

Katherine Beaty
Art Conservation Department
Buffalo State College

**21st c. remedies to 19th c. repairs of an 18th c. Koran:
materials analysis, treatment, and housing**

Abstract: In desperate need of treatment, a copy of the Koran arrived at the Art Conservation Department at Buffalo State College. The provenance of the book stated that it was 18th century Koran from Egypt. This project centered on the examination, analysis, and treatment of this book.

Initially evident, this book had been repaired many times in the past. The most recent restoration campaign rendered the book unusable. The book could not be opened. Many of the pages were stuck together, and the spine was incredibly stiff. The binding was reinforced with a red cloth tape, and new pastedowns had been pasted over the originals.

The decoration on the elaborate opening pages was analyzed with a number of analytical techniques, polarized light microscopy, scanning electron microscope coupled with energy dispersive spectroscopy, x-radiography, and x-ray fluorescence spectroscopy. A number of pigments were identified, including gold, red lead, orpiment, copper blue, smalt, carbon black, as well as organic lake pigments.

The book was disbound in order to correct the poor openability. After the repair tape was removed, the binding could be separated from the text block. Three reasons were discovered to cause the poor openability of the text block. One reason was a thick layer of stiff adhesive on the spine of the text block. Next, damaged loose leaves were tipped to each other, preventing flexing at the spine fold. And three, the moisture from the adhesive used was causing the paper to cockle along the spine edge, further restricting the opening.

The tipped leaves were humidified in a Gore-tex package and separated. The residual adhesive was reduced mechanically with methylcellulose. The leaves and folios were humidified and flattened. After the gatherings had been guarded, the book was resewn using the Islamic link stitch. New Islamic chevron endbands were sewn at the head and tail for both structural and aesthetic reasons.

Several materials added to the original binding were removed, including the red repair tape, the modern pastedowns, and cloth spine lining. The spine of the binding was relined with a thinner more flexible Japanese paper. A hollow was added to the spine of the text block and used as one of the text block to binding connections. A clamshell box with a fold out cradle was made to house the book. After treatment, the resulting book structure could be easily opened for reading and enjoyment.

1. INTRODUCTION

A copy of the Koran (reportedly 18th century, Egypt) belonging to the collection at the Buffalo Museum of Science in Buffalo, New York, was brought to the art conservation laboratory at Buffalo State College



Figure 1: (Top) Before Treatment – Front
Figure 2: (Bottom) Before Treatment - Back

for conservation treatment (Figs. 1-4). At some point in its history, the textblock and binding of this Koran had been damaged and improperly repaired. The resulting book structure could not be opened safely for reading. Many of the pages were stuck together, and those that were not did not open smoothly due to extreme cockling at the spine edge of the text block. The binding was heavily reinforced with a red cloth repair tape along the spine and fore edge flap. Before this book could be conserved, it was necessary to gain an understanding of Islamic bookbinding and the nature of materials used in its construction.

2. CULTURAL FUNCTION

Islamic cultures have an extremely high literacy rate, and books were heavily used, especially the Koran, the central religious text for Muslims (Bloom 2001). When compared to western bindings, one might view Islamic book structures to be weak, because so many are found in need of repair or

improperly restored (Husby 1991). The characteristics of Islamic bindings are determined by their function within the culture. Religious texts, such as the Koran, were always supported in a *rahl*, a wooden cradle that held the book during prayer (Fig. 6). Though, it may be possible that the use of the *rahl*, negated the need for a stronger binding structure (Szirmai 1999). When not being read, books were stored horizontally on the shelf, negating the need for the binding to support the textblock vertically (Fig. 5).

3. ISLAMIC BOOKBINDING

Two people, the calligrapher and the binder were responsible for the manufacturer of Islamic books. The calligrapher was responsible for the writing and sewing. The appropriate sized cover would be constructed and decorated by the binder, who was skilled in leatherwork. The cover is made off the book, and could be easily attached to the text block. This division of labor allowed for both parties to perform the high degree of decoration and design that associated with Islamic books (Bosch, Carswell, and Petherbridge 1981).



Figure 3: Before treatment - Back

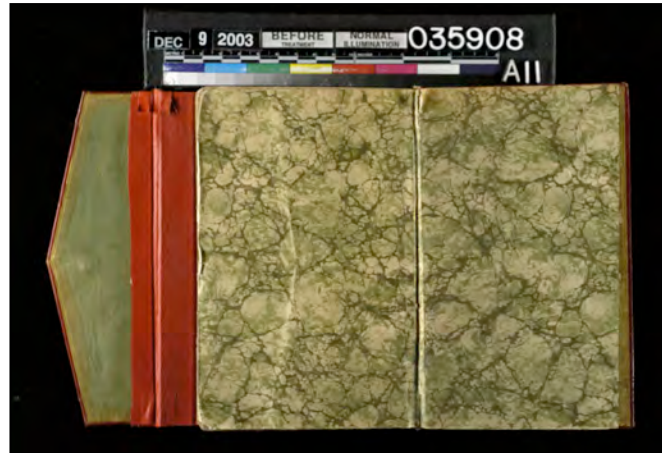


Figure 4: Before treatment – Front Inside



Figure 5: A medieval Arabic library, al-Hariri's Assemblies, Baghdad, 1237. Paper Before Print, J. Bloom

