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Tattered Tapa: How a Multi-disciplinary Collaboration Revived a 19th-Century Fijian Bark Cloth

Abstract: A highly degraded 19th-century Fijian bark cloth from the University of Pennsylvania Museum of Archaeology and Anthropology was treated by a team of objects and paper majors in the Winterthur/University of Delaware Program in Art Conservation (WUDPAC). The use of objects and paper practices provided a unique opportunity to borrow from both fields to contribute to the conservation of an object that defies the definition of object or paper. This study will contribute to recent studies of bark cloths and demonstrate that collaboration in the treatment of cultural artifacts is essential.

Previous treatment on the bark cloth, performed by objects majors in the WUDPAC Class of 2015, included surface cleaning, pressure-sensitive tape removal, and humidification. The bark cloth's unusually deteriorated state would require an innovative approach to removing remaining pressure-sensitive tape, removing a non-original lining, and devising a strategy for consolidation and stabilization. Technical analysis aimed to answer questions regarding the object's manufacture and condition challenges and informed future treatment. Methods included fiber identification, XRF, FTIR, and GC-MS. The team worked with outside experts and explored different methodologies across specialties. These discussions on the level of intervention were important to the evaluation of the object and the path of treatment. As research on the topic of highly degraded bark cloths is largely unpublished, information gleaned from the treatment of this object will contribute to the current literature. This collaboration not only produced an innovative treatment of a bark cloth but also had a profound impact on the team by enhancing skills in problem solving and teamwork.

Introduction

In Fall 2014, the authors began treatment on a 19th century Fijian bark cloth in the collection of the University of Pennsylvania Museum of Archaeology and Anthropology (Penn Museum). The bark cloth is a unique object that defies a single categorization. The cellulosic material is most similar to other paper objects, but the cultural context and traditional use is closer to what is found with objects and textiles. Therefore, the treatment was conducted as a group project between paper majors Anisha Gupta and Jacinta Johnson and objects majors Lauren Gottschlich and Alexandra Nichols, graduate fellows in the Winterthur / University of Delaware Program in Art Conservation, Class of 2016. The team, dubbed Team Tapa, called on outside researchers such as anthropologists and curators from the Penn Museum and the Smithsonian Institution's National Museum of Natural History to understand the manufacture of the bark cloth. In addition to Winterthur professors and conservation scientists, Team Tapa collaborated with paper conservator Betty Fiske to help form an appropriate treatment protocol for the bark cloth. The resulting treatment is the product of a thorough investigation of different treatment techniques from across disciplines.

Historical Background

Bark cloth is made from the inner bark of the mulberry tree, and is a commonly found material in cultures from Africa, South America, and throughout Oceania. In Fiji, bark cloth is named *tapa*.

To create bark cloth, strips of bark are pounded to make them wider and to join different sections together to make a larger cloth (fig. 1). Fijian bark cloth is almost exclusively constructed from strips of the inner bark of the paper mulberry tree, *Broussonettia papyrifera* (Spicer and Me 2008, 20). Decorated *tapa*, or *masi kesa*, features stenciled geometric designs (Kooijman 1977). While undecorated *masi vulavula* can be used for clothing and everyday home decor, the decorated *masi kesa* were used strictly for ceremonies as wall or floor coverings for marriages, births, and funerals (fig. 2), or as clothing by high-ranking officials (fig. 3) (Kooijman 1977).

Fig. 1. Pacific Islanders folding bark cloth, 20th century. Courtesy of www.angelasancartier.net.

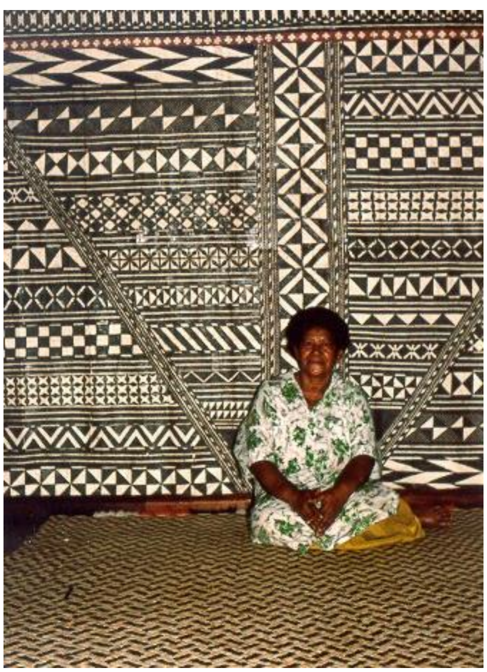

Fig. 2. Example of *masi kesa* in use as floor and wall coverings. Courtesy of www.mi.sanu.ac.rs.

