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**CONSERVATION TREATMENT OF EARLY PRINTED BOOKS:  
POSSIBILITIES, METHODOLOGIES AND OUTCOMES**

**ABSTRACT:**

Development of treatment strategies for conservation is challenging when an object has undergone many campaigns of repair in its lifetime. Determining the appropriate level of intervention requires an understanding of the object's history, coupled with achievable goals for preservation and improved function. *Historia Troiana*, an incunabule from 1486, and the *Breeches Bible* from 1597 are two books that offer an opportunity for contrasting approaches to treatment. Cover to text *detachment* and prior rebinding campaigns have been identified in the *Historia Troiana*, providing an opportunity for a full leather rebind in order to restore functionality to the book and offer a more sympathetic style of binding that relates to the period of the text. In contrast, a study and minor treatment is offered to the *Geneva Bible* that suffers mainly from a loose gathering near the center of the text. The bible as received retained its initial binding. Though significantly worn, the structure was functional and provided a visual account of the history for the piece. It is important to note the nature of the book as a commodity, as this underpins the context through which these objects have been treated throughout time. As the modern-day book conservator seeks to move the book from commodity to artifact, implications for treatment require new examination as well.

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## 1. INTRODUCTION:

Two books from the early period of printing were brought to the Art Conservation Department for treatment from the Buffalo History Museum (BHM). The first being *Historia Troiana Guidonis*, Strasbourg 1486, and the second, the *Geneva Bible*, London 1597.

Incunabula (books printed prior to 1500) as well as the early texts of the hand-press period mark an important shift in book production that goes beyond the translation of script into type. The increase in production and availability of printed books compared to the laborious delivery of manuscripts had a profound effect on the accessibility of knowledge to literate members of society. Information became more prevalent and accessible to a much wider audience than ever before, and with this an interest in education and increased literacy flourished. These first printed titles were important texts to the scholars of the time, and were often translations of much earlier Classical texts that were studied. In this case, *Historia Troiana*, is a Latin translation of the siege of Troy composed by Guido de Colonna in 1282 and printed in Strasbourg, Germany in 1486. Originally derived from the Greek it passed through numerous translations and interpretations before reaching this printed state.

The *Geneva Bible*, also referred to as the *Breeches Bible*, is a further example of how the accessibility of printed works impacted society. This book was the first English edition of the bible to be translated from Greek and Hebrew texts. Protestant reformers who left England for Geneva, Switzerland, then the home of John Calvin and the biblical scholar, Theodore Beza, produced it. The work was a collaboration of these scholars and others, such as William Whittingham, John Knox, and Anthony Gilby. First published in Geneva in 1560, the bible was designed as a small quarto format set in Roman style type, as opposed to the previous Gothic style, making it a more affordable text for a growing population of readers. This version of the bible was notably referenced by William Shakespeare and John Donne in their literary works, and was among Protestant exiles aboard the Mayflower as they traveled to the New World. The *Geneva Bible* was printed until 1644 when it was outlawed in favor of the King James version (Gleeson, 2009).



Figure 1: Historia Troiana Guidonis



Figure 2: Geneva Bible

The significance of these books requires that treatment preserve elements of the artifact that give evidence to its rich history. With early printed matter determining appropriate treatment can become complicated. Printed texts of this period were not typically bound by the printer, and may have been stored as sheets for years before receiving any type of binding. By studying evidence of prior sewing stations and material found in the construction of these books, a hypothesis may be made concerning the initial structure for each book. Research conducted aims to understand structures and materials that would be appropriate for the period in which these books were created, and ultimately hopes to yield a balanced treatment that speaks to the historic, aesthetic and functional origins of each piece.

## 2. EXAMINATION AND CONDITION:

This project undertakes the examination and treatment for two volumes and will be addressed distinctly in terms of documenting their study and treatment.

### Historia Troiana

Incunabula mark a transition period as the book moves between an exalted status in the form of manuscripts displaying exquisite calligraphy and illumination (as seen with liturgical works), to a commodified version of printed text, one that becomes accessible to a wider audience not only through the increased production derived from printing multiples, but also through more personal formats such as quarto and octavo sizes, and rethinking of text to provide greater legibility and ease for readers.

The book as received was in disrepair due to a detached cover, degraded spine linings, and disfiguring stains throughout the text block. Upon further examination, it was determined that a series of rebindings had been undertaken on the book, and that the cover, a speckled paper case (presumed to be 18<sup>th</sup> century), was not likely to have been produced as part of the initial binding.



Figure 3: *Troiana* as received

Investigation of the book began with the identification of a watermark appearing throughout the text. The watermark was identified as a bull's head with a five-pointed star and was documented using beta radiography shown here.



Figure 4: Beta radiograph, bull's head watermark

L.B. Styr. Incun. 779  
Strassburg 1486

Imp. [G. Husner] 1486

### Wasserzeichen Informationssystem

Detailansicht

Referenznummer DBS100-PO-74752 <Permalink>

Motivgruppe Ochsenkopf (in Bearbeitung) - Mit Augen und Nasenlöchern - Darüber einkanturiger Stern - Ohne weitere Bezeichnungen

Quelle Deutschland, Stuttgart, Württembergische Landesbibliothek, Stuttgart, Incun. 779  
1486, Straßburg  
Aussteller: G. Husner [erschlossen]  
Impr. [G. Husner] 1486

Abmessungen || 35 mm, Breite 38 mm, Höhe 62 mm

Bezüge Piccard-Online

# 🔍 📄 🔗

Helligkeit

Figure 5: Bull's head watermark located via database search

The motif was searched using the online database *Bernstein The Memory of Paper* and a likely match was determined. This bull with a five-pointed star was found in printed papers in Strasbourg during the 1480's. The x-radiograph was a very good match to images derived from the database. Location of chain lines as well as close comparison of design elements of the mark were used to make this determination.

The identification of the watermark provided a link to identifying the printer as Georg Husner, a known printer from Strasbourg, Germany during this time period. With this information a search was conducted using Worldcat, a database of the Online Computer Library Center (OCLC). The search led to the discovery of two other copies of the book, held by local libraries, as well as one digital copy accessible online<sup>1</sup>. Further investigation unfortunately showed that the local copies were both later editions that could not offer information regarding the initial binding, as hoped. Though the binding was not visible in the digital copy, this version did prove useful in clarifying collation of the text. Missing leaves became apparent in the last gathering, as compared to the digital copy. The last leaf (O8 recto and verso) of the BHM copy is missing.

Copy comparison helped to illustrate pertinent design elements of the book. *Troy* seats itself in the midst of the transition from manuscript to printed book. Though the majority of the work is printed text, spaces have been left blank for the insertion of rubricated initials that would have been done by hand. In the case of the BHM copy the rubrication was never completed, though a naïve attempt is apparent on the opening leaf of text.



Figure 6: Buffalo History Museum Copy



Figure 7: Digital copy, Universitat Darmstadt

<sup>1</sup> Digital copy published by the Universitat Darmstadt [<http://tudigit.ulb.tu-darmstadt.de/show/inc-iv-169/0001>]



The double column layout seen in *Troy* was common for manuscripts, as this improved legibility of small calligraphic work. In contrast to manuscript style however, printers' copies started their own design evolution. In the earliest printed works, typefaces were cut to emulate manuscript hand. Later on however, faces became more open and legible as they moved from Gothic style towards Roman. With the increased production and demand that accompanied printing, more titles became available to prospective readers. Sheets were printed en mass, collated into texts and sold. They were not bound until after their purchase, leaving binding design up to the owner, not the printer. Because titles were held in stacks of sheets, printers introduced title pages to more easily identify different copies, and also to protect the text block from dirt or damage prior to binding. Title pages came into use in the 1480's and *Troy* displays this new trend.