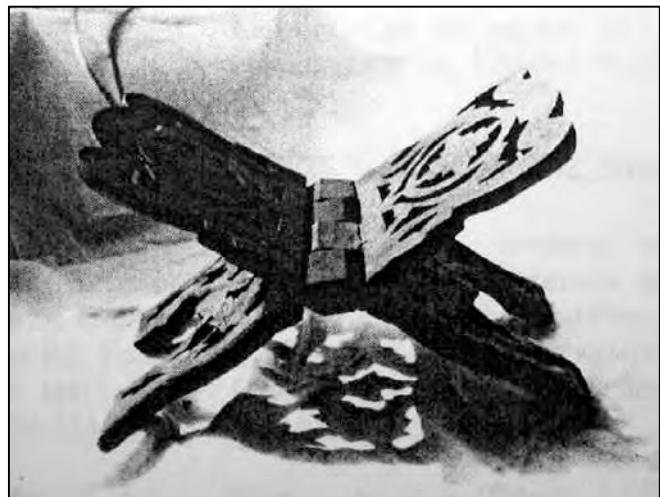


Figure 6: Rahl, Islamic book support

3.1 TEXTBLOCK

The text block could be composed of gatherings of four, five, or six folios. The grain direction of the folios is not always parallel or perpendicular to the spine, and often varies through out the book, as is the case in the Koran. In western bookbinding, the size of the resulting book was directly related to standard sizes of paper and how they were folded during the binding process. This is not necessarily the case in Islamic bindings. There is no indication of standards for paper or book sizes.

The gatherings would be sewn together using the Islamic chain stitch. A book of this size would have typically been sewn on two sewing stations that divide the height book into thirds. Larger books might

have been sewn on four sewing stations (Szirmai 1999). Islamic chain stitch resembles the coptic stitch, except that it is sewn with only one needle and uses silk thread. Islamic books are not sewn over supports.

After the sewing was complete, any resulting swell in the spine would have been beaten out down with a heavy mallet (Bosch, Carswell, and Petherbridge 1981). Islamic books have a flat spine and no shoulder, so any swelling from sewing is not desirable. The spine of the textblock would have been pasted and lined with muslin or a woven fabric. This spine lining would have been left long to allow attachment of the binding.

Endbands were sewn at the head and tail of the textblock, with the traditional Islamic chevron, or zigzag pattern. The endbands were traditionally sewn over a leather core 3-4 mm wide (Parker 2002). This core is tied down with silk threads at the center of each gathering. These tie down threads act as the warp threads on which the colored chevron pattern is woven. Two colors of silk threads were woven over the warp threads. By twisting the colored threads as they pass over the warp threads, the chevron pattern is formed (Fisher).



Figure 7: Front Cover

3.2 BINDING

Islamic bindings are made off the book similar to a case binding. The bindings have no square, meaning the boards are the same size as the text block. The most obvious characteristic of Islamic book bindings is the fore edge flap. This pentagonal flap extends from the bottom board, and wraps around the text block underneath the top board. Islamic bindings of this period are commonly constructed of leather over pasteboard. Pasteboard is a rigid board made by laminating sheets of paper with a starch paste.

This Koran's binding was made in two pieces, the back board with fore edge flap and the front board. When each board is covered, a flap of leather is left at the spine. The leather flaps of each of the boards can be pasted over the spine individually. The leather was pared so thinly the two leather surfaces blend together, so that the overlap is barely visible.

The leather binding has been embellished by a number of methods. First, the center medallion and corner pieces were block stamped (*Fig. 7*). The decorative blocks were heavily impressed, causing the inside of

the boards to bulge outwards and the leather surface to be incised. Two gold lines applied by brush with shell gold border these designs. The gold lines were then tooled with a decorative cable pattern, probably with a roulette or roll. Thinner shell gold lines were painted with a thin brush around the block stamped elements.



Figure 8: Left opening page

4. MATERIALS ANALYSIS

4.1 PIGMENT IDENTIFICATION

The first two facing pages of the book feature the opening of the Koran (Fig. 8). These opening pages are more highly decorated than the rest of the book with extensive gilding and painting that fill the margins. Several colorants were identified without removing any samples from the original, using x-radiography and x-ray fluorescence spectroscopy. Also, small fragments of paper and pigments were found in the gutter. Since these pieces were too small to reintegrate into the text, they could be subjected to destructive analysis, such as polarized light microscopy and scanning electron microscopy.

4.1.1 Black pigment

Islamic manuscripts on paper are typically written with carbon black ink and a pen or fine reed. Carbon black ink is made from finely divided soot mixed with gum Arabic. Carbon black ink is chemically stable and light fast, but remains sensitive to moisture. This sensitivity is evident through out the text, as numerous sweaty fingers in the past have smudged the ink (Fig. 9). When examining the x-radiograph of the pages, the text is not visible, because both the ink and paper are mainly carbon and have essentially the same atomic density.

