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Conservation of a Plains-style Tuscarora Feathered Headdress

A thesis submitted in partial satisfaction of the requirements for the degree Master of Arts in the Conservation of Archaeological and Ethnographic Materials

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ABSTRACT OF THE THESIS

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Professor Ellen Pearlstein, Chair

This thesis discusses the investigation and stabilization treatment of a feathered headdress commissioned as part of an ensemble by or for Chief Silver Eagle, also known as Mr. John Green, of the Tuscarora Tribe, Iroquois Nation. The adoption of established stabilization and loss compensation techniques for use on the headdress' severely deteriorated Golden Eagle feathers required both aesthetic and ethical consideration. Research and consultation was undertaken to assess the suitability of use of synthetic versus natural materials, the suitability of use of non-eagle feathers, and the suitability of use of non-feather materials. All materials were determined as appropriate for use; however, the use of toned non-eagle feather 'inserts' was most aesthetically and technically successful. Ultimately, a minimal approach to conservation intervention was employed, thereby acknowledging that preservation of the headdress' current state best conveys its historical trajectory, both as a personal item and as a museum object.

The thesis of Geneva Jackson Griswold is approved.

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Introduction

This thesis discusses the investigation and stabilization treatment of a feathered headdress commissioned as part of an ensemble by or for Chief Silver Eagle, also known as Mr. John Green, of the Tuscarora Tribe, Iroquois Nation (Figure 1). A resident of Grass Valley, California, Mr. Green is pictured wearing the headdress c.1948, which is characteristically Plains in style (Figure 2). Upon Mr. Green's death, the headdress was gifted to a friend, Margaret Matusovic of Marysville, California. The ensemble and headdress were packed in a suitcase from at least 1973-1985,[1] at which time it was donated to the California State University, Chico Valene L. Smith Museum of Anthropology (VLSMA).

The headdress (223.002) is composed of a soft, brown wool cap that provides the structure off of which the trailer extends.[2] A decorative beaded leather band is sewn to the front of the cap, dyed satin ribbons in various colors are attached at each end of the band, and 23 Golden Eagle feathers (*Aquila chrysaetos*) are strung through a cotton cord running perpendicularly over the crown of the cap. The trailer attaches and hangs from the backside of the cap, and is composed of red wool 'trade cloth' backed with cotton muslin. A threaded cotton cord attaches 72 Golden Eagle feathers to the trailer (Figure 1).

Figure 1. The headdress shown on proper right (L) and proper left (R) sides after initial cleaning and ribbon stabilization.

The headdress' condition was undocumented when acquisitioned by VLSMA in 1985, and deemed "In Need of Stabilization" when it was catalogued in 2000. During the 15-year period at the museum, the headdress was stored in a string-tied polyethylene bag and suspended from a ceiling-mounted hanger with little support. As such, the headdress is unstable, heavily soiled, and in very poor condition, largely due to improper storage and insect infestation. Fragments of brittle and detached feathers, red wool fibers, frass, and insect casings were loosely scattered as well as embedded throughout the fabric when the headdress was received in the J.P. Getty Villa conservation laboratories for study in the Autumn of 2012.

The project goal, as discussed with Dr. Georgia L. Fox, conservator and co-director of the CSU, Chico Museum Studies Program/VLSMA, was to stabilize the headdress so that it may be displayed alongside other items from Mr. Green's ensemble. Treatment required a balance of both theoretical and practical concerns for a headdress at this stage of deterioration; that is, mediating preservation of the object's 'conceptual integrity' and its 'physical integrity' (Clavir 1996: 102). This methodology was achieved by taking a minimal approach to conservation intervention: acknowledging that preservation of the headdress' current state best conveys its historical trajectory, both as a personal item and as a museum object.

Tuscarora identities and manifestations thereof are many, resulting from a modern history of continued movement and evolution. Prior to European contact, numerous Tuscarora settlements were located in present-day North Carolina and Virginia before unremitting conflict with colonists led to the Tuscarora War of 1711-1713, which significantly reduced their population and forced many to migrate northward to Pennsylvania and New York over the next century: in 1722, the Tuscarora (supported by the Oneida) became the Sixth Nation of the Iroquois Confederacy in New York; in 1723 the Indian Woods reservation was formed for Tuscarora remaining in North Carolina; in 1779-1784 (following the American Revolution during which the Tuscarora fought against the British), a third community settled in Six Nations of Grand River, Ontario, Canada. Additionally, the Tuscarora Tribe of the Southern United States-Eastern North Carolina and South Carolina borderlands incorporates several bands that are currently not federally recognized. Today, geographically disparate Tuscarora communities are neither politically nor culturally affiliated with one

another. Tuscarora material culture produced during the twentieth century may therefore be difficult to contexualize within such discontinuous narratives: indeed, the maker of headdress 223.002 is unknown, the owner was Tuscarora, yet the style is a Plains Indian derivative. Consultation with Tuscarora was thus sought as an aid in positioning the headdress, and therefore its conservation treatment, within an appropriate cultural framework.

Chapter 1: Consultation addresses the aesthetic and ethical implications of treating a headdress of Tuscarora provenance with Golden Eagle feathers. The appropriateness of intervention options was weighed, including replacement or loss compensation for the feathers and wool elements, via consultation with tribal members, tribal representatives, and conservators. *Chapter 2: Material Selection* describes the assessment process undertaken to determine suitable materials for use in the headdress' treatment, with consideration given to aesthetic consistency and retreatability of the object in the future. *Chapter 3: Treatment Execution* details the steps taken toward completing the treatment of the headdress. Following a written and graphic documentation of the headdress (Appendix II), investigation of the technical construction of a twentieth-century Plains Indian headdress was conducted. Treatment included overall surface cleaning and heavy metal pesticide residue analysis, stabilization of the red wool textile, preparation of insert feathers to be used in future display, and assembly of a contemporary, commercial 'double trailer war bonnet kit,' utilized for visual, technical, and material comparison to its twentieth-century counterpart.

Chapter 1: Consultation

Consultation has been established in the conservation and art history fields as an integral and essential aspect in the preservation and conservation of heritage collections from indigenous cultures[3]. David Leigh aptly describes this shift in his closing remarks on the theme "The Objects in Context: Crossing Conservation Boundaries," given at the 2006 International Institute for Conservation Congress in Munich:

> Those cozy conservation norms, even as recently modified, are reduced to shadows when we realize the extent to which different cultures and belief systems simply do not share our expectations, cannot accommodate our formal approaches to conservation: in some countries our so-called ethical, literal approach to the tangible, original material may not be as important or as relevant as local respect for the sacred, the spiritual, the intangible; mending broken things may be bad; minimal replacement could be wrong, wholesale replacement with new materials may be better; the intervention of a conservator might bring bad results for society, and opening things up to investigate them could be dangerous to our karma (Leigh 2006: 2).

For the conservator, consultation is especially important as a means of understanding the stakeholders' desires, as well as comprehending aspects of material selection and use. The identification of and consultation with appropriate stakeholders - including conservators, tribal members, and tribal representatives – was therefore undertaken in order to assist provenance queries, address ethical considerations, and explore treatment options for the headdress. The rewards of such information, and the relationships initiated in the process, contribute both tangibly and intangibly to the headdress's significance and to treatment decision-making.

Communication with identified consultants occurred primarily via email during the winter of 2013.[4] Individuals contacted for communication are listed alphabetically (Table A):

Consultant	Tribe	Title	Affiliation
Stephen Augustine	Míkmaq	Curator of Ethnology, Eastern Maritimes	Canadian Museum of Civilization Corporation
Jameson C. Brant	Iroquois	Coordinator of the Aboriginal Training Program in Museum Practices	Canadian Museum of Civilization Corporation
Simon Brascoupe	Southern Band of the Tuscarora		Native American Museum of Art
John Fadden	Mohawk		Six Nations Indian Museum
Nancy Fonicello		Ethnographic Objects Conservator	Ancient Artways Studio LLC
Georgia L. Fox		Professor; Co-director; Director	Department of Anthropology; Museum Studies Program/Valene L. Smith Museum of Anthropology; Heritage Resources Conservation Laboratory at California State University, Chico
Margaret E. Geiss-Mooney		Textile/Costume Conservator and Collections Management Consultant	Private Practice
Christine Giuntini		Conservator, Arts of Africa, Oceania, and the Americas	The Metropolitan Museum of Art
Emil Her Many Horses	Oglala Lakota	Curator	National Museum of the American Indian
Judy Hall		Curator of Eastern Woodlands Ethnology	Canadian Museum of Civilization Corporation
Kimberly Hobbs		Feather Vendor	Ozark Feather Co.
Joyce Ertel Hulbert		Textile Conservator	Private Practice
Marian A. Kaminitz		Head of Conservation	National Museum of the American Indian
Susan M. Lawrence		Division of Migratory Bird Management	United States Fish and Wildlife Services
Emily Lin		Research and Collections	Canadian Museum of Civilization Corporation
Caroline Marchand		Objects Conservator	Canadian Museum of Civilization Corporation
Janet Mason		Objects Conservator	Canadian Conservation Institute
Catherine C. McLean		Senior Textile Conservator	Los Angeles County Museum of Art
Wanda McWilliams		Conservation and Preservation Collections Manager	Canadian Museum of Civilization Corporation
Kelly McHugh		Objects Conservator	National Museum of the American Indian
Stuart Patterson	Tuscarora	Member of the Council of Chiefs	
Cheryl Podsiki		Contaminated Objects Conservator	Private Practice
Jolene Rickard	Tuscarora	Artist	Cornell University
Felicia Rodriguez		Feather vendor	Ozark Feather Co.
Sarah C. Stevens		Textile conservator, Division of Historic Preservation	Peebles Island Resource Center
Steven A. Tamayo	Lakota		Native American Advocacy Program
Wendy Teeter		Curator of Archaeology	UCLA Fowler Museum
Pepper Trail		Senior Forensic Scientist and Ornithologist	National Fish and Wildlife Forensics Laboratory

Deborah Trupin		Textile conservator, Division of Historic Preservation	Peebles Island Resource Center

Table A: Individuals contacted for consultation.

Three versions of an introductory email were composed: one addressed to tribal members or representatives, another to conservators in museums or private practice, and the last to migratory bird policy experts. The emails introduced the headdress as the focus of a Master's thesis in conservation, explained how the consultant's contact information was accessed, summarized the provenance of the headdress as stated in the VLSMA record, introduced the conservation interventions required by the headdress's deteriorated state, and provided three images of the headdress including one image of Chief Silver Eagle wearing the headdress c. 1948 (Figure 2).

Figure 2. Chief Silver Eagle wearing his headdress c.1948. VLSMA object file.

Communication with Tribal Representatives

The email addressed to tribal members or representatives additionally solicited information on Tuscarora traditions of feather work, the appropriateness of using replacement feathers for Golden Eagle feathers, and any information known about Chief Silver Eagle. Responses from tribal members and representatives were less consistent than those received from conservators overall: several consultants provided opinions on issues of provenance, while several others remain unresponsive.[5]

John Fadden (Mohawk, Six Nations Indian Museum[6]) provided a list of the Six Nations Councils' contact information, and said that he has "no information regarding preservation of the headdress, including the feathers." However, John confirmed that the headdress is Plains-style and that Chief Silver Eagle's last name, Green, is of Tuscarora derivation:

> It's a plains style headgear, plus the leggings and tunic are also of western plains design. During the period of time of the first half of the 20th century many eastern nations sported that style. Since that time, the nations of the east, including the Tuscarora, tend to use their own traditions, when there is a need to dress in traditional gear.
>
> The name, Chief Silver Eagle, doesn't ring a bell, however the surname, Green, does. However, I think the name is spelled with an 'e' at the end...Greene. I believe there are still some who have the name, Greene, at Tuscarora.

Indeed, two Tuscarora authors, Elton Greene (Sachem Chief of the Sand Turtle Clan) and Elwood Green, share the surname.[7] Further, the caption of a 1923 photograph (Figure 3)[8] notes a John Green, wearing a Plains-style headdress with a white beaded band. The headdress is a construction similar to- or likely, the very same headdress- as that worn by Chief Silver Eagle in the c.1948 photographs included in the VLSMA object file (Figure 2).

Figure 3. John Green, pictured at far right, in 1923. Image published in Rickard 1973: 33.

Simon Brascoupe (Southern Band of the Tuscarora; Native American Museum of Art) also confirmed that "some Tuscarora chiefs wore this type of headdress" but specified that "it was not a traditional Haudenosaunee headdress." Indeed, the Tuscarora and Plains headdress styles differ significantly. Headdress 223.002 is a popularly stylized version of a trailer war bonnet- worn by chiefs or warriors of the Great Plains tribes, including the Sioux, Crow, Blackfeet, Cheyenne, and Plains Cree- which is characterized by a single or double row of golden eagle tail feathers, attached to a support that runs from head to foot down the wearer's back.[9] Beginning in the Reservation Period (c. 1870-1930), other indigenous tribes adopted this form of headdress and it became recognized as a pan-Indian symbol of authority. A 1954 account describes the "confusion" wrought amongst anthropologists regarding the use and distribution of Plains-style feathered headdresses:

> When the common person thinks of an American Indian man, he usually pictures

> him as wearing a large eagle feather 'war bonnet.' This stereotype has become so widespread that nowadays even the Indians themselves have taken it up, and members of tribes who never used the headgear in aboriginal times now wear it on occasions when white people expect them to 'look like Indians' (Howard 1954: 23).

The form proliferated via the tourist trade from then onward. The article further notes: "the eagle feather bonnet, when seen, is usually worn by 'professional Indians' who appear in native costume only for commercial purposes" (Howard 1954: 24). Twentieth century manifestations of 'performing indianness' usurped the Plains-style feather headdress, such that the form lost its value -via alteration of its symbolism- for those who adopted it.[10] Headdress 223.002 therefore obfuscates concepts of authenticity (both of itself and its owner) as well as questions tribal rights (or desire) to claim ownership.

Stuart Patterson, member of the Tuscarora Council of Chiefs, was reached by telephone at his home on the Tuscarora Reservation, near Lewiston, New York. Patterson claims that he does not recognize the name John Green nor Chief Silver Eagle, and frankly opined that the latter "sounds like a made up name." Having served as Chief since 1967, Patterson concluded that he would recognize the title, if authentic, as it would likely be in active use considering that titles are typically passed on.

Patterson acknowledged the commonality of various headdress forms employed during the mid-twentieth century, especially in the Carolinas[11], yet he clarified that the Tuscarora style of war bonnet is very different from that of the Plains headdress. As he generally explained, Six Nations war bonnets are made of black ash[12] that forms a band across the top, with attached trailing and standing feathers: the particular Six Nations tribe is identified by the number of standing eagle feathers, while deer antler attached or "hanging off" one side may distinguish the Chief. Patterson's narrative appears to describe the gasdowä´: a fitted cap

with beaded bands encircling the base, and an arrangement of standing or trailing feathers of various bird types (used split or whole) attached at the crown. The number and position of whole eagle feathers signifies the wearer's tribal association: gasdowä´ with no erect or trailing feathers designates the Tuscarora. The Rochester Museum and Science Center collections contain several gasdowä´, images and drawings of which can be accessed in their online archives. Patterson concluded that access to eagle feathers has not been made difficult by the law,[13] as not many eagle feathers are needed for each war bonnet: one, two, or three feathers for each 50 tribal titles are required.

When queried as to the best approach regarding the eligibility of headdress 223.002 as regards the North American Graves Protection and Repatriation Act (NAGPRA), Patterson said that a war bonnet is usually buried with the Chief, and further, that a headdress has no value if "we don't know what the feathers were used for." Therefore, the Tuscarora would not seek a headdress of this type for return. As of 1974, headdresses were not included in a list of religious objects prohibited for sale to non-Natives by the Six Nations Council of Chiefs (Hill 2008: 77).[14] Moreover, the VLSMA is NAGPRA compliant; the museum sent lists of their collections holdings to tribes in 2001 yet no response or requests were received. Without desire on the tribe's behalf, and without a proven ceremonial or burial context, the headdress is not a candidate for return via NAGPRA.[15]

Evidence supporting this headdress as belonging to a 'professional Indian' raises challenges about how to conserve it. At present, the headdress is truly a museum object, indicative of the historical period of pan-Indianism, and it may be used to tell this story. Indeed, its treatment should assist if not promote doing so.

Communication with Conservators

The email to conservators additionally sought experiences and/or approaches to feather loss compensation or replacement, as well as questioned the appropriateness of feather replacement. All of the conservators that were contacted responded readily with materials suggestions, accounts of their own consultation experiences, and further references to explore.

Conservators' responses reflect a heavy utilization of stakeholders' input when devising a treatment plan. As Caroline Marchand (Objects Conservator**,** Canadian Museum of Civilization Corporation)[16] states: "as a conservator, I won't proceed on an object without a discussion and authorization from the curator who tends to be in contact with communities and translate their needs." Emily Lin (Research and Collections, Canadian Museum of Civilization) agrees: "In terms of ethical consideration for replacing the entire feather, I take a more conservative position in general and think it is the decision that needs to come from the curator, and only for exhibition purposes." Meanwhile, Kelly McHugh (Objects Conservator, Smithsonian Institution's National Museum of the American Indian) writes that it is imperative "to question the appropriateness of loss compensation or replacement of eagle feathers on a war bonnet," as "it has been my experience that communities feel strongly and differently about the care of their eagle feathers." As such, the treatment plan must include and strike a compromise between stakeholders' desires.

Museum conservators generally take a conservative approach to feather treatment, which is informed by the results of consultation with various stakeholders, while tribes may seek

more exhaustive intervention. Caroline Marchand clarifies that "we tend as conservators to minimize our impact on objects but it could be that they [tribes] require a totally different approach. Sometimes an object with a lot of meanings should be treated with great respect and this means replacing the damaged parts." The restoration-based approach is reflected in a response received from Steven A. Tamayo (Lakota, Rosebud Reservation, South Dakota)[17], a consultant on Great Plains cultures for the Smithsonian Institution's National Museum of the American Indian. Steven has previously restored several war bonnets, and opines: "I'm all for restoration and if this entails utilizing replacement feathers then so be it. The original feathers will always remain with the bonnet and the documentation will explain the treatment plan carried out for future generations to understand." While removal and replacement of the original feathers on the Tuscarora headdress is considered too invasive in this case, the importance of documentation justifying the treatment taken is essential.

Moreover, Nancy Fonicello (Ethnographic Objects Conservator, Ancient Artways Studio LLC) is currently undertaking loss compensation using pieces of hand painted turkey feathers as fill. Responding to the desires of her private client, the goal of Nancy's treatment is to display the object "looking as good as it can, so simply cleaning it and straightening the damaged feathers will not be sufficient." In museum practice, however, Caroline Marchand claims that while cleaning and realignment of feathers is common, replacement of feathers is not: "In some case replacement [occurs] but not with loss compensation, as this application is not a common approach for us." This is not to say that replacement does not occur. As Emily Lin explains: *"Feathers with extensive losses can be replaced temporarily with new feathers for exhibitions.* After the exhibition the replacement feathers are removed and the original ones returned to the objects." Marian A. Kaminitz (Head of Conservation, Smithsonian

Institution's National Museum of the American Indian) describes a feather replacement treatment executed in a museum setting in collaboration with tribal representatives: "We have done feather replacement for a Kwakwakawak'wa Raven mask [for the exhibition *Chiefly Feasts*, at the American Museum of Natural History (AMNH)]… In collaboration with the tribe, we replaced very damaged eagle feathers with fake eagle feathers available from a supplier online[18]… I have also done compensation with Acrylic painted Tyvek for a Kwakwakawak'wa headdress at the AMNH. The feathers were from a raven, which was attached almost whole to the headdress. So the inserts could be hidden amongst the rest of the feathers." No standard feather treatment exists, and the range of aforementioned treatment approaches results from the variety of stakeholders' desires expressed through dialogue with tribal members, representatives, private owners or museum curators.

