Marie Stewart

Winterthur/University of Delaware Program in Art Conservation

The Investigation and Treatment of a Javanese Shadow Puppet from the University of Pennsylvania Museum of Archaeology and Anthropology

Abstract

This paper discusses the examination, technical analysis, and the conservation treatment of a Javanese shadow puppet from the University of Pennsylvania Museum of Archaeology and Anthropology. Research on the history and construction of Javanese puppets was done by the author to learn more about traditional practices and materials. Technical analysis was carried out with the help of scientists from the Winterthur/University of Delaware Program in Art Conservation Scientific Research and Analysis Lab, to help gain information on the materials used in the puppet and to aid in treatment decisions.

The shadow puppet is constructed of untanned skin and has horn handles, both possibly from a water buffalo. The puppet is decorated on both sides with multiple layers of ground, paints, and gilding. The very unstable paint is actively flaking and there are large losses, especially in the pink and red painted areas. Technical analysis with a variety of instruments, including x-ray fluorescence, scanning electron microscopy, Fourier-transform infrared analysis, Raman spectroscopy, and gas-chromatography mass spectrometry, in addition to cross-sectional analysis and polarized light microscopy, was used to determine the composition of the ground and paints. It also began to give information on why the pink and red paints are so much less stable than the other colors. Finally, analysis helped determine what conservation materials should be used for the treatment to stabilize and clean the paint. Further treatment will include stabilizing several breaks in the horn handles, cleaning all of the handles, and readhering the secondary handles to the puppet's hands.

1.1 History of Javanese Shadow Puppets

The tradition of Javanese puppet theatre (*wayang purwå*) has been around since at least the 10th century. Although there are no earlier references to it, puppet theatre was probably known earlier than the 10th century as well. (Scott-Kemball 1970, 22) It is highly integrated in Javanese society. Many of the different

Figure 1: Traditional *Wayang Purwå* (Puppet Theatre) performance; Photo courtesy Djajasoebrata, A. 1999. *Shadow Theatre in Java*

characters function as role models for people and parents sometimes name their children after certain characters. The precise origins of *wayang purwå* are unknown. It seems to have developed from a type of ancient theatre with religious characters, and then into more of an art form. Influences for the stories and puppets have come from both Hindu (Indian) and Islamic sources. (Djajasoebrata 1999, 24)

The stories told during the plays come from Indian epics like the Ramayana and the Mahabharata, and from tales from ancient Indonesian myths. Stories in the *purwå* repertoire include tales about the beginning of the world, struggles between demons and gods, the early kings, cosmic events, and divine will. All of the stories have strong moral implications, teach the difference between right and wrong, and can be an outlet for opinions. (Scott-Kemball 1970, 22)

Wayang purwå is performed for many different important social or domestic events to ensure good fortune or ward off calamity. Performances can be given for weddings, births, moments of unexpected luck, or harvest times, among other events. Certain performances are believed to have protective powers for the audience. (Djajasoebrata 1999, 17) A performance can last the entire night. The audience is not expected to sit still for the entire event, though. They can talk, eat, or nap if they get tired. Traditionally, women sat on the far side of screen to see the shadows of the puppets. Men sat on same side as the puppeteer (*dalang*), and could see the actual puppets, not just the shadows. This tradition is normally not followed anymore. (Scott-Kemball 1970, 28) Shadows of the puppets are cast on a white fabric screen set in a wooden frame, and a lamp is used to give constant bright light to create the shadows. (Djajasoebrata 1999, 77) When the puppets in the play are not in use, the puppeteer sticks their handles in banana tree trunks to keep them upright. Musical accompaniment with an orchestra (*gamelan*) for the plays began in the 18th century. (Scott-Kemball 1970, 38)

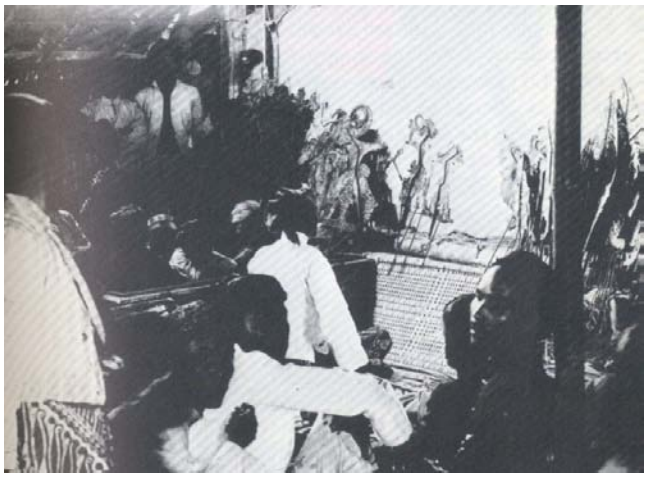


Figure 2: Men watch a the *dalang* conduct a performance; Photo Courtesy Scott-Kemball, J. 1970. *Javanese Shadow Puppets*