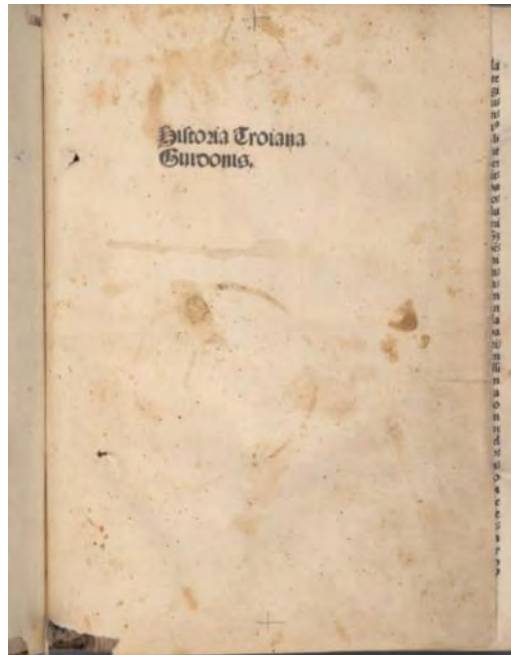


Figure 8: Title page

In addition to title pages, other features such as chapter headers began to appear, creating works that were designed for a more practical reader who valued legibility and continuity over a singular aesthetic sense for the page.

While the printing of this text offers a wealth of information for in-depth study, the binding in this case tells a unique story of the provenance of the BHM *Troy* copy. A method of identifying historical binding structure proposed by Gary Frost, was followed and focused on three major

structural elements: kerf, edge and crop. “Kerf refers to evidence of current and previous sewing stations, their types and patterns. Edge refers to evident clues of edge trimming methods and re-trimming. Crop refers to evidence of missing manuscript annotation and margin” (Frost, 2013). Through this method both edge and crop were identified as having been disrupted from the initial binding. The margins of the text have been trimmed. The head of the book is most noticeable in this case, as the section headers run very close to the edge of the page; nearly clipping it and no deckle remains to the edge of the paper. Comparison of the BHM to the digital Darmstadt copy shows a decreased margin for the BHM copy at the head, tail and foreedge of approximately 50% as compared to the Darmstadt digital copy. While the digital copy does not necessarily represent the full printed sheet size prior to trimming, it does provide enough evidence to show that the BHM copy has indeed been significantly cut down along the three outer edges. In other areas of the text annotations run off of the page into the foreedge, showing evidence for disruption of crop. The most interesting observations however came from the kerf.

*Troy* was sewn through the folds, but in addition, a stab sewing was added throughout the entire textblock. The sewing was still intact, and clearly the last campaign of sewing for the item. Unfortunately for the volume the stab sewing introduced holes in the text block, damaging the printed sheets. This unappealing effect also introduced a functional problem for the book as the text pages are not free to open all of the way, and a great deal of stress is centered along the stab sewing margin, which would likely create a breaking edge over time.

Following photo-documentation and collation, the textblock was disbound and examined in detail noting kerf. A sketch was produced noting sewing stations in current use, possible sewing stations no longer in use, and the position of threads for each section of the book. After disbinding, signatures A-O were examined and a mark was made on the diagram for every pierced station found. In some cases tears through the folds made identification of stations approximate, however distinct patterns of sewing began to emerge.

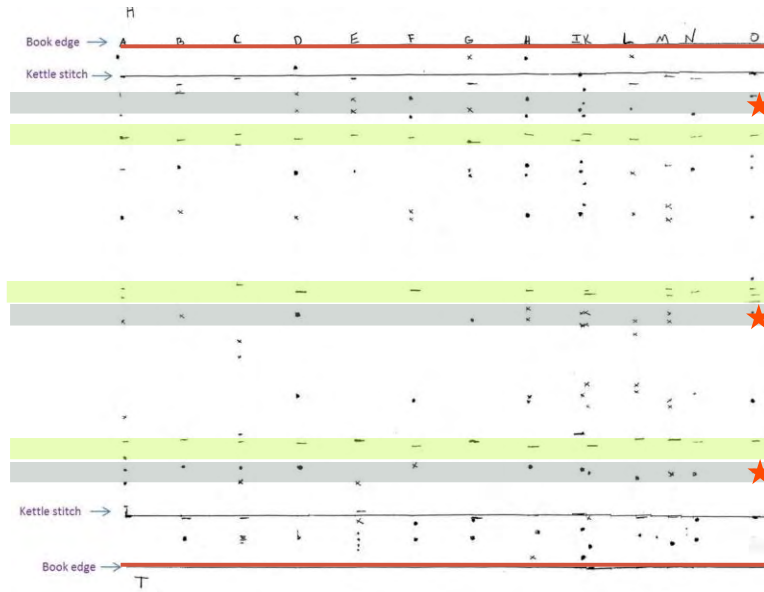


Figure 9: Kerf Diagram

Based on this study two sets of sewing stations were identified. Three concentrated areas of marks (green line) were located that suggest a possible pattern for sewing onto cords, while a secondary sewing pattern was seen that suggested paired stations (gray), as would be expected for a book sewn onto support such as vellum tapes. A single-station stitching onto cords would have been a more likely pattern in relation to the period of printing for *Troy*, whereas paired sewing onto tapes would suggest a later or secondary sewing. Stitching onto tapes could have been done all-along with the paper case binding structure in which *Troy* was received.

One set of kerfs begins close to the tail of the book, and was likely the earlier set, sewn prior to the trimming of the textblock. The second set of kerfs mimics the first set, but starts approximately ½” higher for each sewing station. This set appears more natural for the current state of the book and was assumed to be added later. Further supporting this hypothesis, remnants of sewing threads were found in the folds of the text where these secondary kerfs appear.

It was decided that rebinding of the *Historia Troiana* would follow the five-hole kerf pattern using the secondary (blue/starred) kerf pattern as a guide. This decision was in keeping with

what was inferred to be the initial binding of the text, while accounting for its newly trimmed edges, and altered format.

### Geneva Bible

In contrast to the *Historia Troiana*, the *Geneva Bible* was received in seemingly poor condition, though further examination revealed it was more intact than previously seen. The bible arrived in the department heavily soiled, with tattered edges, and missing sections of text. The first few sections of the book were clearly missing, as noted by performing collation of the text. A section in the middle of the text was loose due to slack sewing, and protruding beyond the edge of the text block. The spine of the book showed evidence of being rebacked. A piece of vellum was attached around the spine with adhesive, and beneath this layer a leather rebacking piece was also attached to the spine. This likely indicated that these spine pieces were holding together a break or split of the original binding. Breaks along the joints of books are very common as this is where the action of opening is concentrated. The vellum spine piece was removed mechanically with a microspatula, and the leather rebacking piece was lifted from the front cover after removing tacks that had been driven through the front board to hold it in place. An examination of the initial leather spine beneath these outer coverings showed no evidence of damage.

The leather binding that covers the *Geneva Bible* has many attributes that suggest it may be the initial binding for the piece. The leather is heavily cracked and damaged, and has likely undergone a consolidation treatment at some point. Metal bosses and hardware adorn the boards and do not appear to have been later additions. The pasteboard covers in *Geneva* would be correct for the period of production (1597) as the 1500's marked the shift away from wooden boards. Nails attaching the parchment spine were driven directly through the original leather into the cover boards and straight into the text.

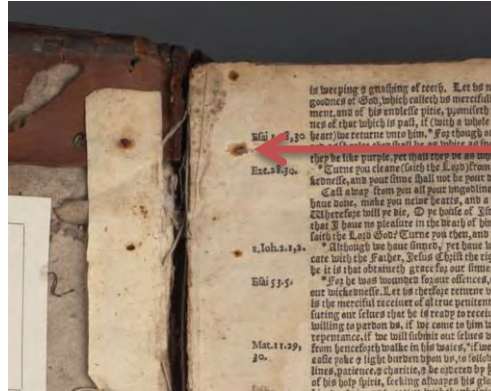


Figure 10: Nail holes in Geneva Bible from front cover into the first page

Given the possibility of the structure being an initial binding, and also given that the binding was still intact, it was decided that any treatment to address the loose section had to be made without further disruption to the spine. A leather reback had been considered as a treatment option based on first impressions of the book, but with greater study, it was determined that this treatment would be invasive and damaging to original material and was therefore deemed inappropriate. Questions surrounding the need for any intervention began to emerge. Attempts at treatment for this binding returned over and over again to questioning the suitability of treatment, and assessing the ultimate purpose and context for the future use of the book. The initial proposal sought to secure the loose section of text that had protruded past the foredge of the text block by reseating the section within the block. After some attempts, and further examination it became apparent that the section was hindered by adjacent sections of the block. Initial collation of the text indicated that it comprised more than one volume or groupings of material, known as a sammelsband or “bound with.” Closer visual examination of the exterior of the text at the head and tail illustrated where the protruding section was sandwiched between two adjoining text blocks. The texts were originally rounded and backed and in their placement together the shoulders of each text butted against one another, creating a “scallop” along the spine (a). Ultimately it was the shoulders not just loose sewing, which was responsible for pushing the section forward in the block.