Communication with Policy Experts

The Bald and Golden Eagle Act prohibits the possession of eagles, eagle parts, and eagle nests without a permit, which are restricted to members of federally recognized tribes for religious use. According to correspondence with U.S. Fish & Wildlife Service (USFWS), it is nearly impossible for conservators to obtain eagle feathers in good condition and such feathers would need to be requested by a tribal member, which is a strong reinforcement of consultation.

Susan M. Lawrence, Division of Migratory Bird Management at USFWS, in coordination with the Regional Migratory Bird Permit Chiefs and the supervisor of the National Eagle and Wildlife Property Repository, explains a second option:

> There is a small source of items that may be available to the public institutions for

> purposes of restoring Native American artifacts. The USFWS National Wildlife Property Repository (NWPR) holds items that have been forfeited or abandoned to the Service. From time to time, they may receive eagle items that are not of use to tribes, such as old mounts or other materials in poor condition. These items may be available to a public institution for scientific or educational purposes once the institution obtains the appropriate eagle permit... If a public institution wishes to obtain such parts, it must apply for an Eagle Exhibition permit through NWPR; if granted, the permit would authorize the conservator working on behalf of the institution to incorporate the item into the artifact.

Nevertheless, the desire to obtain replacement Golden Eagle feathers was not expressed by tribal members consulted for this project, and was therefore considered neither an appropriate nor a feasible treatment option.

After communication with conservators, tribal representatives, policy experts, and the headdress' keeper, Dr. Georgia L. Fox[19], the development of a feather insert was decided upon. Loss compensation was deemed not useful for the headdress, as the state of deterioration is too significant: extant barbs and rachis are not strong enough to support the attachment of compensating materials. Dr. Fox seeks to display the headdress, yet agrees with the suggestion of retaining the headdress' deteriorated state as a marker of its history. As such, the feathers will not be removed; instead, feather inserts (dyed turkey feathers) will be temporarily adhered to the original feathers to visually integrate the feathers' losses during exhibition only. Janet Mason (Objects Conservator, Canadian Conservation Institute) suggested the *use of a standard feather shape and color, perhaps trimmed with portions of barbs cut away*, so as to blend with the originals yet remain easily recognized as additions. This treatment reduces excessive handling of the original feathers, thereby preventing further loss, while acting as a temporary loss-compensation tool. The approach does not require removal of the original feathers, it is time-effective, and the inserts can be easily added or removed if the stakeholders' desires change in the future.

Chapter 2: Material Selection

Feathers

The adoption of established stabilization and loss compensation techniques for use on the headdress' Golden Eagle feathers (*Aquila chrysaetos*) requires both aesthetic and ethical consideration. Research and consultation was undertaken to assess the suitability of use of synthetic versus natural materials, the suitability of use of non-eagle feathers, and the suitability of use of non-feather materials. All were materials determined as appropriate for use; however, the use of toned non-eagle feather 'inserts' were considered most aesthetically and technically successful after execution of the following tests.

Feather fills:

Testing of loss compensation methods for feathers was based on published and anecdotal feather fill experiments. Toned Japanese papers, Tyvek, Reemay®, silk Habutae, and sacrificial feather barbs have been employed by conservators to integrate local areas of loss on feathers[20], yet techniques to better register barb texture in loss such materials was desired.

Two silicon molds were cast to test paper fill methods: one from a section of turkey feather, another from aluminum foil impressed with lines simulating a feather. Several weights of Japanese tissue paper were dampened and tamped into the aluminum feather mold to assess their ability to maintain the texture created. Deionized water, 0.5% methyl cellulose in deionized water, and 0.5% chitosan in 1:1 deionized water: ethanol were tested on Senka-shi Thick (120t) and Kozo White #8 (162w) papers. The 0.5% methyl cellulose in deionized water was the most effective adhesive on both types of paper, with the Senka-shi Thick retaining more texture overall. Textured fill techniques certainly merit further refinement,

but the percent of overall loss of the eagle feathers requires a more holistic approach to reintegration.

Janet Mason, Objects Conservator at the Canadian Conservation Institute, suggested the use of full paper feather replacements attached behind the eagle feathers. Testing was conducted using a mixture of methyl cellulose pulp and 0.5% methyl cellulose in deionized water, laid into the silicon mold and left to dry over a period of 24 hours. The molds captured the fine texture of the barbs very well, however the cellulose mixture lacked cohesion and was too thick for use.

Marian Kaminitz, Objects Conservator at NMAI, used acrylic paints to tone small sections of thin, stiff Tyvek, chosen for its strength and because the material approximates a feather's "tough, keratinaceous-ness" appearance. A 1" x 2" section of toned Tyvek appeared matte and flat in comparison to the varied surface texture of the damaged feathers, while they are too damaged to support even the thinnest form of Tyvek. Likewise, barbs cut from a sacrificial feather and adhered to areas of loss was considered. While the visual consistency between the filler barbs and original feather is superb, the severe distortion of the eagle feather barbs and their overall weakness prohibited successful attachment points for the barb fills.

Ultimately, loss compensation methods proved too time-consuming, considering the extent of loss on the headdress, and the visual results were unsatisfactory; the headdress' golden eagle feathers are simply too deteriorated to support fills.

Replacement feathers:

While pre-prepared replacement feathers would have served well, the brown color and mottled nature of the young Golden Eagle feathers used on the headdress do not match with faux tail feathers sold by vendors (these are typically large, vat-dyed turkey feathers; white with black tips). After approaching several feather vendor options, Ozark Feather Co. LLC was selected for their willingness to sort through hundreds of pounds of turkey feathers to find the proper dimensions: a thin yet long rachis measuring approximately 0.5 cm at the calamus and 2 mm at the tip, and approximately 32 cm long. Felicia Rodriguez and Kim Hobbs, vendors at Ozark Feather Co., were contacted to find suitable replacement feathers with matching dimensions to those on the headdress. The feathers being replaced are true Golden Eagle, which are shorter and have a thinner rachis than turkey feathers (those commonly used as replacements):

> Part of the reason you are having trouble replacing them is because in order to get the smaller rachis you are going to have to find the feathers of *a very young male* or a *female turkey*. The picture of the full feathers you sent [of the headdress] looks very much like a wild otherwise known as a Bronze turkey. These feathers are not easily found as most hunters are looking for the long beard and they will naturally be mature Toms. [21]

The longest feathers are placed on the crown of the headdress, and they decrease in length from head to foot. 15 white left turkey feathers and 13 white right turkey feathers were ordered to replace the longest and widest feathers on the headdress crown; 35 left barred turkey feathers and 37 right barred turkey feathers were selected to replace smaller feathers on the headdress body. Bronze turkey feathers have smaller (brown) rachis, in general, and their mottled texture successfully integrates into the original feathers. After achieving the appropriate sized feathers, each was dyed to match the originals.

Dye selection and application on feathers:

The following dyes and their delivery method were assessed: Telana powder dyes have been used to immersion dye feathers, Irgalan dyes are widely used on silks by textile conservators, while Orasol® and XSL pigments were used at the American Museum of Natural History to recolor taxidermy (Nunan 2012). Ultimately, Orasol® dyes were selected for their ease of use and cost-effectiveness. Orasol® dyes are 1:2 metal complexes, commercially available in 17 colors, soluble in organic solvents, and require no rinsing after application. The dyes are approved and widely used in the conservation field, such as for wood stains or colorants in epoxy or resins. The manufacturer states the dyes' lightfastness as moderate to high (Nunan 2012: 54); however, this does not take into consideration the lightfastness of the substrate on which the dyes are being applied.

Brush application, airbrush application, and immersion dyeing using Orasol® dyes on white and bronze turkey feathers was tested to approximate the uneven coloring of the deteriorated Golden eagle feathers. Direct brush application was successful - the feathers easily took up the dye - however the method is best suited for creating a single color feather, and was considered too costly in time to paint the 104 feathers needed as each feather must be painted individually. Immersion dyeing was considered (Vuori 2008, Lewarne and Lin 2011) but requires a large volume of dye, does not produce the mottled affect desired, and is significantly more time consuming.[22] Airbrushing proved very successful and rapid in execution, as multiple feathers could be painted at once.

Wool Textile

Stabilization fabric:

The following were assessed for visual consistency and working properties as stabilization

fabrics for the red wool fragments: swatches of red cotton fabrics in various weaves[23], nylon netting, Crepeline, Stabiltex, and polyester organza (Table B).

Fabric	*Advantages*	*Disadvantages*
Stabiltex (100% polyester)	Aesthetically compatible (matte appearance, cotton weave visible beneath); inert; widely used in conservation field.	No longer manufactured; difficult working properties (hard to heat-cut to shape, unravels easily); difficulty to dye.
Nylon net	Inert; recently adopted by conservation field.	Open net pattern and thick fibers are visually distracting.
Crepeline (100% silk)	Dyes easily; matte appearance.	Fine weave obscures original textile; less stable than synthetic options (susceptible to insect attack).
Organza (100% polyester)	Excellent working properties (cuts easily to shape with a blade, does not unravel); pre-dyed; inexpensive.	Slightly shiny and stiff.

Table B. Materials assessed for appropriateness as backing support fabrics.

All of the cotton fabrics were visually obtrusive (too bright compared to the browned appearance of the original wool even after intentional soiling), heavy, and none matched the weave pattern of the original wool. The circular filament pattern of the nylon netting and Crepeline's fine weave are both visually distracting, as they obscure the wool and muslin weave patterns: these are each unique facets that historically situate the headdress' period of manufacture and therefore should remain visible. The nylon netting is slightly stretchy, and therefore would not provide enough structure to stabilize the wool fragments. Stabiltex (also called Tetex® or Terelene) is a lightweight polyester fabric often chosen by conservators in textile stabilization treatments for its excellent resistance to ultraviolet radiation, decay, bacteria, acids, and oxidizing agents. Its open-weave does not obscure the wool or muslin weaves, and its use would provide consistency between treatments undertaken on the headdress' ribbons and wool fragments.

Unfortunately, Stabiltex is discontinued by its manufacturer. White (undyed) Stabiltex was procured for dye testing, as no Cherry Red Stabiltex could be located. However, Christine Giuntini, textiles conservator at the Metropolitan Museum of Art, and others suggested an alternative material via the Textile Conservation Digest: polyester organza manufactured by TestFabrics.[24] The organza has a higher thread count than Stabiltex and thus appears more opaque, yet it is inexpensive, available pre-dyed in a suitable red color, and its working properties are significantly superior to Stabiltex: it is easy to handle, does not unravel during handling, and cuts easily to shape with scissors or a knife (thus significantly reducing treatment time by avoiding the use of hot-melt cutting). Pre-dyed organza avoids the time and expense required by the dye process, and ensures an even coloration throughout the material.

Dye selection for (polyester) backing fabrics:

Prior to selecting pre-dyed polyester organza for use as the backing material, dye tests were conducted on white Stabiltex. Combinations of three red shades of Jacquard Dye-Na-Flow dyes were thoroughly mixed, brushed onto swatches of Stabiltex, and hung to air dry. Stabiltex (polyester) is notoriously difficult to dye; indeed, the dye tended to dry across the polyester filaments, 'filling' the holes in the weave in uneven patterns. Dye-Na-Flow fabric paints are currently in use by conservators, yet no stability testing has been conducted to assess their long-term aging properties nor have they been used in conjunction with adhesives.[25] Oddy testing was therefore conducted to assess the stability of 825 Brick, 827 Burnt Umber, and 805 Scarlet Dye-Na-Flow dyes[26], which gave results of passing stability for all three colors for all three colors (Appendix III).

Dye-Na-Flow dyes were also tested for light stability and found to be moderately stable. The dyes were painted onto swatches of fabric, mounted on blotter paper, partially covered with aluminum foil, and set in an east-facing window (glass with no added UV filter) for 90 days. Of the reds, 825 Brick on cotton and 825 Brick on silk both show visible changes, 827 Burnt Umber on cotton shows a visible change, 805 Scarlet on cotton shows a barely noticeable change, and 1:1 825 Brick: 805 Scarlet on cotton shows a barely noticeable change after light exposure causing a just noticeable change at ISO Blue Wool Standard 5, considered an acceptable level of light fastness for a conservation materials, which is equivalent to 53 years in a UV rich environment or 200 years in an environment without UV (50 lux/hour at 3000 hours/year) until a noticeable fade occurs (Michalski 2013).[27] The headdress is a teaching tool, likely be viewed in fully lit environments for study and display, thus the long-term stability of the materials used is paramount.

Application of stabilization fabric:

Pre-dyed polyester organza was selected as the backing material to stabilize the detached red wool fragments, which can be either sewn or adhered above or below the fragments.[28] Placing the organza over the red wool is a less invasive treatment yet more aesthetically intrusive. It requires sewing the organza into the seams of the cotton muslin through original needle holes, encapsulating the wool but not affixing the detached fragments in place, thereby introducing potential for further disruption during handling. Many couching stitches would be required throughout in order to isolate the fragments. While sewing is simple to reverse, piercing new needle holes is a permanent and irreversible intervention.

Placing the organza beneath the wool fragments is the most visually compatible approach.

While the treatment is more physically intrusive, requiring adhesive to attach the reverse side of the wool to the backing fabric, the approach is reversible and firmly secures the wool fragments in place. A mixture of Lascaux 360 HV and 498 HV thinned in deionized water was selected for its superior workability: Lascaux can be brushed onto the backing support and dried as a film, which remains slightly tacky at room temperature. Individual sections can be pre-cut to shape and prepared away from the object before final placement and heat-setting. The method is consistent with that utilized in the treatment of the headdress' ribbons, and it can be reversed mechanically or by solubilizing the Lascaux in acetone, toluene and xylene. Adhesive provides the surest bond between the red wool and cotton muslin, while restoring the integrity of the detached wool by acting as a binder between the frayed, loose strands. Adhering the wool to a backing fabric prevents further loss, enables visibility of the wool weave, and significantly improves the handling capacity of the headdress for study and display.

Chapter 3: Treatment Execution

The headdress was unstable and in poor condition when it arrived at the UCLA/Getty Conservation laboratory, largely due to prior insect infestation. Deterioration occurred in all the materials present, including soiling, severe loss, and instability of the golden eagle feathers, severe loss and detachment of the red wool trade cloth, presence of mold and loss in the satin ribbons, losses in the wool hat, soiling and presence of mold on the cotton backing, as well as soiling and loss of the glass beads.

Treatment included: 1) pesticide residue testing using portable X-Ray Fluorescence spectroscopy (pXRF) to detect inorganic pesticides; 2) dry cleaning using a HEPA vacuum and brushes; 3) stabilization of the satin ribbons using an appropriate backing to prevent further loss and assist handling; 4) stabilization of the red wool trade cloth with an appropriate backing to secure detached areas; 5) stabilization of the feathers; 6) construction of housing suitable for storage and study.

Replica:

The Plains headdress or warbonnet is a well-known form, adopted by many tribes over the past several centuries and currently in use today by native and non-native regalia makers, craftsmen, and others. As such, its method of manufacture is well documented[29]; therefore, it was determined unnecessarily invasive to replace the headdress' wool, feathers, and ribbons since no new information would be gained in doing so. Instead, a Double Trailer Warbonnet Kit (no. 4803-302-900) was purchased from Missouri River® and assembled in order to compare construction methods and materials between headdress 223.002 and a contemporary iteration. While the replica is composed of distinctly different materials, it is

constructed in the same way. The kit was assembled in the UCLA-Getty Conservation laboratory according to the assembly directions included in the kit (Appendix IV), and will be returned to CSU, Chico with the headdress. Archival hot-melt adhesive[30] was used in its assembly instead of the white craft glue[31] included in the kit, and red, blue, yellow, and green ribbons were purchased and sewn to the leather cap instead of the rabbit fur adornments included in the kit so as to best stylistically match the Chico headdress. Beaded roundels were included in the kit, yet these are not present on the headdress. The trailer is composed of waxed, floral printed cloth instead of the cotton backing, and red synthetic felt instead of red wool trade cloth. The trailer was sewn by hand using cotton thread, and the holes were punched with an awl through which a thin suede lace attaches the feathers to the trailer through their rawhide loops. Wax-coated raffia, meant to simulate sinew, was passed through holes made in each feather vane to stabilize them, instead of cotton muslin that serves the same purpose on the headdress. The hat is chrome tanned leather (assumed due to its suppleness and blue-gray appearance)[32] in comparison to the wool hat used on the headdress, the 1.25" x 10" hand-loomed beaded band and 2" rosettes were pre-beaded on nylon monofilament fishing wire before being sewn onto the hat with cotton thread during assembly, and the feathers are white turkey feathers dip-dyed to have black tips to replicate mature Golden Eagle feathers. A 'black major plume wing spike' was sewn onto the back of the leather hat and appears to be made of plastic (imitative of a feather with partially stripped and trimmed barbs); black horsehair was included in the kit but not added during assembly because the horsehair, if it is so, appears white in the photographs of Mr. John Green. Red dyed plumulaceous feathers were glued to the base of each feather before the calamus was wrapped in red felt and tied with cotton string, while white plumulaceous feathers were glued to the tip of each feather. The 90 Jumbo imitation eagle feathers were first separated

into lefts and rights and straightened using a tacking iron per the kit's directions (Appendix IV).

Testing and Analysis:

X-Ray Fluorescence spectroscopy using a portable Bruker Tacer III-V was conducted to detect inorganic pesticide residues (Tables C-F, Appendix I). The presence of mercury (Hg) was found on the wool hat, likely the result of its manufacture, but which requires careful handling nonetheless.[33]

Cleaning:

The headdress, excluding the feathers, was dry cleaned using a HEPA-filter vacuum to remove loose particulate, frass, and heavy soiling present throughout the headdress and storage cloth used for continued support. A soft, dry brush was used to dislodge frass from crevices, while microfiber clothes and cosmetic sponges were tested but ineffective. The headdress was vacuumed a total of four times to remove frass and particulate that continued to dislodge during treatment. The feathers were gently brushed to remove loose particulate, while tweezers were used to remove displaced barbs and insect casings.

Humidification of Ribbons:

Each satin ribbon was gently flattened and straightened via local humidification to facilitate the application of a backing material to the reverse side. Blotter paper was moistened with deionized water, placed over the ribbon with a Gore-Tex barrier between, and weighted for 20 minutes on each location. Humidification was executed in 3" sections until each ribbon's flat and straight form was restored.