Besides the *wayang kulit* shadow puppet, there are several other types of *wayang* puppets. *Wayang klitik* are flat, painted wooden puppets cut in bas-relief with leather arms. *Wayang golek* are three dimensional wooden puppets that are painted and clothed. *Wayang beber* utilizes scenes painted on long lengths of textile or bark paper. In addition, two types of *wayang* are acted out by humans. In *wayang wong* the play is spoken and acted out by actors dressed as puppets. In *wayang topeng* actors wearing masks act, but the plot is narrated by a storyteller. (Djajasoebrata 1999, 13)

1.2 Historic Construction and Materials

Wayang kulit are typically made in a very ordered fashion, with many artisans and craftsmen involved. The first person prepares the hide for the body of the puppet (*kulit gudel*), usually from a two to three year old water buffalo. The hide is sun dried and soaked in calcium hydroxide for two to three days. Once swollen, the hair and epidermis are removed, and the hide is again stretched in the sun. It is scraped with a knife, polished with a rag, and put on a frame to dry. Finally, it is rolled and stored in a warm place for approximately eight years. (Djajasoebrata 1999, 35) Another craftsman prepares the horn used for the central handle (*gapit*) and the arm handles (*cempurit*), also from a water buffalo. The horn is cut, filed, and rubbed down before being shaped with heat and split down the center. Once the puppet is completely decorated, the hide substrate is inserted in the split and tied in several places. The arm handles are attached to the hands with plant fibers. (Scott-Kemball 1970, 58)

The *penatah* fashions the puppet from the prepared hide. He traces the design on the hide before using many differently shaped small metal chisels to cut out the perforations. (Djajasoebrata 1999, 43) The shaped puppet is then decorated by a gilder, before going to the artist (*penjungging*). As an alternative to gilding, bronze paint can be used.

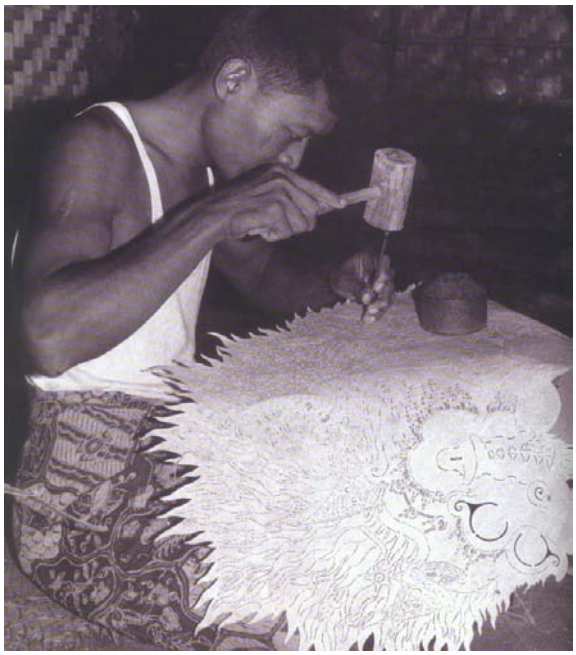


Figure 3: the *penatah* removes sections of hide to create a design; Photo courtesy Djajasoebrata, A. 1999. *Shadow Theatre in Java*

(Djajasoebrata 1999, 35) The artist can use as many as 16 different colors of paint to decorate the puppet, although typical pigments include vermilion, indigo, orpiment, yellow ochre, lamp black, and bone ash white. Binders for the paint and white bone ash ground typically include fish glue, carpenter's glue, ash from burned rattan (used as a lye), and sometimes egg. (Gowers, 1975) There is an established order in which different colors should be applied and primary colors should not be placed next to each other. The two sides of the puppet are painted in an identical manner. Strict rules for decoration apply for each type of character. (Scott-Kemball 1970, 58)

