions.	Note the added height and width with the base added. Clasp closes neatly over the hinge.
B2N	Overall, Normal Illumination, During Treatment	Lighting approximates standard viewing conditions.	Note the opening capacity and range of the secured lid and doors. The drawers sit neatly in place, and are paired according to color.
B3N	Overall, Normal Illumination, During Treatment	Lighting approximates standard viewing conditions.	The overall effect of the box is now cohesive with the base installed and components aligned. Aesthetic fills on the lid edges are in progress.
B4DET	Detail, backside of pull tab from the front right door, During Treatment	A detail of about 13 x 18.5 mm area was captured via a stereomicroscope.	Note the thick, flaking layers of corrosion near the opening, and the exposed core metal beneath.
B5DET	Detail, lower left corner of the front right pull tab, During Treatment	A detail of about 8.6 x 12.9 mm area was captured via a stereomicroscope.	The coating appears as a pale green haze over the metal, accumulating in the crevices along the flaking edges of the corrosion layer.
B6DET	Detail, lower left corner of the front right pull tab, During Treatment	A detail of about 8.6 x 12.9 mm area was captured via a stereomicroscope.	Coating partially removed, revealing the true color of the base metal, and the green flakes of coating.
B7DET	Detail, upper right hinge plate, During Treatment	A detail of about 5.3 x 7.8 mm area was captured via a stereomicroscope.	Removal of the coating on a hinge plate, visible as greenish-white chunks removed from the surface.

AFTER-TREATMENT PHOTOGRAPHS

No.	DESCRIPTION	TECHNICAL NOTES	COMMENTS
D1N	Overall, Normal Illumination, After Treatment	Lighting approximates standard viewing conditions. Camera Filtration: Modified D810 with X-nite CC1	The red silk ties the aesthetic of the box together, creating a cohesive and functional appearance.
D2N	Cabinet Interior, Normal Illumination, After Treatment	Lighting approximates standard viewing conditions. Camera Filtration: Modified D810 with X-nite CC1	Note the positions of the drawers, and the fabricated tab on the lower right.
D3N	Front, Normal Illumination, After Treatment	Lighting approximates standard viewing conditions. Camera Filtration: Modified D810 with X-nite CC1	Discoloration remains on the left door from the paraffin wax, but with the wax removed the overall sheen is even. The inlays and metal components are clean and appear brighter. Note the new pins on both right hinges and in the lower left hinge.
D4N	Left, Normal Illumination, After Treatment	Lighting approximates standard viewing conditions. Camera Filtration: Modified D810 with X-nite CC1	Note that while the split remains, it is less distracting due to the Tyvek bridge blocking light and filling in the space with a similar color tone. The brass chain is reattached to both loops.
D5N	Back, Normal Illumination, After Treatment	Lighting approximates standard viewing conditions. Camera Filtration: Modified D810 with X-nite CC1	Note the alignment and tightness of the re-glued left back join. Note the new pins in both hinges.
D6N	Right, Normal Illumination, After Treatment	Lighting approximates standard viewing conditions. Camera Filtration: Modified D810 with X-nite CC1	Now that the cabinet walls have been resecured, note the slight gap between the lid and the cabinet. The misalignment and damage to the hinges created a false appearance of sitting flush.
D7N	Top, Normal Illumination, After Treatment	Lighting approximates standard viewing conditions. Camera Filtration: Modified D810 with X-nite CC1	Note that the split at the front of the lid (top of the image) had been repaired and reintegrated. Also note the aesthetic fills in the top corners, which are differentiable by sheen in raking light.

D8N	Bottom, Normal Illumination, After Treatment	Lighting approximates standard viewing conditions. Camera Filtration: Modified D810 with X-nite CC1	The gap at the back of the floor is visible, as well as the Tyvek support created to support the loose edge. Otherwise the base assembly is square and flush.
D9UVA	Front, longwave ultraviolet (UVA) induced visible fluorescence, After Treatment	The subject was photographed in a darkened room while irradiated by a long wave ultraviolet lamp (blacklight). The ultraviolet radiation causes some materials in the subject to fluoresce (emit light). Camera Filtration: D810 with X-nite CC1 + Peca 918 + Kodak 2E	Note the reduction of the coating on the metal components.
D10UVA	Left, longwave ultraviolet (UVA) induced visible fluorescence, After Treatment	The subject was photographed in a darkened room while irradiated by a long wave ultraviolet lamp (blacklight). The ultraviolet radiation causes some materials in the subject to fluoresce (emit light). Camera Filtration: D810 with X-nite CC1 + Peca 918 + Kodak 2E	Note the reduction in excess adhesive from the mouth of the split, and the evidence from previous gluing attempts on the base assembly.
D11UVA	Back, longwave ultraviolet (UVA) induced visible fluorescence, After Treatment	The subject was photographed in a darkened room while irradiated by a long wave ultraviolet lamp (blacklight). The ultraviolet radiation causes some materials in the subject to fluoresce (emit light). Camera Filtration: D810 with X-nite CC1 + Peca 918 + Kodak 2E	Note the slight traces of fish glue visible in the gaps between the dovetails, and the repaired dovetail with fill in the lower left.
D12UVA	Right, longwave ultraviolet (UVA) induced visible fluorescence, After Treatment	The subject was photographed in a darkened room while irradiated by a long wave ultraviolet lamp (blacklight). The ultraviolet radiation causes some materials in the subject to fluoresce (emit light). Camera Filtration: D810 with X-nite CC1 + Peca 918 + Kodak 2E	Note the acrylic aesthetic fills in the upper edge of the lid, which do not fluoresce and appear dark.
D13UVA	Lid, longwave ultraviolet (UVA) induced visible fluorescence, After Treatment	The subject was photographed in a darkened room while irradiated by a long wave ultraviolet lamp (blacklight). The ultraviolet radiation causes some materials in the subject to fluoresce (emit light). Camera Filtration: D810 with X-nite CC1 + Peca 918 + Kodak 2E	Note the acrylic aesthetic fills along the split and at the corners, which do not fluoresce and appear dark. However the paste wax coating applied to integrate the fills does fluoresce slightly, giving a blueish tint. This image was taken with a different setup than the before treatment photo, and appears brighter due to the settings.