4.1.2 White pigment

The white pigment was identified as lead white through x-radiography. In a radiograph, denser or higher atomic weight materials appear lighter in tone than lower atomic weight materials, because higher atomic weight materials are absorbing more of the x-rays that expose the film. In the radiograph of the title page, writing in a white pigment over a gold



Figure 9: Detail, opening page, smeared carbon black ink

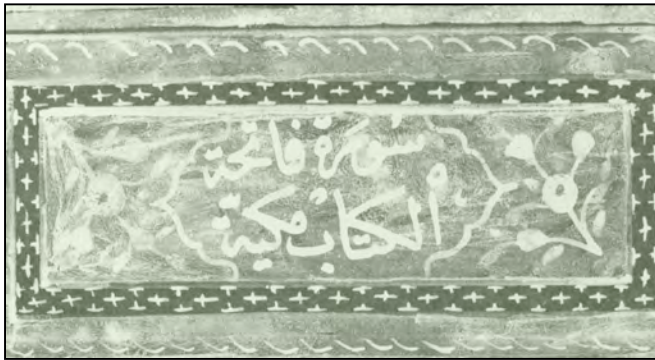


Figure 10: (Top) Detail from opening page, lead white writing over gold

Figure 11: (Bottom) Detail from radiograph of opening page, lead white writing over gold

background appears much lighter in tone than the gold (Figs. 10-11). For this time period, the only white pigment available that contains elements denser than gold would be lead carbonate or lead white. The identity of this pigment was further confirmed through x-ray fluorescence spectroscopy, which yielded a high lead peak.

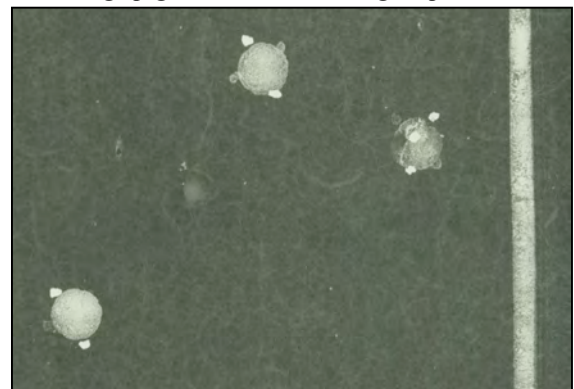
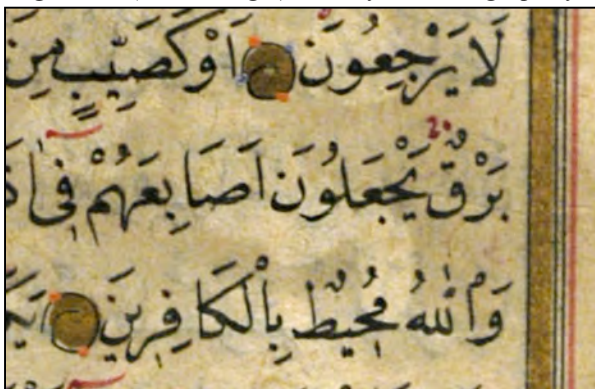
4.1.3 Orange pigment

On the title page and through out the text, large gold periods separate sentences. Around the punctuation, small blue and orange dots were used as embellishment. In the radiograph, this orange pigment was also denser than the adjacent gold, and equally as dense as the lead white (Figs.12-13). During the 18th century, only two orange red pigments were available

that contained elements heavier than gold, red lead and vermilion, which contains mercury. Many of the orange dots around the punctuation had fallen off through out the textblock. During treatment, loose particles of the orange pigment were observed in the gutter of the textblock. They were collected and analyzed using polarized light microscopy. Under 400X magnification, the collected particles appeared as small, (<4 μm , round translucent orange yellow particles) which confirmed the identity as red lead. The identity of this pigment was further confirmed through x-ray fluorescence spectroscopy, which yielded a high lead peak.

Figure 12: (Bottom Left) Detail from text page, red orange pigments used around gold punctuations

Figure 13: (Bottom Right) Detail from radiograph of text page, red orange pigments used around gold punctuations



4.1.4 Purple pigment

The purplish red pigment used in the border of the title pages was examined using ultraviolet radiation. It was observed to have an orange fluorescence, and is assumed to be rose madder, an organic dye/ lake pigment. When examining this pigment with XRF, no significant peaks for the colorant were observed, but a small peak for calcium could indicate that calcium carbonate was used as the mordant for the lake pigment.



Figure 14: Opening page, right

4.1.5 Blue pigments

Two blue pigments were used in the decoration of the title pages, one used within the gold decoration around the text, and the other around the margin (Fig. 14).

The blue pigment used around the margin of the title pages was very finely ground and applied with a stylus or pen (Fig. 15). This pigment was causing accelerated degradation of the paper substrate, and there were many fractured losses from handling due to the embrittlement of the paper (Fig. 16). A loose fragment of the paper containing this blue pigment was found in the gutter. Because it was too small to reincorporate into the page, it was subjected to destructive analysis. This fragment was analyzed with a scanning electron microscope with energy dispersive spectroscopy (SEM-EDS). The EDS showed a large peak in the spectra for copper.