It is not uncommon to find groupings of texts such as this, particularly in religious material. These personal books often traveled, and having a single binding for a group of texts as opposed to transporting numerous loose bindings was advantageous. Records indicate that these scalloped

bindings may have been the format that travelled from England to the New World as Protestant exiles fled religious persecution.

While treatment to remedy this would clearly be invasive, these features of the artifact illustrate the provenance of the item, and for this reason were left as is. The binding clearly speaks to the history and use of the piece, and conjures up ideas regarding the type of owner it may have had, as this book was a utilitarian commodity. The binding was not precious but instead emphasized functionality above all other design constraints. Given the limitation to treatment, the section was secured with sewing and a tissue hinge, but no attempt was made to bring the foreedge square. A box was constructed to house the item and facilitate future handling.

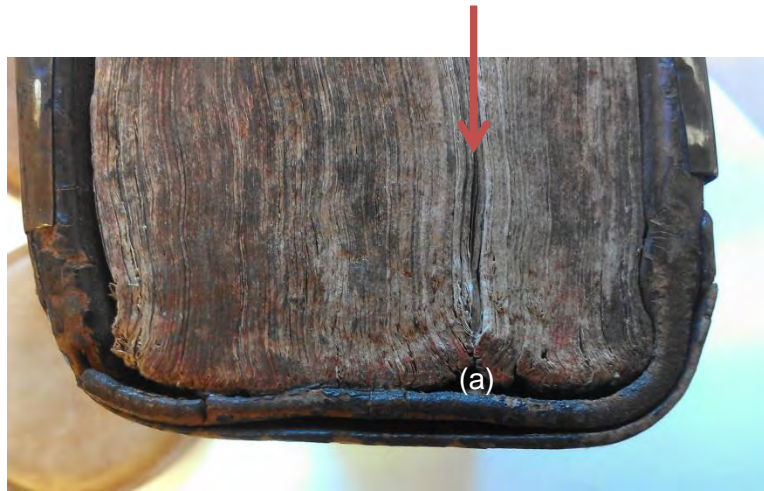


Figure 11: Scalloped head of *Geneva* and protruding section

### 3. COMPARATIVE FEATURES OF *HISTORIA TROIANA* AND THE *GENEVA BIBLE*:

*Historia Troiana* and the *Geneva Bible* presented two paths of conservation methodology with radically different treatment goals.

With *Troy*, many physical features suggested that it might be a candidate for rebinding:

- The cover to text attachment of the front board was broken upon receipt.
- The text block was sewn multiple times, with a final stab sewing to secure the text block. The stab sewing impaired use and was not appropriate for this type of binding.
- The paper case binding did not relate to the period of production. (Note: as mentioned previously, books of this time period would have been sold in sheets, so determining the

initial binding for this text is problematic, as there is no way to prove it was ever bound at, or near the time of printing.)

- The significance of the book is as a physical artifact of the incunabula, or dawn of printing. The binding did not provide structural support to allow the book to be studied and handled. In this case this artifact of printing would be of more value to researchers than the intellectual value of the text itself, which is widely available in other sources.

In contrast, the following factors suggested that the *Geneva Bible* would be better served in its current state, without rebinding:

- The book as received appeared to be in its initial binding.
- Its condition, though damaged, does not impair careful use. Like *Troy*, use for the sole purpose of studying the text would be low, as other sources of the content are widely available.
- The book at present is secure and any treatment undertaken to improve stability would be invasive at this point. If the structure showed more significant failure in future, treatment could be re-evaluated then.
- Treatment to improve the structure of the book, in particular the scalloped binding and protruding section, would disrupt the evidences of use that authenticate the history of the object.

Taking into account these factors, the conservator is called upon to apply treatment that is responsible to the artifact, to its intended use and is in keeping with ethical practices and guidelines as established by the American Institute for Conservation (AIC). Treatment in practice is admittedly subjective but informed by thorough review of available options, a complex understanding of materials and sensitivity to the context of the artifact in use. Treatment of any type is always an invasive approach, no matter how minimal it may seem. When opting to treat an object the benefits must outweigh retention of the object in its current state. Choosing to postpone treatment for an object is appropriate when desired use can be supported and further deterioration is not eminent. While curators and custodians often push for intervention when an object has aesthetic concerns, it is the responsibility of the conservator to assess the structural integrity of the object, and to provide a compelling argument to forgo treatment when the

situation warrants it. In this case it is the conservator's role to go beyond that of a technician, to provide not only technical expertise, but to be able to educate custodians to the full range of options and the benefits and risks of each. The conservator must advocate for the significance of the physical provenance of the work, beyond the perceived aesthetic value which does not always tell the whole story.

In light of these factors, a treatment plan was developed for both of these objects that would address the goal of protecting the items and facilitating their use in a research setting. While the *Geneva Bible* would be left untreated, the *Historia Troiana* would undergo a full rebinding to return the book to a usable state and create a more sympathetic appearance related to its period of production.


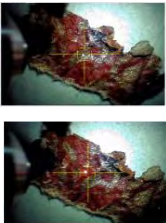
#### **4. MATERIALS ANALYSIS:**

##### *A. Introduction:*

Analytical techniques were used to further investigate the physical components of these books. This work supplements examination in order to document materials and provenance and to provide guidance in developing treatment strategies. Table 1 provides a complete list of the techniques used in this study.



Table 1: Analysis Summary

Analytical Technique	Purpose	Sample Location	Settings	Result	
Breeches Bible 126940	Grenz x-radiography	To examine details of the spine and underlying sewing structure.	Book spine	Using a bare-IP digital imaging plate, 34" height, 45° angle, 101, S, 20kV, 200 mAS, 5 mA, 40 seconds	Resulting image showed location of metal tacks and indication of four sewing supports beneath the leather and vellum covered spine.
	Visual examination at head and tail	To determine cause for the protrusion of loose section at center.	Book head and tail	N/A	Resulting photograph illustrates the assembly of two previously rounded and backed texts that have been rebound into the current format. Note the shoulders of the individual texts that are responsible for protrusion of the center section at sewing break.
Historia Troiana 126917	Beta x-radiography of Bull's head watermark	To examine and identify watermark appearing throughout the text block at the center of the sheet.	Interior text page, imaged while text was disbound	Using a Beta C-14 digital imaging contact plate, 20 minutes, min 930, max 2390, mean 1736	The watermark was clearly imaged using this technique; laid and chain lines are visible, and white spots indicative of points of higher density are visible in the image. These spots could indicate localized build up of fibers or other inclusions in the paper.
	Grenz x-radiography of Bull's head watermark	To examine and identify watermark appearing throughout the text block at the center of the sheet.	Interior text page, imaged while text was disbound	Using a bare-IP digital imaging plate, 15" height, 90° angle, 101, S, 5kV, 6000 mAS, 10 mA, 10 minutes, min 1983, max 2439, mean 2284	This image more clearly defines the detail seen in the Beta radiograph. Laid and chain lines are more prominent, and the antique laid settlement of the paper fiber during sheet formation can be identified. White spots are still clearly visible in the image.
	Grenz x-radiography of Historia cover boards	To examine layers of material composing the cover boards.	Three images were recorded in order to capture the entire set of boards (left, right and center). The images were stitched together resulting in a single composite image.	Using a bare-IP digital imaging plate, 15" height, 90° angle, 101, S, 8kV, 4500 mAS, 10 mA, 7 minutes 30 seconds	The image shows areas of greater density at the corners and along the spine of the boards. This indicates the boards were at one point used in a half-leather style binding as these would have been areas covered by additional material.
	Polarized Light Microscopy (PLM) of sewing thread	To examine and characterize the fiber content of the initial sewing thread.	Remnants of thread removed from sewing through the folds of the text (i.e.: presumed to be the earliest remaining sewing extant)	The sample was prepared on a temporary mount with water applied to the fiber placed on a microscope slide. Microscopy was performed using a Zeiss AXIO M1 microscope. The sample was observed in reflected light bright field, (PLM) at 200x magnification.	Images show "x" patterned lumen characteristic of bast fibers, such as linen.
	X-ray Fluorescence Spectroscopy (XRF)	To examine the characteristics of the manuscript ink, and text paper substrate.	1) First page, brown inked initial "L"; 2) non-printed paper area 	X-ray fluorescence spectra 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 40 kV. The X-ray beam was directed at the artifact through a masked aperture of 1.0 mm in diameter. X-ray signals were detected using Peltier cooled XFlash silicon drift detector (SDD) with a resolution of 146.4eV. Spectral interpretation was performed using the Artax Control software. Spectra was collected over 180 seconds live time.	XRF spectra show intense peaks for iron, generally indicative of iron gall ink. Unprinted areas of the paper also show equally high peaks for iron. This may be due to migration of iron ions throughout the sheet, or also through iron contamination of the water used in initial sheet formation. Ca, K, and S are also prominent in the spectra as these would be associated with alum sized paper of this period.
X-ray Fluorescence Spectroscopy (XRF)	To examine the characteristics of a decorative paper fragment found along the spine of the book.	1) Paper fragment metallic surface; 2) Paper fragment pigmented surface 	X-ray fluorescence spectra 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 40 kV. The X-ray beam was directed at the artifact through a masked aperture of 1.0 mm in diameter. X-ray signals were detected using Peltier cooled XFlash silicon drift detector (SDD) with a resolution of 146.4eV. Spectral interpretation was performed using the Artax Control software. Spectra was collected over 180 seconds live time.	XRF spectra show intense peaks for copper, in addition to the presence of Zn, Pb, and possibly Cd. The pigment could not be determined from this result alone, but the metallic surface is identifiable as copper, or copper alloy.	