MATERIALS ANALYSIS

Physical Samples Removed

Type	Number of Samples
Coating and adhesive samples, miniscule flakes removed with a Tungsten needle	12
Metal corrosion sample, miniscule flake removed with a Tungsten needle	1
Wood sample, 3x5mm cross-section cut with scalpel	2

ANALYTICAL RESULTS

Adhesives and Hardware

Material	Sample Location	Visible Color	UVA-Fl.	MT-FTIR	XRF
Lid Coating	back left corner	milky	pale blue	alkyd resin spray coating	-
Tab Corrosion	left door, endgrain next to tab	powdery white, green	white	silica content, potentially copper sulfates	Strong silica peak, with Cu traces, consistent with brass corrosion
Lid Adhesive	interior upper right edge	yellow-brown	green	proteinaceous glue	-
Split Adhesive	interior upper edge of split, left panel	yellow-brown	green	proteinaceous glue	-
Runner Adhesive	interior lower right line	yellow-brown	green	proteinaceous glue	-
Hinge Adhesive	interior right, upper pin	glossy yellow-brown	bright green	epoxy resin	-
Joint Adhesive	back right, 4th notch	yellow-brown	green	proteinaceous glue	-
Cabinet Coating	lower right corner, & exterior edge above joint	none	pale blue-white	natural wax, likely beeswax	-
Door Residue	left door panel, below figures	translucent, milky	none	petroleum-based wax	-
Hinge Corrosion	lower left edge of bubbling on front clasp	matte brown, textured	pale blue	methyl/ethyl acrylate coating	-
Brass Hardware	Upper hemi circle of main latch (no sample removed)	metallic yellow with areas of dark brown patina and corrosion	none	-	Notable Zn, Cu, Pb, & Ni peas - 60/40 brass alloy

Wood Identification

Sample Location	Transverse	Tangential	Radial	Identification
Interior right of back wall, lower runner mortise	diffuse, porous, banded aliform parenchyma	uniform biseriate transverse rays, 5-8 units	ray and axial parenchyma with vesured pits, crystals	Tropical hardwood, likely *Dalbergia* (rosewood)
Right, back edge of base floor	same as above	same as above	same as above	same as above

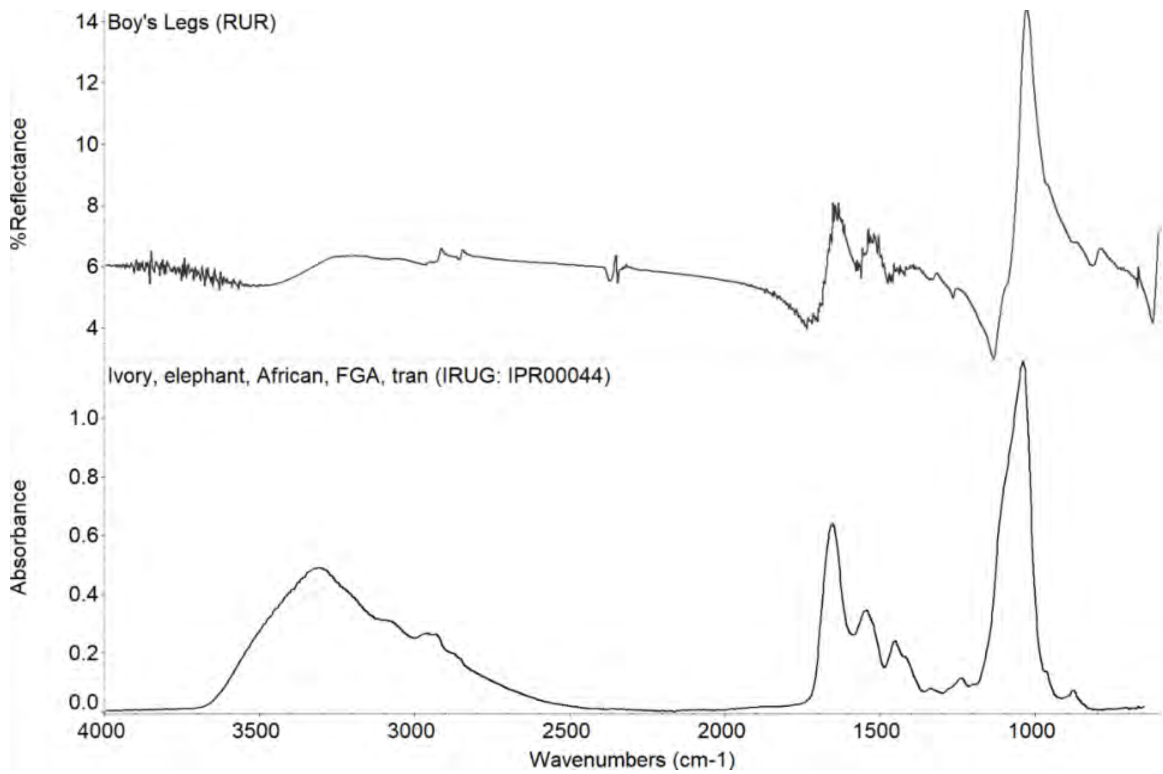
Inlay Materials

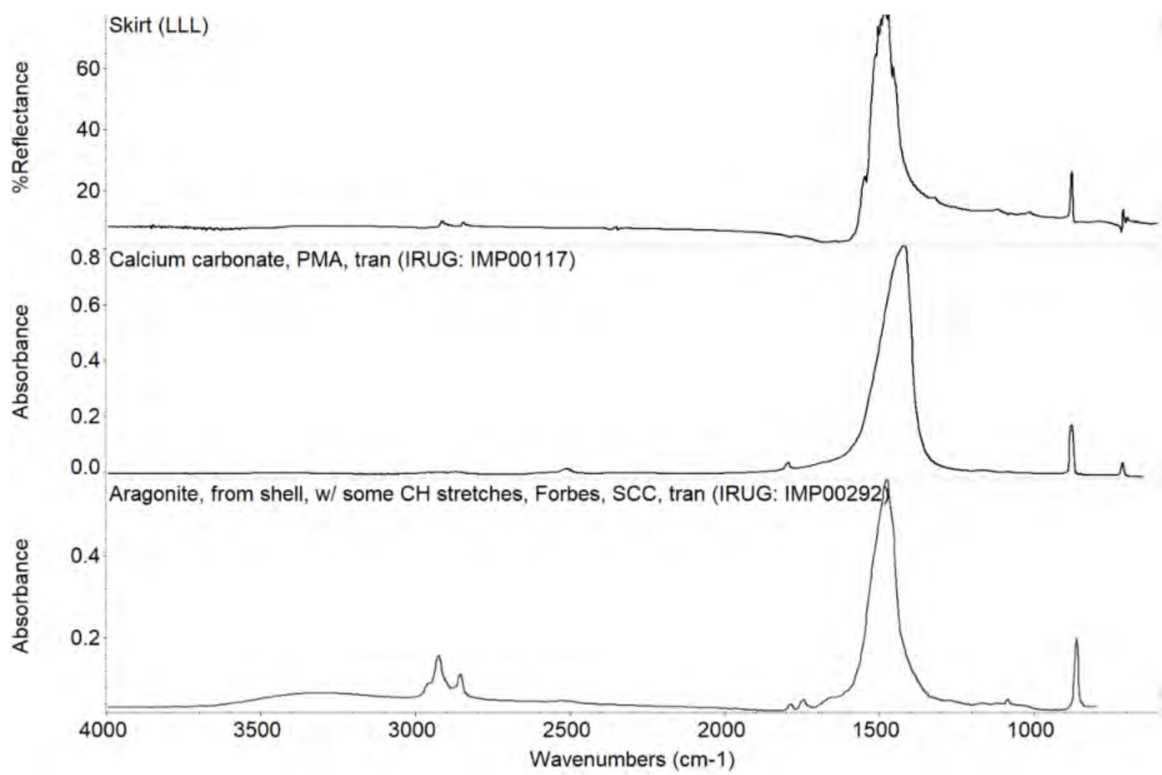
Location	Visible Color	UVA-Fl.	Reflectance-FTIR	XRF
RLR Lady, Body	brown	cream	siliceous, inorganic	-
RLR Lady, Skirt	white, pearlescent	blue	shell	-
RLR Boy	brown	cream	siliceous, inorganic	-
RLL Boy, Robe	blue-white, pearlescent	blue	shell	-
RLL Boy, Head	brown	cream	siliceous, inorganic	-
LLR Boy	light pinkish-brown	white	siliceous, inorganic	siliceous mineral, see below
LLL Boy	brown	cream	siliceous, inorganic	siliceous mineral, see below, negligibly higher iron
LLL Lady, Skirt	white, pearlescent	blue	shell	-
LLL Lady, Tunic	light pinkish-brown	white	siliceous, inorganic	-
LLL Lady, Head	brown	cream	siliceous, inorganic	-
LUL Boy	light pinkish-brown	white	siliceous, inorganic	-
LUR Boy, Tunic	green-white, pearlescent	blue	shell	-
LUR Boy, Head	brown	cream	siliceous, inorganic	-
RUL Boy	brown	cream	siliceous, inorganic	-
RUR Boy	dark brown	grey	siliceous, inorganic	siliceous mineral, traces of Mg, Cr, Fe, & Zn
RUR Boy, Pants	yellow beige	bright white	ivory	-
R Lion, Body	streaky beige	mottled grey	inconclusive, protein	iron-rich silicate, traces of Al & K
R Lion, Tail	white, pearlescent	blue	shell	-
L Lion, Body	streaky beige	mottled grey	inconclusive, protein	iron-rich silicate, slightly lower levels of Fe & K than above
L Lion, Tail	white, pearlescent	blue	shell	-
TR Spotted Pomegranate	streaky cream	white	inconclusive	-
TL Pomegranate	yellow-white, pearlescent	light blue	shell	-
T Striated Leaves	banded yellow	cream	inconclusive	-
T Light Leaves	beige	light blue	inconclusive	-
TR Half-Flower	green beige	dark beige	inconclusive, protein	-
T Center Flower	translucent green	dark beige	inconclusive	-
T Center Leaf	yellow	white	inconclusive	-
TL Dark Leaf	dark brown	dark	inconclusive	-
Red Pigment	deep, rich red	dark red	-	vermillion or cinnabar

