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HAIR CONSOLIDATION AND TREATMENT OF AN INSECT-DAMAGED DANCING HAT FROM SIERRA LEONE

Anya McDavis-Conway, Jakki Godfrey, Bruno P. Pouliot and Richard Wolbers

Abstract

This paper was presented in the form of a poster at both the AIC's 34th Annual Meeting in Providence, RI and the 2006 Association of North American Graduate Programs in Art Conservation (ANAGPIC) conference at Winterthur Museum. The poster discussed the consolidation and overall treatment of an insect damaged dancing hat from Sierra Leone. The object is part of the collection at the University of Pennsylvania Museum of Archaeology and Anthropology (UPMAA). The hat was treated as a practical component of the second year studies for the Winterthur/University of Delaware Program in Art Conservation. The dancing hat is primarily composed of goatskin/hair and raffia, and is decorated with cloth, cowrie shells, wooden elements, and mirrors. In the early 1980's, the object became severely infested by clothes moths, which resulted in extensive damage to the goat hair. Before treatment, much of the hair remained, but was lying unattached to the skin. A novel method for consolidating the hair in situ was developed for the hat after both consultations with other conservators and testing. Different consolidants were tested using a nebulizer (mist application). Among the consolidants tested, a mixture of hydroxypropyl methylcellulose and Aquazol 500 produced the best results. This solution along with this method of application served to consolidate the loose hair in place while leaving it somewhat flexible and unchanged in appearance.

1. Introduction

The Sierra Leone dancing hat is a complex construction made of goatskin, cowrie shells, fabric, wood, plant fiber thread, and mirrors. The object is a large hat consisting of a drum-shaped crown with a raffia brim. There are added elements at the front of the hat that imitate a face with two eyes and a nose. The crown is decorated with panels wrapped in coral, black, white, blue, and red fabrics, cowries, and white goat hair fringe. Twelve tongue-shaped goatskin ornaments lay atop the raffia brim. These ornaments are decorated with cowries, white goat hair fringe, mirrors, and elements wrapped in colored cloth. Three separate goatskin ornaments, decorated with white hair fringe and red fabric, hang further down along the sides when the hat is worn (Figs. 1, 2).

This object is part of the collection at the University of Pennsylvania Museum of Archaeology and Anthropology (UPMAA #29-61-1e-h), and has been at the museum since at least 1929. Catalogue records from the University describe the hat as part of an "abon" or costume of a medicine man. The culture is listed as Timne from the Bumpe Chiefdom of Sierra Leone. A similar hat is part of costumes made by the Mende people, who also live in southern Sierra Leone. Assuming that the closely related cultural groups share some traditions, this type of hat and costume may be common to both the Mende and Timne. The hat may also have been used by members of the Poro secret men's society. This is a powerful society into which all young

Mende men were initiated before they were considered adults (Hommel 1974). The hat is most likely part of a *goboi* or *gbini* masquerade costume. These masquerades manifest the spirit of Poro and emphasize the secret society's role in supporting political authority. *Goboi* appears for leaders and initiation ceremonies, while *Gbini* is used at numerous Poro events. These masks accompany raffia costumes, and their ornaments are meant to swing out and shake while a dancer performs (Visonà 2001).



Figure 1. Hat before treatment, front.



Figure 2. Hat before treatment, back.



Figure 3. Insect damage. The surface of the skin can be seen where the black hair is missing.

Although the hat was structurally stable before treatment, the hair and plant fibers would actively fall out, particularly when handled. This is due in part to the inherent deterioration of the skin and embrittlement of the cellulosic component of the plant fibers. However the major cause for the loose hair was a severe clothes moth infestation that occurred in the early 1980's. Insect wings, frass, and webbing were present everywhere, particularly in the more hidden sections of the goat hair. The insects, attracted to keratin, grazed primarily on the oily part of the hairs nearest to the skin. This resulted both in extensive hair loss and instability of the remaining hair (Fig. 3). Related condition details included widespread surface grime, dust, and deformation / detachment of some of the skin ornaments.

This hat was treated by Anya McDavis Conway and Jakki Godfrey as a practical component of second year studies for the Winterthur/University of Delaware Program in Art Conservation (WUDPAC) under the supervision of Winterthur objects conservator Bruno P. Pouliot, and with the assistance of Professor Richard Wolbers. The WUDPAC students who major in objects conservation are given the opportunity to treat, among other materials, one ethnographic object and the UPMAA has for many years allowed students to work on objects from their extensive ethnographic collection.

2. Methodology and Rationale

Treatment began with vacuuming and removal of the insect frass, webbing, and other debris from the surface of the hat. Both a Nilfisk vacuum with HEPA filter and a dental vacuum with a water filter were used. During this process, it became clear that the insect debris was often interwoven with the hair and could not be completely removed from the ornaments without further disturbing, and in many cases entirely removing, the remaining goat hair. Therefore, it was determined that many areas of the goat hair would need to be consolidated in situ as part of this treatment.