Fig. 3. Drawing of Natuacolo, the Tui Nadrau, Fiji Museum Accession number P 25.6 29. Courtesy of www.museumvictoria.com.au.

According to University of Pennsylvania Museum of Archaeology and Anthropology records, the bark cloth (fig. 4) was acquired from Fiji in 1865 by Charles Alonzo Curtis (Hartman 2010). In the 1940s, a descendant of Curtis gave the bark cloth to Dr. Frederica de Laguna, a Bryn Mawr College professor and anthropologist renowned for her studies of Native American cultures in the Arctic (Kaeppler 2014, Katz 2014). In addition to her professorship at Bryn Mawr, Dr. de Laguna also taught at the University of Pennsylvania, University of California, Berkeley, and Smith College (Kaeppler 2014). Dr. de Laguna gifted the bark cloth to the University of Pennsylvania Museum of Archaeology and Anthropology in 1995 (Kaeppler 2014).

Fig. 4. Bark Cloth, Fijian, circa 1865, 3.5 feet x 6.4 feet (1.06 m x 1.91m), University of Pennsylvania Museum of Archaeology and Anthropology (before treatment). Courtesy of Curran, Brown, and McCauley.

Similar decorated Fijian bark cloths are present in the collections of the Metropolitan Museum of Art (fig. 5) and the Denver Museum of Art (fig. 6). Bark cloths contemporary to the bark cloth owned by the Penn Museum are generally in good condition, with little fading or losses.

Fig. 5. Bark Cloth Panel, Fijian, mid to late 19th century, The Metropolitan Museum of Art, Accession number 1990.333.9. Courtesy of www.metmuseum.org.

Fig. 6. Examples of bark cloth on display at the Denver Art Museum for the exhibition *Printed and Painted: The Art of the Bark Cloth.* Courtesy of Courtney VonStein Murray.

Manufacture

Fijian *masi kesa* are traditionally made and decorated by women. *Masi* can be formed out of the bark of the paper mulberry tree in approximately two hours. To make *masi*, sheets of inner bark are first cut and separated from the tree and soaked in water overnight (fig. 7). The wet bark is then beaten with a wooden tool called an *ike* on top of a wooden anvil called a *dudua* (fig. 8) to widen them into larger, flat strips (Kooijman 1977, 110; Spicer and Me 2008). The edges of two strips are overlapped and further beaten, joining them in a process similar to felting. Typically, this felting is the only way the strips are adhered to one another, but for specific ceremonial

Fig. 7. A woman separates the inner bark of the mulberry tree. Courtesy of www.tonjasgatherings.com.

cloths, the bark cloth "is generally much longer and will be pasted together with a paste made from a potato-like tuber or the *yabia* plant" (Kooijman 1977, 46). For a standard size *masi kesa*, about 50 cm wide and 230 cm long, six strips will be beaten together (Kooijman 1977, 34). In contrast, *masi* made for the tourist market are cut into smaller sizes.

Fig. 8. A Fijian woman beats the cloth on an anvil named the *dudua* with a wooden tool called an *ike*. Courtesy of Indiana University Bloomington.