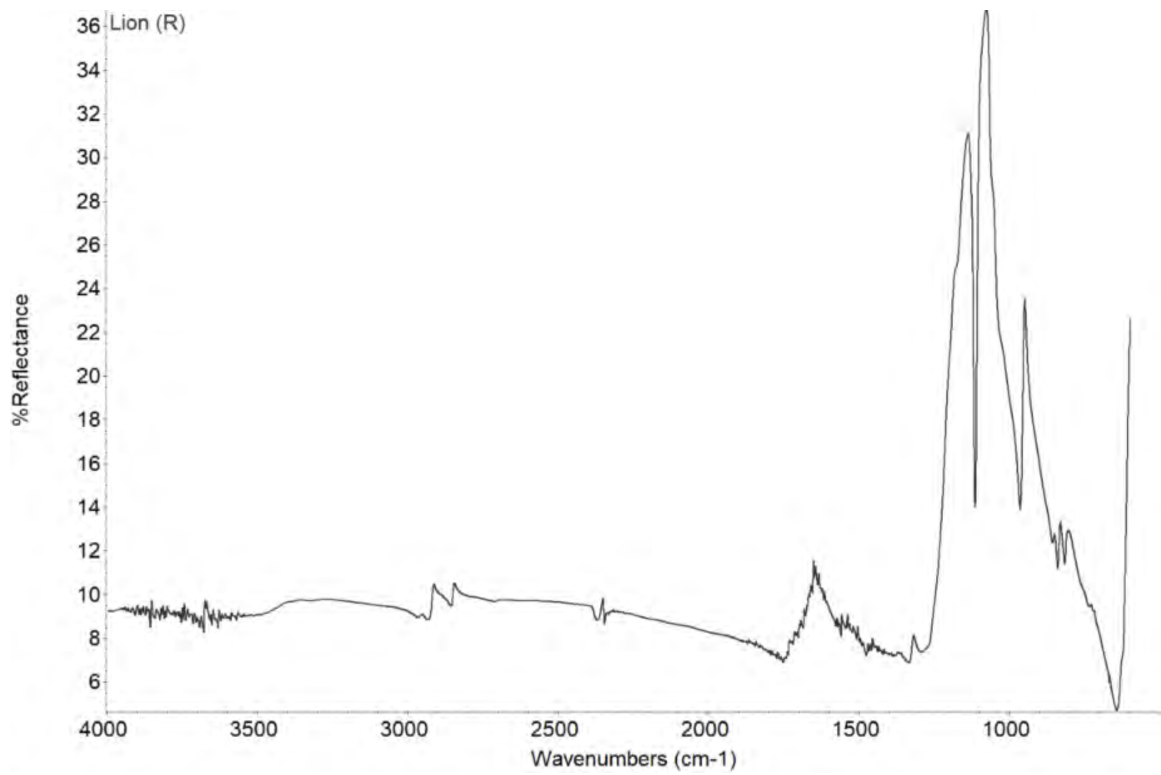
Note: Locations are indicated using "door, register, side" notation:
R/L/T = Right/Left/Top, U/L = Upper/Lower, R/L = Right/Left

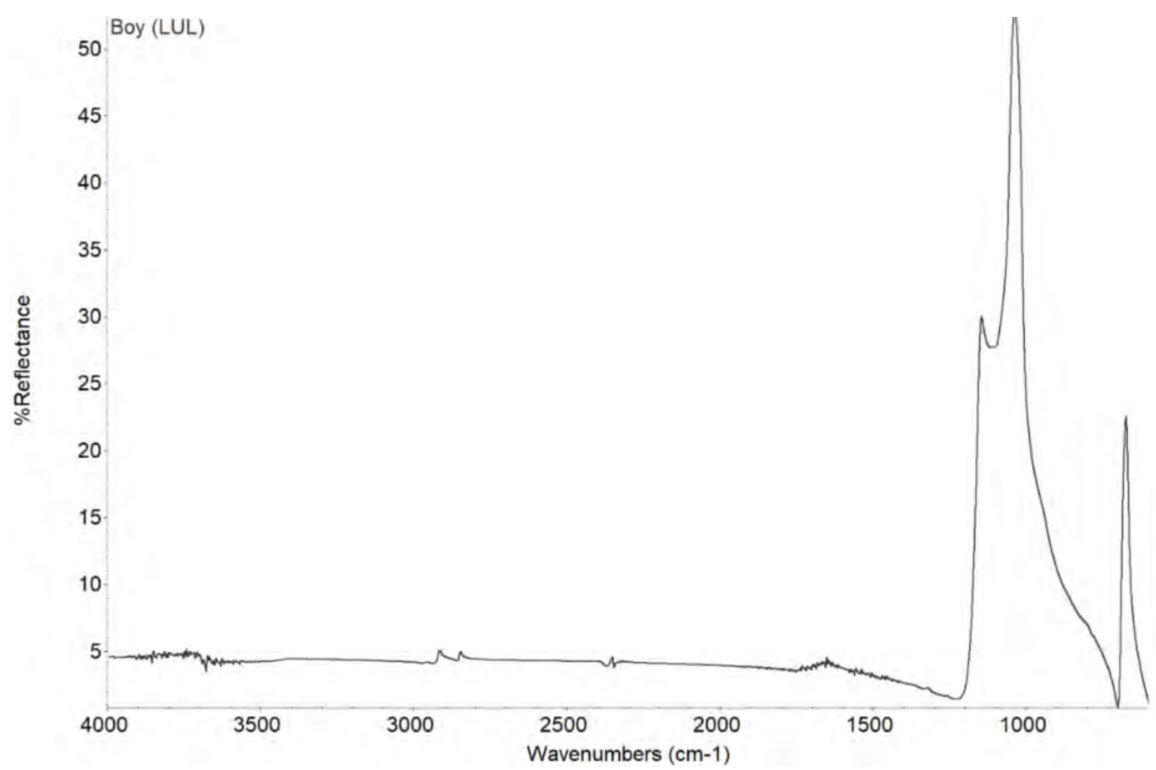
i.e.: "LLL" = left door, lower register, left side,
"RUR" = right door, upper register, right side,
"TR" = Top, right side