Ribbon Stabilization:

The satin ribbons were backed with Stabiltex, a heat set polyester filament fabric, using an adhesive mixture of 1:1 360:498 HV Lascaux in 3:1 deionized water. 'Copper' colored Stabiltex was used for the red, green, and blue ribbons, while 'Marigold' was used for the yellow ribbons. To make 1" sections of Stabiltex the fabric was placed under a glass weight with a straight edge, pulled taught, and weighted at the opposite end. The hot tip of a soldering iron was slowly drawn along the edge of the glass weight, fusing the polyester filament ends while cleanly separating the fabric into sections. The sections were coated with the Lascaux mixture and allowed to dry for 24 hours, until minimally tacky. The sections were adhered to the back of each ribbon using a warm tacking iron. Once the ribbons were backed, the top of each Stabiltex section was looped and heat-set to itself, with a black 4-ply cotton string passing through the loop. The string was sewn through existing stitch holes to the base of the wool hat, so that the weight of the ribbon is fully supported by the backing.

Humidification of Wool Hat:

The wool hat has a strong crease running over the crown of the head, resulting from long-time flat storage. In order to return its three-dimensional form, Ethafoam blocks were gradually placed into the recess of the hat to open the sides, allowing the wool to slowly acclimatize to the ambient humidity. The crease was thereby softened, and after approximately five months, an interior mount was made to support the wool hat's open shape. The mount is human head-shaped, composed of an Ethafoam core padded with polyester batting inside an un-dyed 100% cotton stockinette flexi-tube tied at both ends.

Red Wool Textile Backing:

Pre-dyed polyester organza was used as a backing material to stabilize the severely degraded, detached red wool fragments. The backing was locally adhered to the reverse of the wool fragments and to the muslin support with an adhesive mixture of 1:1 360:498 HV Lascaux in 3:1 deionized water. Sections of organza were individually cut to shape with scissors using a Mylar template, coated with the Lascaux mixture and allowed to dry for 24 hours, placed between the wool and the cotton muslin, and heat-set with a tacking iron on low setting using a Mylar barrier. In local areas, such as holes in areas of continuous fabric, uncoated organza was carried over areas of exposed muslin where wool has been lost to restore visual integration and to improve the area's structural integrity.

Bead stabilization:

Three loose beads on the front of the beaded band were restrung onto white cotton thread, as the original thread was broken, using original needle holes. The ends were tied off for simple reversibility.

Feather sheath reattachment:

Four feathers on the proper left side of the headdress were stabilized. Each feather was originally attached in two places: a cotton cord passing through the middle of each rachis and another cotton cord passes through each leather sheath at the feather's base. The latter cord frayed such that four feathers were unattached to the trailer. Two strips of cotton textile were torn, toned with Orasol® dyes to match the soiled appearance of the original muslin backing, and dried. The strips were passed through the original holes in the muslin

backing and through each leather sheath; the ends were tied off on the reverse side, providing simple reversal if necessary.

Preparation of Turkey Feather Inserts:

Turkey feathers were hand-selected and purchased from Ozark Feather Co. LLC: 15 white left turkey feathers and 13 white right turkey feathers to replace the longest and widest feathers on the headdress crown, plus 35 left barred turkey feathers and 37 right barred turkey feathers to replace smaller feathers on the headdress body. A generator-powered airbrush was used to deliver a 1% solution of ethanol and the following combination of Orasol® dyes: Yellow 2GLN, Brown, 2RL, Black CN, and Blue (1:5:2:1). The solution was thoroughly mixed and brushed onto blotter paper and directly onto both sides of a white turkey tail feather to assess the color tone before application, and the solution was tweaked as necessary. The feathers were sorted into lefts and rights, barred and white before dye application. Approximately 4-6 feathers were inserted into a foam block, and the block was placed inside the fume hood. The sets of feathers were airbrushed on the ventral side first, ensuring coverage of the rachis, and then on the dorsal side; it was found that a darker color could be achieved overall by painting both sides of the feather. As well, overall coverage is necessary, as the feathers will be seen from both sides when the headdress is mounted for display. The feathers were left in the fume hood to set for several hours, after which it was determined that the dye applied in a solvent and without a binder does not rub off the barbs once applied. The rachises of the white feathers, however, were particularly difficult to tone (the barred feathers have naturally brown rachises): the dye spread unevenly over the surface and smudged easily when rubbed vigorously before drying. A preparation manual for the feather inserts, including trimming and straightening, is included in Appendix II.[34] When

displayed, the feather inserts are to be attached behind the original eagle feathers on the headdress, so as to restore its former fullness by visually integrating the losses.

Storage:

An archival box was designed to store the headdress in its most stable configuration: open with the muslin side facing down, so that the wool fabric lies flat, the feathers are supported at a 45-degree angle, and the wool cap is supported by its internal mount. The box is composed of three parts: a base that serves as a permanent study tray with Ethafoam supports, a wrap-around removal wall that fits into the tray, and a lid that secures the wall and tray in place. The base minimizes handling while maximizing visibility of the headdress for study. The headdress should remain sealed while in storage to prevent dust accumulation, as the feathers and textile elements are particularly difficult to clean. The storage facility should maintain a relative humidity of 50% +/- 5% and temperature of 70 +/- 2 degrees throughout the year, thus ensuring stability of the adhered elements. Careful handling of the headdress should be conducted to prevent disruption of the wool fragments and to prevent further feather loss, while the adhesive textile joins should be monitored after each handling to confirm their integrity.

Conclusion

The headdress is an object born of 'cultural translation' and the treatment methodology developed for its care was an equally collaborative effort, assisted by tribal members, conservators, librarians, curators, art historians, migratory bird policy experts, among others.[35] Identifying consultants who could relate headdress 223.002 to Tuscarora material tradition was especially difficult, and further communication could certainly be of benefit to further develop its provenance. With regard to treatment, the line between restoration and conservation - why the replacement of original materials was to be carefully weighed or avoided altogether - was challenging to convey. Golden Eagle feathers are protected under the law, making their replacement both ethically and politically inappropriate; meanwhile, deteriorated feathers are complicated to clean and repair in such a way that conservation intervention is retreatable, visually unobtrusive, and ethically sound. The goals of each stakeholder were measured against material limitation and consultants' input, and decisions were made accordingly.

Ultimately, the conservation treatment undertaken enables headdress 223.002 to be displayed and will ideally elicit its interpretation as both a personal item and a museum object. Queries regarding the headdress's import to Mr. John Green (personal context) and his relationship to the Tuscarora (political context) – as well as how these frameworks mingled - remain elusive. He was photographed wearing the headdress on at least two occasions, yet the images provide mere glimpses of the ensemble's use throughout its decades-old history. Is the headdress a symbol of acculturation, of authority, of 'Indianness', a reflection of personal taste, periodization, or a product of current stylistic trend? Was it inherited, commissioned, or otherwise? Such questions are perhaps as fundamental to the object's import as the

conclusions they may invoke. While provenance issues remain open for many Native American museum materials, "recent theories of cultural translation and hybridity [can be employed] to rethink older judgments of authenticity" (Phillips 2005: 92). Indeed, object-based research can be in itself a form of repatriation. While Chief Golden Eagle's role within the twentieth-century context may remain elusive, his headdress nevertheless serves to represent a period marked by prolific mobility, appropriation, and material exchange.

Endnotes

[1] According to museum records, this date may have been as early as 1960.

[2] See Appendix II for detailed descriptions and visual documentation of the headdress components.

[3] For further sources on consultation, see Jolene Rickard. 2007. "Absorbing or Obscuring the Absence of a Critical Space in the Americas for Indigeneity: The Smithsonian's National Museum of the American Indian." *RES: Anthropology and Aesthetics* 52, Museums: Crossing Boundaries. The President of Fellows and Harvard College and the Peabody Museum of Archaeology and Ethnology: 85-92; Janet Catherine Berlo and Ruth B. Phillips. 1998. *Native North American Art*. Oxford History of Art. Oxford and New York: Oxford University Press; B. Lynn Harlan. 1996. "Museum Perspectives from Within: A Native View." American Indian Ritual Object Repatriation Foundation. *Mending the circle: A Native American repatriation guide: Understanding and implementing NAGPRA and the official Smithsonian and other repatriation policies*. American Indian Ritual Object Repatriation Foundation: 50; Kaminitz, M., Kentta, R. and Moses Bridges. 2005. "First person voice: Native communities and conservation consultations at the National Museum of the American Indian." *Preprints of the 14th Triennial ICOM-Committee for Conservation Meeting, the Hague*, I: 96-102; Johnson, Jessica S. 2005. "Practical aspects of consultation with communities." *Journal of the American Institute for Conservation* 44, 3: 203-215; Capone, Patricia and Diana Loren. 2004. "Stewardship of Sensitive Collections: Policies, Procedures, and the Process of their Development at the Peabody Museum." *Stewards of the Sacred*, L. E. Sullivan and A. Edwards, eds., Washington D. C.: American Association of Museums with Center for the Study of World Religions, Harvard University: 167-181; Clavir, Miriam. 1996. "Reflections on changes in museums and the conservation of collections from indigenous peoples." *Journal of the American Institute for Conservation* 35, 2: 99-107; Clavir, Miriam. 2002. "Heritage Preservation: Museum Conservation and First Nations' Perspectives." *Ethnologies* 24, 2: 33-45; Wharton, Glenn. 2005. "Indigenous claims and heritage conservation: an opportunity for critical dialogue." Conservation, Identity and Ownership in Indigenous Archaeology, *Public archaeology*, 4: 199-204.

[4] Quotation marks are used where possible so as to preserve the anecdotal content of the consultants' responses. Italics are used to signify statements with which I agree, and which were adopted in the headdress' treatment approach.

[5] Three tribal consultants were contacted without reply. Jolene Rickard (Tuscarora) is a curator, artist, and art historian at Cornell University; Richard Hill, Sr. (Tuscarora, Beaver Clan of the Six Nations) is an artist, curator, educator, and spokesman for the Native American Graves Protection and Repatriation Act (1990); Emil Her Many Horses (Oglala Lakota) is an artist and associate curator at the Smithsonian Institution's National Museum of the American Indian. Kelly McHugh, Objects Conservator at the Smithsonian Institution's National Museum of the American Indian, suggested I contact Emil Her Many Horses "to assess the level of appropriateness, particularly if it is in fact Plains in origin;" however he did not replay to my initial email nor to hers.

[6] John Fadden is a contemporary artist and the son of Ray Fadden, who founded the Six Nations Indian Museum on the family's property. The museum is housed in a replica of a Mohawk longhouse and displays objects of Iroquois heritage and contemporary Mohawk artwork, including baskets, headdresses, vestments, ceramics, metalwork, and beadwork. The Fadden family provides interpretive tours of the museum and its environs to the public.

[7] See the following publications for further reference. Greene, Elton. 1969. *The Tuscarora Language*. Murfreesboro, N.C.: Johnson Publishing Co.; Green, Elwood. 1971. *Shining symbols: contemporary Iroquois silverwork*. Niagara Falls, N.Y.: Native American Center for the Living Arts. Both books are included in Marilyn L. Haas. 1994. *The Seneca and Tuscarora Indians: An Annotated Bibliography*. Metuchen, N.J.: Scarecrow Press.

[8] The image is courtesy of Nellie Gansworth, Tuscarora Reservation, and it is illustrated in *Fighting Tuscarora: the autobiography of Chief Clinton Rickard* (1973: 33).

[9] Another form of headdress currently worn by tribes in the eastern United States is the roach: composed of

stiff animal hair (porcupine guard hair, moose, or deer's tail hair, depending on the geographic region) is attached to a bone, leather, or wooden support so as to allow the hair to stand vertically. Single feathers are added to the top of the roach headdress, as well as other decorative elements. Contemporary versions of the roach headdress were danced at the Tuscarora Nation of North Carolina Pow Wow in 2011, among many others.

[10] For further discussion of 'performing indianness' see: Bates, Craig D. 1982. "Dressing the part: A brief look at the development of stereotypical Indian clothing among native peoples in the far west." Malki Museum Inc. *Journal of California and Great Basin Anthropology* 4, 1: 55-66; Büken, Gülriz. 2002. "Construction of the Mythic Indian in Mainstream Media and the Demystification of the Stereotype by American Indian Artists." Mid-American American Studies Association. *American Studies International* 40, 3: 46-56; Maddox, Lucy. 2002. "Politics, Performance and Indian Identity." Mid-American American Studies Association. *American Studies International* 40, 2: 7-36; Cothran, Boyd. 2010. "Working the Indian field days. The economy of authenticity and the question of agency in Yosemite Valley." University of Nebraska Press. *The American Indian Quarterly* 34, 2: 194-223.

[11] For a succinct timeline of events, see the *Native Heritage Project*'s "Tuscarora Populations," accessible at <http://nativeheritageproject.com/2012/06/24/tuscarora-populations>. Additionally, see Sider, Gerald M. 2003. *Living Indian Histories: Lumbee and Tuscarora People in North Carolina*. Chapel Hill: University of North Carolina Press; Wishart, David J., ed. 2004. *Encyclopedia of the Great Plains Indians*. Lincoln, NE: University of Nebraska Press; Blanton, Dennis B. and Julia A. King, eds. *Indian and European contact in context: the mid-Atlantic region*. Gainesville: University Press of Florida, 2004.

[12] Black ash (*Fraxinus nigra* Marsh) is a ring-porous wood, commonly used by Eastern United States tribes for its medicinal (bark) properties and easy workability when soaked and beaten. For further details, see Moerman, D.E. 1998. "Native American ethnobotany." *Plant Guide*. Timber Press, Portland, Oregon and the United States Department of Agriculture, Natural Resources and Conservation Service. Accessible at <http://plants.usda.gov/plantguide/pdf/cs_frni.pdf>

[13] Patterson refers to two laws that restrict the possession, use, and sale of eagle feathers and parts: The Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d; 1940, 1962) and the Migratory Bird Treaty Act (16 U.S.C. 703-712; 1918). Golden eagles were first protected in 1962. Members of federally recognized tribes (under the Federally Recognized Tribal List Act of 1994, 25 U.S.C. Section 479a, 108 Stat. 4791) may seek permits to receive and possess eagle feathers from the National Eagle Repository. For further information, see the U.S. Fish and Wildlife Service, Office of Law Enforcement located in Arlington, Virginia.

[14] For a timeline of repatriation events from the nineteenth century through the birth of NAGPRA, see Hill, Richard Sr. 1996. "Reflections of A Native Repatriator." American Indian Ritual Object Repatriation Foundation. *Mending the circle: A Native American repatriation guide: Understanding and implementing NAGPRA and the official Smithsonian and other repatriation policies*. American Indian Ritual Object Repatriation Foundation: 71- 87.

[15] Native American Graves Protection and Repatriation Act. 1990. U.S. Public Law 101-601. 101st Congress, 1990. Instituted in 1990, the act strives to return Native American human remains, sacred and funerary objects, and cultural property to First Nation parties. NAGPRA and the National Museum of the American Indian Act (1989) were drafted to refine the American Indian Religious Freedom Act (1978), which grants the right and freedom to practice religion. Previously, access to sacred sites required for religious practice was limited, while the use and possession of sacred objects required in ceremony was prohibited. While NAGPRA requires museums to send Natives Peoples inventories of their collections, Native Nations are responsible for repatriation; they must present their case to the museum and prove their shared heritage with the contested cultural material they seek to repatriate. For further information on NAGPRA, see <http://www.nps.gov/nagpra>

[16] Others contacted at the Canadian Museum of Civilization Corporation include: Wanda McWilliams, Conservation and Preservation Collections Manager; Jameson C. Brant (Iroquois), Coordinator of the Aboriginal Training Program in Museum Practices; Judy Hall, Curator of Eastern Woodlands Ethnology; and Stephen Augustine, former curator.

[17] Steven A. Tamayo is an artist, traditional dancer, regalia maker, and Cultural Activities Specialist for the *Native American Advocacy Program*.

[18] This treatment is described in Kaminitz, Marian Andrea, Barbara S. Mogel, Barbara Cranmer, Jessica Johnson, Kevin Cranmer, and Thomas V. Hill. 2008. "Renewal of a Kwakwaka'wakw Hamsamł mask: community direction and collaboration for the treatment of cultural heritage at the National Museum of the American Indian: a panel presentation." *Preserving Aboriginal Heritage*: *Technical and Traditional Approaches*: proceedings of a conference symposium 2007: Ottawa, Canada, September 24-28, 2007. Eds. Carole Dignard, Kate Helwig, Janet Mason, Kathy Nanowin, and Thomas Stone**.** Canadian Conservation Institute, Ottawa, Ontario: 75-87.

[19] Georgia L. Fox is a professor in the Department of Anthropology, co-director of the Museum Studies Program/Valene L. Smith Museum of Anthropology with Dr. Stacy Schaefer, and director of the Heritage Resources Conservation Laboratory at California State University, Chico.

[20] Published sources include Lewarne, Clare and Emily Lin. April 2011. "Loss Compensation in Damaged Feathers." ICOM *Ethnographic Conservation Newsletter* 32: 2-7; De Alarcon, Tessa. 2012. "Treatment of Eagle and Northern Flicker Feathers on a Native American Shield Cover." Poster presented at the ANAGPIC conference, New York University; Drummond, G. 1994. "The Mending of Feather Vanes." *AICCM Bulletin* 19 (3&4): 39-59.

[21] Personal communication with Felicia Rodriguez, Ozark Feather Co. LLC vendor. 11 March 2013.

[22] A further complication with immersion dyeing was noted by Janet Mason, Objects Conservator at the Canadian Conservation Institute, who recalled that during immersion dying the rachis also takes on a less-brilliant color of the dye (yet not as intense as the barbs), so a resist is required or the rachis needs to be bleached afterward to prevent discoloration.

[23] Swatches of fabric were ordered from onlinefabricstore.net for comparison, including: Red Gabardine (S-GAB402), Red Cotton Canvas (S-121718), Red Trigger (S-TRIGRED), Red Single Fill 10 oz Duck (S-PICRED), and Red Broadcloth (S-6184-05).

[24] Polyester Organza, Style: 700-8752, Color 16, Red, 60"/150cm wide. TestFabrics Inc.

[25] Dye-Na-Flow dyes were recommended by Deborah Trupin and Sarah C. Stevens, textile conservators in the Division of Historic Preservation at the Peebles Island Resource Center (PIRC). The dyes are hand painted and then heat sets on nylon bobbinet to encapsulate historic flags. For an annotated bibliography on fabric dye options in conservation, see Vuori, J. April 2008. "Applying colour locally to fabric for use in textile conservation: An annotated bibliography." *ICOM* Newsletter 25: 5-13. Further references for uses of textile paints include: Szuhay, Beth and Joy Gardiner. 2001 "The unfolding of a sticky situation: the treatment of a 19th-century temple hanging." *The Textile Specialty Group postprints of papers delivered at the Textile Subgroup Session: American Institute for Conservation annual meeting* 11: 19-26; Britton, Nancy. 1997. "The use of textile pigments in conservation applications." *The Textile Specialty Group postprints of papers delivered at the Textile Subgroup Session: American Institute for Conservation annual meeting* 7: 40-48; Vuori, J. 1995. "Painting Irgalan dyes onto silk Crepeline." *Textile Conservation Newsletter* Spring: 5-8.

[26] The Oddy Test determines how chemically stable or reactive a given material is, and if it off-gasses acidic or basic fumes. See Appendix III.

[27] The ISO Blue Wool Standard is used to measure the relative light fastness of materials, translated as the number of years to perceptible fading. The rating is based on a 50 lux/hour exposure of 3000 hours/year, or approximately 8 hours/day, 365 days/year, for a total yearly exposure of 150,000-lux hours. Conservation literature generally recommends using materials with a BWS rating of 4 or higher. See Michalski, Stefan. 2013. "Agent of Deterioration: Light, Ultraviolet and Infrared." Ottawa: Canadian Conservation Institute. Accessible

at < http://www.cci-icc.gc.ca/caringfor-prendresoindes/articles/10agents/chap08-eng.aspx#toc1>

[28] Time constraints prohibited Oddy testing and light testing of the polyester organza, as this option was discovered late in treatment planning. However, such testing should be included in future work.