1.3 Characteristics of Wayang Kulit Puppets

There are over 500 different *wayang kulit* characters, many of which have various versions at different ages or in different moods. The different categories of characters include royalty, nobles, gods, wise men, court officials, giants and demons, monkeys, and servants, among others. Characters can be classified as distinguished, intermediary, or coarse (or refined or unrefined). Personality and classification can be determined by the characteristics of the puppet, including stature, stance, shape of eyes, and the face and body color. Social position is indicated by the clothing and ornaments the puppet is wearing. (Djajasoebrata 1999, 39)

Figure 4: varying shapes of possible eyes; Photo courtesy Djajasoebrata, A. 1999. *Shadow Theatre in Java*

The characteristics of the treated puppet revealed a lot of information about the type of character it portrays. The medium stature suggests that the puppet possesses self-control and finesse and the slim, small body is an expression of his refinement. The puppet's feet are wide-set, indicating speed and capability. The fact that his head is facing straight ahead is a neutral quality, as are his *kedelen* or soya bean-shaped eyes that are round but elongated and his long and well-shaped nose. His face was originally pink, which is not typical of the more noble and refined types, as it indicates uncontrolled passion and rage. A more noble character would have a black, white, or gold face, indicating tranquility, dignity, or beauty.

The hair is black, as is normal, and in the *supit urang* or like a lobster claw hairstyle. The puppet is wearing the typical royal dress and long silk trousers. Finally, the puppet wears bracelets on his upper and lower arms, necklaces, anklets, rings, and a *sumping*, a piece of jewelry behind the ear. All of these attributes except the pink face indicate that he is a fairly refined character. One possible reason for the presence of the pink face is that the character is in a harsher mood than normal.

2. Description and Condition of Puppet

The Javanese shadow puppet, or *wayang kulit*, is constructed of five pieces of hide, joined with bone pins. It has three horn handles with which to manipulate the puppet. The male figure is decorated with colored paint and gold leaf. He has a narrow waist, wide shoulders, a long neck, curled hair, and a pointed nose, which is typical of these puppets. On both hands, he is pointing three fingers. The puppet is wearing pantaloons, a loin-cloth, and a pointed adornment around his shoulders. His costume is enhanced with a necklace, armbands, bracelets, and rings.

The hide substrate, measuring approximately 3/64" in thickness, is thin and light colored. One piece of hide makes up the head, body, and legs of the figure, while each arm is composed of two extra pieces. The arms are jointed at the shoulders and elbows with small bone pins, allowing them to be moved and manipulated. Sections of the hide are cut out to delineate the body, the largest of which are in the hair and in between the legs. A strip of hide remains in between the feet, to offer better support to the figure. Intricate piercing in the hide provides embellishment to the puppet.

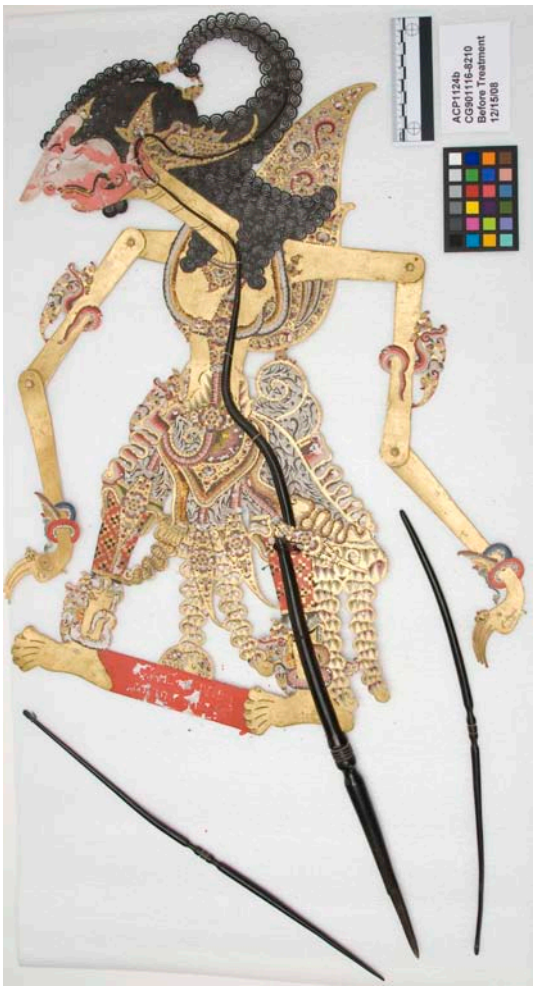


Figure 5: Shadow Puppet, Before Treatment

There are three dark brown, slightly translucent horn handles with which to manipulate the puppet. The main handle extends below the puppet by 8 ½". The