Portable Reflectance FTIR (compared to transmission spectra, at bottom of groupings)

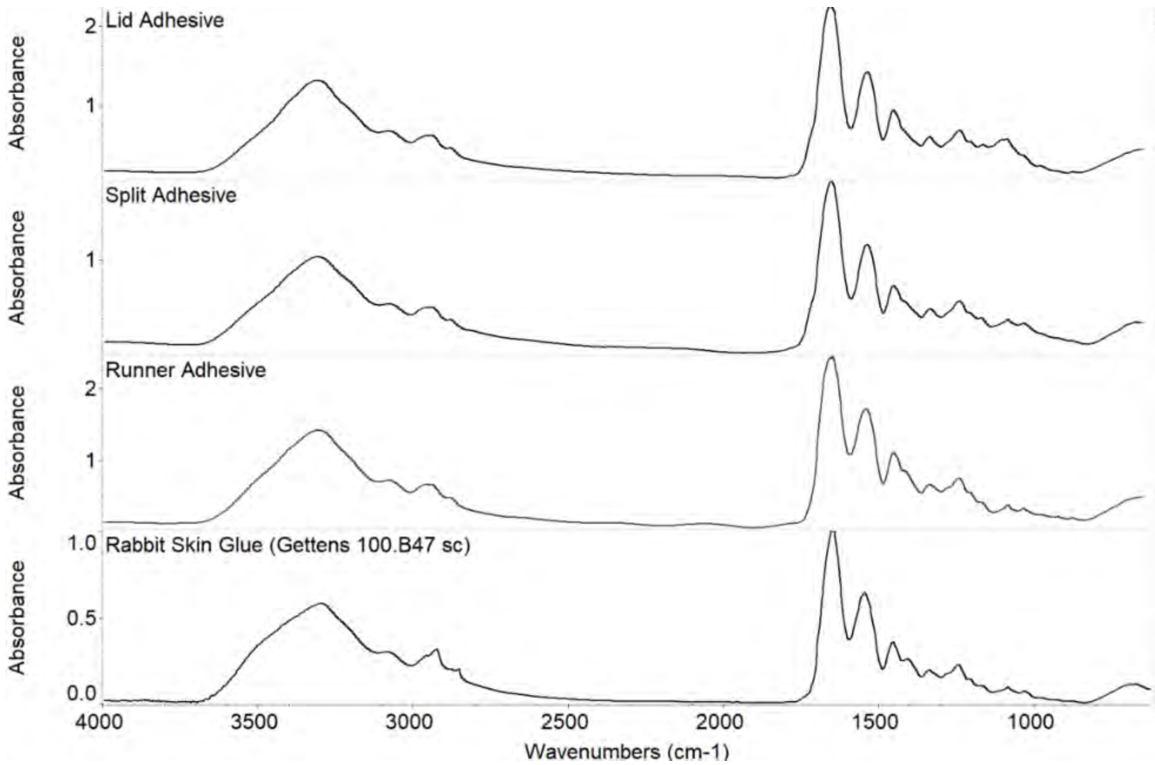


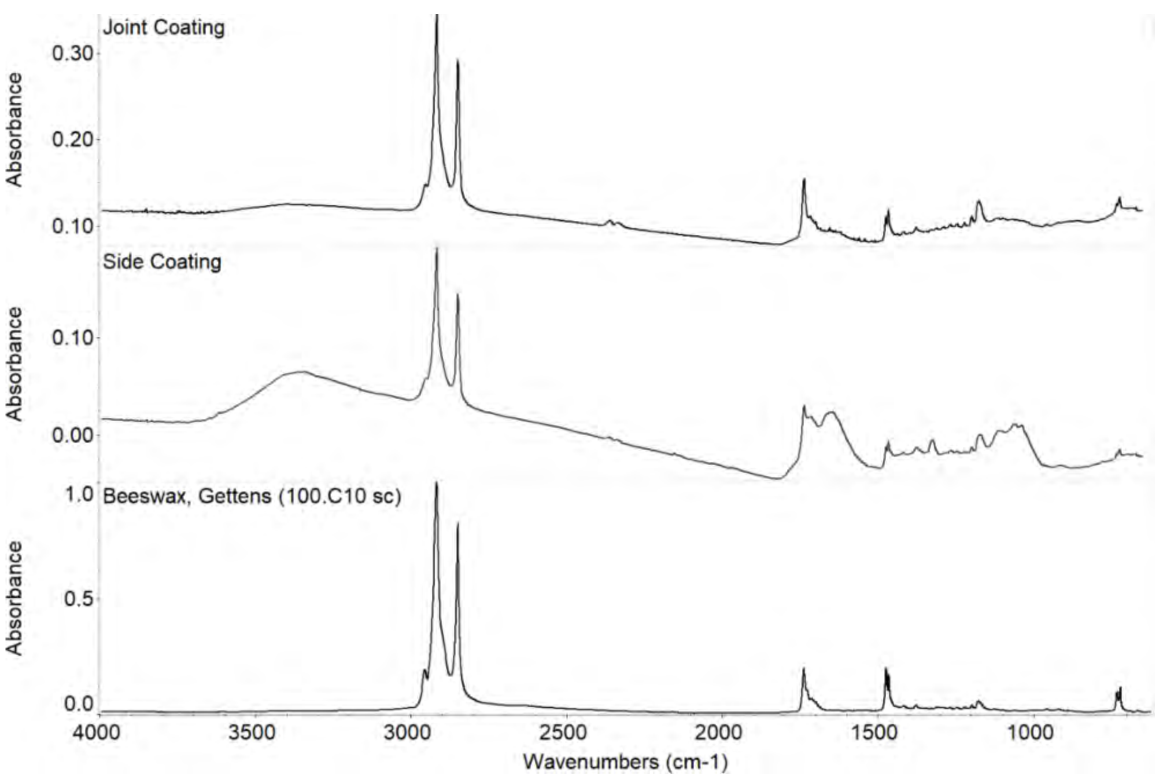


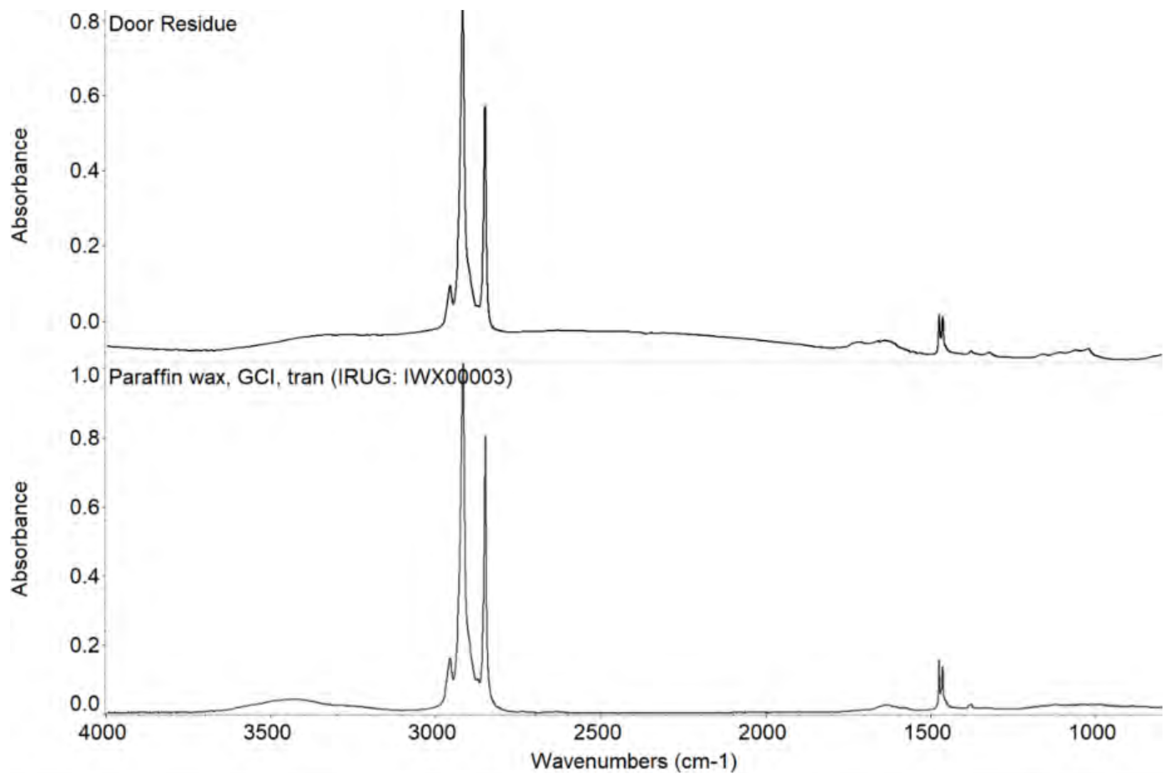

Lion (R)
%Reflectance