[29] See especially Taylor, Colin F. 1996. *Wapa'ha: the plains feathered head-dress.* Die Plains-Federhaube; deutsch-englisch/German-English. Wyk auf Foehr: Verl. für Amerikanistik and Forsythe, J. Andrew. 2008. *A Focus on Feathers: Sioux Specialties' Guide to Feather Craft.* Baton Rouge, LA: Sioux Specialties, as well as Crazy Crow Trading Post's online resources for regalia makers.

[30] Hot-melt adhesive is an archival grade, non-corrosive glue primarily composed of an ethylene vinyl acetate copolymer, dispensed via a generic hot glue gun. It is used in conservation for its ability to bind a variety of materials, such as polyolefins (Ethafoam, Volara), polyethylene, Tyvek, and paper.

[31] White craft glue is composed of polyvinyl acetate (PVA). While non-toxic, PVAs creep over time if load-bearing and are intractable after hardening, making their reversibility difficult. PVAs are therefore not appropriate for use in conservation.

[32] Chrome tanning was invented in 1858 and remains the most common, industrial tanning method. The process uses chromium sulfate and salts of chromium, which lends the leather pliability yet also its recognizable gray-blue appearance.

[33] For further information on the use of pesticides on museum objects, whether applied during or post-manufacture, see Odegaard, Nancy, and Alyce Sadongei. 2005. *Old poisons, new problems: a museum resource for managing contaminated cultural materials.* Walnut Creek, CA: AltaMira Press.

[34] The feather preparation manual is designed to guide a student working under the supervision of Dr. Georgia Fox to prepare and attach the feathers for exhibition purposes, when desired.

[35] Ruth B. Phillips describes a similar headdress considered for permanent display at the Liverpool Museum, gifted to the museum by a man called Chief Hiawatha from the Six Nations reservation. The questions provoked lend new voice to the object: "Was Chief Hiawatha a travelling entertainer, or a soldier? What does the fineness of these objects- and their deposit in an English museum- say about the survival of traditional Iroquois artistry and spiritualty during the period when assimilation pressures were at their highest?" (Phillips 2005: 92). But what if we cannot conclude the identity of the owner, can the object still speak to these questions? Certainly, as Phillips contends: "Rather than facilitating an inquiry into unique stylistic characteristics or describing patterns of historical diffusion from bounded and stable communities, then, this assemblage of objects exhibits the mobility and transmutability produced by the lively traffic in concepts of folk, Indianness, and Europeanness that was conducted in the Great Lakes during the eighteenth and nineteenth centuries through visual and material exchanges" (Phillips 2005: 93).

Object (title): Headdress
Cultural attribution/provenance: Tuscarora Tribe (Iroquois Nation), mid-20th c.
Identification number: 223.002; Margaret Matusovic Native American Collection
Medium: Leather, Wool, Cotton, Golden Eagle Feathers, Glass beads, Silk
Dimensions: L: 62.5"/158.8 cm W: 18"/ 45.7 cm H: 1"/ 2.5 cm
Current/past owners: California State University Chico Museum of Anthropology
Purpose of Examination: Treatment
Date of examination: 10/28/2012
Conservator: Geneva J Griswold

Object Description

Plains Indian style headdress composed of red wool 'trade cloth'[1] on cotton backing, a wool hat, glass beads, satin ribbons, and approximately 100 Golden Eagle feathers in leather sheaths (Figure 1).

Materials and Techniques

The headdress was commissioned as part of an ensemble for Chief Silver Eagle, also known as Mr. John Green, of the Tuscarora Tribe, Iroquois Nation. Chief Silver Eagle was a resident of Grass Valley, CA, and is pictured in 1948 wearing the headdress and ensemble (Figure 2). Tuscarora tribe members are associated with Iroquois style feathered headdress, making this Plains style headdress uncharacteristic. Upon Mr. Green's death, the headdress was gifted to a friend, Margaret Matusovic of Marysville, CA. The ensemble and headdress were packed in a suitcase from at least 1973-1985, at which time it was donated to the California State University Museum of Anthropology.

A soft, **brown wool hat** provides the structure on which the headdress is constructed. The hat is round yet presently flattened (with a flat radius of 7") and thin (1 mm) (Figure 5). A decorative leather beaded band is sewn to the front of the cap, while the cotton-backed trailer attaches and hangs from the backside of the cap. Along the perimeter of the beaded band, a cotton cord is woven through holes in the wool cap. Twenty-three of the ninety-five feathers are attached to the cotton cord with leather sheaths and run perpendicularly over

[1] While this cloth was made with a herringbone weave, 'trade cloth' (also called list cloth, broadcloth, or Stroud cloth) is typically a plain-weave textile made of short, fine wool fibers. Trade cloth was initially known for its density and heft, and it was dyed during manufacture in a variety of colors. English 'trade cloth' was first manufactured in Stroud Valley, Gloucestershire, England. After 1620, a dye process using cochineal and tin mordant was employed to yield red cloth, which was widely available for trade to American Indian tribes on the east coast of the United States by 1609 (Corey 2005: 134).

the crown of the cap (Figure 6). Satin[2] ribbons of various colors are attached to the cap at the intersection between the beaded leather band and the trailer.

The trailer is composed of **red wool 'trade cloth'** in a twill weave, which is sewn into a single layer of **un-dyed plain weave, cotton textile** backing. The trailer is made from one piece of fabric (53" long x 5.25" wide), which folds lengthwise at the center. Approximately 25" from the bottom of the trailer, the backing is cut into two sections so that each section hangs freely on either side of the wearer's body. Red 'trade cloth' covers the cotton backing, and is sewn into its seams using a running stitch and un-dyed, plied cotton thread (Figure 7). The seams are made on the exterior of the trailer by simply rolling the edges of the cotton cloth over the trade cloth and securing both cloths together with stitching. Roughly punched pairs of holes in the cotton are present every 1.5-2", running from the front corner of the cap diagonally down and across the trailer, with the holes terminating at the center of the trailer's end. A cord, composed of a ripped ¼" section of cotton backing material, is threaded through the holes (with the long stitch on the interior face of the backing), onto which the feathers are strung (Figure 8).

Ninety-five Golden Eagle feathers are located on the headdress' trailer. The feathers are pennaceous[3] flight feathers[4] from immature Golden Eagles. The feathers are dark brown with white areas at the base, some of which are speckled or "marbled"[5] brown at the transition point. There are forty-seven feathers on each side of the trailer, with one feather centered on the cap. The feathers' barbs have been trimmed to form rounded tips. Originally, the tips of approximately thirty-six feathers on the crown were adorned with white, plumulaceous[6] feathers, which are evident in a 1948 photograph of Mr. Green wearing the ensemble (Figure 2). All of these additional feathers have been lost; however, white, dry adhesive residue and white fibrous accretions remain on at least twelve of the feathers (Figure 9). The feathers are sheathed in leather in order to attach them to the trailer, while the feathers' vanes are spliced at the center in order to thread a second ¼" cotton cord through each one, effectively stabilizing them in an erect position (perpendicular to the wearer's vertical axis) when worn.

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[2] Satin is a silk, warp-dominated textile, which has a shiny and matte side.

[3] Pennaceous feathers are defined as having a central shaft (or rachis) from which smooth vanes extend to either side. Barbs connect to one another by small barbules or hooks. GG, vanes are made up of barbs and barbules=gross morphology rather than an individual part

[4] The feathers on the headdress have been cut to form rounded tips. It is therefore difficult to ascertain the type of flight feather used. Inner flight feathers, or secondaries, are rounded, with equally sized vanes on each side of the shaft. Tail feathers, however, are also rounded and have equally sized vanes if they originate from the inner or center of the tail (Trail 2003: 1). It can therefore be difficult to decipher between secondaries and inner tail feathers.

[5] The white down at the feather's base it usually pure white, yet the amount varies depending on the individual bird and the location on the bird from which the feather derives. Spots of brown "marbling" at the perimeter of the white area is an indication of the mature Golden Eagle's feather pattern, which is light brown overall with white marbling (Trail 2003: 1-2).

[6] Plumulaceous feathers appear downy, with non-interlocking barbs extending from the calamus.

Leather sheaths are wrapped in a U-shape around the calamus of each feather, covered in red wool trade cloth, and bound with doubled threads of plied, S-spun, white cotton string (Figure 10). Each sheath loops around the cotton cord that runs the length of the headdress through the cotton backing, thereby attaching the feathers to the cotton backing at their base. The majority of sheaths are likely buckskin (deerskin) as the hair follicles are small, dense and uniformly dispersed; the leather is tan in color, thin (0.5 – 1 cm), very stiff, and yellowed on the surface. Three sheaths on the headdress' proper left side (feathers nos. 9, 23, 24 from the bottom) and one sheath on the proper right side (no. 21) appear to be replacements; the leather is grey in color with small, dense, uniformly dispersed hair follicles. The leather is soft, and the sheaths are prepared wider and thicker (3 cm) than the originals (Figure 11). The red cloth is also different from the original; it has a wide weave, bright red color, and is less soiled than the originals.

Round, glass 'seed beads'[7] are used to form a decorative border attached to the front of the cap. The beads are sewn onto a 1" leather strip using un-dyed, plied, S-spun cotton thread to form a geometric design. The colors of seed beads employed include: light blue, dark blue, white, and red. The border is made of successive rows of vertical lazy stitch, each strand containing approximately 17 beads. The design includes a red square (7 x 4 beads) surrounded by three triangular blue blocks to form a semi-pyramidal shape, with dark blue lines extending from the base of each form; three pyramidal forms are interspersed on a white background (Figure 12). A modified netting stitch, creating a scalloped effect of two floating beads to each single stitched-down bead, is used to decorate the outer edges of the border using light blue beads.

Two groups of dyed, satin ribbons are attached to the cap with black thread at each end of the beaded border (Figure 13). Five ribbons are extant on the proper right side of the headdress (two blue, one each in green, red, yellow) and eight ribbons are extant on the proper left side (two of each color). The ribbons each measure ½" wide and up to 17" long, however the ends of all the ribbons have been lost so their original lengths are unknown.

Condition:

The headdress' condition was undocumented when acquisitioned by CSU Chico in 1985, and deemed "In Need of Stabilization" when it was catalogued in 2000. During the 15-year period, the headdress was stored in a string-tied polyethylene bag and "hung from a ceiling-mounted hanger with little support."[8] Prior to acquisition, the museum record states that the headdress and ensemble were stored in a suitcase between 1960-1985. The headdress displays severe signs of insect damage, thought to have occurred before 2000, as no active pest infestation was noted in a collections survey conducted between 2000-2012. No earlier documentation of such treatment exists, and neither anoxia nor freezing treatments were conducted on the headdress at the time of acquisition according to the current curator.

[7] Seed beads are embroidery beads typically measuring 0.1-0.3cm in diameter and are spherical, irregularly shaped, opaque or translucent, and manufactured in a variety of colors (Hail 1980: 53). Early geometric designs using seed beads in Plains collections date to 1840-1870 (Hail 1980: 54).

[8] Personal communication with Georgia Fox, 16 May 2012.

The headdress is currently unstable, heavily soiled, and in poor condition. The headdress arrived at the Getty Villa conservation laboratory in a 1.5ft^2 generic cardboard box. It was folded twice and wrapped in a white, polyester fabric with substantial nap (Figure 14). Soiling, fragments of brittle feather, red wool fibers, frass, and insect casings[9] (many of which are tinted red from consuming the 'trade cloth') are embedded in the fabric and are loosely scattered throughout the headdress. No active insect activity is noted.

Extensive insect damage is noted on all proteinaceous materials. The **wool cap** is collapsed, while significantly thin and brittle. The cap's crown shows irregular losses, up to 0.5" wide, due to insect activity. The edges of the cap are degraded and partially detached from the beaded leather border.

The **trade cloth** is very unstable and 70% lost due to insect damage and neglect; extant areas of trade cloth are attached to the cotton backing only where sewn into the seams. The majority of trade cloth is loosely attached and the edges of the extant areas are actively fraying. Loose, red wool fibers are present throughout the headdress. Local areas of the trade cloth are stained, particularly at the trailer's end.

The **Golden Eagle feathers** are matted, brittle, and evidence significant loss due to prior insect activity and inappropriate storage. Broken, detached sections of vane, distorted, or broken feather vanes are present throughout the headdress. More than half of the feathers have lost 50%+ of their vanes, leaving nearly-bare rachis behind. Extant vanes show significant loss in the form of holes (vanes, barbs and barbules lost) or significantly grazed surfaces (barbs and/or barbules eaten but portions of vane remain). The splices in the vanes are stable (where they thread into the cotton strip), yet one feather has detached and sits outside its leather sheath.

The **leather sheaths** are stable and intact, yet the leather has yellowed overall and blackened in some areas of the interior. The grain layer of several sheaths, which faces outward, was grazed by insects leaving shallow recesses in the leather. The curved ends of several sheaths are soiled and some show black spots of mold.

The **cotton backing** is fully intact yet discolored, heavily soiled, and stained. Patches of black, spotty mold are present on the exterior center and interior ends of the trailer. The backing adjacent to the wool cap is darkly stained along the edges and across the back, likely a result of wear (sweat). The cotton cords are intact yet significantly frayed.

The **satin ribbons** are largely intact yet fragile. The ends of each ribbon have been lost. Insect damage has created holes and weak areas in the ribbons, such that many are loosely held together. Areas of black, spotty mold are present on a yellow and a red ribbon.

[9] The casings are likely from casemaking clothes moths (Tinea pellionella), whose larva spin silk cases as they feed to produce small tubes with consumed fibers intermixed. The cases may be attached to the material they've been feeding on by small silk thread produced by the larva. Casemaking clothes moths feed on keratin materials, particularly wool and feathers, in a random pattern. The moths prefer soiled materials for their added nutrient content, especially sweat-stained silk and cotton. Fecal pellets will fall freely in adjacent areas, and into folds of the material as they feed. The moths prefer warm, humid, and low light environments.

Glass beads are soiled yet intact and stable. The surface of one blue bead appears cloudy, perhaps a sign of glass disease. The light blue, netted beads along the trim have detached in some areas, while the majority of beads are stable. The cotton thread is intact and in good condition.

Condition Summary:
The headdress is unstable and in poor condition, largely due to prior insect infestation. Deterioration has occurred in all the materials present, including: soiling and loss of the glass beads, soiling and molding of the cotton backing, loss and molding of the satin ribbons, loss of the wool hat, severe loss and detachment of the red wool trade cloth, as well as soiling, severe loss, and instability of the Golden Eagle feathers.

Proposed Treatment:

1. Pesticide residue testing: portable XRF (pXRF) will be used to detect inorganic pesticides; FTIR can be used to detect organic pesticides, only if residual crystals are found; detection of gaseous, volatile pesticides is beyond the scope of this project.
2. Dry cleaning using a HEPA vacuum and brushes, microfiber clothes, cosmetic sponges, and in the case of the beadwork, possibly ethanol.
3. Stabilization of the red wool trade cloth with suitable inserts to secure detaching areas mechanically, wherever possible, to minimize the use of adhesives and assure reversibility.
4. Stabilization of the satin ribbons using an appropriate backing to prevent further loss and assist handling.
5. Stabilization of the feathers. Experiments for stabilization and compensation of feathers include building on the work of conservators at the Canadian Conservation Institute (CCI), and will be based on results of tribal consultations, a survey of appropriate colleagues, and ethical research about the suitability of use of non-eagle feathers, suitability of use of non-feather materials, and suitability of use of synthetic versus natural materials. In this case, the adoption of established loss compensation techniques for feathers require both aesthetic and ethical consideration. The use of modified goose feathers may be ethically unacceptable, satin fills tested by the Canadian Conservation Institute were shown to have a compromised appearance, while Japanese tissue is effective yet lacks the appropriate texture for large losses. If suitable, synthetic feathers- that can be shaped by thermal manipulation- can be analyzed for composition, assessed for long-term aging properties, and evaluated for manipulation into loss compensation.
6. Construct a mount and storage housing.

Testing and Analysis:

XRF: Inorganic pesticide residue testing was conducted using portable X-Ray Fluorescence spectroscopy (pXRF); FTIR was not feasible because no residual crystals were found on the headdress during cleaning and inspection. XRF spectra overlay of the wool hat, using a filter for heavy metals (red) and no filter (blue) settings, show the presence of mercury (Hg), a result of the wool's production process (Tables C-D, Figure 15). XRF spectra overlay of the red wool textile, using a filter for heavy metals (red) and no filter (blue) settings, shows the possible presence of heavy metal residues (Tables E-F, Figure 16).

Table C. XRF of wool hat after cleaning (Figure 15)	
Instrument; Analytical Setting/Calibration Mode:	Bruker Tacer III-V (rhodium source).
Date and Time Tested:	3/19/2013; 11:00am
Summary of Equipment Setup:	No filter. No vacuum, 40 kV, 1.9 μA
Data:	Hg, S, Ca, Ti, Fe, Cu, Zn
Conclusion/Discussion of Results:	Presence of Hg, careful handling required.

Table D. XRF of wool hat after cleaning (Figure 15)	
Instrument; Analytical Setting/Calibration Mode:	Bruker Tacer III-V (rhodium source).
Date and Time Tested:	3/19/2013; 11:10am
Summary of Equipment Setup:	Cu (1) - Ti - Al filter, copper side down toward the Rh source. No vacuum, 40 kV, 1.9 μA
Data:	Hg
Conclusion/Discussion of Results:	Presence of Hg, careful handling required.

Table E. XRF of red wool cloth after cleaning (Figure 16)	
Instrument; Analytical Setting/Calibration Mode:	Bruker Tacer III-V (rhodium source).
Date and Time Tested:	3/19/2013; 11:20am
Summary of Equipment Setup:	No filter. No vacuum, 40 kV, 1.9 μA
Data:	As-La,Ka, Sn-La,Ka, S, Ca, Ti, Fe, Cu, Zn, Pb-La
Conclusion/Discussion of Results:	Possible presence of heavy metal pesticide residue.

Table F. XRF of red wool cloth after cleaning (Figure 16)	
Instrument; Analytical Setting/Calibration Mode:	Bruker Tacer III-V (rhodium source).
Date and Time Tested:	3/19/2013; 11:30am
Summary of Equipment Setup:	Cu (1) - Ti - Al filter, copper side down toward the Rh source. No vacuum, 40 kV, 1.9 μA
Data:	Fe, Sn
Conclusion/Discussion of Results:	No heavy metals present.

Treatment:

Cleaning: The headdress, excluding the feathers, was dry cleaned using a Nilfisk HEPA-filter vacuum to remove loose particulate, frass, and heavy soiling present throughout the headdress and storage cloth. A soft, dry brush was used to dislodge frass from crevices, while microfiber clothes and cosmetic sponges were tested but ineffective. The headdress was vacuumed a total of four times to remove frass and particulate that continued to

dislodge during treatment. The feathers were gently brushed to remove loose particulate, while tweezers were used to remove displaced barbs and insect casings.