__Decoration__

The term *masi kesa* is derived from the dye, *kesa*, a dark red color that is used to stencil the designs onto the *masi*. According to Kooijman, dye is collected from the roots of the *gadoa* (*Macaranga seemannii*) tree (Kooijman 1977, 37 and 173). However, in *Fiji masi: An ancient art in the new millennium,* Spicer and Me describe the dyes as being made from the sap of the *kesa* tree (*Elaeocarpus pyriiformus*) and the true mangrove (*Rhizophora sp.*) (Spicer and Me 2008, 42 and 47). It is unclear which dye was used for the Penn Museum bark cloth. It is possible that the discrepancies found in the references are due to regional differences on islands within Fiji. Further testing and research is necessary to characterize the exact components of dyes found in Fijian bark cloths. The *kesa* is then mixed with colorant materials such as black soot (*loaloa*), traditionally obtained from burning candlenuts, turmeric, or powdered iron-containing soil (*umea*). (Kooijman 1977, 37; Spicer and Me 2008, 42; Gillespie and Clague 2009, 274).

Masi kesa are characterized by the use of geometric shapes composed of several borders, formed by the repetition of a small number of stencils. The designs on the Penn Museum bark cloth have been identified as being "most similar to those of the Cakaudrove district, which includes the eastern half of Naua Levu along the Natewa Bay and Buca Bay, including the island of Taveuni (Hartman 2010)." Traditionally, the stencil shapes were cut out of dried banana leaves using a small knife (Kooijman 1977, Spicer and Me 2008). The banana leaves with incised designs are placed directly on the bark cloth, and then the dye is applied on top (fig. 9). The uncut banana leaf portion acts as a resist, preventing the dyes from contacting the fibers directly underneath. For contemporary cloths, x-ray film (fig. 10) may also be used for stenciling (Kooijman 1977).

Fig. 9. Stenciling using cut banana leaves. Courtesy of www.kivu.com.

Fig. 10. X-ray film stencils used by contemporary bark cloth makers.

Description

The Penn bark cloth is composed of seven sheets of bark pounded together (fig. 4). It has four quadrants with diagonally opposite quadrants matching in appearance. The decorative elements were made with black and reddish-brown dyes. The border around the outside edge consists of groupings of five brown lines oriented perpendicular to each edge. Geometric line designs are present separating the four quadrants and as a diagonal line in two of the quadrants. Rosettes are present as decorative elements in all quadrants. Under ultraviolet radiation, there is no fluorescence overall on the cloth, with the exception of some areas that may relate to past undocumented efforts at consolidation. This will be described in detail later in the paper.

Previous Treatment

Since the bark cloth arrived at Winterthur in 2010, it has been fulfilling its role as a research object. It has been a teaching tool across classes and created the opportunity to collaborate with graduate fellows in the years before. When WUDPAC objects majors examined the cloth in 2013, they stated that the undyed areas were structurally unstable and very brittle, with fragments that were detached or lost. In contrast, the dyes were in very good condition with little evidence of instability. Significant planar deformations resulted from both prior folding and rolling onto a tube for storage.

Fig. 11. Brittle and structurally unstable cloth with many losses

Fig. 12. Significant planar deformations are visible in raking light.

Previous restoration campaigns prior to the cloth's arrival at Winterthur included a textile lining on the verso with running stitches all along the edges. Heavily damaged areas were repaired with stitching and pressure-sensitive tape applied directly to the surface, including areas with decoration. Pressure-sensitive tape was also applied to the verso, though the extent of its application was not known at the outset due to the fabric lining covering the verso.

Fig. 13. Previous stitching attaching the bark cloth to the textile lining

Fig. 14. Pressure-sensitive tape on the bark cloth

During the 2013-2014 academic year, the objects majors completed five major treatment steps. First, they surface cleaned the cloth with a low-powered vacuum to remove loose dust and

Fig. 15. Removing pressure-sensitive tape at an acute angle with a heated microspatula

debris. All of the stitching tying the textile lining to the bark cloth was removed, leaving the cloth directly on top of the lining but in no way attached. Pressure-sensitive tape was removed from the recto with a heated spatula (fig. 15).

The cloth was humidified with Gore-tex and damp blotter with no additional weight. After this treatment step, the bark cloth no longer exhibited the planar distortions associated with rolled storage and folding. Typically bark cloth is expected to retain some natural undulations created by mild tensions inherent to its manufacture, but the complete planarity and stiffness of this bark cloth is likely an indication of its highly deteriorated state and the lack of cohesive strength of the plant fibers.