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4000
3500
3000
2500
2000
1500
1000
Wavenumbers (cm-1)

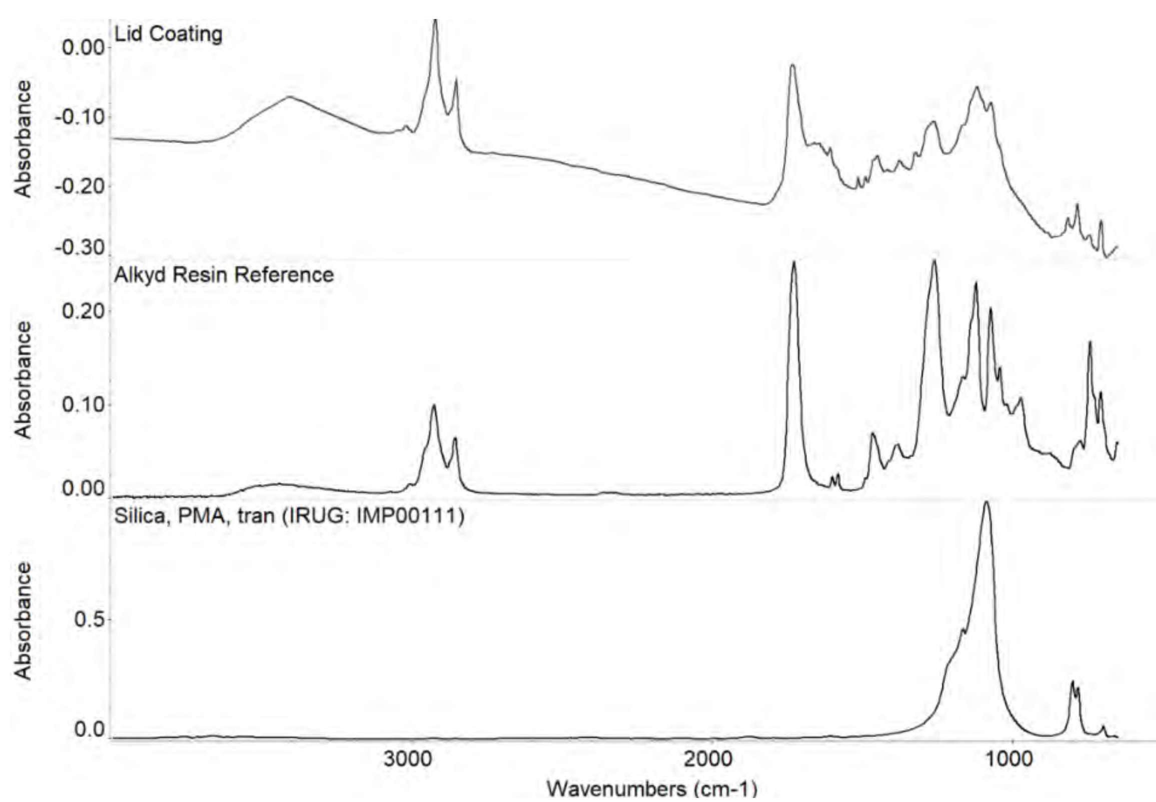

Boy (LUL)
%Reflectance
50
45
40
35
30
25
20
15
10
5
4000
3500
3000
2500
2000
1500
1000
Wavenumbers (cm-1)