Humidification of Ribbons: Each satin ribbon was gently flattened and straightened via local humidification to facilitate the application of a backing material to the reverse side (Figure 17). Blotter paper was moistened with deionized water, placed over the ribbon with a Gore-Tex[10] barrier between, and weighted for 20 minutes on each location. Humidification was executed in 3" sections until each ribbon's flat and straight form was restored.

Ribbon Stabilization: The satin ribbons were backed with Stabiltex[11], a heat set polyester filament fabric, using an adhesive mixture of 1:1 360:498 HV Lascaux[12] in 3:1 deionized water.[13] 'Copper' colored Stabiltex was used for the red, green, and blue ribbons, while 'Marigold' was used for the yellow ribbons. To cut 1" sections of Stabiltex, the fabric was placed under a glass weight with a straight edge, pulled taught, and weighted at the opposite end. The hot tip of a sautering iron was slowly drawn along the edge of the glass weight, fusing the polyester filament ends while cleanly separating the fabric into sections.[14] The sections were coated with the Lascaux mixture and allowed to dry for 24 hours, until minimally tacky (Figure 18). The sections were adhered to the back of each ribbon using a warm tacking iron. Once the ribbons were backed, the top of each Stabiltex section was looped and heat-set to itself, with a black 4-ply cotton string passing through the loop. The string was sewn through existing stitch holes to the base of the wool hat, so that the weight of the ribbon is fully supported by the backing.

Humidification of Wool Hat: The wool hat has a strong crease running over the crown of the head, resulting from long-time flat storage. In order to return its three-dimensional form, Ethafoam[15] blocks were gradually placed into the recess of the hat to open the sides,

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[10] Gore-Tex Laminate (W.L. Gore) is 100% expanded PTFE (membrane) and calendered polyester (substrate), which allows airflow and moisture permeation.

[11] Stabiltex was chosen for its excellent resistance to ultraviolet radiation, decay, bacteria, acids, and oxidizing agents. Stabiltex (also called Tetex® or Terelene) is a fabric made from 100% fine, polyester multifilament yarn (85 microns thick). The product is longer manufactured. Stabiltex is thought to be dyed with disperse dyes, however the information is unavailable from the distributor (Ellis 1997: 5).

[12] Lascaux Acrylic Adhesive 360 HV and 498 HV are a thermoplastic copolymer butyl-methacrylate dispersions thickened with acrylic butyl-ester, which are slightly tacky at room temperature. They can be thinned with water, but are insoluble in water after drying. Once dry, it is soluble in acetone, toluene and xylene.

[13] This process was conducted on silk ribbons by conservators at the National Museum of the American Indian, and detailed in the following article: Takami, Mika, Susan Heald, Jessice S. Johnson. "Collaborative Treatment of a Native American Robe from the Miami Community with Silk Ribbonwork and Metal Decoration." *The Textile Specialty Group Postprints of Papers Delivered at the Textile Subgroup Session: American Institute for Conservation Annual Meeting* 12, no. 2002 (2003): 85-95.

[14] Established methods of cutting Stabiltex use either a hot wire (Thomsen 1988), or a heat-conducting metal sheet with a hot air blower, to cut and fuse the frayed edges of Stabiltex were tested but found difficult to execute. Instead, a hot sautering iron simplifies the equipment necessary, minimizes wasted material (both cut edges are usable and uncontrolled burning is avoided), and lends a higher degree of control than the aforementioned methods currently in use.

[15] Ethafoam is archival, rigid, inert polyethylene foam.

allowing the wool to slowly acclimatize to the ambient humidity (Figure 19). The crease was thereby softened, and after approximately five months, an interior mount was made to support the wool hat's open shape. The mount is human head-shaped, composed of an Ethafoam core padded with polyester batting inside an un-dyed 100% cotton stockinette flexi-tube[16] tied at both ends (Figure 20).

Red Wool Textile Backing: Pre-dyed polyester organza was used as a backing material to stabilize the severely degraded, detached red wool fragments (Figure 21). The backing was locally adhered to the reverse of the wool fragments and to the muslin support with an adhesive mixture of 1:1 360:498 HV Lascaux in 3:1 deionized water (Figure 22). Sections of organza were individually cut to shape with scissors using a Mylar template, coated with the Lascaux mixture and allowed to dry for 24 hours, placed between the wool and the cotton muslin, and heat-set with a tacking iron on low setting using a Mylar barrier (Figure 23). In local areas, such as holes in areas of continuous fabric, uncoated organza was carried over areas of exposed muslin where wool has been lost to restore visual integration and to improve the area's structural integrity (Figure 24).

Previously, white Stabiltex fabric was to be dyed[17] red and used as the backing material. The dye was mixed in several shades, and applied by brush to test swatches of Stabiltex. As a necessary treatment yet difficult to reverse, Oddy testing[18] was conducted to assess the stability of three red shades of Dye-Na-Flow dye. Oddy testing was successful for all three colors. As of yet, no stability testing had been done on Dye-Na-Flow products to assess their long-term aging properties; however, Dye-Na-Flow fabric paints are currently being used by conservators for similar treatments.

Bead stabilization:
Three loose beads on the front of the beaded band were restrung onto white cotton thread, as the original thread was broken, using original needle holes (Figures 25-26). The ends were tied off for simple reversibility.

Feather sheath reattachment:
Four feathers on the proper left side of the headdress were stabilized. Each feather was originally attached in two places: a cotton cord passing through the middle of each rachis and another cotton cord passes through each leather sheath at the feather's base. The latter cord frayed such that four feathers were unattached to the trailer. Two strips of cotton textile were torn, toned with Orasol dyes to match the soiled appearance of the original muslin backing, and dried. The strips were passed through the original holes in the muslin

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16 Flexi-tube is an open weave, lightweight gauze stockinette made of 100% cotton.

17 Preliminary testing has compared the tensile strength of dyed and undyed Stabiltex yarn after exposure to fluorescent light to induce accelerated photodegradation, finding that the presence of dye actually increases the yarn's strength, while reducing its elongation after ageing (Ellis 1997). For an annotated bibliography on fabric dye options in conservation, see Vuori 2008: 5-15.

18 The Oddy Test determines how chemically stable or reactive a given material is, and if it off-gasses acidic or basic fumes. The Brooklyn Museum of Art's Oddy Test guidelines were followed. See Appendix III.

backing and through each leather sheath (Figure 27); the ends were tied off on the reverse side, providing simple reversal if necessary (Figure 28).

Feather Simulations:
Two silicon molds were made, one from a trimmed section of a turkey feather and another from a section of aluminum foil impressed with lines simulating a feather.
- Several weights of Japanese paper were dampened and tamped into the aluminum feather mold to assess their ability to maintain the texture created (Figure 29). Deionized water, 0.5% methyl cellulose in deionized water, and 0.5% chitosan in 1:1 DI water: ethanol were tested on Senka-shi Thick (120t) and Kozo White #8 (162w) papers. The 0.5% methyl cellulose in deionized water was the most effective adhesive on both types of paper, with the Senka-shi Thick retaining more texture overall. This paper-adhesive system could be toned and used to fill losses in the feathers, if appropriate.
- Loss compensation methods for missing barbs on the feathers were explored using methyl cellulose pulp and 0.5% methyl cellulose in deionized water. The cellulose mixture was laid into the feather mold and left to dry over a period of 24 hours. The molds captured the fine texture of both very well, however the cellulose mixture did not have enough binder to maintain its structure (Figure 30).
- Replacement feather options were pursued through several vendors. None of the pre-painted, commercially sold 'golden eagle feather' options are appropriate replacements for the headdress' deteriorated feathers due to their size and color. Commercial feathers are made to imitate golden eagle feathers, using large white turkey feathers from a mature male - a 'wild' or 'bronze' turkey[19]- and painting them with dark tips and white bases. The headdress has immature golden eagle feathers, which are smaller overall, with a thinner and shorter rachis, and are mottled brown in color. Ozark Feather Co. LLC thus assisted selection of 15 white left turkey feathers and 13 white right turkey feathers to replace the longest and widest feathers on the headdress crown, as well as 35 left barred turkey feathers and 37 right barred turkey feathers to replace smaller feathers on the headdress body.

Preparation of Turkey feather Inserts:
Brush application, airbrush application, and immersion dyeing using Orasol® dyes[20] on white and barbed turkey feathers were tested to approximate the uneven coloring of the deteriorated Golden eagle feathers. Direct brush application was successful, however the method did not produce the mottled affect desired, and was considered too costly in time for the 104 feathers needed as each had to be painted individually. Immersion dyeing was considered (Vuori 2008) but requires a large volume of dye and does not produce the mottled affect desired. Airbrushing was very successful and rapid in execution, as multiple feathers could be painted at once.

[19] Personal communication with Felicia Rodriguez of Ozark Feather Co. LLC. 11 March 2013.

[20] Orasol® dyes are 1:2 metal complexes, commercially available in 17 colors, soluble in organic solvents, and require no rinsing after application. The dyes are approved and widely used in the conservation field, such as for wood stains or colorants in epoxy or resins. The manufacturer states the dyes' lightfastness as moderate to high (Nunan 2012: 54); however, this does not take into consideration the lightfastness of the substrate on which the dyes are being applied.

A Paasche Double Action airbrush and D500 generator was used[21] with a 1% solution of ethanol and the following combination of Orasol® dyes[22]: Yellow 2GLN, Brown, 2RL, Black CN, and Blue (1:5:2:1).[23] The solution was thoroughly mixed and brushed onto blotter paper and directly onto both sides of a white turkey tail feather to assess the color tone before application, and the solution was tweaked as necessary (Figure 31). The feathers are sorted into lefts and rights, barred and white before dye application (Figure 32). Approximately 4-6 feathers were inserted into a foam block, and the block was placed inside the hood (Figure 33-34). The sets of feathers were airbrushed on the reverse side first, ensuring coverage of the rachis, and then on the obverse side (Figures 35-36); it was found that a darker color could be achieved overall by painting both sides of the feather. As well, overall coverage is necessary, as the feathers will be seen from both sides when the headdress is mounted for display. The feathers were left in the fume hood to set for several hours (Figure 37), after which it was determined that the dye does not rub off the barbs once applied. The rachises of the white feathers, however, were particularly difficult to tone (the barbed feathers have naturally brown rachises): the dye spread unevenly over the surface and smudged easily when rubbed vigorously before drying. A preparation manual for the feather inserts, including trimming and straightening, is included in Appendix II. When displayed, the feather inserts are to be attached behind the original eagle feathers on the headdress, so as to restoring its former fullness by visually integrating the losses.

Storage:
The headdress should be stored in its most stable configuration: open with the muslin side facing down, such that the wool fabric lies flat, and the wool cap is supported by its internal mount (Figure 38). The feathers may lie flat, or be supported at a 45-degree angle. The headdress should remain sealed while in storage to prevent dust accumulation, as the feathers and textile elements are particularly difficult to clean. The storage facility should maintain a relative humidity of 50% +/- 5% and temperature of 70 +/- 2 degrees throughout the year, thus ensuring stability of the adhered elements. Careful handling of the headdress should be conducted to prevent disruption of the wool fragments and to prevent further feather loss, while the adhesive textile joins should be monitored after each handling to confirm their integrity.

[21] Double Action Internal Mix Airbrush No. 46918 and D500 Diaphragm Air Compressor (115 volts, 60 hertz, 1/10 H.P., 3 amps). Paasche Airbrush Company.

[22] Orasol® dyes were successfully utilized by conservators at the American Museum of Natural History to re-tone taxidermy animal fur, as well as tested for lightfastness and reversibility/retreatability. The authors note the reversibility of Orasol® dyes with ethanol, as well as the potential for local reduction. See Nunan, Elizabeth, Judith Levinson, Lisa Elkin, Dr. Corina Rogge, Julia Sybalsky, Becca Pollak. 2012. "In their true colors: developing new methods for recoloring faded taxidermy." Presented at the RATS/OSG join session 40th Annual meeting of The American Institute for Conservation of Historic and Artistic Works, Albuquerque, NM, May 8-11, 2012. *RATS Postprints* Vol. 3. American Institute for Conservation: 25- 87.

[23] Orasol® dyes from Kremer: Blue (94416), Brown 2RL (94410), Yellow 2GLN (94402), and from Museum Services Corporation: Black CN (no. 4104-004), Brown 2RL (no. F4102-004).

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Products

Dye-Na-Flow fabric paints
Jacquard
Rupert, Gibbon & Spider, Inc., P.O. Box 425, Healdsburg, CA 95448
(707) 433-9577
www.jacquardproducts.com

Turkey Feathers
Ozark Feather Company LLC
14162 Kafir Road, Carthage, MO 64836
(417) 994-2294
ozarkfeather@hotmail.com

Lascaux Acrylic Adhesives 360 HV + 498 HV

Conservation Support Systems
P.O. Box 91746 Santa Barbara, CA 93190-1746
(800) 482-6299
info@conservationsupportsystems.com

Stabiltex, Gore-Tex Laminate, Ethafoam, Polyester batting
Talas
330 Morgan Ave, Brooklyn, NY 11211
(212) 219-0770
info@talasonline.com

Polyester Organza
TestFabrics, Inc.
P.O. Box 3026, 415 Delaware Ave, West Pittston, PA 18643
(570) 603- 0432
www.testfabrics.com; info@testfabrics.com

Double Action Internal Mix Airbrush No. 46918 and D500 Diaphragm Air Compressor
Paasche Airbrush Company
4311 N. Normandy, Chicago, IL, 60634-1395
(773) 867-9191; www.paascheairbrush.com

Flexi-tube Stockinette
Bandages Plus
1701 NW 82 Ave, Miami, FL 33126
(800) 770-1032; www.Bandagesplus.com

Figure 4. Proper left side of the headdress before cleaning.

Figure 5. The wool hat is flattened and thinned from use.

Figure 6. Feathers strung with cotton cord over the crown of the wool hat.

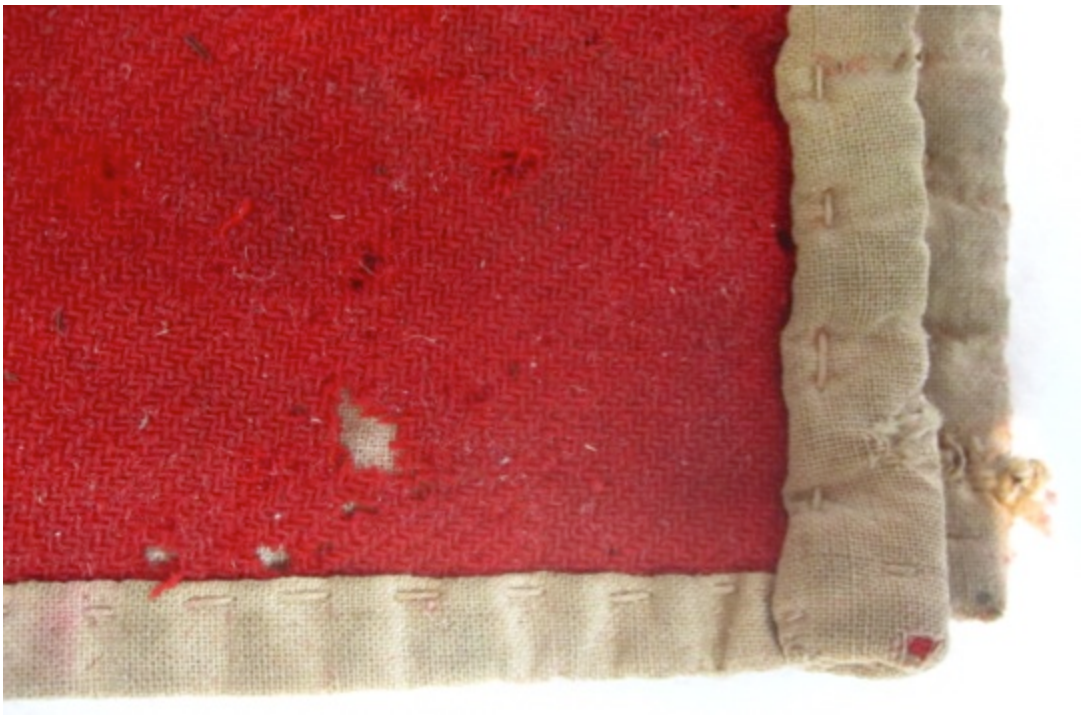


Figure 7. Red, wool 'trade cloth' sewn into cotton backing seams.

Figure 8. Feathers strung onto cotton cord through loops in leather sheaths.

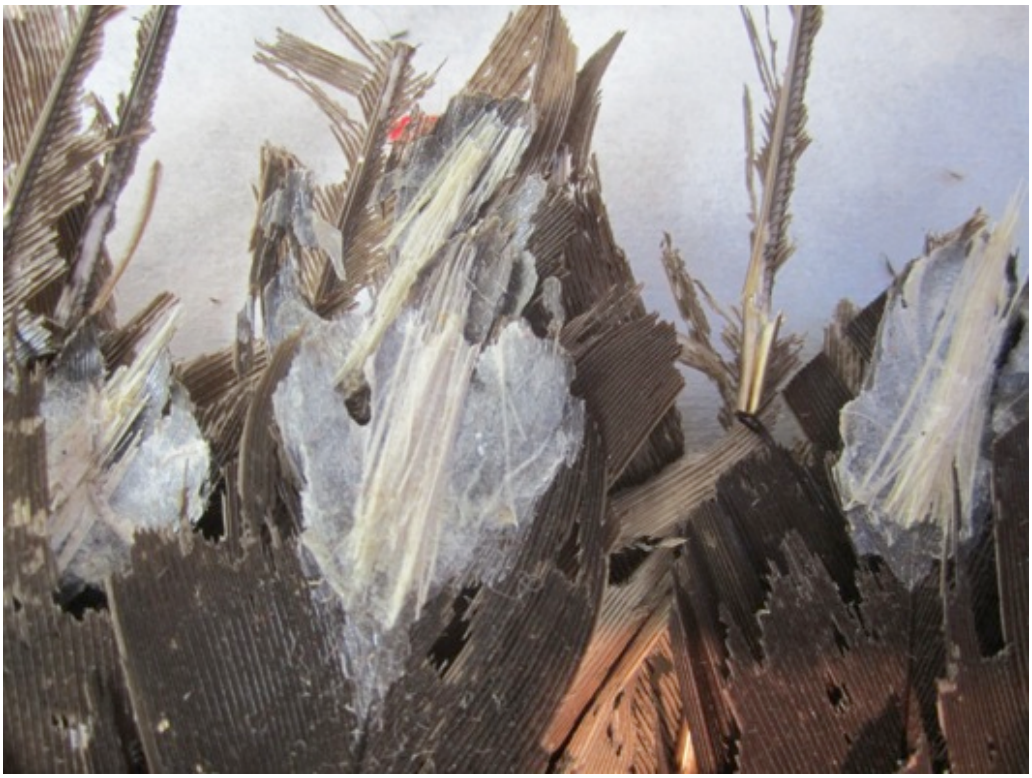


Figure 9. Adhesive residue and fibrous accretions remain on at least twelve of the crown feathers.

Figure 10. Original leather sheath wrapped around each calamus and bound with cotton string.

Figure 11. Original (bottom) and replacement (top) leather sheaths.

Figure 12. Geometric beaded design on leather band.

Figure 13. Satin ribbons attached to wool cap with black thread.

Figure 14. The headdress arrived folded and wrapped in polyester fabric.