The blue pigment that was used within the gold illumination on the title pages could be visually discerned as a different pigment. When observed under magnification using a stereomicroscope, this blue pigment



Figure 15 (Left): Detail of blue pigment used around margin, copper containing blue

Figure 16 (Right): Verso of opening pages, showing the accelerated degradation caused by the copper containing blue pigment



Figure 17: Detail of blue pigment used within the gilding, smalt

appeared as transparent blue glassy particles that were very coarsely ground (Fig. 17). When examining this pigment's density in the radiograph, it was not as light in tone as the lead, but closer to the tone of the gold. X-ray fluorescence spectroscopy (XRF) analysis of this pigment revealed strong peaks for arsenic, lead, and cobalt. This elemental combination strongly suggests the use of smalt, a blue pigment made from ground glass (Feller 1994).

4.1.6 Paper

The text block of this Koran is made from a thin, cream-colored, laid and chain hand made paper. Unlike western paper, Islamic paper is typically made in a grass or reed mould. These flexible organic materials used for the mould wear with use, and can be seen in the paper as sagging laid lines. This characteristic is evident in the paper used in this Koran. Another indication of indigenous papermaking is the grouping of three chain lines, visible in transmitted light. Groupings of three chains lines is typically associated with papers produced in Syria and Egypt (Loveday 2001)

The fiber content of the paper is made of primarily flax or bast fibers. When viewing the papermaking fibers under polarized light microscopy, two differently processed pulps are identifiable. One pulp is highly beaten, and appears as short fibrous fragments. Also, large raw fiber masses which are less beaten and barely defibrillated.

The paper used for this manuscript is starch sized and highly burnished. The sizing agent was tested using the micro-chemical spot test, potassium iodide. The small paper sample turned bluish black, indicating the presence of starch. Islamic papers are sized with a starch slurry, commonly wheat starch. After starch sizing, the paper surface is burnished, either with an agate, smooth stone, or glass ball (Bosch, Carswell, and Petherbridge 1981). This surface treatment of the paper creates a smooth glossy surface that is ideal for calligraphy and illumination. Also, burnishing causes the paper to become more translucent, by compacting the paper and decreasing the air pockets which scatter the light, and decreasing the visibility of the laid and chain lines (Loveday 2001). The effects of burnishing can be observed on the microscopic level as well. Scanning electron microscope images shows the flattening of the paper fibers in burnished paper compared to that of unburnished paper (Figs. 18-19).

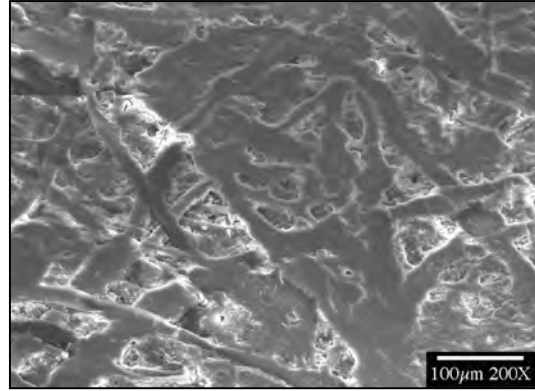
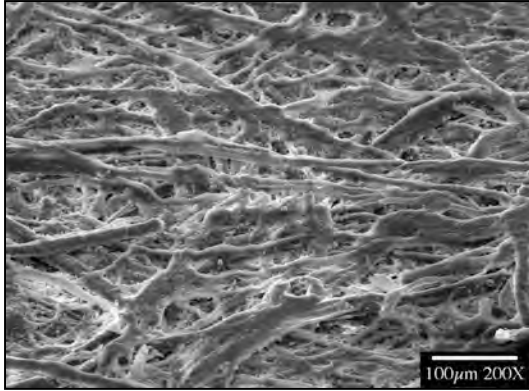


Figure 18: Scanning electron microscope, secondary electron image of an unburnished Indian paper

Figure 19: Scanning electron microscope, secondary electron image of burnished paper from this Koran

5. OVERALL TREATMENT

Initially, it was impossible to determine the overall of the book until the red cloth repair tape was removed. Only when the spine of the binding and the text block were exposed could the extent of the damage be determined. The treatment steps are as followed:

1. removal of repair tape, and detachment of binding from spine of text block
2. collation of text block and pagination
3. disassembly of text block and separation of leaves and folios
4. mending of paper, humidification and flattening
5. resewing text block, spine lining, and end bands
6. removal of added pastedown and woven fabric spine lining material
7. replicating green coated paper
8. repairs to binding, spine and flap
9. attachment of text block to binding
10. construction of protective housing



Figure 20: Removal of the repair tape

5.1 TREATMENT SPECIFICS

5.1.1 DETACHING BINDING

Until the repair cloth was removed, the condition of the spine of the binding was unknown. The red cloth material used to reinforce the binding was applied in multiple strips over the spine and the fore edge flap of the binding. A positive with the potassium iodide stain test determined that the adhesive used for the book repair tape was starch-based. The repair tape was locally humidified by placing a damp blotter of the same width over the cloth (*Fig. 20*). After sufficient humidification, the tape could be peeled away, but it left an adhesive residue. This adhesive residue was softened locally with a poultice. A viscous

methyl cellulose (2.5% A4M) was applied by brush. When the adhesive residue had softened, it was reduced mechanically with a dental tool. The methyl cellulose was cleared from the leather surface with cotton swabs dampened with deionized water.