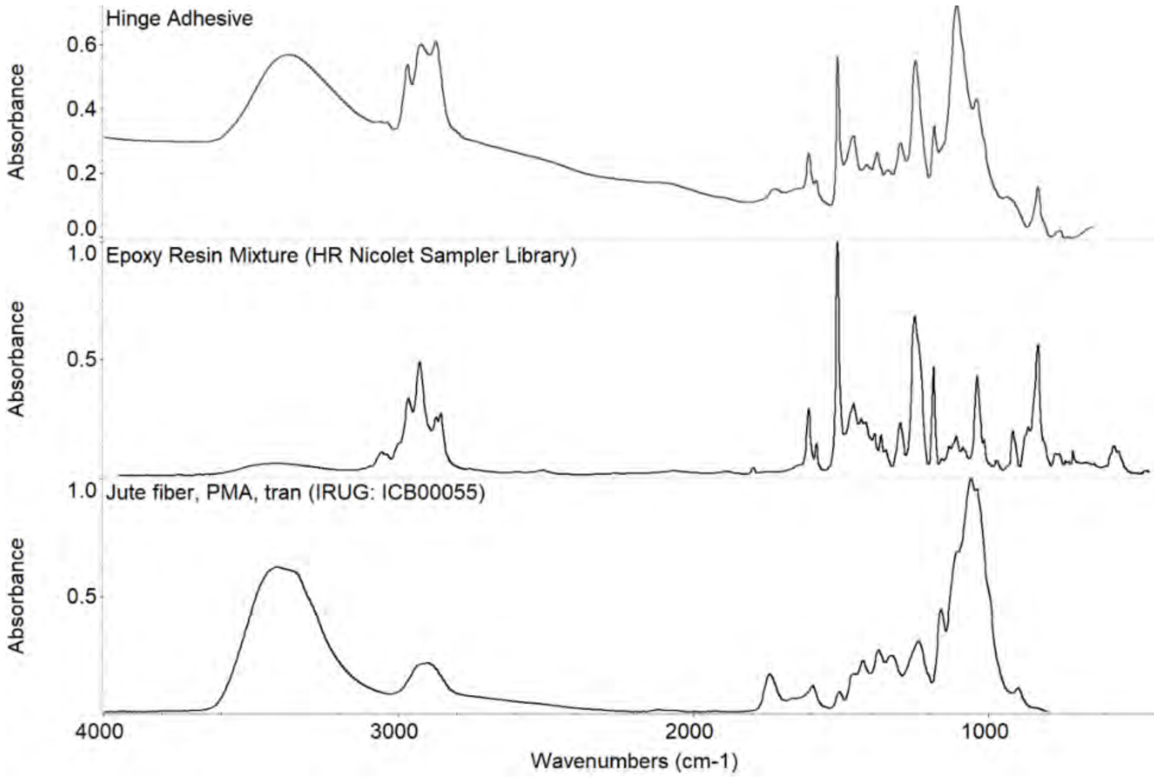
Micro-Transmission FTIR

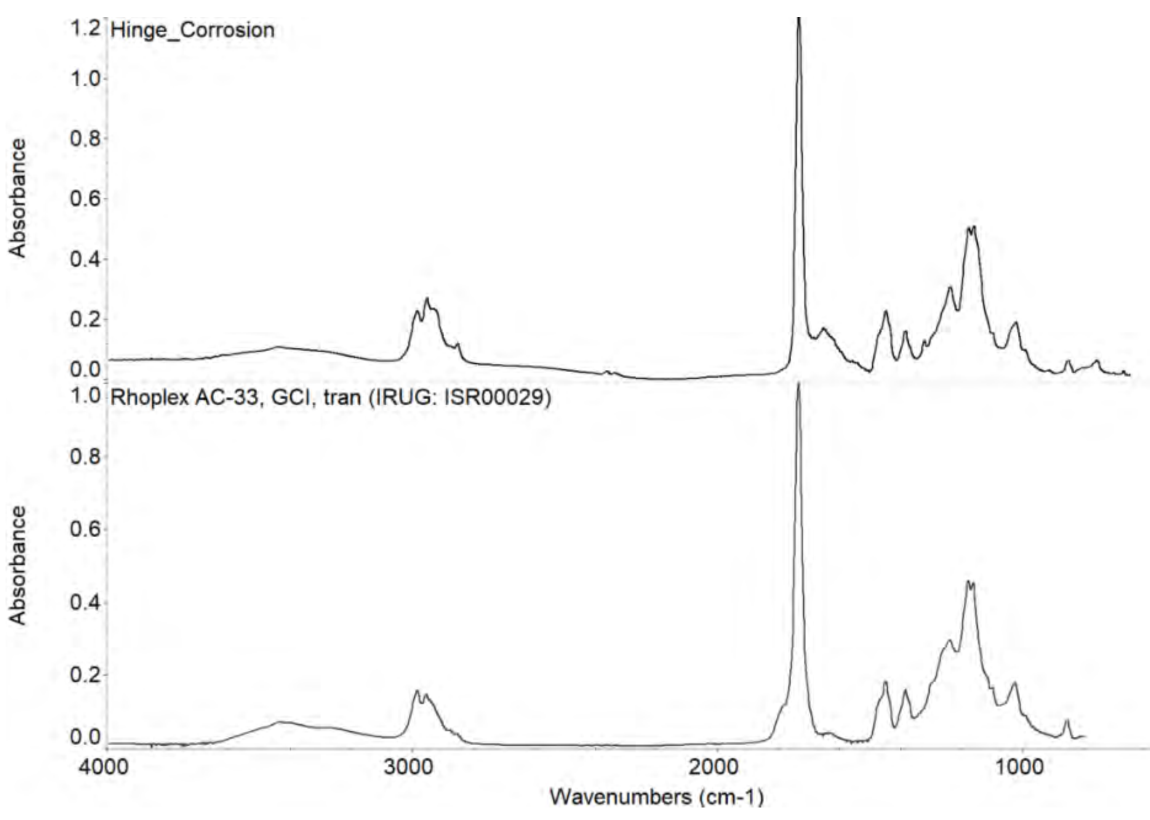





Door Residue
Paraffin wax, GCI, tran (IRUG: IWX00003)
Absorbance
Absorbance
0.8
0.6
0.4
0.2
0.0
1.0
0.8
0.6
0.4
0.2
0.0
4000
3500
3000
2500
2000
1500
1000
Wavenumbers (cm-1)