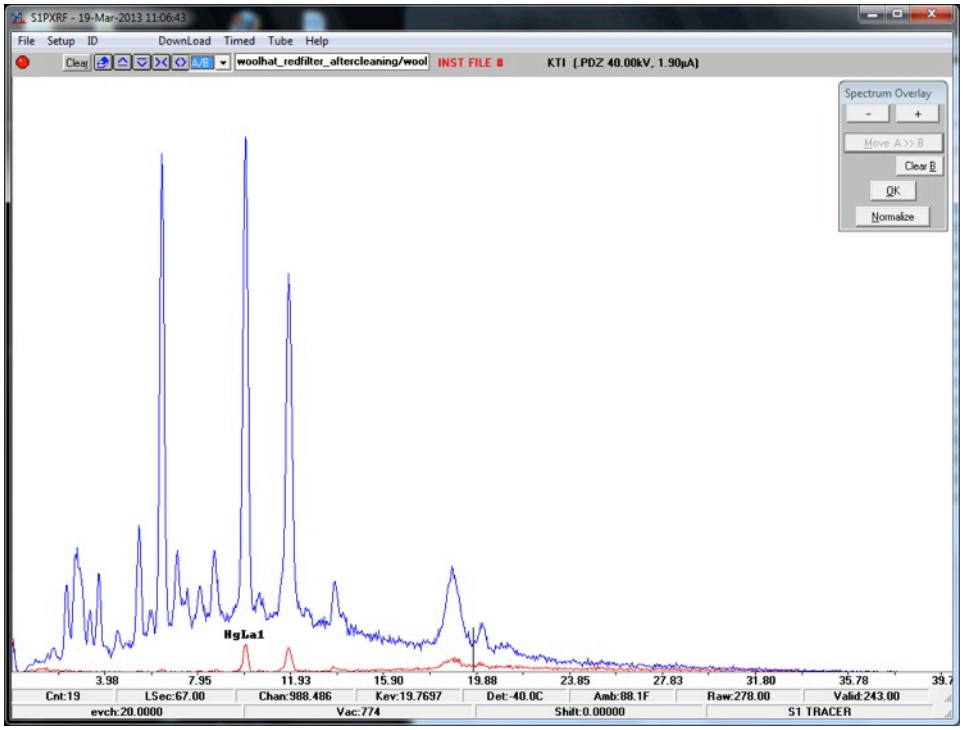


Figure 15. XRF spectra overlay of the wool hat, using a filter for heavy metals (red) and no filter (blue) settings. Both spectra show the presence of mercury (Hg), possibly a pesticide residue.

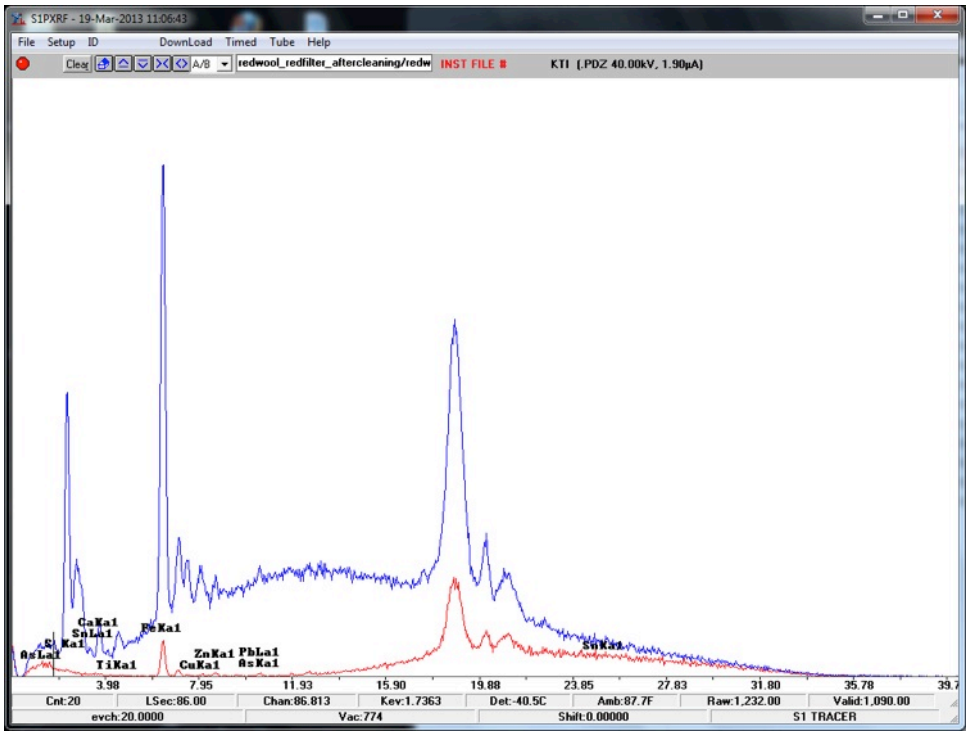


Figure 16. XRF spectra overlay of the red wool textile, using a filter for heavy metals (red) and no filter (blue) settings. Neither spectrum shows a presence of heavy metal residues (Tables 3-4).

Figure 17. Humidification of satin ribbons using damp blotter paper and weights.

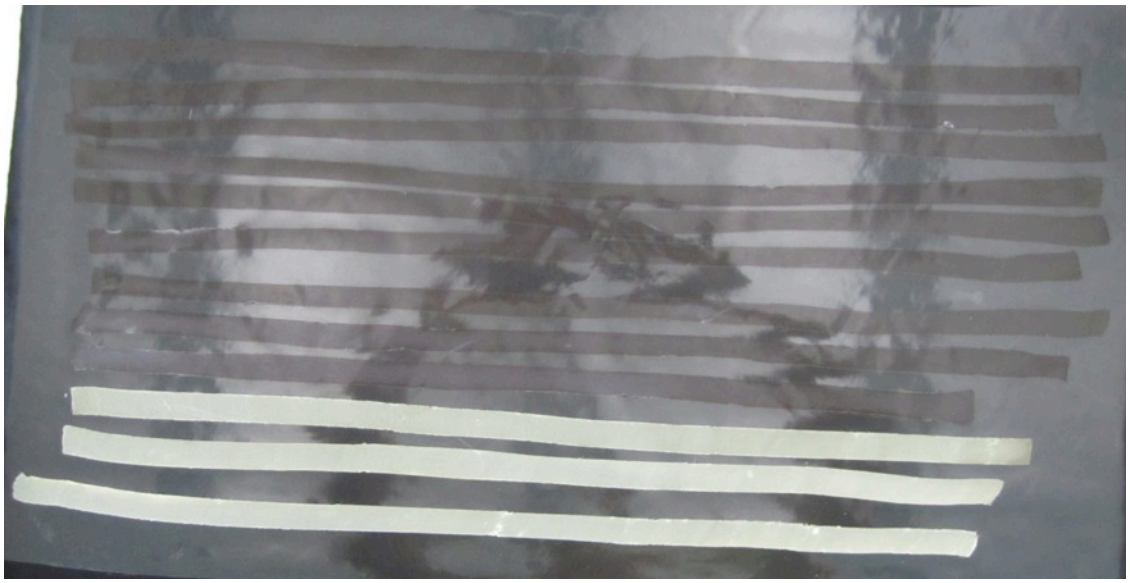


Figure 18. Stabiltex strips cut and coated with Lascaux 360HV, prior to backing ribbons.

Figure 19. Ethafoam blocks used to relax wool hat in ambient humidity.

Figure 20. The mount for the wool hat is composed of an Ethafoam core padded with polyester batting inside a cotton tube tied at both ends.

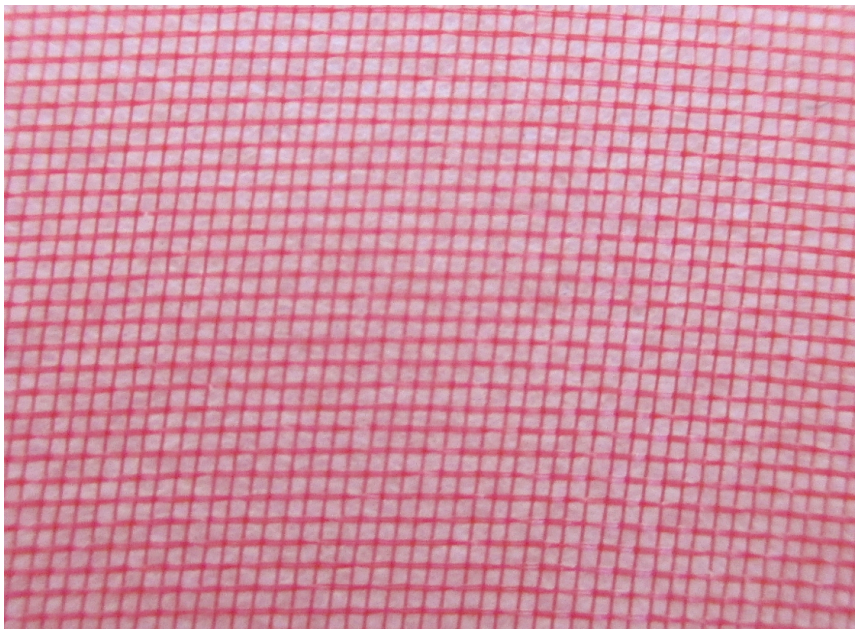


Figure 21. Pre-dyed polyester organza was used as a backing material to stabilize the severely degraded, detached red wool fragments.

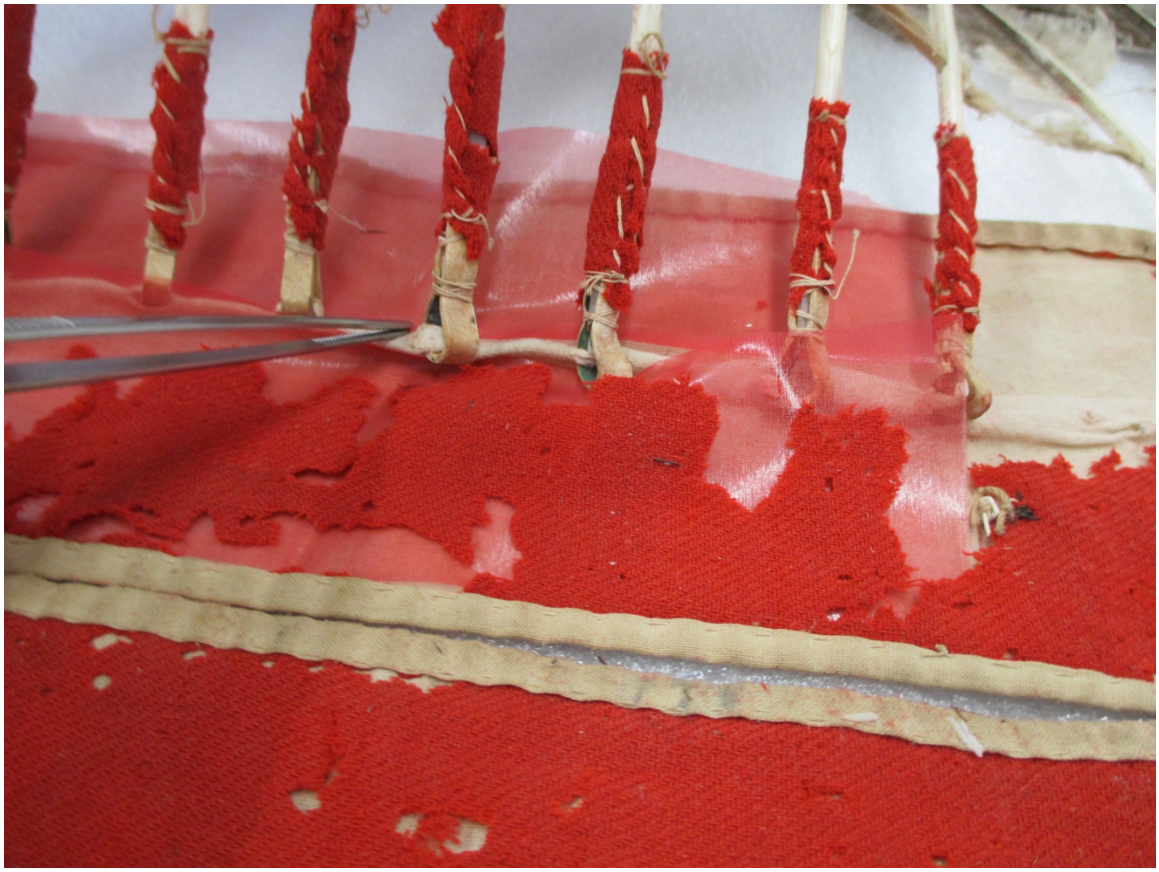
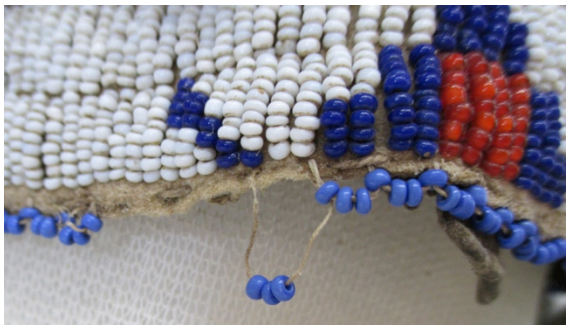


Figure 22. The organza was coated with Lascaux 1:1 360:498 HV adhesive, which appears shiny when dry, and inserted between the wool fragments and the muslin support.

Figure 23. Sections of coated organza are heat-set with a tacking iron on low setting using a Mylar barrier.

Figure 24. In areas of loss, such as at the base of the trailer, uncoated organza was carried over areas of exposed muslin to restore visual integration and to improve the area's structural integrity.



Figures 25-26. Three loose beads were restrung on white cotton thread. Left: before treatment, Right: After treatment.

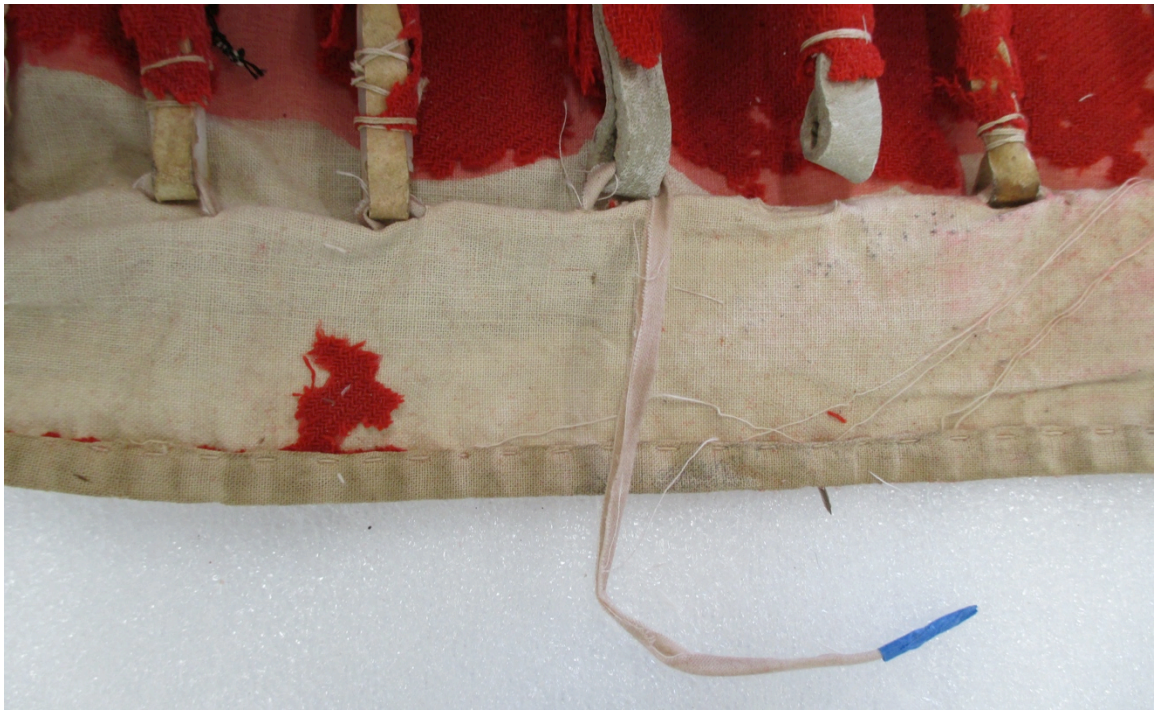


Figure 27. Toned cotton strips were passed through the original holes in the muslin backing and through each leather sheath.

Figure 28. The ends of the strip were tied off on the reverse side, providing simple reversal if necessary.

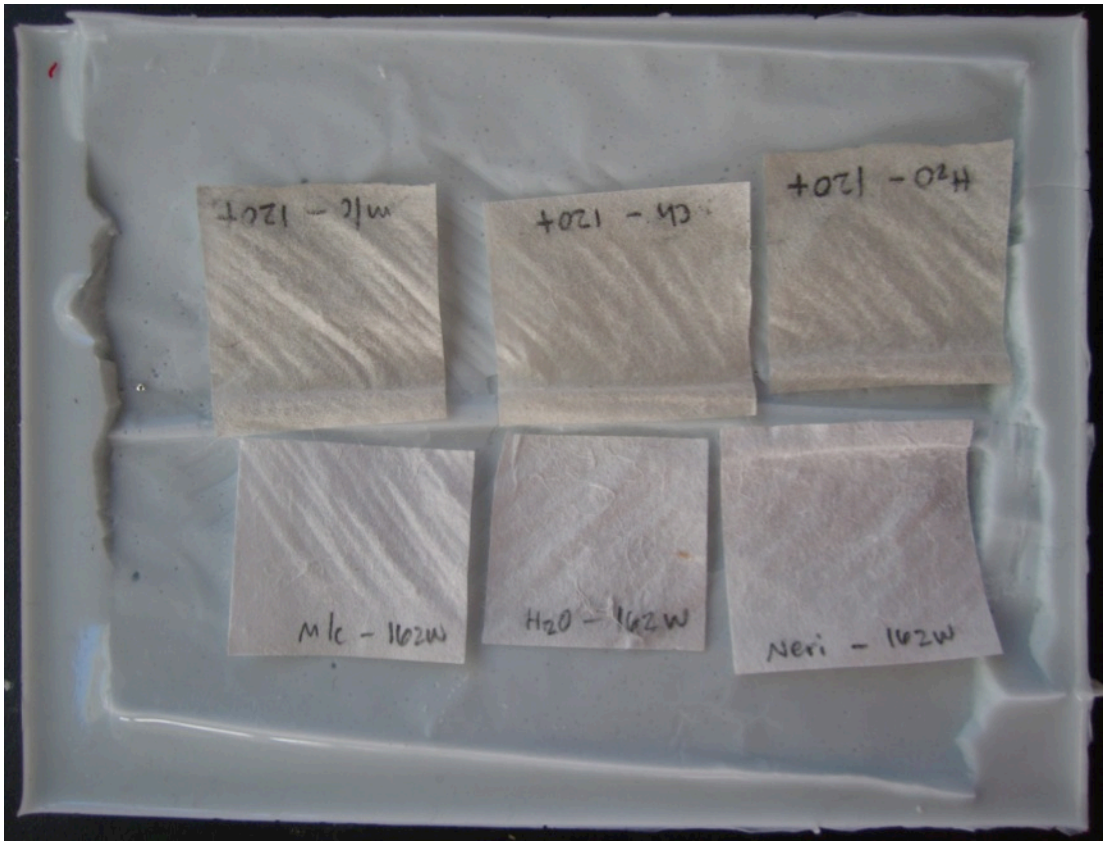


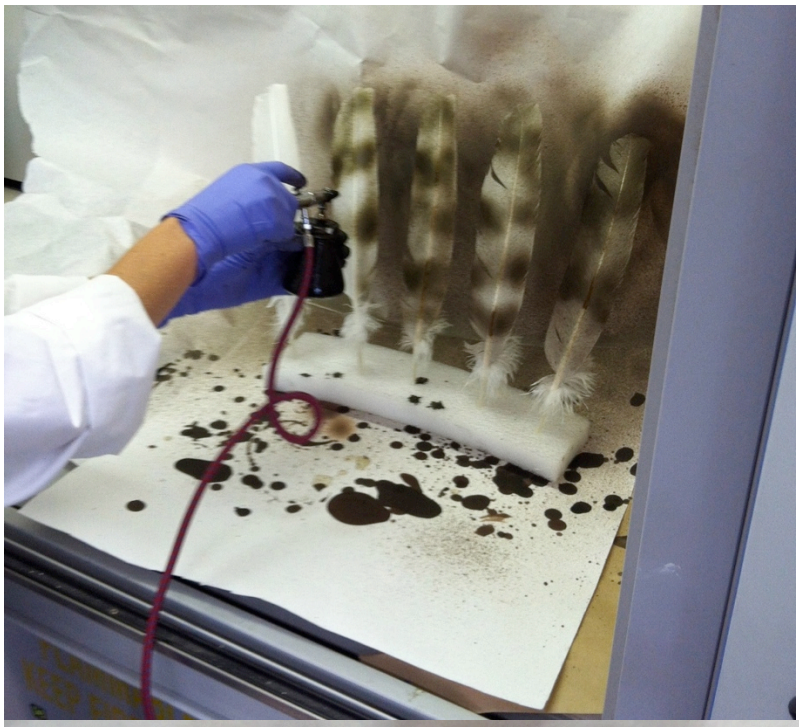
Figure 29. Japanese tissue paper fill trials, impressed in a silicon feather mold after drying.