Multi-spectral Imaging (MSI)			A set of 4 identical views of the subject were captured under illumination ranging from 650 to 1000nm, spanning the ultraviolet, visible and infrared spectrum.	MSI showed the disappearance of the manuscript inks from about 700nm onward (near IR range)
Micro-reflectance Transfomation Imaging (RTI)	To examine the impression of the type in comparison to the manuscript ink and the page.		A set of 6 identical views of the subject illuminated with a single light source was made, each image taken with the light at a different position. The image set was computer processed using RTI builder software to create an RTI file that calculates surface topography and allows for virtual imaging of the subject with the light at any position and with variations in surface characteristics. The virtual imaging is done using RTI reader software that also allows for still captures to be made.	While the text in this volume was letterpress printed, RTI shows how relief in the impression of the type. The printed text lies nearly in plane with the paper surface, and is comparable to and applied ink also visible in this sample.
InSb Infrared Reflectography and Transmittography	To examine layers of material composing the cover boards, and attempt to identify patterned paper underneath.	Cover boards.	Examined with both transmitted and reflected IR luminescence using a Xenics Dnca-SWIR-MWIR-InSb camera.	No clear indication of underlying patterns could be detected.

*B. Summary of selected techniques: Geneva Bible*

A limitation to assessing condition of the *Geneva Bible* was access to the spine of the book. Grenz radiography was used to examine the sewing structure of the binding, and to look for clues that may suggest alterations over time. The Grenz radiograph image shows that the book was bound using four sewing supports that are laced onto the boards. The sewing shows no evidence of disruption and is in keeping with the format of this binding.

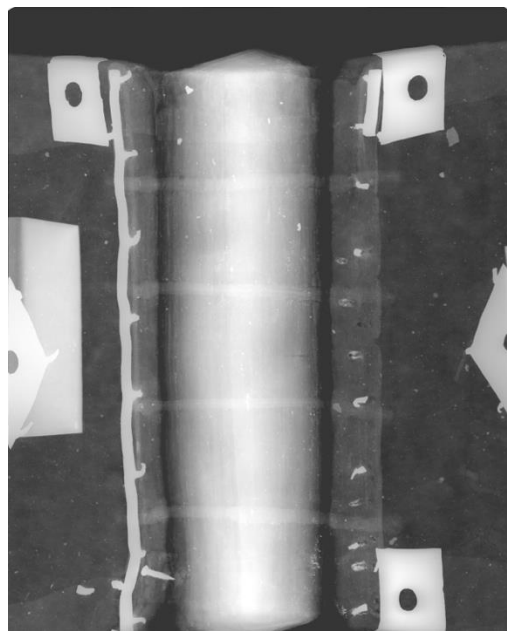


Figure 12: Grenz x-radiograph *Geneva* spine

Also visible in the image are small metal tacks that were used to attach the outer vellum to the exterior of the binding, and also to secure metal hardware to the front and rear boards. Both the

sewing and the hardware appear undisturbed and stylistically are appropriate for the era in which the text was produced. This observation supported the idea that the book maintains its initial structure, and calls into question the need for significant treatment intervention.

*C. Summary of selected techniques: Historia Troiana*

While the kerf diagram provided a good basis for establishing sewing patterns and documenting alteration of the binding through multiple campaigns of stitches, x-radiography further supported this discovery by providing evidence of reuse of the cover boards. A composite x-radiograph of the cover was constructed using Grenz radiography. The image clearly shows areas of increased density along all four corners and the spine. It is likely the boards were part of a half-leather binding at some point, in which the corners and the spine would have been covered in leather.

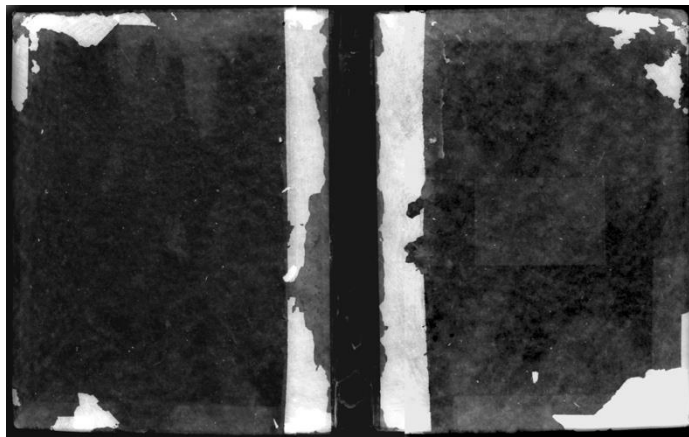


Figure 13: Composite x-radiograph *Troiana* cover boards and spine

A tear in the covering paper along the right foreedge of the cover board revealed a decorative red paper beneath the speckled outer cover. During rebinding, a small fragment of a gilded red paper was discovered lodged within the inner cover near the head of the book. The question arose, could this gilded paper be the same as the red paper beneath the top covering? Infrared reflectography and transmittography was used to attempt to answer the question without invasive procedures. The boards were imaged using an InSb camera in the near infrared region (750-2500 nm) with the expectation that a gilded pattern may be visible as a layer beneath the covering material. Unfortunately no such information was found. As the original boards would not be reused in treatment, the librarian responsible for the book was contacted to request permission to

mechanically remove some of the covering material in order to examine the red paper beneath. With permission granted, the covering layer was peeled back using a microspatula along the torn edge of the front board. A quarter inch wide section of paper was revealed, and was apparent to be different from the gilded sample discovered along the spine. The paper beneath the speckled outer covering is not gilded and appears to have a combed appearance like those seen in 19<sup>th</sup> century non-pareil or peacock patterned marbled sheets (University of Washington). This pattern and appearance on the cover boards are indicative of a much later binding, not related to the period of production of the text.

Ultimately examination of the fragment did not correlate to the exposed layer of marbled paper of the reused boards. This investigation did however, further illustrate that the boards had been used in more than one campaign of binding, which was not necessarily related to the Troy text. They were certainly an addition to the most recent rebinding of Troy, and not original to the text whatsoever.



Figure 14: Foreedge with lifting cover paper, *Troiana*

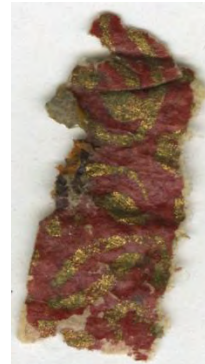


Figure 15: Gilded fragment, *Troiana*

#### *D. Further Study*

Additional techniques were used to examine *Troiana* and provided information to characterize the materials used in construction of the piece. A brief overview of these techniques includes:

##### Microscopy

Remnants of thread sewn through the folds of the book were found throughout the text. These threads, thought to be from the initial sewing were analyzed using polarized light microscopy on

a Zeiss AXIO M1 microscope. The threads were identified as bast fibers based on the characteristic “X” pattern visible within the lumen.