Once the repairs were removed, the spine of the binding was revealed. The leather was mostly intact except for a few losses. Through these losses, the spine of the text block was visible. All that could be made out was a thick layer of brittle adhesive. This could be one of the explanations for the poor open ability of the text block. It would be necessary to pull the text block to address this problem.



Figure 21: spine of the text block

The text block was removed from the binding by working a wide Castelli spatula between the text block and the spine lining interface. The thick layer of brittle adhesive crumbled away, and allowed the easy detachment of the text block (*Fig. 21*).

The adhesive on the spine was also softened with a viscous methyl

cellulose poultice (2.5% A4M) and reduced mechanically with a micro spatula.

5.1.2 COLLATION

With the spine of the text block now free, the text could now be collated. Collation is an examination and documentation process that denotes gathering formation, sewing structure, and any damages to each page. Even though the text contained catch words, leaves were paginated with a soft graphite pencil in the top left hand corner, to ensure that the pages were returned to the correct order. After treatment, the graphite page numbers were removed with a vinyl eraser.

During the collation process, another problem influencing the open ability of the text block was discovered. As folios were damaged, text leaves became loose at the spine fold. As a means of repair, these loose leaves were tipped onto the adjacent leaves, instead of being properly repaired. Tipping is a method of attaching two sheets of paper by running a bead of adhesive, along one edge. By tipping pages together, the opening movement is shifted from the fold of the paper to in side the sheet. This motion puts stress on the paper and illumination that is close to the gutter, and creates a breaking edge upon

which the paper will likely fail. These tipped pages were also extremely cockled, which further restricted the opening. Either the moisture from the adhesive application or the pull of the adhesive over time has caused the pages to cockle along the spine edge. In order to address this problem, the sewing threads were cut, and loose folios and tipped sections were separated.

5.1.3 DISBINDING

In order to separate tipped leaves, the sections were humidified in a Gore-Tex® sandwich. Hollytex® and Mylar were placed on each side of the leaves to prevent the exposure of the water sensitive inks to



moisture. Gore-Tex® sheets were placed on each side of the sections. A thin strip of dampened blotter was placed over the tipped area, covered with Mylar, and lightly weighted. After the adhesive was sufficiently softened, the tipped leaves were peeled apart (Fig. 22). This adhesive was applied very thickly, and often oozed close to text borders



The residual adhesive on the spine edge of the leaves was softened by brush applying a methyl cellulose poultice (2.5% A4M). When the adhesive had softened, it could be scraped away with a dental tool. Mechanical removal of the adhesive was possible because of the smooth burnished surface of this paper (Fig. 23). Methyl cellulose residue was cleared from the paper surface with cotton swabs dampened with de-ionized water.

Figure 22 (Top): Peeling apart tipped leaves

Figure 23 (Bottom): Reduction of adhesive residue with methyl cellulose, picture shows before treatment on the right, and after on the left.

5.1.4 PAPER TREATMENT

After the residual adhesive was removed, loose leaves and folios were humidified in a plastic tray. The tray bottom was lined with wet capillary matting, over which plastic gridding was elevated. Before the humidity chamber was covered with a piece of Plexiglas, the paper was placed on Hollytex® on the

plastic gridding. The pages were humidified for approximately thirty minutes, long enough to relax the cockled edge, but not to soften the paint's binding medium.

After humidification, the leaves were quickly transferred to a blotter stack for drying. The sheets were flattened between a sandwich of the smoothest Hollytex®, thin smooth blotter, thicker softer blotter. The pages were allowed to in the screw press with only the weight of the metal plate applied. Layers of mat board were inserted between the blotter sandwiches to ensure that the leaves were evenly pressed against a completely smooth surface. The leaves were allowed to dry for twenty four hours in the press. Then, they were removed, refolded, and left under light weight until repairs were done.

Loose leaves were guarded with a thin smooth handmade Japanese paper and a 1:1 mixture of wheat starch paste and methyl cellulose (2.5% A4M), connecting them to their conjugate leaf. After an entire gathering had been guarded, it was nipped in the screw press to flatten the repairs and decrease the swell at the spine.

The edges of the title page were cracking along the lines of blue margin decoration, and were in need of reinforcement to ensure safe handling. Analysis proved that this blue pigment contained copper, and for this reason a non-aqueous adhesive repair was chosen. The presence of water in the repair adhesive could cause the migration of these metal ions, which could further accelerate the degradation of the adjacent paper. A solvent set tissue was prepared from a thin machine made Japanese tissue (RK-0) and 2% Klucel G in isopropanol. The tissue was adhered around the perimeter of the verso of the title pages by rolling a swab dampened with isopropanol to reactivate the adhesive. Edge losses were filled with a historic handmade burnished Indian paper. The insert papers toned with dilute acrylic emulsion paints, and inserted onto the solvent set tissue with 2% Klucel G in isopropanol.