In order to safely turn over the cloth to have access to the verso and continue treatment, the 2013-2014 objects majors tested temporary facing materials to secure the loose fragments. They tested different remoistenable lens tissues adhesives and application methods (table 1). The most successful combination was a remoistenable lens tissue using 2% methyl cellulose, reactivated with deionized water.

Table 1: Adhesives tested for temporary facing application

Methocel A4M 1%	1:1 methylcellulose:wheat starch paste (1%)
Methocel A4M 2%	1:1 methylcellulose:wheat starch paste (2%)
Methocel A4M 4%	1:1 methylcellulose:wheat starch paste (4%)
Methocel A4M 5%	1:1 methylcellulose:wheat starch paste (5%)
Wheat Starch Paste	

The completed phases of the treatment provided more stability by removing superficial dirt and tape and overall reduction in planar distortions. As we received the cloth in the fall of 2014, it still remained in an extremely vulnerable condition, with major structural weakness and damage, a high degree of brittleness and disintegration, and active delamination.

Technical Analysis and Testing

Along with the collaboration between paper and objects conservation, the expertise of the scientists in Winterthur's Scientific Research and Analytical Laboratory (SRAL) was an essential component in the technical analysis of the bark cloth. Three goals were outlined for this investigation:

1. Determine if the materials in the bark cloth were consistent with other bark cloth.
2. Explore possible causes behind the degradation of the cloth.
3. Gather data to make the most informed treatment decisions possible.

The following analysis and testing was completed: fiber identification, X-ray fluorescence spectroscopy (XRF), Fourier transform infrared spectroscopy (FTIR), gas chromatography—mass spectroscopy (GC-MS), Raman spectroscopy, surface pH and conductivity, a test for the presence of Fe 2+, ultraviolet (UV) illumination, and solubility of the colorants.

Many of these techniques were employed during the 2013-2014 project and the results of their investigations were used as comparative data when applicable.

Fiber Identification

Fiber analysis characterized the fibers as bast, likely mulberry and is a material used frequently in the manufacture of bark cloths (see **Manufacture**). The fibers were homogenous, long fibers with distinct striations and irregularly spaced cross-markings extending across the full width of the fiber. They had thick walls and narrow lumen. A cuticle was present on many of the fibers. No lignin was present. The fiber ends were frayed, but did not appear to fibrillate easily. The fibers were either fully intact, or completely destroyed.

X-Ray Fluorescence Spectroscopy

Using the nondestructive analysis technique, x-ray fluorescence spectroscopy (XRF), the elemental composition of the cloth and backing cloth was analyzed under the guidance of Winterthur Museum staff at the Scientific Research and Analysis Laboratory (SRAL). Catherine Matsen, Associate Scientist (SRAL) assisted us in detecting the elements calcium, sulfur, iron, and potassium. These elements are consistent with other bark cloth and the previous year's analysis. Lead was detected in the black colorant. Matsen suggested that the presence of lead could also come from soil used to make the dye. Zinc was the major element identified in the backing textile. Matsen and Senior Scientist, Dr. Jennifer Mass, suggested that zinc may be present in waterproofing agents for textiles.

An unusual discovery was the presence of bromine in all areas of the cloth. Possible explanations for the presence of bromine were explored. Bromine has been used in cultural heritage preservation as a fumigant, flame retardant, but has also been detected in the ash of seaweed and algae. Relatively higher concentrations of bromine were detected in dyed areas than in the undyed areas, which may correlate to the manufacture of the dye, or bromine's affinity to bond with the dyed regions if a fumigant or flame retardant was used. Further investigation is required to fully resolve this question.

Exposure to bromine can pose possible health and safety risks, so nitrile gloves were recommended to be worn at all times when the object is handled.