Figure 16: Sewing thread polarized light, 200x magnification

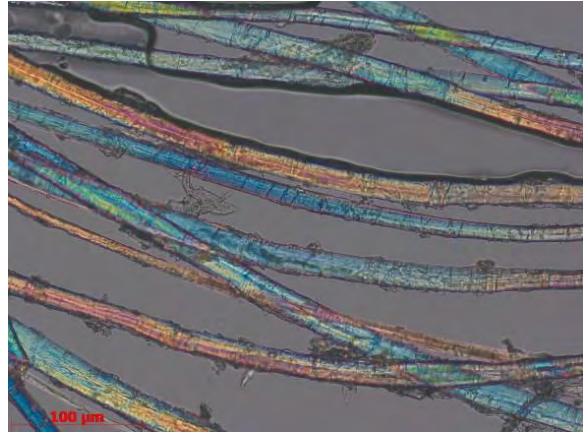


Figure 17: Sewing thread, crossed polarized light, 200x magnification

## RTI

Micro-Reflectance Transformation Imaging was used to characterize relief patterns of the printed text. The image below shows a single still from the RTI series. This technique showed that the letterpress printed text was in fairly minimal relief in comparison to the texture of the paper surface, as well as in comparison to hand drawn annotations composed in ink. The lettering type was not deeply impressed into the sheet, but appears at a similar level as the pointer seen in this image.

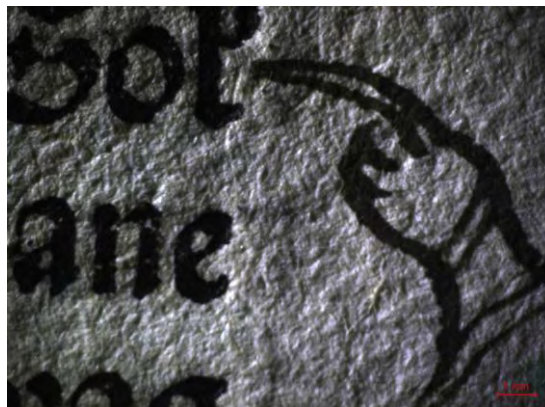


Figure 18: RTI *Troiana*, leaf b5

## XRF

X-ray fluorescence spectroscopy of the hand-drawn ink annotations showed a marked level of iron content in the ink. This finding is indicative of iron gall ink, which would be expected for the period, and is consistent with the color, application and use for this sample.

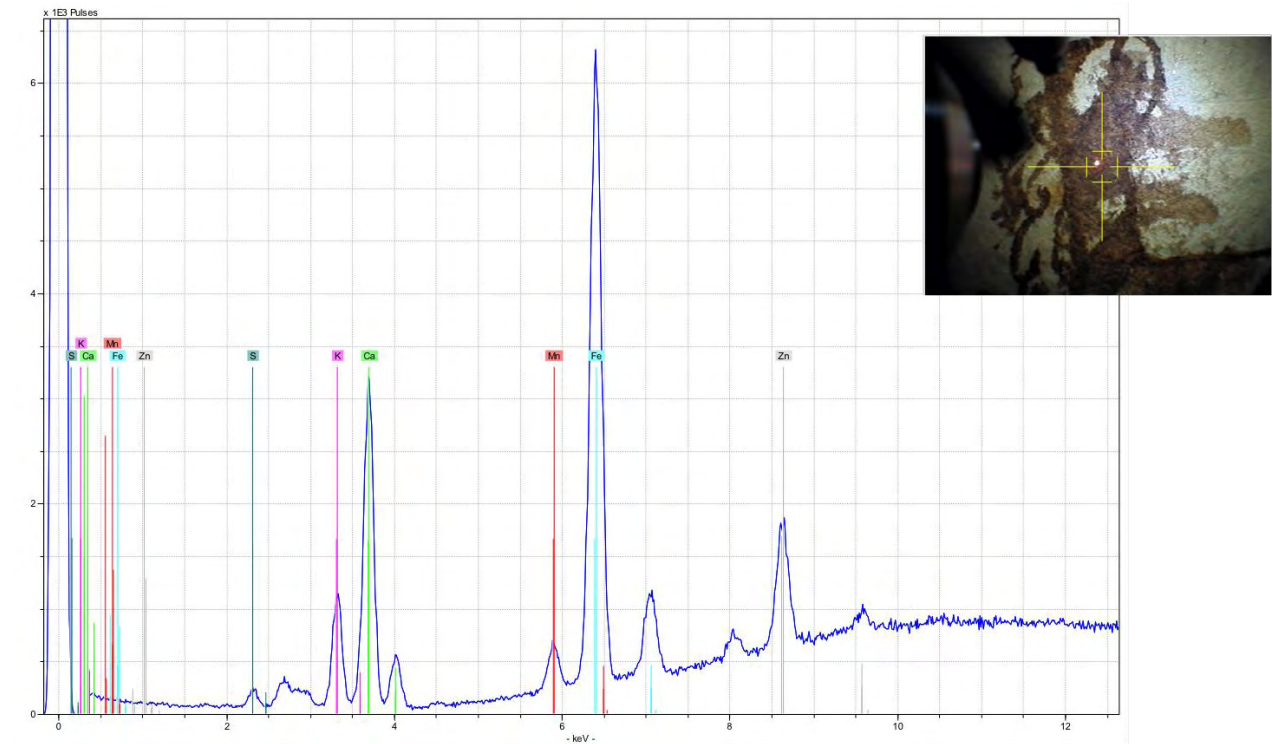


Figure 19: Annotation ink, XRF spectrum

## Multispectral Imaging (MSI)

Inks were further characterized using multi-spectral imaging. False-color imagery was produced that illustrated distinction between the iron gall ink annotations and the black letter press printing ink used in the text.

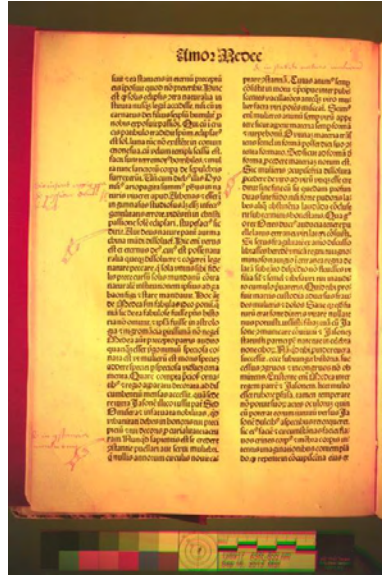


Figure 20: False color image printed and hand applied inks

Furthermore, the annotation inks are seen to disappear when viewed at higher wavelengths of the infrared spectrum. Figure 21 shows an image taken at 900nm in which the printed text is visible while the annotations have become effectively invisible. Iron gall goes transparent in the near infrared range at about 1000 nm (Walmsley, 228).



Figure 21: MSI image at 900 nm, invisible hand applied ink

## **5. TREATMENT OVERVIEW FOR THE *HISTORIA TROIANA*:**

Having considered historical context, visual examination, condition and material analysis and intended usage, treatment for *Historia Troiana* went forward in an effort to support improved use for the item. The goal of treatment was to improve stability, and functional characteristics of the text while returning the structure to an aesthetically sympathetic style related to the period of production. The book's significance is primarily as an example of an early printed text. To that end, treatment focused on the preservation of the text, and avoided any work that might undermine characteristics of the printing. While significant stains were noted on some pages of the text, washing was not considered as a treatment option due to the potential for distortion of the leaves, and possible alteration of the texture of the impressed lettering on the page. The text was printed onto a good quality handmade paper that was in excellent condition even after 500 years of existence. Minimal page mending was required, and guarding of the sections was needed essentially due to the multiple campaigns of sewing, leaving the folds of the sections perforated and weakened.