The last page of the text block was a blank paper that was thicker than the paper used for the rest of the text block. The matching blank page was no longer present on the front of the text block next to the title pages. A single flyleaf was added to the front of the text block. It was guarded around the first signature. The flyleaf was added as a means to protect the title pages. A historic handmade Indian paper was selected. Before it was added, the page was washed in deionized water and burnished with an agate. This sheet was labeled in the gutter (KB 2004) with graphite pencil, to indicate when it was not original to the book.

5.1.5 SEWING, SPINE LINING, AND END BANDS

The text block was re sewn using the link stitch at two sewing stations, which divided the height of the spine into thirds (*Fig. 24*). The sewing was



Figure 24: Sewing

executed through the original holes, not those left by the most recent sewing. Though these books were traditionally sewn with silk thread, silk was not used for structural sewing because it is weak and brittle. The book was sewn with a 100% cotton 3-ply embroidery thread. This thread was chosen over commercially available linen book binding threads, because it was thinner, which created fewer swells at the spine.

Swell is the increase in thickness at the spine compared to the fore edge, which can be created by the sewing threads or guarding. It was important to create minimal swell when rebinding this book for two reasons. To keep this book close to its original form, Islamic books have a flat spine and no shoulder. Also, the spine of the binding restricted me, which was intact. The original folds in the spine leather of the binding had prescribed the thickness of the text block.

After sewing, the text block was jogged on the head and fore edge, and placed under sufficient weight. The spine of the text block was pasted up with thick wheat starch paste and allowed to dry under weight. The spine was lined with a laminated Japanese paper. This laminated Japanese paper was made by adhering two papers with the grain directions crossed with wheat starch paste. This laminated Japanese paper was chosen to line the spine, because it created less bulk than a woven linen fabric. Every added layer would effect how the text block had to fit into the binding. The spine lining extended at the front and back of the text block, to act as the internal joint material when attaching the text block to the binding.

Also, the spine lining was allowed to extend at the head and tail. These flaps were folded back onto the spine, which created the core material on which the end bands. The Islamic chevron end band was first sewn with a foundation end band stitch with the same cotton embroidery thread used to sew the text block. The colored silk threads were woven across these threads to create the zigzag pattern (Fischer 1986).

In choosing the end band colors, I found two colored thread fragment. One fragment was a blue thread, found piercing the textile spine lining, and the old repairs of the folios. Through polarized light microscopy, it was identified as a bast fiber, likely flax. Traditionally, Islamic end bands are sewn with silk thread, not flax. Also, this thread was found piercing old paper repairs, so it could be assumed that the blue thread was not original. One green thread fragment was found in the gutter. It was found to be silk when observed through the microscope. For this reason, green and cream colored silk threads were chosen for the end bands.

5.1.6 PASTEDOWN REMOVAL

During the last restoration campaign, a decorative end sheet had been added to the book as a means to attach the text block to the binding. This single folio was tipped onto the text block, one half left to act as

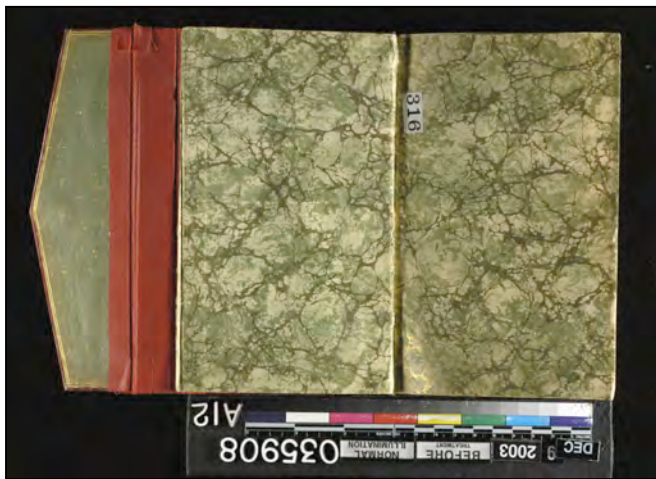


Figure 25 (Top): Before treatment, inside binding, back
 Figure 26 (Bottom): Lifting of pastedown

a fly leaf, and the other pasted onto the inside of the boards. The paper that was used was a machine made half-tone printed marble patterned paper. It had been pasted haphazardly over the original pastedown, extended off the edge of the board and leaving the original exposed in other places (Fig. 25). The original decorative paper, a green paste paper sprinkled with gold, was still visible on the pentagonal fore edge flap. In order to reveal the original pastedowns, it was decided to remove these modern additions. The paper was thinned with a Castelli spatula (Fig. 26). The remaining paper fibers and adhesive were softened with a methyl cellulose poultice (2.5% A4M) and removed mechanically with a dental tool. Methyl cellulose residue was cleared from the paper surface with cotton swabs dampened with deionized water. The pastedown had been

abraded prior to being covered by the marbled paper. Small losses occurred in the green coated paper during the treatment. Damaged areas were consolidated and isolated by brush applying a layer of methyl cellulose. Subsequent inpainting was executed with watercolors in areas of loss.