Fourier-transform Infrared Spectroscopy (FTIR)

Samples were taken from undyed fibers, black dyed areas, and brown dyed areas of the cloth. With the help of Matsen, the data was analyzed and indicated that the samples were consistent with other known bark cloth materials. Samples of the undyed fiber had good correlation with known organic cellulosic fibers. The data from the black dyed area gave strong peaks for gum, as well as cellulosic and lignin-containing fiber. No other products were found. In the brown dyed area, spectra were found for an organic dye taken from plant material. The reference spectrum for the organic dye, cutch, provided the best correlation to our unknown dye sample, but cutch was likely not the dye in the bark cloth since this plant material is not found in Fiji. Subtle differences between the sample and the cellulosic lignin reference spectrum were also found, suggesting that more than one fiber may be present.

Gas Chromatography—Mass Spectrometry

Dr. Chris Petersen, affiliated Associate Professor at SRAL, executed GC-MS analysis, further clarifying many of the organic compounds present. Three samples, including the black, brown, and undyed areas were tested and provided very similar results to the 2013-2014 study. The brown dyes contained triterpenoids and the black dye lacked triterpenoids. Palmitic and stearic acids, and nicotine were detected. Xylose, glucose, and arabinose were particularly abundant in the brown dye. Beeswax was also detected, but may also be characterized as a wool wax (Peterson 2015). Brominated compounds, such as those used for the fumigation of insects, were also sought out, and none were found in the GC-MS data. These materials are consistent with known materials for bark cloth as well as the previous year's findings.

Raman Spectroscopy

Samples of the colorants prepared for FTIR were used for Raman spectroscopy, specifically the black and brown dyed areas. Results were inconclusive as there were high levels of fluorescence for both black and brown samples. These high levels of fluorescence are typical of cellulosic materials.

Surface pH and Conductivity

The surface pH and conductivity of the dyed and undyed areas of the cloth and the textile used to line the cloth were tested to help identify possible causes for degradation and inform treatment. See Appendix 5 for pH testing locations. When tested with a Horiba pH meter, the pH of the dyed and undyed areas was 7. This was unusually high for degraded bark cloth, which are generally more acidic at a pH of 2-4. A second round of testing was conducted using ColorpHast pH strips. The strips gave a pH of 6 in the undyed area and a pH of 4.7 for the dyed areas.

Fe^{2+} Test

The presence of Fe^{2+} ions was tested using Iron Gall Paper, a bathophenanthroline paper available from University Products. Testing was conducted by dampening the indicator paper with deionized water and applying it lightly to the surface of the bark cloth. The paper was then evaluated for a change in color. The presence of Fe^{2+} ions would result in a pink color. No positive results for Fe^{2+} ions were recorded in any of the areas tested.

Ultraviolet Examination

The bark cloth was examined under long- and short-wave ultraviolet radiation using a Mineralight Lamp Model UVGL-58 multiband UV-254/366nm. UV images were documented using a Nikon D800 DSLR camera illuminated with Broncolor Mini ultraviolet lamps. Under ultraviolet radiation, some areas have a fluorescent material that resembled animal glue.

Solubility Testing

This test provided an understanding of the sensitivity of the dyes on the bark cloth. Solubility tests were conducted in two ways:

1. Lightly dampening a small area on the surface of the bark cloth with a solvent, placing a piece of blotter on top of the damp area, weighting the area, and allowing the area to dry. Upon drying, the blotter was checked for any dye transfer.
2. Dropping a small drop of solvent on the cloth, and immediately blotting the drop with a small strip of blotter.

The following solvents were tested for solubility of dyes and other colorants in the bark cloth:

- Deionized water
- 1:1 mixture of deionized water and ethanol
- Ethanol
- Isopropanol
- Acetone
- Benzyl alcohol
- Shellsol D-38

Seven locations were tested: two areas of black dye, two areas of brown dye, an area with shiny dye, an undyed area, and an undyed area that fluoresced under UV. The dyes were only found to be sensitive in water but stable in all other solvents, including a 1:1 mixture of deionized water and ethanol.

Other possible factors in the degradation of the cloth, otherwise known as Agents of Deterioration, include long exposure to light and physical forces. The cloth has a history of long-term display in the office of Frederica de Laguna prior to the acquisition of the object by the Penn Museum. Incorrect relative humidity and incorrect temperature may have also been significant factors contributing to the object's current condition.