Figure 30. Feather fill retains the texture of barbs but lacks cohesion and is too thick.

Figure 31. Orasol dye in ethanol was mixed and brushed onto a blotter paper and onto a white turkey tail feather to assess the color tone before application.

Figure 32. The feathers are sorted into lefts and rights, barred and white before dye application.

Figures 33-34. Sets of white (top) and barred (bottom) turkey feathers were inserted into a foam block and placed inside the hood.



Figures 35-36. White turkey feathers were airbrushed on both sides in a mottled pattern (top) to match the original crown feathers (bottom).

Figure 37. Feathers were left in the fume hood to set for several hours after dye application.

Figure 38. The headdress after treatment.

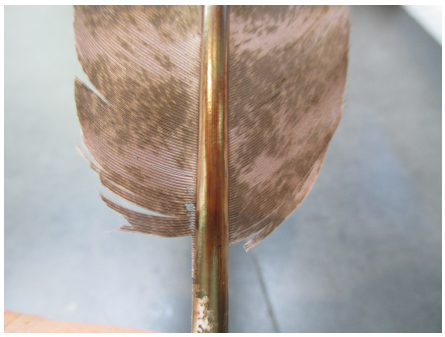
Appendix II: Feather Insert Preparation Manual

Traditionally, feathers are trimmed, straightened, and preened before use. As replications of existing eagle feathers, the turkey feather inserts should be prepared in the same manner. Deterioration of the original feathers has altered their shape and size, thus each turkey feather insert should be specifically prepared to fit an original feather by taking account of its current length, width, and shape.

Separate the feathers into 'lefts' and 'rights,' determined by the direction that the rachis curves.

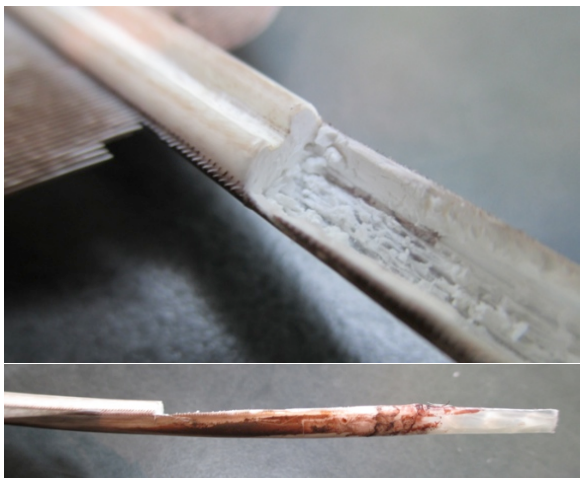
Select your tools: a small pair of scissors and a sharp scalpel.

Straighten the feather by heating and manipulating the rachis. Apply pressure with the iron as it warms, while gently bending the rachis in the opposite direction of its natural arc. Turn the feather over so that it heats evenly on both sides. Remove the feather from the heat and hold it straight as it cools, repeating until the feather remains flat. Straightening will lengthen the feather while providing a flat surface over which the eagle feather will be placed.

Cut away the plumulaceous (downy) feathers at the base of the feather using scissors.

Trim the tip of the feather with scissors to the desired length and shape. Use caution, as the barbs cut away easily. This may be done while holding the feather in midair, or by placing it on cutting board and using a scalpel. The shape and length of the original feather should determine the trimming required on the insert feather.



Use a scalpel to cut the calamus in half. The length of the incision will be determined by the shape of the original feather, so adjusts may be necessary. Hollow the interior so that the remaining sheath will fit over the exterior surface of the eagle feather's calamus.

Finally, apply a small amount of solvent-borne adhesive to the interior surface of the hallowed calamus and place the insert feather behind the original eagle feather. [An adhesive such as Paraloid B-72 in acetone or toluene would be ideal, as the keratin in feathers is unaffected by solvents. Avoid using a water-based adhesive.] Press the calamuses together to ensure contact, and allow the adhesive to set. To remove the insert, pipette a small amount of solvent into the join and release.

Appendix III: ODDY Test Guidelines

Oddy tests are a simple method of determining whether or not a material used in a conservation treatment, or in the museum itself, could be harmful to an object. The directions followed are courtesy of The Brooklyn Museum, February 2006, and have been modified for use:

Materials:

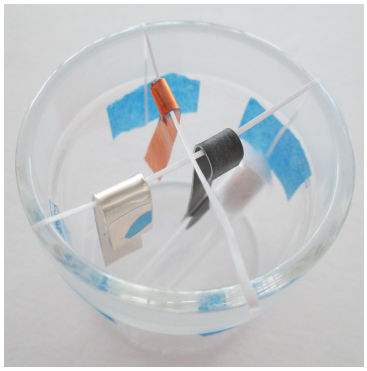
Test materials: 3 drops each Dye-Na-Flow dyes on round glass cover slip, dried.
4 45ml glass Kimax weighing bottles with ground glass outside caps.
4 1ml glass vials
Cotton to stopper each glass vial
4 sets of metal coupons: silver, copper, lead.
Deionized water
Acetone
Cotton swabs
Parafilm® M barrier film
Crest Glide Floss (floss coated with polytetrafluoroethylene or PTFE)
Calcium carbonate powder
Gloves
Pliers
1ml transfer pipette to transfer 0.5 ml water into vials

Steps:

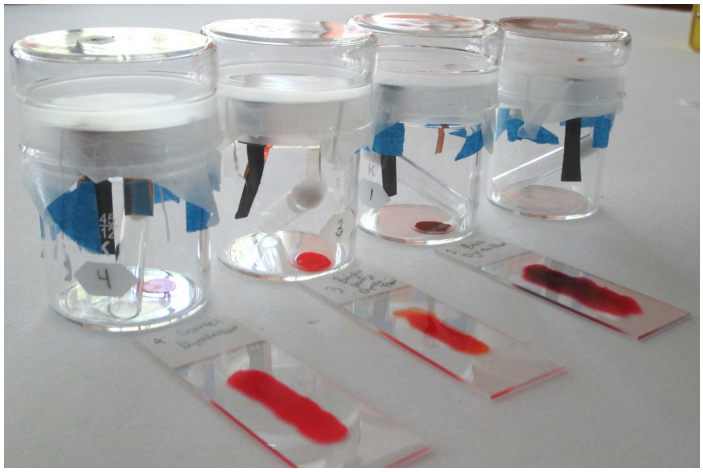
Wear gloves at all times.

1. Clean glassware thoroughly and rinse with deionized water.
2. Using cotton swabs and acetone, wipe down the glass containers, glass beakers, and vials. Set the glassware aside to air dry completely.
3. Label each jar with the name of the test material, date, and initials.
4. Polish the metal coupons (4 each) with cotton swabs and calcium carbonate+water slurry. Do not touch the coupons with bare hands. After polishing, wipe the coupon surfaces with acetone and cotton swabs. Set the coupons aside.
5. Pipette 0.5 ml of deionized water into the small glass vial.[1] With tweezers, stuff a small ball of cotton into the top of the vial without letting it fall into the water.
6. Place a water vial and test material (each on glass cover slip) each into a Kimax glass container. The fourth setup will be used as a control with no sample inside.
7. Using floss, create a taut X over the Kimax glass container and tape the ends to the exterior of the glass.

8. Using pliers bend the coupons into U-shapes, and hang one of each metal over the floss. Ensure that the coupons do not contact one another. Wipe the pliers with acetone before bending each new coupon.



9. Cover the lip of the bottle with Paraffin sheeting, and turn the lid over the sheet to ensure an air-tight seal. Be careful not to disrupt your coupons or the water filled glass vial. The coupons should not touch each other.



10. Place the containers in the lab oven at approximately 60° C (~140° F) for 28 days.
11. Check the jars once a week to ensure the water has not evaporated. (Water evaporation indicates potential loss of volatile Organic compounds from the container, which nullifies the test). Avoid moving the containers to prevent water droplets on the lid from contacting the coupons.
12. After 28 days, remove the tests and compare the degree of corrosion on the metal sample-coupons to the control-coupons. Recommend whether the material fails completely, passes for temporary exhibition (~3 months), or passes for long-term use.

Materials:

Kimax Weighing Bottles with Ground Glass Outside Caps (45ml, 40 x 50mm, 45/12, #03-422F)
Fisherbrand Autosampler Shell Vials for Waters Autosamplers (1ml, #03-391-23)
Fisher Scientific (800) 926-1166

Copper Foil. (99.98% purity, 0.25 mm thick, 49.5 g) #349178-49.5G
Silver Foil. (99.9% purity, 0.25 mm thick, 6.6 g) #348716-6.6G
Lead Foil. (99.9% purity, 0.5 mm thick, 56g) #265918-56G
Aldrich Chemical Company (800) 325-3010

Parafilm® M barrier film
4" (10.2 cm) x 250 ft (76.2 meters)
SPI Supplies (800)-2424-SPI

Crest Glide Floss
Oral-B, Procter & Gamble

Selected Bibliography:

Bamberger, J., E. Howe, and G. Wheeler. 1999. A variant Oddy test procedure for evaluating material used in storage and display cases, *Studies in Conservation*. 44:86-90.

Blackshaw, S. M. and V. D. Daniels. 1979. The testing of materials for use in storage and display in museums. *The Conservator* 3:16-19.

Green, L. R., D. Thickett. 1993. Interlaboratory comparison of the Oddy test. *Conservation science in the UK: preprints of the meeting held in Glasgow, May 1993*. ed. N. H. Tennent. London: James & James Science Publishers Ltd. 111-116.

Green, L. R., D. Thickett. 1995. Testing materials for use in the storage and display of antiquities - a revised methodology. *Studies in Conservation* 40:145-152.

Lee, S., H. Roh,Y. Yi. 2004. Effects of wood materials on metal corrosion – Oddy test. *Conservation Science in Museum* 5:31-36.

Oddy, W. A. 1973. An unsuspected danger in display. *Museum Journal* 73:27-28.

Zhang, J., D. Thickett, L. Green. 1994. Two tests for the detection of volatile organic acids and formaldehyde. *Journal of the American Institute for Conservation* 33:47.53.

[1] The amount of water placed in the vial is dependent on the volume of the container. The ratio is roughly 1:100 water to container volume. The volume of the Kimax weighing bottle with cap is roughly 65ml, so 0.6ml of water should be added to the vial in the container. However, better condensation results have been noted with 0.5ml water (while still providing 100% RH), so 0.5 ml is recommended. Excess moisture will often result in corrosion of the lead coupon, providing a false result. Large droplets of water on the lid of your container dripping on the coupons or test material indicates excess water. This is less likely to occur if your test material absorbs moisture (wood or paper materials), and more likely to occur with non-absorbing materials.

MISSOURI RIVER®
Brand

Double Trailer Warbonnet Kit

Item # **4803-301-900 & 4803-302-900**

* Kit No. 4803-302-900
Uses Imported Beadwork & comes without ribbon.

Supplies Needed:
Large and small sewing needles, pliers, craft knife (Xacto ®), cutting board, ruler with metal edge, pencil, awl (optional)

The warbonnet as we know it today evolved over several hundred years. Probably the most universally recognized item of Indian regalia, it has been adopted by a large number of tribes across the country. The earliest references to Plains warbonnets in literature speak of headdresses of eagle feathers stuck in headbands worn by tribes along the upper Missouri River in the late 1700s.

Earliest examples in museum collections, as well as old photos of Plains bonnets, show that they were of simpler construction than modern examples, having fewer decorations and not always adorned with beadwork. This indicates a gradual enhancement of the bonnet up to the present day, with most of the elaborate and highly decorated pieces being later examples. These contemporary bonnets feature fancy trim feathers, ermine strips, beaded medallions, etc.

The widely flared bonnet was originally developed primarily by tribes of the northeastern and central Plains (Sioux, Northern Cheyenne, Arikara, Hidatsa, Mandan, Crow, Plains Cree, and Omaha). Bonnets with feathers that fell rather straight back (instead of flaring to the sides) were the style of Southern tribes, such as the Southern Cheyenne, Kiowa, Comanche, and others. The common thread is that all of these tribes placed a high emphasis on "counting coup". A coup was an act of bravery in battle, such as taking a scalp, touching an enemy without killing him, capturing an enemy horse or weapon, or killing an enemy in hand-to-hand combat. Each of these feats gave the warrior the right to wear an eagle feather, and, eventually, the bravest and most successful men counted enough coups to give them the right to assemble a warbonnet to display their coup feathers. If a warrior had enough feathers, he could attach them to a trailer extending down the back of his bonnet. A common myth is that is was the chiefs who wore warbonnets when, in fact, you can see that any brave warrior with enough coups was entitled to such a headdress.

Over time, the flared bonnet gained popularity with all the above tribes and even was adopted by Prairie tribes, such as the Osage, Otoe, Ponca, Pawnee, Sauk & Fox, who heretofore had not traditionally worn bonnets. With increasing travel by tourists to Indian reservations during the early 1900s, even Pueblo tribes (who formerly had not worn them) began wearing bonnets in dance demonstrations, as warbonnets had become what the public associated with "real Indians". Today, the warbonnet is used by almost all tribes and has become the most widely known piece of American Indian regalia.

We encourage you to visit museums, books, and on-line sites to look at original bonnets for variations and ideas on finishing your bonnet in a distinctive but appropriate manner. Other good sources for ideas on old style bonnets are old photos found in books and on-line sites. Many variations are possible in making a warbonnet, and each should reflect the individual who wears it. However, these personal touches should be limited to materials and supplies that were used by Indians. Listed below are some ideas that are authentic and will allow you to create a warbonnet that is specifically yours but is still historically accurate.

A. Bonnet crowns were sometimes left bare or covered with fluffs, small feathers, or ermine strips.
B. Many bonnets, especially those from earlier periods, did not feature beaded medallions. In such cases, side drops were attached directly behind the browband ends.
C. Not all bonnets had side drops, but those that did included ribbons, ermine skins, rabbit strips, quilled strips, small clusters of hawk, owl, or eagle feathers, buckskin thongs, etc.
D. Sometimes metal-backed mirrors (and occasionally conch shell discs) were substituted for beaded medallions.
E. Metal rings were sometimes attached at the ends of the browband along with the medallions, as well as a row of hawk bells along the top edge of the browband. A highly embellished bonnet took on even greater significance for the wearer and may have included, in some cases, attachments of the skins of birds or other creatures that had specific mystical significance to the owner.
F. Tie thongs for use under the chin have been observed on approximately 25% of bonnets in old photos. It is assumed that they kept the bonnet from blowing off the wearer when he rode horseback.
G. Trailers were sometimes decorated with several horizontal lanes of beadwork spaced down the material. Edges of trailers also were frequently bound with ribbon, with fabric tassels at the bottom corners.

Materials:
90 Jumbo Imitation Eagle Feathers
1-1/3" oz. 5" - 6" base plumes
1/4 oz. 2" - 3" tip plumes
6 pcs. 2 1/2" x 24" red felt
1 pc. calico cloth 8" x 72"
6 pcs. 4 1/2" x 4 1/2" leather for loops
3 1/4 oz. bunch white horsehair
1 leather bonnet crown
2 leather primary laces
4 bobbins heavy cotton thread
4yds. Ribbon
18' simulated sinew secondary lace
1 bottle craft glue
1 pc white rabbit fur for strips
1 5" x 72" wool felt trailer
1 hand-loomed beaded brow band 1 1/4" x 10"
1 pr. 2" hand beaded rosettes
1 major plume wing spike
1 set instructions

Construction:
Please read ALL the instructions before beginning.

Step 1: Prepare the feathers according to the "Feather Preparation" instruction sheet. The leather loop holes should be smaller than the diameter of a pencil, and the loop holes MUST be properly aligned on the feather quill, as shown in the diagram.

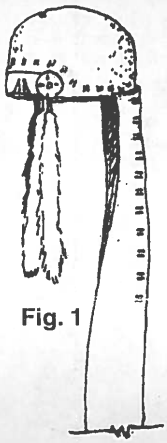


Fig. 1

Next , use a sharp craft knife, straight edge, and cutting board to cut the rabbit fur into four 3/4" - 1" wide pieces roughly the same length. Cut in the direction that the hair lays. Do this outdoors and shake them thoroughly to get rid of loose hair. Next, sew the brow band, rosettes, and rabbit strips to the crown. **Fig. 1**

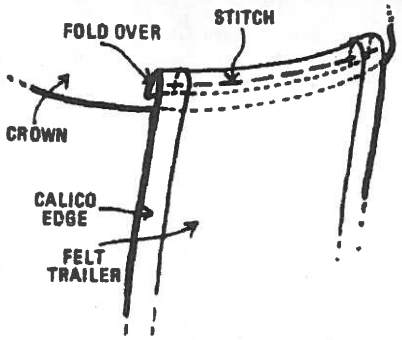
√ **Step 2:** Mark the crown for 26 pairs of lacing slits (13 on each side) with approximately 1" between the pairs. The slits of each pair should be 1/4" long and spaced 1/4" apart. Space the slits evenly around the crown as in **Fig. 1 & 2**, then cut them with a sharp craft knife. (Leave enough space on the back edge of the crown to sew on the trailer.)