5.1.7 SPINE LINING REMOVAL

When the text block was removed from the binding, the woven linen spine lining material was left attached to the binding. This spine lining was causing the leather on the spine of the binding to be stiff,

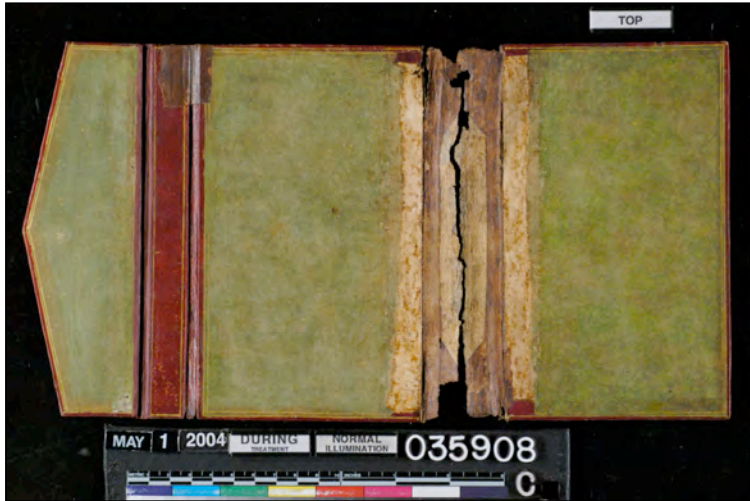


Figure 27: During treatment, binding inside, original pastedowns

and it could not be bent around the text block. The adhesive used to apply the textile was softened with methyl cellulose (2.5% A4M) and easily lifted away. Residual adhesive was softened with methyl cellulose and removed mechanically with a dental tool. After the spine lining was removed, it was obvious that it was providing support for the leather spine, because a crack running vertically down the middle of the spine was evident (Fig. 27).

In order to reinforce the leather spine, it was relined with two layers of thin Japanese paper. The first layer was the thickness of the text block, and was applied to the center of the binding. The second layer extended across the entire spine and onto the boards. The lining papers were applied with a thin layer of wheat starch paste. This new lining is not as thick as the textile spine lining, and allows the leather to be more flexible. While the leather was still damp from the lining, the binding was folded around the text block. The text block was wrapped in 1 mil Mylar to protect it from the moisture of the lining. The binding was placed under sufficient weight and allowed to dry. Narrow strips of mat board were cut and placed on the shoulder of the binding to ensure that even pressure was applied over all during the drying process.

5.1.8 REPLICATING GREEN PASTE PAPER

After the spine lining textile was removed, it was discovered that there were large losses in the pastedowns, where the spine lining was once adhered (Fig. 27). A green coated paper was made to replicate the original and to fill these losses. A smooth handmade western paper was dampened. A combination of dry pigments was mixed with a 2% solution of gelatin, and it was brushed onto the dampened paper. While this coating was still wet, gold flakes were sprinkled onto the surface. When the surface was dry, it was burnished with an agate. This paper was sanded from the back to reduce its thickness. After the text block was attached to the binding, fills were inserted with wheat starch paste over the internal joint material.

5.1.9 BINDING REPAIRS

After the binding was folded around the text block and allowed to dry, small cracks in the leather were evident in the joints. The joints of the binding were reinforced with thick Japanese paper, RK 17, on the outside. The Japanese paper was toned with diluted acrylic emulsion paints to match the color of the leather. The paper was adhered with a mixture of 3:2 Lascaux 360 HV: 498HV acrylic emulsion adhesive. This alternative adhesive is reversible with solvents or heat, and remains flexible as it ages. Once in place, the Japanese paper repairs were treated with a 1:1 mixture of 2% Klucel G in isopropanol and SC6000 acrylic wax emulsion. This surface treatment protects the paper from abrasion and gives it a similar sheen as the leather.

After the repair tape was removed, it was discovered that the pentagonal fore edge flap was completely disconnected. In order to reattach the flap, a slit was cut along the center of the thickness of the each of the boards, similar to the technique of board slotting. The boards easily split in this manner because they were paste boards, a board made by laminating sheets of paper with paste. To reHINGE the flap, wheat starch paste and Japanese paper was inserted into the slits. The hinge was covered with toned Japanese paper in the same manner as above. The Japanese paper repairs extended onto the original leather surface, but did not cover any gold decoration. Slotting the boards provided another means of attaching the flap, rather than depending solely on the adhesion of the Japanese paper on the surface of the leather.

After the spine was lined, the losses in the spine leather could be addressed. Losses in the spine leather were filled with matching goatskin leather, adhered to the lining paper with wheat starch paste. The leather was pared thin, leaving only the grain surface. The end caps had also been worn away from previous use. Thin leather overlays were applied to build up the end caps. The original binding leather was a goatskin that had been polished to reduce the grain surface of goat. The leather fills were locally polished with a heated spatula to flatten the grain to match the original leather surface.