As part of the Buffalo History Museum, the book serves a purpose as a subject of scholarly research. It therefore needed to withstand careful handling for consultation and visual inspection. As the paper case binding in which it was received did not relate to the period of production, the decision was made to rebind the text in a more appropriate style of binding. A 15<sup>th</sup> century Gothic style wooden boards binding was chosen as an exemplar of the period of production. The binding included sewing onto cords that are laced in over wooden boards. The boards are covered in full leather, with a tightback application. Not only does the binding offer great protection to the text with the strength of the boards, beveled board edges provide a range of motion as the text is seated to the boards, and supported by the raised cords. The sewing and board attachment are fluid and functional creating a nearly flat opening, and smooth drape of the text. In addition to the functional considerations, the full leather binding is aesthetically relevant to the period of production. It is important to note that a new binding can never recreate, or restore the experience of the original object, but in choosing a binding style of the period, the book will be aesthetically sympathetic when viewed with other works of its period. As an object for research, it is useful that the binding will not distract or confuse the user with features that are anachronistic to the text.



*A. Brief discussion on Gothic Binding:*

Gothic wooden board bindings date from the early fourteenth century through the seventeenth century. A main feature of Gothic style is that the sewing supports travel up and over a beveled spine edge of the board and are laced down from the outside to the inside of the cover. This results in a rounded spine as the boards are drawn onto the text block during lacing. Boards are generally beveled along all edges though the style of bevel varied widely. The rounded spine shape produced a flexible support for the text block. In combination with packed sewing the Gothic text has a better ability to support its shape, with even distribution of stress along the spine, as compared to the flat spines of Carolingian and Romanesque predecessors. The design was problematic for parchment books but was actually beneficial to books on paper (Szirmai, 272).

Text blocks in this period were trimmed using a plough versus a drawknife that was used on earlier styles. Edge decoration began to appear late in the 15<sup>th</sup> century. Endbands were typically plain. Calf and tawed pig were commonly chosen leathers. Full leather covers predominate the era, but quarter leather was seen beginning in the 15<sup>th</sup> century as a way to hasten production and preserve expensive materials.

*B. Highlights of Treatment:*

A full leather rebinding was selected as the primary treatment for the *Historia Troiana*. In preparation for this work, a wooden boards binding model was prepared as a study to examine techniques related to the final conservation binding.



Figure 22: Gothic binding model

While the structure for the model is the same as that used for *Troy*, some modifications were made that are applicable to conservation of the textblock, in order to avoid alterations of original material. These modifications include the following:

- The use of a plough to trim the edges of the text block was not used for the actual *Troy* textblock. The book was clearly trimmed during previous rebinding campaigns and much of the margins have been lost. It is no longer considered appropriate conservation practice to trim original material, as loss of original material threatens the integrity of the physical object.
- For similar reasons the *Troy* text was not edge painted as done for the model. *Troy* features a blue speckled design along its edges. While faint, obscuring this evidence would clearly be inappropriate.
- Wooden boards used in the model were replaced with laminated book boards for the treatment of *Troy*. The laminated boards provide the same strong protection as wood, and are similarly beveled and shaped, however they avoid the possible off gassing of volatile acidic components that are known to occur with wood during aging. In this case book board, museum boards and cardstock were laminated together using wheat starch paste to achieve the same thickness as wood.

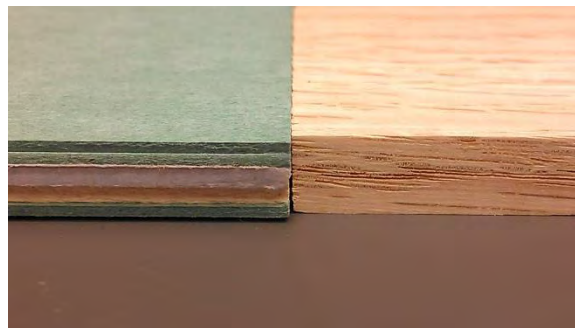


Figure 23: Lamine versus wooden boards

### *C. Selected techniques*

#### Sewing of the text block

The text was sewn onto double cords with a modified packed sewing. The first and last three sections of the block were packed, while the interior sections were not. As seen in the illustrations below, packing helps provide additional support to the first and last sections that

absorb the greatest amount of stress through opening. By lessening the packing for the center sections the text has more mobility and can flex along the sewing supports with minimal restriction.



Figure 24: Partially packed sewing on *Troy*

Endsheets were constructed out of parchment bifolios, sewn to the textblock through a hinge of alum-tawed goat. The parchment provided a sympathetic pattern that matched the characteristics of the stained and mottled text pages. It also created a very protective sheath to the text upon first opening of the boards.

#### Board preparation and shaping

The decision to use laminate boards instead of wooden boards was made primarily for preservation reasons. Wood is known to off-gas organic acids upon deterioration setting up an environment for acid migration into the text block (Tetreault). Using a laminate of more stable materials such as museum quality book board, and mat board, not only avoids this problem, but offers the opportunity to control the shaping and pull of the boards by way of deliberate pasting up of the laminate.

In an ideal setting, boards would be made by laminating materials with a slow drying adhesive, such as wheat starch paste, and allowing them to dry flat under weight for a considerable amount of time, up to a few years. This “seasoning” of the boards, gives time for the adhesive and the board material to set into a particular shape, and a solid flat board is most desired. In pasting up

the boards the effect of the adhesive penetrating through the material is a factor to the way in which the boards pull during drying. To control this issue the boards were pasted up and assembled in the following sequence where “O” is the outside of the finished board, and “I” is the inside of the board. This assembly aided in producing a slight positive draw of the boards towards the text, as the laminate dried.

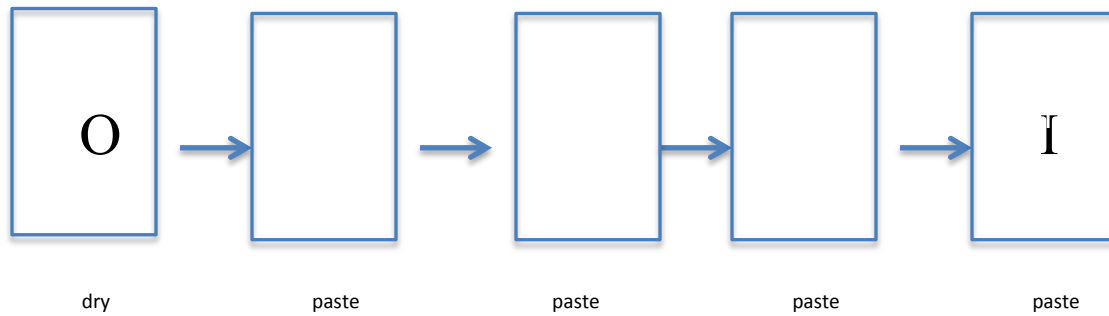


Figure 25: Preparing laminate boards

Shaping of the boards was completed using a block plane with the boards restrained in a press. The outer bevel was planed to create a round, or “pillowed” effect that cushioned the action of the cords that travel up and over the edge. The inner boards were planed to an angle that meets the shoulder of the text. The inner bevel is flat, unlike the round of the outer bevel. This shape created an important point where transmission of the leverage of the board guides the action of the text block upon opening.



Figure 26: Texts in boards

## Covering

The book was covered in full leather that was edge paired using a spoke shave. Special attention was given to drawing the leather across the spine, and shaping it around the cords. Adding paste to the spine of the book, as well as the spine edge of the boards, helped the leather to adhere better during shaping, and minimized tenting of the leather that would create air pockets along the bands. The book was tied up in a press using a nylon cord to help seat the leather tight to the spine around the cords of the book. The finished binding was allowed to dry under weight for approximately a week, and then opened cautiously to exercise the leather and boards together to achieve the final action of the book while avoiding creasing marks of the leather along the spine.