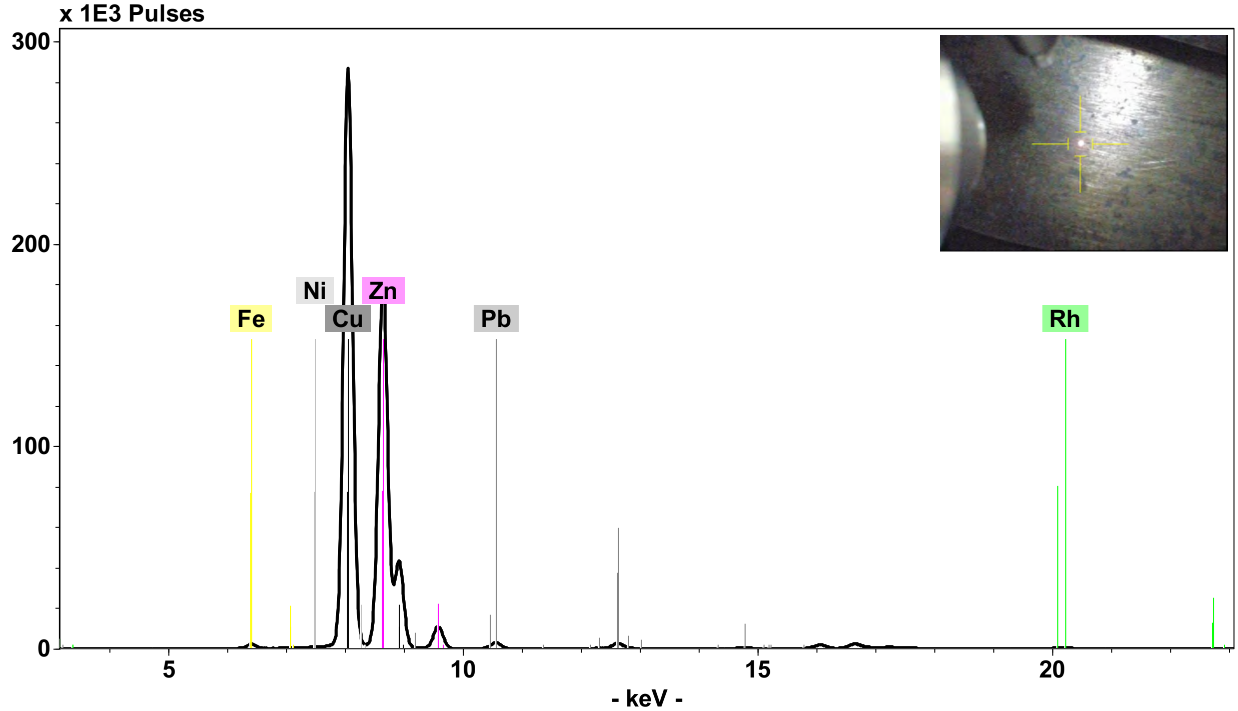

Lid Coating
Alkyd Resin Reference
Silica, PMA, tran (IRUG: IMP00111)
Absorbance
Absorbance
Absorbance
0.00
-0.10
-0.20
-0.30
0.20
0.10
0.00
0.5
0.0
3000
2000
1000
Wavenumbers (cm-1)


Hinge Adhesive
Epoxy Resin Mixture (HR Nicolet Sampler Library)
Jute fiber, PMA, tran (IRUG: ICB00055)
Absorbance
0.6
0.4
0.2
0.0
1.0
0.5
4000
3000
2000
1000
Wavenumbers (cm-1)

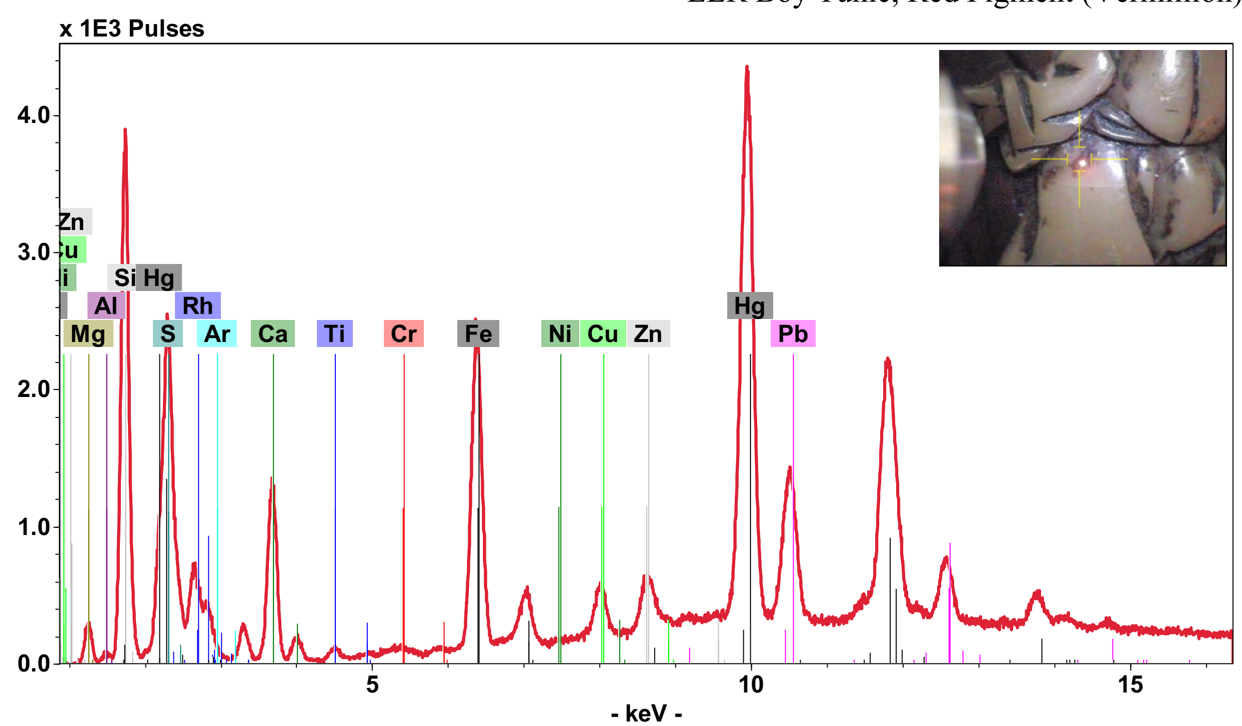

Hinge_Corrosion
Rhoplex AC-33, GCI, tran (IRUG: ISR00029)
Absorbance
1.2
1.0
0.8
0.6
0.4
0.2
0.0
4000
3000
2000
1000
Wavenumbers (cm-1)

X-Ray Fluorescence Spectroscopy

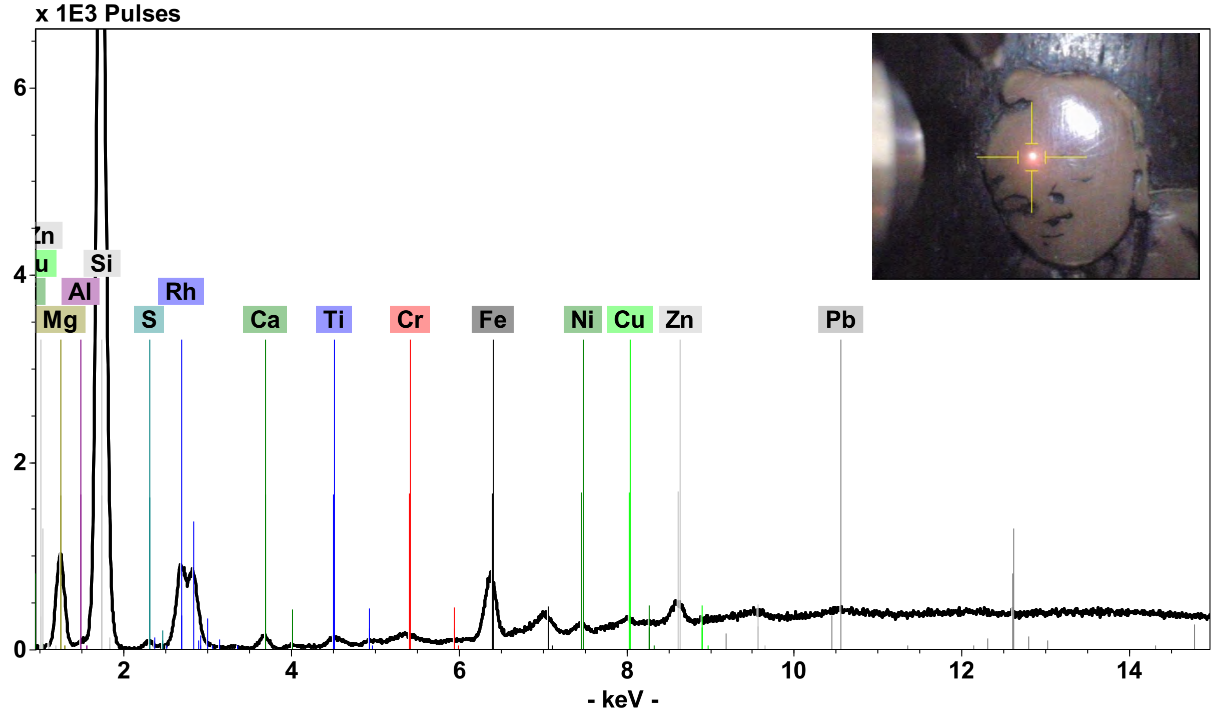
Metal Hinge (60:40 Brass)