From fiber identification to health and safety recommendations, this analysis was instrumental in creating an informed treatment plan with a well-defined purpose. The Penn Museum indicated that the future use of the bark cloth is limited to research. Our collaboration with outside experts led us to conclude that a less interventive approach would be more in concordance with the intent of the originating culture. The bark cloth in its current state, however, is structurally unstable and cannot be handled safely. The purpose of our treatment will aim to balance intervention while still adequately supporting and stabilizing the bark cloth.

Formulating a Treatment Plan

The treatment plan evolved over the course of the collaboration and was informed by research and testing. A true test of problem solving skills, the bark cloth challenged the team to consider the treatment from multiple angles to determine a treatment plan that not only stabilized the object, but was ethical as well. The goals of the treatment were to remove past restoration materials, improve the structural integrity to the bark cloth, and reassemble the fragmented areas, respecting the aesthetics of the object and minimizing intervention.

Several different options and variations of possible stabilization methods were explored prior to deciding on the treatment plan. Pressure mounting, localized mending, partial lining, and a full lining were all considered (fig. 16).

Fig. 16. Options for treatment ranked by level of invasiveness

Due to the high level of fragmentation of the object and the possibility for future damage, pressure mounting and localized mending were deemed inappropriate as they would not provide the stabilization needed to ensure the preservation of the object. Partial lining was also explored, however, there were significant concerns about damage caused to the areas that were not lined. As a partial lining would locally strengthen areas and leave others unsupported in their heavily deteriorated state, it was felt that should the object be handled, the areas that were not locally lined would become damaged due to differences in strength of the lined and unlined areas. Additionally, bark cloths typically expand and contract with fluctuations in relative humidity. The partial lining could cause local cockling or distortion of the surface if RH constantly shifted. Using a combination of pressure mounting and localized mending or partial lining was considered, but it was felt that these would not be effective enough to stabilize the object. Therefore, a full lining was considered.

While a full lining was the most interventive of the four options, the object required a more substantial stabilization than what would be provided with pressure mounting, localized mending, and/or partial lining. The decision to line the object was one that was discussed at length and was the product of consultations, research, analysis, and most importantly, the demands of the object. It was felt that the lining would accomplish the goals of the treatment and would enable the bark cloth to be used as a research object without the danger of causing further damage which could result in the dissociation of the fragments from their original locations.
A full lining of the object would require the following steps to properly treat this bark cloth for its return the Penn Museum. The necessary steps were to flip the bark cloth, remove the remaining pressure-sensitive tape, vacuum the verso, line the object, flip it again, reattach the

detached fragments, and create a long-term storage system. As there were multiple methods by which each task could be achieved, each with their own advantages and drawbacks, the team considered each step from the perspective of multiple disciplines.

Testing of Treatment Options

Testing was a vital part of guiding the formulation of a treatment plan. Solubility testing of the bark cloth determined that the dyes and degradation products were slightly soluble in water. Deionized water, 1:1 ethanol/deionized water, ethanol, isopropanol, acetone, benzyl alcohol, and Shellsol D-38 were all tested to cover a broad range of possible solvents to be used in the lining process.

Facing Tests

It was critical that the bark cloth be flipped to gain access to the verso, however, the highly fragmented areas required stabilization so that they would not shift during the process. A lining of the object with misaligned fragments would hinder the reading of the bark cloth, therefore, facings were tested. Attempts were made to face the object with an overall spray of cyclododecane. Different methods of application were tested, however, the wax failed to adhere the facing tissue to the bark cloth regardless of the method of application. The cyclododecane spray was deemed unsuccessful and the idea was abandoned. Following the protocol established by McCauley, Brown, and Curran, the team retested the method of a facing by remoistenable tissues. Like the previous year, a 2% methyl cellulose remoistenable tissue proved to be most effective in terms of stabilization and ease of removal. These strips of remoistenable tissues were reactivated using a 1:1 mixture of ethanol and deionized water in a spray bottle and then gently pressed to the surface. Removal required the local reactivation of the remoistenable strip which when pulled at an acute angle detached from the surface with few fibers from the bark cloth.