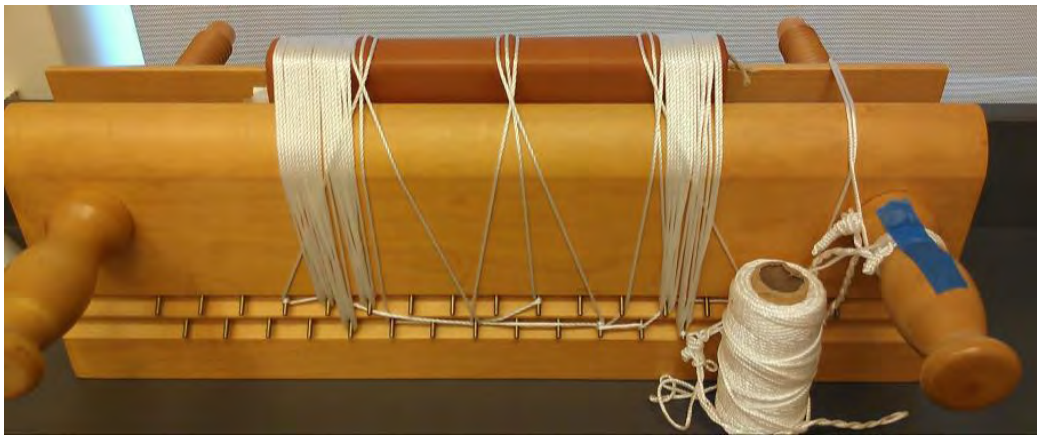


Figure 27: Tying up



Figure 28: Finished spine

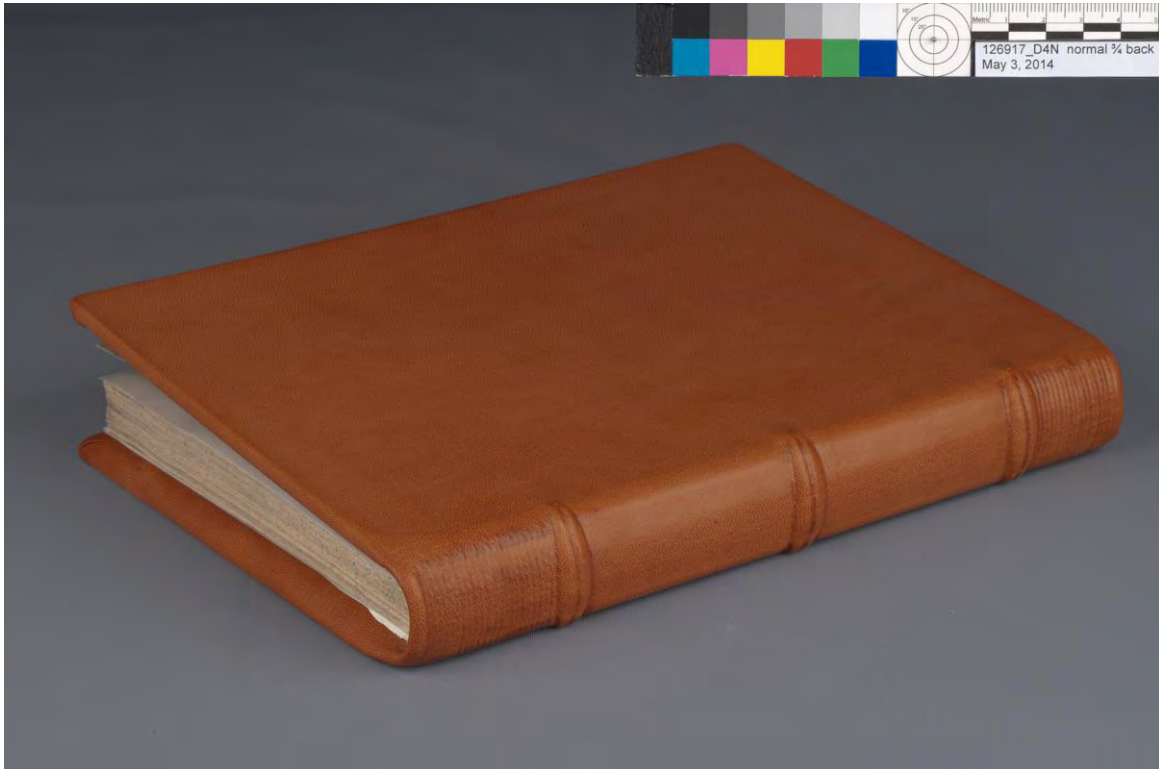


Figure 29: Finished binding

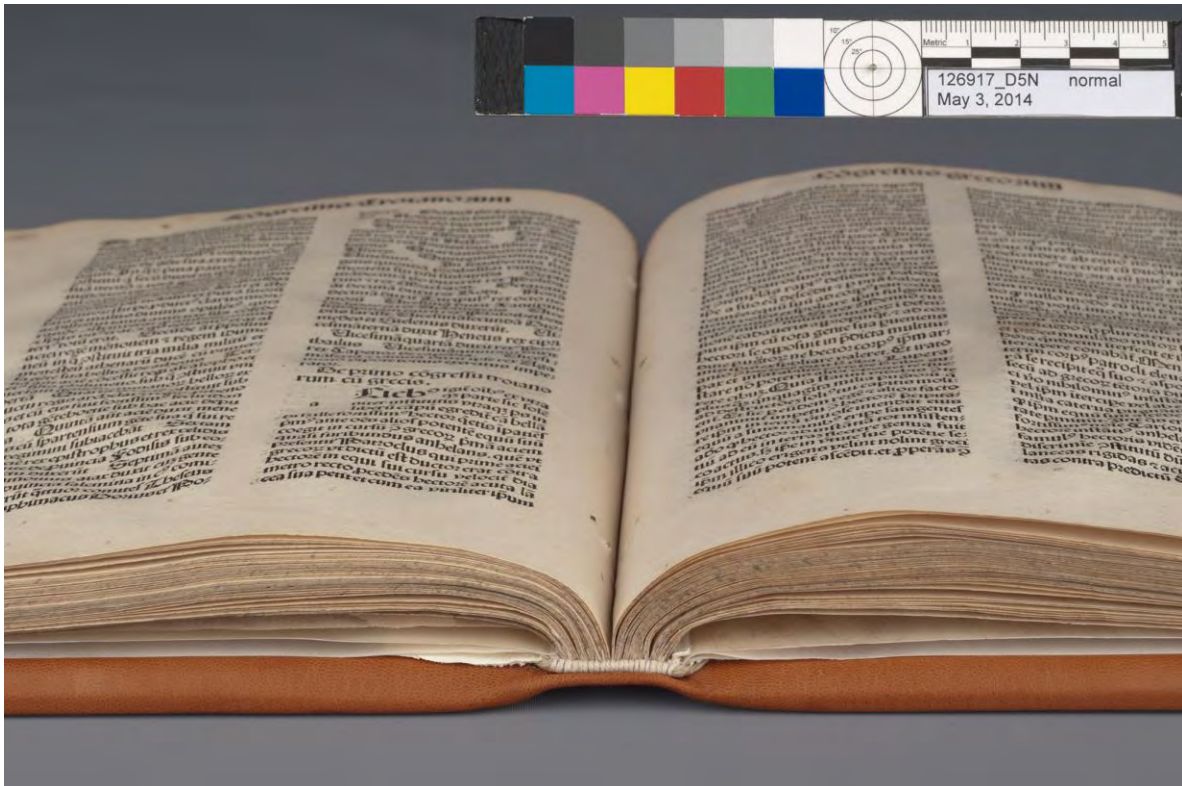


Figure 30: Opening

## **6. PREVENTIVE CONSERVATION RECOMMENDATIONS:**

To ensure the long-term stability of *Historia Troiana* and the *Geneva Bible*, the following recommendations are provided to offer best practices for their preservation.

### *A. Housing*

Drop spine boxes have been constructed to house the books safely. As the *Historia Troiana* has shown some expansion of the boards due to the pull of the leather covering material, the box designed for *Troy* includes a compression flap that will hold the book securely in the proper shape and reduce the potential for improper pull of the boards.

The drop spine box will protect the books from dust, debris, abrasion and other physical damage during storage and handling. It buffers the objects from extreme fluctuations in the environment by creating a microclimate that offers a level of protection to slow the effect of rapid changes in temperature and humidity. The box also provides protection from light exposure. It may provide immediate protection in the case of a water disaster as the box creates an initial barrier; however a box can also trap moisture close to the object. Close inspection following any change in storage environment is strongly advised.

Due to their unique nature and significant value, the books should be housed in a non-circulating, closed-stacks environment with appropriate security. Shelving would ideally be baked enamel steel. If wood shelving is used, a coating should be applied to mitigate off gassing from the wood. High quality acrylic paint is a good choice for this purpose. Shelving needs to offer adequate support to the books. Depth of shelving should be sufficient to ensure books do not protrude over the edge of the shelves. Books should be stored vertically. The shelves should not be overcrowded, and bookends or other supports should be used.