Varied past experiences from the project supervisors, as well as other conservators, helped determine that an effective method of stabilizing the loose hair in situ could be through mist consolidation. This method was chosen due to its gentle nature, since the pressure of the mist results in only minimal movement of the loose hair. Additionally, any movement quickly subsides once the hair becomes somewhat damp. Misting also provides small consolidant particles that do not significantly change the hair's appearance, yet form small bridges at the points where two hairs touch or where they are in contact with the skin. In order to produce an effective and fine mist, it was important that the consolidants be soluble in water, due to its high surface tension. The high surface tension of polar solvents promotes the formation of stable droplets in the air when nebulized. Additionally, low viscosity solutions, typically those between ½ % - 2%, are necessary for effective misting.

Aquazol (poly(2-ethyl-2-oxazoline)) and several cellulose ethers including methyl cellulose, ethyl cellulose and hydroxypropylmethyl cellulose were chosen as test consolidants because they are all water soluble and typically have good aging characteristics. Organic consolidants such as the cellulose ethers and materials such as gelatin are often used in treatments of organic objects. The cellulose ethers differ from each other by their functional group substitutions and molecular weights. The specific cellulose ethers were chosen because of their different molecular weights and corresponding strengths. Methyl cellulose has a methyl functional group and the lowest molecular weight of the chosen cellulose ethers. Hydroxypropylmethyl cellulose is a cellulose ether with both methyl and hydroxypropyl functional group substitutions. It also has a relatively high molecular weight, which translates into increased strength. The lower surface tension and lower polarity of hydroxypropylmethyl cellulose will also allow it to wet better onto the goat hair substrate. Our testing confirmed that the hydroxypropylmethyl cellulose was a stronger consolidant in this application compared to other cellulose ethers. According to Feller and Wilt, water soluble cellulose ethers were found to have good aging properties (Feller and Wilt 1990).

Aquazol 500 was chosen to test because as a synthetic consolidant it is less attractive to insects. Its solubility in water allows it to form a mist; and its lower polarity, relative to the cellulose ethers, allows it to wet onto the goat hair. Aquazol 500 was chosen because it is the highest molecular weight Aquazol compound, and is therefore relatively strong. According to testing performed by Richard Wolbers, Aquazol maintains a neutral pH and good solubility after aging (Wolbers, McGinn and Durbeck 1994). Aquazol 500 has a Tg of 55 °C and an elongation at break of 380%. During testing, it was found that Aquazol 500 increased the flexibility of a consolidant solution and allowed for a less viscous solution at higher concentrations.

Tests were performed on samples of zebra hair, which closely resembles goat hair in texture, thickness and length. Small strips of zebra skin were cut for testing (approximately 2 1/8" x 7/16"). The hair on half of each strip was cut just above the skin with a razor and left to lie as is, mimicking the loose goat hair on the hat. Consolidation tests were performed on these samples using the cellulose ethers and Aquazol 500 individually and in combination. Consolidant solutions of varying viscosity, ranging from ½% - 2%, were tested. The consolidants were applied to the zebra hair samples with a nebulizer (Sunrise De Vilbiss Pulmo-Aide LT Compressor, see Fig. 4) until the hair appeared saturated (approximately 12-14 passes). Once dry, the samples were examined, and in many cases a few more applications of the consolidants

were necessary to impart enough stability to the hair. Respirators were worn during this treatment to prevent inhalation of the mist.



Figure 4. Mist consolidation of the hair.

3. Results and Observations

After preliminary testing, it was determined that hydroxypropylmethyl cellulose, and a mix of this adhesive with Aquazol 500, provided the best results. This was due to the Aquazol not providing enough strength on its own and the hydroxypropylmethyl cellulose being slightly too strong and viscous. Compared to the cellulose ethers, a large amount of Aquazol can be added to a solution while maintaining a low viscosity and therefore allowing it pass through a nebulizer. Ethyl cellulose, methyl cellulose, and plain Aquazol 500 were not strong enough to successfully consolidate the zebra hair samples.

Photomicrographs were taken of two zebra hair samples before consolidation, and respectively after one and two applications of a consolidant (Fig. 5). Sample #1 was consolidated with 1% hydroxypropylmethyl cellulose in deionized water while sample #2 was consolidated with a 1.5% solution of 2:1 Aquazol 500: hydroxypropylmethyl cellulose in deionized water. After two consolidation campaigns, no visual change could be seen in the samples when viewed normally, and only minimal accumulation of adhesive could be seen under magnification with a stereobinocular microscope.