5.1.10 BINDING REATTACHMENT

The binding was reattached to the text block two ways. First, it was attached with a hollow. A Japanese paper hollow tube was applied to the spine of the text block with wheat starch paste. The text block was aligned on the binding. The other side of the hollow was pasted up, and the binding was folded around the text block.

Islamic books are typically constructed as tight backs, meaning the spine leather is adhered directly to spine of the text block. When a tight back book is closed, the spine is slightly convex. When the book is

opened, the text block and spine leather are forced into a concave orientation. This movement puts stress on the leather spine, which in this case is already damaged and creased. By adding a hollow tube, the spine leather will remain convex when the book is opened, by allowing it to move freely of the text block



Figure 28: Detail of opening with a hollow

(Fig. 28). The structure of this book was altered to allow a smoother opening of the text block, with out putting stress on the spine

The text block attachment to the case was further reinforced on the inside joint. The extended spine lining was adhered on the inside of the boards with wheat starch paste. The replicated green paste paper later hid this attachment.

5.1.11 PROTECTIVE HOUSING

A custom made clam shell box with a fold out cradle was made for this Koran. A clam shell box was constructed out of mat board, wheat starch paste, and Japanese Asahi book cloth. Cloth surfaces that would be in contact with the book were lined with a smooth acid-free hand made paper and wheat starch paste. Two boards fold out of the bottom of the clam shell, creating a cradle that can support the book at approximately 100°. A black ribbon was inserted into the fold out cradle, to allow it to be easily lifted into place. Pulling the black ribbons fully extends the cradle and locks it against the clam shell walls (Figs. 29-34). The clam shell box is housed in a four flap envelope made from acid-free card stock. Pictorial instructions were added to the four flap envelope to direct the reader on use of the cradle and proper handling.

Figure 29: Book in clamshell, open



Figure 30: Cradle opened

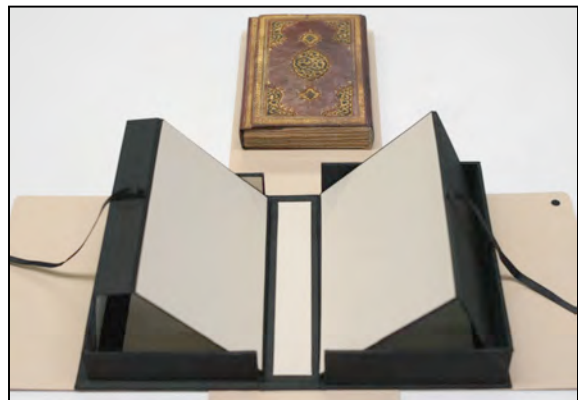




Figure 31: Book in cradle



Figure 32: After Treatment, cover front



Figure 33: After treatment, cover back



Figure 34: After treatment, openability

Bibliography

Bloom, Jonathan M. Paper Before Print: the History and Impact of Paper in the Islamic World. Yale University Press: London, 2001.

Bosch, Gulnar, John Carswell and Guy Petherbridge. Islamic Bindings and Bookmaking. catalogue of an exhibition at the Oriental Institute, the University of Chicago, 1981.

Duggan, T.M.P. "Bookbinding, the conservation of manuscripts and calligraphy." *Turkish Daily News*, 11 August 2000.

Feller, Robert and Elizabeth Fitzhugh. Artists' Pigment: A Handbook of Their History and Characteristics, vol 1. Oxford University Press, 1994.

- Fisher, Barbara. Sewing and Endband in the Islamic Technique of Binding. Restaurator Vol. 7, p. 181-201, 1986.
- Gray, Basil. The Arts of the Book in Central Asia: 14th-16th centuries. Shambhala Publications Inc: Boulder, CO. 1979.
- Greenfield, Laura and Jenny Hille. Headbands and How to Work Them. Oak Knoll Press, 2001.
- Haines, B.M. Leather under the Microscope. British Leather Manufacturers' Research Association, Information Document ID-81, 1981.
- Haldane, Duncan. Islamic Bookbindings in the Victoria and Albert Museum. The World of Islam Festival Trust. London, 1983.
- Husby, Scott H. "Islamic Book Conservation" *AIC: Book and Paper Group Annual*, vol. 9, 1991.
- Jacobs, David. "A Simple Form of Book Support." Library Conservation News. British Library, issue 33, October 1991.
- Loveday, Helen. Islamic Paper: A Study of Ancient Craft. Don Baker Memorial Fund
- Parker, Alan B. "Islamic Binding" *The Quarto*, vol. 19, spring 2002.
- Safadi, Yasin Hamid, Islamic Calligraphy. Shambhala Publications: Boulder, CO. 1978.
- Schimmel, Annemarie. Islamic Calligraphy. E.J. Brill, Leiden, Netherlands. 1970.
- Szirmai, J.A. The Archeology of Medieval Bookbinding. Ashgate Publishing: Burlington, VE. 1999.
- The History of Bookbinding 525-1950 A.D. exhibit catalogue from Baltimore Museum of Art. The trustees of the Walters Art Gallery: Baltimore, MD. 1957.