Placement of stacks should take into account areas of increased risk such as beneath damp pipes, near radiators, or adjacent to loading docks or areas where air pollution may pose a threat. Whenever possible, these areas need to be avoided.

Good housekeeping practices are essential to proper collections maintenance. A regular monitoring system should be used to inspect spaces for signs of pest infestation, or general dirt and debris.

### *B. Climate Control*

Ideal climate control for paper based objects would indicate consistent conditions with a temperature below 70°F +/- 2° and a relative humidity range between a minimum of 30 and maximum of 50% +/-3%. Mold spores can grow at temperatures above 70°F, whereas polymeric materials can become brittle at low temperatures. While the range of acceptable temperature varies significantly, consistency is the most important factor in minimizing deterioration. To extend the life of these objects cool storage may be implemented (approximately 50°F at 30-50% RH). A dramatic increase in longevity for low sensitivity materials (such as rag paper and leather) is seen with each 5 degree drop in temperature as the following excerpt shows:

Normal room ~20°C	Millennia ~1,000 yr+
Cool store ~10°C	~5,000 yr+
Cold store ~0°C	20,000 yr+

While extremes in temperature pose significant deterioration, fluctuations in relative humidity are responsible for the most harm to book materials, as they can expand and contract with changes in the amount of moisture in the air. Controlling RH with a properly calibrated HVAC system, or locally with humidifiers/dehumidifiers can increase longevity for these books (Basic Care of Books).

### *C. Light Exposure*

While drop spine enclosures will protect the books from light exposure during storage, special attention must be paid to reduce the effects of light exposure on the objects during use and exhibition. Reading rooms and exhibit spaces should use the following preventative measures to dampen the effects of light:

- filter windows and skylights in reading rooms using scrims or shades



- filter lights within reading rooms by adding UV blocking sleeves to fixtures
- use automatic shut off systems for lighted stack areas to reduce exposure as well as maintain cost-effective space
- maximum 150 lux display level with UV content of less than 75  $\mu\text{W}/\text{lum}$

A light meter should be used to check light levels particularly for exhibits where constant exposure will be an issue (Himmelstein).

#### *D. Stability of Materials*

Of primary concern for degradation with these two books are their leather coverings. Leather will become brittle over time due to loss of natural oils and will become prone to cracking, particularly if subjected to dry environments. Extreme environments can desiccate leather. Application of leather dressings or coatings is not recommended as these products do not permeate the leather and degradation will continue from the inside. Also some dressings will form a tacky film that not only affects the object but anything it may come in contact with during storage. Leather is also prone to chemical decay if subjected to atmospheric pollutants such as sulfur dioxide that attacks in the form of sulphuric acid. Ventilation and activated alumina filtration will aid in minimizing contact with damaging pollutants (Ploeger).

Paper stored under good environmental control has extremely good longevity. Paper for both volumes is made from good quality rag fiber and further deterioration is expected to be minimal assuming proper storage.

Vellum endpapers have been used in the *Historia Troiana*, and will be very susceptible to changes in relative humidity. Proper attention to environmental control will be critical in controlling expansion and contraction leading to deterioration.

Overall the greatest risk to these materials is posed by handling and use. Care should be taken to provide a clean and clear workspace during use, and patrons and staff should be instructed in proper handling techniques. Book cradles should be used to support the objects at all times. Digital versions of these texts are available and should be used to aid research based solely on the content of these works in order to minimize direct handling of the artifacts.

## 7. CONCLUSION:

This project considers what is arguably the most important skill of a conservator, that being judgment. The *Historia Troiana Guidonis* and the *Geneva Bible* provided great examples through which to consider the ramifications of treatment. Works of art have long since established their place as culturally significant artifacts. They are housed in special institutions called museums, and great consideration is given to the impact of their use and display. Books traditionally, are housed in libraries. They too are cared for and preserved, but they have a greater calling in that they are subject to the wear and tear of patron use. Conservation treatment for books has focused primarily on this functional aspect. The structure of the binding serves the higher intellectual value of the text contained within. *Troy* marks the dawn of printing, while today we embrace the dawn of the digital artifact. As we move further into this ephemeral world, the physicality of the book artifact is taking on greater importance. Like works of art, the book as an object has gained significance, and the ability of the structure to speak for itself has become an issue.

For the book conservator it becomes important to develop treatments with caution and respect to the book artifact that preserve those elements that authenticate the period of production, but also document historic alterations to structure which narrate this position of book binding as a mechanism for transmission of intellectual property throughout time. The binding is responsible for the survival of text, of image, of ideology, of philosophy, of development and ultimately of culture. Written expression has been the predominant mode of the historical record for millennia, and the book format has served as its vehicle. Elements such as manuscript, print, paper, board, skin, cloth and thread, their application, and alteration over time tell a story. The conservator in consultation with curators and historians becomes responsible for recognizing the story that each book has the potential to tell, and then developing treatments to promote that intent. Much like the paintings conservator who considers artist intent, the book conservator must take into account the purpose for each book they encounter before them.

As seen in *Troy* and *Geneva*, sometimes altered elements further the story of a text, as in the combined rounded and backed texts seen in *Geneva*, and sometimes those alterations do not as seen in the anachronistic rebinding of *Troy*. Making determinations whether to treat or not treat

a book will always be subjective, but as more attention is drawn to the retention of original elements, perhaps a greater sympathy to the book as artifact will develop, and the story of book history will be retained. The book conservator plays a role in shaping this future by applying their technical skills with thought, sound reason, and good judgment, as an advocate for both the content and containers of their collections.

## **8. ACKNOWLEDGMENTS:**

I would like to thank the following for their generous support and guidance throughout this project:

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With special thanks to: Gary Frost, Judith C. Walsh, Patrick Ravines, and Jonathan Thornton for technical supervision and guidance

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<[http://www.memoryofpaper.eu/BernsteinPortal/appl\\_start.disp](http://www.memoryofpaper.eu/BernsteinPortal/appl_start.disp)>.

## 10. SOURCES OF MATERIALS:

Adhesives: Jade 403, Aytex-P Wheat Starch Paste

Talas

330 Morgan Ave

Brooklyn, NY 11211

p. 212-219-0770

<http://www.talasonline.com/>

Book board: Superior Mill Board - Elephant Green

Conservation By Design

Timecare Works

5 Singer Way, Kempston, Bedford MK42 7AW

p. +44(0)1234 846300

<http://www.conservation-by-design.co.uk>

[info@cxdltd.com](mailto:info@cxdltd.com)

Covering material and endpapers: vegetable tanned goat, alum tawed goat, parchment

Pergamena Parchment

Jesse Meyer

11 Factory Street, Montgomery, NY 12549

p. 845.649.5806

[www.pergamena.net](http://www.pergamena.net)

[jesse@pergamena.net](mailto:jesse@pergamena.net)

Paper: Zerkall Ingres White

Talas

330 Morgan Ave

Brooklyn, NY 11211

p. 212-219-0770

<http://www.talasonline.com/>

Sewing thread: 18/3 linen

Gane Brothers & Lane

1400 Greenleaf Avenue

Elk Grove Village, IL 60007

phone 847.593.3364 or 800.323.0596

fax 800.784.2464

<http://www.ganebrothers.com/index.html>

[sales@ganebrothers.com](mailto:sales@ganebrothers.com)

[info@ganebrothers.com](mailto:info@ganebrothers.com)

## 11. LIST OF ILLUSTRATIONS AND TABLES:

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Figure 6: BHM copy

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Figure 28: Finished spine

Figure 29: Finished binding

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**12. AUTOBIOGRAPHICAL STATEMENT:**

Jennifer Hunt Johnson is a third-year student in the Art Conservation Department at SUNY Buffalo State where she is an Andrew W. Mellon Fellow in Library and Archives Conservation. Jen is a former Conservation Technician for the University of Chicago Library, and has held internships at the Boston Athenaeum, The British Library and the University of Illinois at Urbana-Champaign. She holds an MFA in Book and Paper Arts from Columbia College Chicago, and a BFA in Illustrations from the State University of New York at Buffalo. When she has spare time she enjoys fencing epee.