Sample 2. 1:1 HMC : Aquazol 500 BT 7.5x



Sample 2. 1:1 HMC: Aquazol 500 BT 20x



Sample 2. 1:1 HMC: Aquazol 500 After 1st Consolidation 7.5 x



Sample 2. 1:1 HMC: Aquazol 500 After 1st Consolidation 20x



Sample 2. 1:1 HMC: Aquazol 500 After 2nd Consolidation 7.5x



Sample 2. 1:1 HMC: Aquazol 500 After 2nd Consolidation 20x

Figure 5. Photomicrographs of hair.

After testing, it was determined that a 1.5% solution of 2:1 Aquazol 500: hydroxypropyl methylcellulose best consolidated the zebra hair samples. Therefore, this mixture was applied with a nebulizer to a discrete area of goat hair on the hat. Since this test also proved successful, the consolidation method chosen was used on the remaining areas of loose goat hair. This method effectively consolidated the hair in place while leaving it flexible and not affecting its appearance (Figs. 6, 7).



Figure 6. Detail before consolidation of hair.



Figure 7. Detail after consolidation of hair.

In a few areas where the goat skin hangs down vertically, mist application consolidated the hair into a mat, but did not sufficiently re-adhere the mat to the skin surface. In these instances, a drop of 5% Butvar B-98 (polyvinyl butyral) in ethanol was inserted underneath the mat with a syringe and gently patted down. The Butvars are colorless, flexible, and tough thermoplastic resins. They are soluble in alcohols, acetone, and aromatic hydrocarbons, but are insoluble in water. Butvar B-98 has a Tg of 72-78 °C, a tensile strength of 5.6-6.6 x 10³ psi, and an elongation at break of 110%. It was chosen because of these properties, but especially due to its flexibility, ability to dissolve in ethanol, and its compatibility with skin.

Additionally, consolidation did facilitate the process of frass removal. Once consolidated, the moth frass and webbing could be more easily picked out from the surface with minimal disruption of the goat hair.

4. Conclusion

Our tests determined that a 1.5%, 2:1 mixture of Aquazol 500: hydroxypropyl methylcellulose: in de-ionized water worked best to consolidate the insect-damaged goatskin hair. Application of this mixture with a nebulizer permitted thorough consolidation of the hair, while retaining its

flexibility and maintaining its visual appearance. The consolidant solution was applied until the hair appeared saturated. In some areas, depending on the amount of damage, repeated applications were necessary. After consolidation, a drop of 5% Butvar B-98 in ethanol was applied with a syringe to the few mats of hair that required extra stabilization. A small amount of pressure was applied to secure these sections of hair to the skin. Some practical information gained during this project regarding effective mist consolidation includes using low viscosity solutions and only filling the nebulizer container approximately 1/5 full.

In addition to overall vacuuming of the hat and consolidation of the hair, other aspects of the treatment of this hat included local humidification and re-shaping of the bent goatskin ornaments. The cloth components were cleaned with polyurethane cosmetic sponges (see Suppliers list) and the detached ornaments were re-attached with Japanese tissue toned with acrylic paints using wheat starch paste. A storage mount was also created to properly support the hat. The mount was designed to alleviate stress on the object and prevent further damage from occurring once it is returned to storage at the UPMAA (Figs. 8, 9).

Recommendations for additional study include further investigations of the ageing qualities of the chosen consolidants when used with similar materials, as well as the long-term effectiveness of the stability of the consolidated hair. Results of preliminary tensile tests show that the 1.5%, 2:1 mixture of adhesives used as a consolidant has a breaking strength of 24.29 MPa and is actually stronger than hydroxypropyl methylcellulose alone with a breaking strength of 18.42 MPa. However, the high modulus, suggesting brittleness of the adhesive mixture, is unclear. Past research has found that adhesive mixtures containing Aquazol have only one Tg, signifying that in adhesive mixtures Aquazol acts as a solvent or plasticizer. Following this, the tensile modulus in the tensile testing of the adhesive mixture should have been less steep (Wolbers 2006). Due to the unclear significance of the results of our tensile tests, further physical testing of these materials should be performed in the future.

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Figure 8. Hat, after treatment, on new storage mount. Front view.



Figure 9. Hat, after treatment, on new storage mount. Back view.

Suppliers

Pulmo-Aide LT Compressor/Nebulizer:

DeVilbiss, P. O. Box 2069, Tri-Cities, WA 99302, (509) 374-9530
(www.dmeonline.com/nebulizers.html)

Hydroxypropylmethyl cellulose:

Sigma, 6950 Ambassador Drive, Allentown, PA 18106, (800) 325-3010
(www.sigma-aldrich.com)

Aquazol 500, Butvar B-98:

Talas, 20 W. 20th St., 5th Floor, New York, NY 10011, (212) 219-0770
(www.talasonline.com)

Cosmetic sponges (24 Piece Wedge Sponge Block, Latex Free Polyurethane Foam):

Qosmedix.com, also available from local drug stores/pharmacies

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