Lining Tests

The lining required an adhesive that would provide the adequate tack to hold the bark cloth to the surface without causing tide line formation or movement of the dyes. In order to proceed with the formulation of the plan, sacrificial contemporary bark cloth samples from Fiji were tested. Two different bark cloths, one dyed and the other undyed were ordered from Fiji. To achieve a state of delamination and structural failure, each contemporary bark cloth sample was sprayed with sulfuric acid and baked for approximately a week in an oven. After the artificial aging, the samples were difficult to handle without causing structural damage and better approximated the state of the Penn bark cloth (fig. 17).

Fig. 17. Example of artificially aged contemporary bark cloth used during

Paper conservator Betty Fiske was consulted regarding the lining stage and testing adhesives. It was known from the solubility testing that the degradation products and dyes were slightly soluble in water. Therefore, an aqueous based lining was deemed not appropriate due to the high levels of moisture needed to establish a good bond. A non-aqueous means of lining was pursued in response to the solubility testing results. A variety of blends of Lascaux 360 and 498 HV at different ratios were created for the fabrication of remoistenable tissues. Lascaux is an acrylic dispersion in water that can be reactivated with solvents such as ethanol. Lascaux has a history of use in leather and textile consolidation and its working properties were desirable for this project. The reactivation of a dried film of Lascaux would allow for the lining to be applied without the application of water. The Lascaux blends were cast onto a mid-weight Japanese tissue and then reactivated with ethanol. Using the artificially aged bark cloth samples, the remoistenable Lascaux blends were tested and it was found that a 75:25 blend of Lascaux 498 HV and Lascaux 360 gave the best results. This particular blend created a good nap bond that could penetrate well into the bark cloth's substrate but remained flexible and introduced no moisture to the piece. This adhesive blend was selected to perform the lining.

Projected Treatment Plan

Based on the evaluation of the various methods by which the object could be treated, the following projected treatment plan will be followed. The fragments on the surface will be realigned and the highly fragmented areas faced with the 2% methyl cellulose remoistenable tissues. After the recto is stabilized the object will be flipped by placing the bark cloth between two rigid boards and turning it over. Once the lining fabric is lifted off of the object the pressure-sensitive tape application will be removed with heated spatulas and the surface soil removed with a variable pressure vacuum. The verso will receive an overall lining with the 75:25 Lascaux 498 HV, Lascaux 360 blend remoistenable tissue. The object will be flipped again and then a housing prepared for its return to the Penn Museum.

Conclusion

The collaboration for the treatment of this captivating object has been unique and challenging. The formulation of a treatment plan is the product of drawing from different specialties to come to the best possible course of action. This rewarding experience was one of exploration, problem solving, and balance. Working alongside each other was one that allowed each student to learn more about conservation strategies than what could have been accomplished alone.

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Addendum

This paper represents the progress made to date of the presentation at the ANAGPIC Student Conference held in 2015. Following the presentation, the team completed the treatment of the bark cloth. As projected, the fragments were realigned and the surface was faced with a 2% methyl cellulose remoistenable tissue in fragile areas, areas of high fragmentation, and those previously mended with detectable pressure-sensitive tape on the verso. The object was flipped and the backing textile removed (fig. 18).

Fig. 18. Bark cloth after flipping and before tape removal

Pressure-sensitive tape application was removed by softening the adhesive using a heated spatula and pulling the tape slowly at an acute angle. The verso was vacuumed with a HEPA filter variable pressure vacuum. Cheese cloth was placed over the nozzle and a screen was placed over the bark cloth prior to each vacuuming session. As it was known from testing that the Lascaux blend tenaciously stuck to Hollytex, the losses were locally patched with shaped fills applied directly to the bark cloth with Lascaux 498 HV. The minimal, local moisture application did not cause any movement of the dyes or degradation products. Cast sheets of dried 75:25 Lascaux 498 and Lascaux 360 were created and then heat-set onto sheets of cutch-toned Misu tissue. The lining was reactivated with a spray of ethanol and drop-lined onto the verso using brushes and rollers to achieve a good bond (fig. 20).