Step 3: The red trailer (5" x 72") must be backed with calico as shown in **Fig. 3**. This will add extra body and color to the trailer. Note how the calico edges are folded under and sewn so as to form a binding around the red trailer edges. When finished, sew the trailer to the crown. **Fig. 1 & 3**

Fig. 2

Step 4: On the back of each feather (**Fig. 4**), make a light mark 4" above the looped end of the quill. This is where the feathers will be laced in Step 8. Use an awl or very small craft knife to make a SMALL hole (no bigger than the diameter of a large needle) from side to side through the back of each quill. Be careful not to pull the fluffs into the hole you make.

Fig. 3



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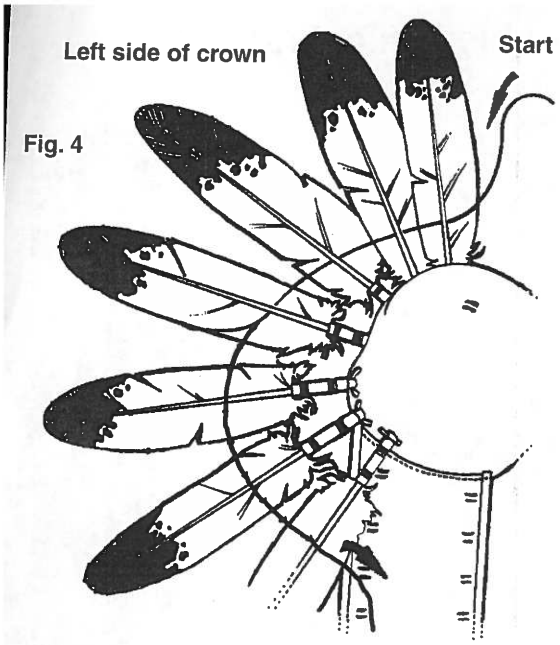


Fig. 4

Step 5: Now note that your feathers are lefts and rights, with 45 for each side of the bonnet. From each group of 45 feathers, select the 32 shortest ones; these will be used on the trailer. The longest 13 lefts and 13 rights will go on the warbonnet crown. Lay out these crown feathers from longest to shortest, still keeping the lefts and rights separate.

Step 6: Take a primary leather thong, mark it in the middle, and lace half of it through the first hole on the left side of the front center of the crown. Start with the longest right feather and begin to lace the right feathers to the left side of the crown. As you lace from the center to the rosette, pull the lace as tight as possible; this will help the feathers stand more erect. (**Fig. 5**) From the rosette on toward the back of the crown, the lace can be a little looser to allow the feathers to spread out and lay properly.

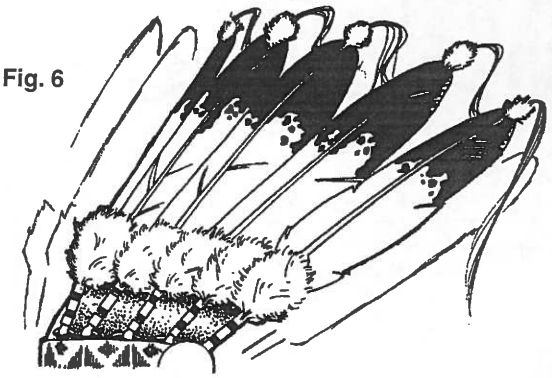
Fig. 5

Step 7: After lacing one half of the crown, start again at front center and lace on the left feathers. Then, when you reach the back center, continue each side by lacing the remaining 32 left and right feathers to the trailer, graduating from the longest to the shortest. Space these trailer feathers 2"-3" apart, depending on your height and how long you want the trailer to hang. An option to cutting lacing slits with a knife is to poke large holes with an awl. Awl holes will be less likely to tear over time.

Step 8: Now lace the feathers together with the waxed secondary lace, as follows: Cut about 4 feet of the lace and begin sewing the crown feathers through the back of each quill at the 4" holes. Start at the back side of one of the front center feathers (and leave about 8" loose to tie to later. (**Fig. 4**), sew around the crown feathers, and continue on through the trailer feathers on that side. As you sew, you must be very careful not to pull the fluffs into the hole in the quill. Tie on additional sinew as needed. Repeat this for all the feathers on the opposite side.

Step 9: Back on the crown, tie the sinew ends together between the 2 center feathers. But, before tying off the ends of the lace at the last feather on each side of the trailer, space the feathers evenly all around the bonnet and down the trailer. (**Fig. 6**) Put it on your head and look in the mirror to make sure everything is laying correctly. When you are satisfied, tie off the ends of the secondary laces.

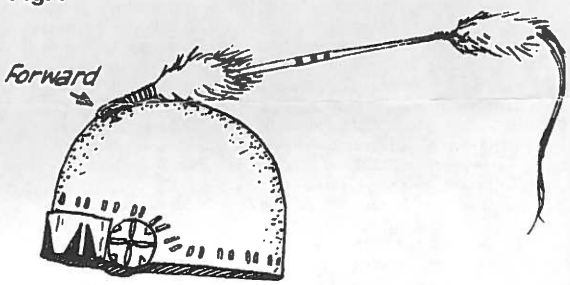
Fig. 6



NOTE: If, over time, you find that the feathers tend to lose position and slide on the secondary lacing, reposition the feathers correctly, then put a drop of craft glue on either side of the quill where the secondary lace comes out.

Step 10: MAJOR PLUME: Take the enclosed wing spike and begin to decorate it be stripping some or all of the webbing from the quill (and you may wish to cut saw-tooth designs in the webbing or parts of it). Sew on a felt-covered loop on the one end and some fluffs on the tip and possibly some horsehair, yarn, thin ribbon, etc. (**Fig. 7**). You may also decorate this feather by wrapping sections of it with colored thread, yarn, or beads. When finished, attach it to the crown as shown in **Fig. 7**.

Fig. 7



Step 11: CROWN DECORATIONS: You may leave the bonnet crown undecorated, or you may choose to cover it with additional materials. One option is to sew horizontal rows of fluffies on the crown, from the bottom up, spaced about an inch apart from side to side. The rows should be spaced close enough together so that the crown material itself is covered. (These fluffies/plumes are not included with this kit.) Sew each plume individually by pushing the needle through from the inside of the crown, and leave 5"-6" of thread on the inside. Then make a double wrap of thread around the tip of the quill, then stitch back through the crown. Now tie off the thread to the extra thread at the beginning of the stitch. Each plume must be sewn on individually this way.

You will find that it is tedious work to sew on crown decorations, as the warbonnet and major plume feathers will get in your way. However, the decorations will make an attractive addition to the bonnet and make it look more pleasing.

This will finish your warbonnet.

Feather Preparation Tips

May 24, 2009: Over the years, the quality, size, and availability of turkey feathers for the craft market have diminished, so that it has become increasingly difficult to supply acceptable feathers. Please know that we are doing everything possible to supply the very best quality feathers available, and to help you make your feathers look as good as possible, we offer the following tips and techniques.

Feathers without broken tips are almost non-existent, and this is due in part to the way turkeys are now raised, as well as increasing government regulations, fewer suppliers, and fewer processors of raw feathers. Therefore, almost all feathers available today need to be straightened, extended, "preened" and trimmed before use. Several before-and-after photos are included so you can see the difference this extra care can make. ***Photo A*** *shows several feathers of typical quality before any preparation work has been done to them. Note: These same techniques apply equally well to spikes used for bustles.*

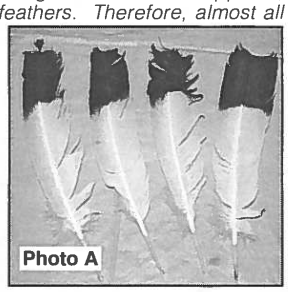


Photo A

SORTING: The first step in preparing feathers for use is to determine which are "lefts" and which are "rights" (i.e., which are from the left side of the wing or tail and which are from the right.) To do this, spread the feathers out with the shiny, brighter side up, and you will see that each one curves naturally to the right or left. Tail feathers may not curve, but there will be more webbing on the left side of a "left" feather and vice versa. Separate the feathers accordingly into "left" and "right" groups.

STRAIGHTENING: Now straighten the feathers by warming the quill over an exposed light bulb as shown in **Figure 1**. We recommend protecting your eyes from the glare of the bulb by wearing sunglasses. Gently apply steady pressure on the quill as you move it back and forth over the hot bulb until it bends in the opposite direction of its natural curve. Do not overly force it to bend, as this may cause the quill to crimp. Occasionally turn the feather as you move it over the light so that it heats the quill evenly. Take it away from the heat and allow it cool, while holding it as straight as possible. Repeat this process, if necessary. This also can be done using steam from a tea kettle or the tip of an electric iron as your heat source. However, be careful using steam, as it can quickly curl the webbing. If possible, do some trial runs with spare feathers.

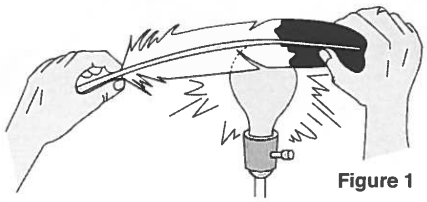


Figure 1

A faster method is to use your thumbnail to make small dents or crimps in the quill, about every ½" to 1". This will cause the feather to straighten out, but extreme care must be used so as not to crimp it too much or break it, as the feather will then be ruined. This method is not recommended for beginners, and you should practice both techniques on a few old feathers first. This method can also be used along with the heating process.

Note: Regardless of which straightening method you use, first note that the feathers usually curve in two directions: from front to back and toward one side. For the straightest possible feather, apply heat or pressure so that the completed feather is straight both up and down and side to side.

PREENING: Each strand of webbing, called a vein, has tiny barbs that help lock it into the veins next to it. The technique used to pull the webbing together so that the webbing is uniform is called preening.

Before trimming, take a few minutes to gently stroke the webbing between your thumb and first two fingers, from the direction of the quill to the edge of the feather, as shown in **Photos B & C**. The oil from your fingers will also help hold the veins together and replace some of the natural oil that was removed from the feather in washing and dyeing. Both the oil and preening help the barbs in each vein to reconnect, holding them together.


Photo B

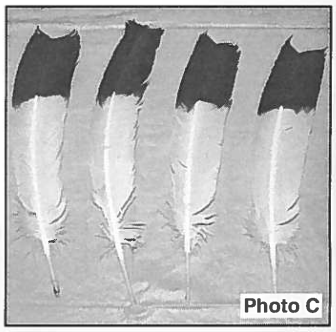


Photo C

TRIMMING: This is one of the most important steps in creating an authentic looking feather, so, for the most realistic look, carefully trim the tip ends with a sharp pair of scissors. First, cut off about ½" to 1" of the flimsy tip, or at least enough to remove any broken or bent area. In the case of Imitation Eagle Feathers, these should be trimmed so that, when possible, there is about 3-4" of black area remaining, as shown in **Figure 2**. Next, cut the tips off the rest of your feathers to match this one, so there is about the same amount of black on the tip of each feather. **Photo D**.

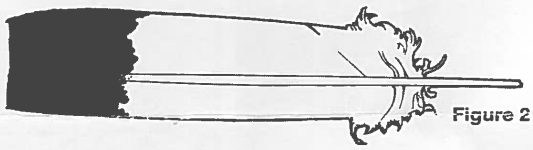


Figure 2

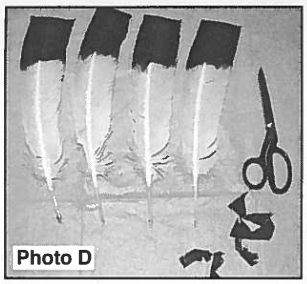


Photo D

Trim the tips (and part of the sides, if necessary) to resemble the various eagle tail feather shapes shown in **Figure 3**, always cutting from the tip toward the base of the feather. The desired shape is more like that of a table knife rather than the extreme point of the natural turkey feather. It is a good idea to look at photos of real feathers, such as warbonnets and bustles, and use these as a reference when trimming your feathers.

Tip: Placing masking tape along the edge of the feather before cutting is helpful in holding the webbing steady while trimming it, as shown in **Photo E & F**. After trimming, gently remove the tape by slowly pulling from the base towards the tip of the feather.

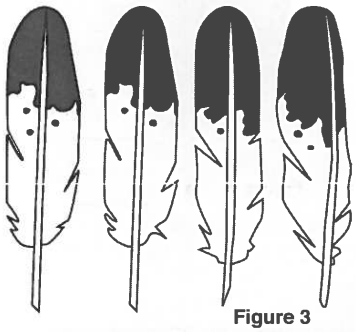


Figure 3

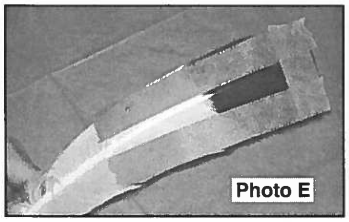


Photo E

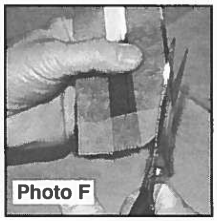


Photo F

EXTENDING THE FEATHER: Eagle feathers are generally longer than turkey feathers, so we recommend extending wing feathers to about 14" so as to resemble large eagle tail feathers. This is accomplished by measuring 12" down from the tip to the quill end and then cutting off the excess quill. Then add just enough wooden dowel rod to make the feather 14" long overall. The length can vary somewhat, depending on the initial size of your feathers as well as their intended use. For example, the feathers used in a fan can be shorter than those used in a warbonnet. **See Photo G.**

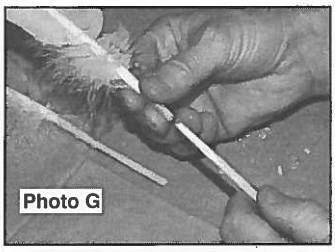


Photo G

The wood dowel should be approximately the same diameter as the thickest part of the quill and tapered slightly on one end before being glued into the quill. You should have approximately 2½" of quill and/or dowel extending below the webbing of the feather. **See Figure 4. Photo H** shows the feathers after they have been straightened, preened, trimmed and extended.

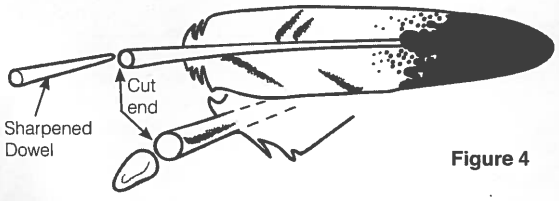


Figure 4

If you are using wing spikes, they should range from about 14" to 17" long and should be straightened and trimmed as well. This is especially important when making bustles with hackles tied on the tips, as trimming them back to a stronger, thicker area of the quill will make your bustles last much longer. The bottom dowel extensions are easily camouflaged by adding fluffs and then wrapping them with wool cloth or felt for warbonnets or with colored tape for bustles.

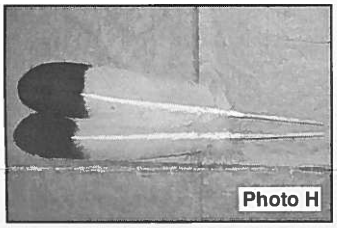


Photo H

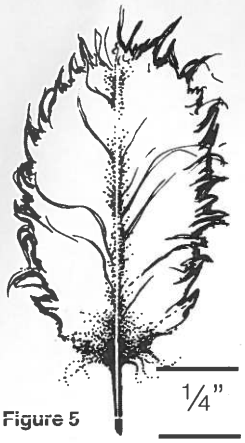


Figure 5

When adding base fluffs to feathers, trim this area to give fluff a smooth finished look.

ADDING FLUFFS: Whether you're making a bonnet, bustle, or fan, 1 to 4 fluffs can be added on the front and back of each feather. Base plumes should be cut to a length of 3½" or 4" by trimming off the bottom end. Do not cut the tips! Next, strip ¼" of the fluffy parts off both sides of the base of the quill as shown. If you are adding tip plumes, cut these to 2½" long but do not strip any away from the bottom. **See Figure 5.**

PREPARING WARBONNET & COUP FEATHERS

BASE PREPARATION: Using stiff leather, cut a strip measuring ¼" x 4¼" for each feather. (The leather should be fairly thin but as stiff as possible. Indians often used thin rawhide.) Glue and tie one strip to each quill to form a small loop, approximately ⅛" - just large enough for a leather lace to pass through- as shown in **Figure 6**. Next, glue the base plumes on the front and back of the quill at the ends of the leather strip, as shown in **Figure 7**. Glue each fluff at the base and at the middle, being careful not to use too much glue. Allow glue to dry before proceeding.

BASE WRAPPING: Cut red wool cloth or felt into 2½" x 1½" patches. Wrap one piece around the base of each feather so that it meets or overlaps in the back and does not cover the leather loop at the bottom. Now wrap 2 bands of white or yellow thread, string, or yarn around the red cloth, about ½" from each end. These bands should be about ¼" wide which will require several wraps of the thread. **See Figure 8** for the look of a finished warbonnet feather.

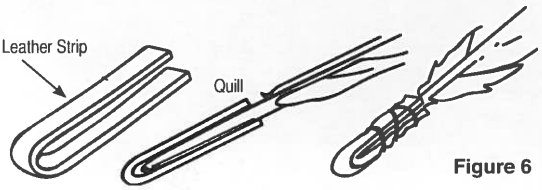


Figure 6

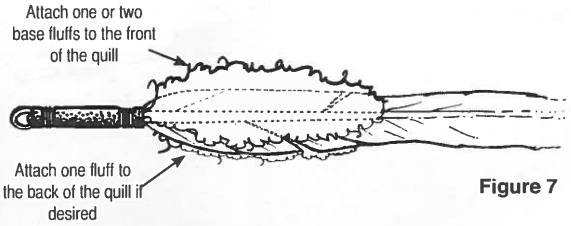


Figure 7

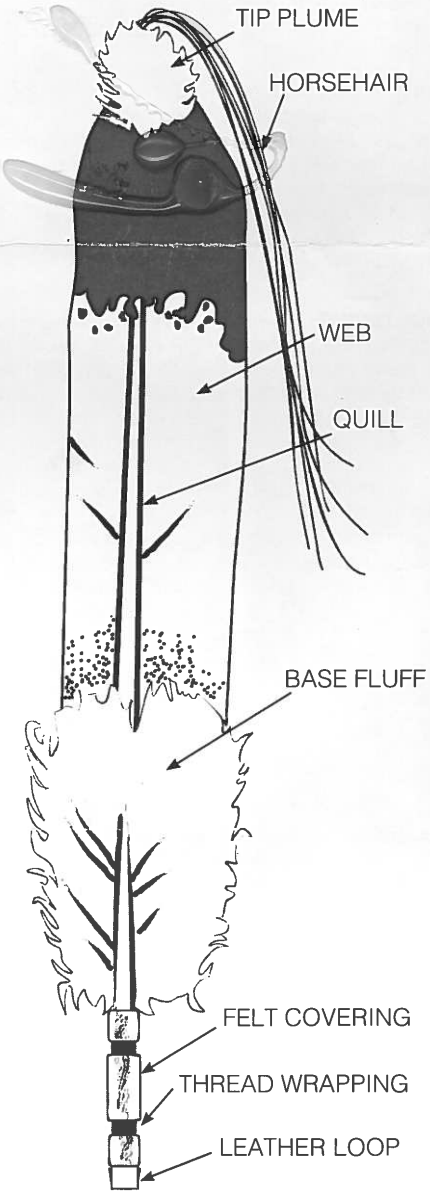


Figure 8

I0050

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