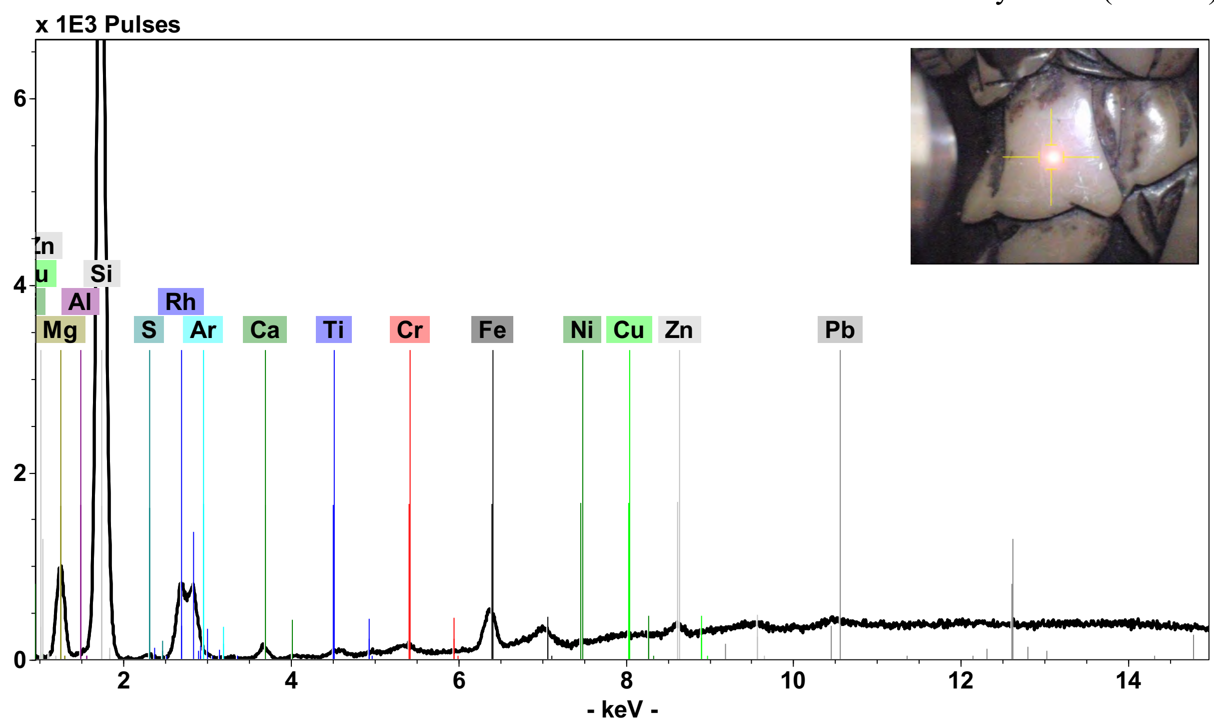
LLR Boy Tunic, Red Pigment (Vermillion)



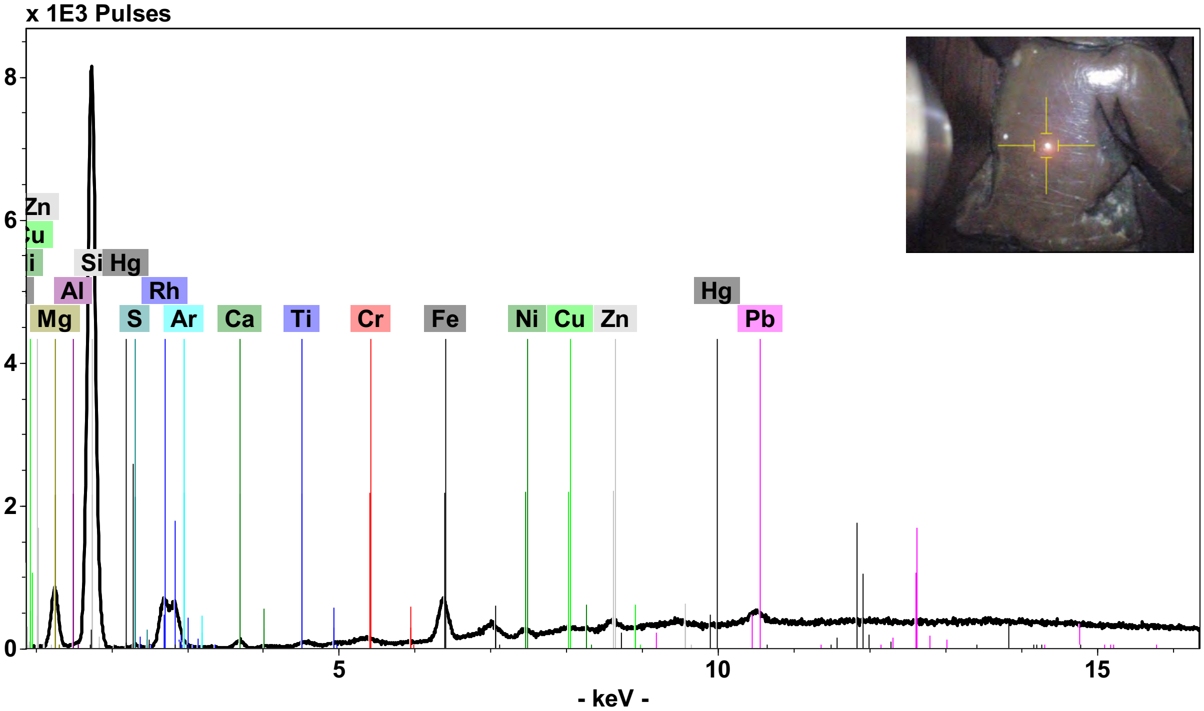
RUL Boy Head (Silicate)



LLR Boy Tunic (Silicate)



LLL Boy Tunic (Silicate)



Left Lion, Flank (Silicate, iron-rich)