Fig. 20. Lining the bark cloth

After drying the object was flipped and the facing reversed. The fragments collected during the treatment that were not adhered to the lining were placed back onto the bark cloth in an effort to reintegrate the design. Fragments were adhered using either a 2% methyl cellulose or Lascaux 498 HV and delaminating areas stabilized with 1.5% methyl cellulose (fig. 21). The object will be stored flat at the Penn Museum.

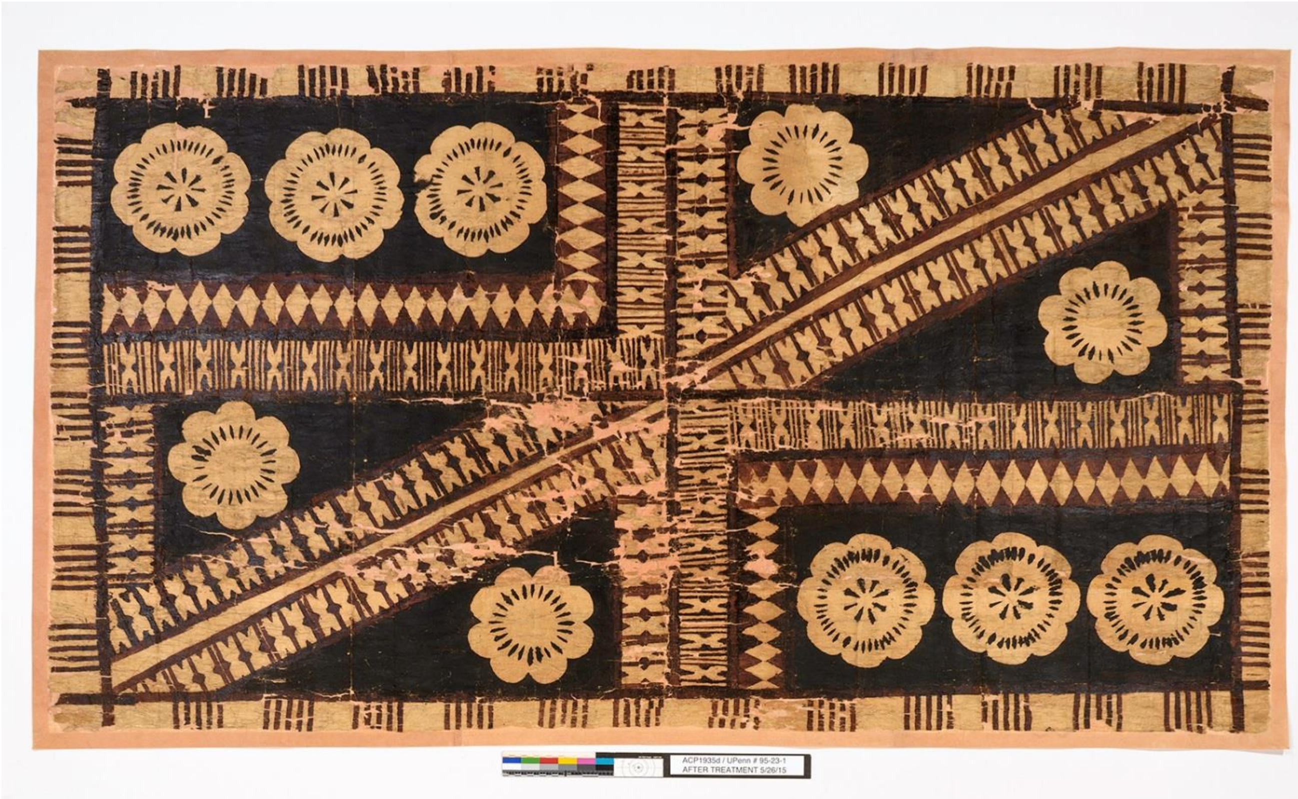

Fig. 21. Bark cloth after treatment

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Anisha Gupta is a second-year WUDPAC graduate fellow in paper conservation, minoring in photographic materials. She completed her B.S. in chemistry and art history from the University of Illinois at Urbana-Champaign in 2012. Anisha is looking forward to interning at the Tate Modern this summer and spending her third year at the Legion of Honor.

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