horn is split in half directly below where it joins the puppet and runs up both sides of the figure. The handle travels up through the figure's body, narrowing from the bottom to the top of the puppet. This handle is made up of two pieces of horn. The second piece begins where the first one ends at the top of the neck. The handle is secured in 14 spots to the puppet with string, tied through piercings and holes in the hide. The bottom two locations are tied with brown thread, while the top 12 are tied with light beige thread. The two secondary handles are detached now, but would have been connected to the hands of the figure. Both handles are approximately 14 ½" long, although one is slightly curved. Each handle has a small hole at the top that would be connected to the small holes in each hand with thread. There is a remnant of blue thread tied around the top of the straight handle.

The hide figure is covered with paint and gold leaf over a white ground. The body is mostly covered with gold leaf, including the bone pins in the arms, while the face is painted pink, and the hair is painted black. The costume and jewelry are painted with multiple colors, including red, pink, black, white, blue, green, yellow, and orange. The paint is brushed on in intricate designs and details. The strip between the feet is painted red and was incised all the way through with an inscription, although it is difficult to read at this point, due to extensive paint loss. The only part of it that is clear enough to identify by eye is the date '1916.' This could possibly be a date of construction.

Figure 6: Strip between feet

In order to identify the rest of the inscription on the strip, the puppet was x-rayed. Because of the differences in x-ray opacity of the different materials, the x-radiograph of the inscription made it much more legible. Now, it's possible to see that the top line reads: 'G W L z n 1916'. One explanation of this line could be the name of the artist and the date that it was constructed, but at this point, it's still hard to know. The bottom line is more legible as well, except that it's written in Javanese script. A Balinese scholar at the College of the Holy Cross in Massachusetts was able to translate this line- it suggests that this puppet is the son of Bima- one of the five Pandawa brothers, who all play a big part in the Wayang plays.

Figure 7: X-radiography images of puppet

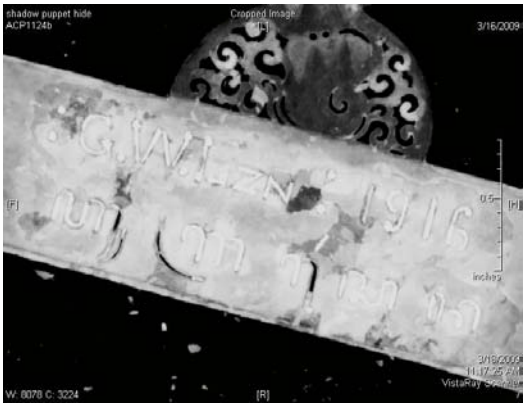


Figure 8: Detail of X-radiograph of inscription on hide strip

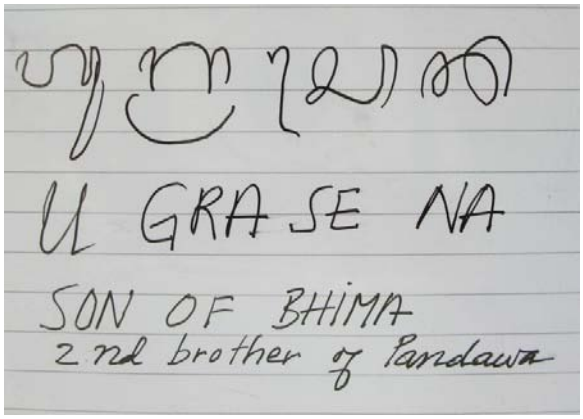


Figure 9: Translation of bottom line of inscription from Javanese to English

The painted surface of the shadow puppet is in poor condition, with extensive loss and flaking of paint and gold leaf. The worst loss is concentrated in the pink and red painted areas. Only approximately 50% of the pink paint remains in the figure's face. Loss in the red strip connecting the feet is associated with and probably began at the incised inscription. There are also small areas of loss in the gilding and the white and black paint. There are fewer losses in the other colors of paint. Detached paint flakes are gathered in a small plastic bag. The remaining paint has large areas of flaking, lifting, and curling. The gilding exhibits fine

Figure 10: paint loss in face

cracking and lifting, as well. The paint surface is abraded around both holes in the hands, at the joints in the arms, and underneath the handles, due to use and movement of the puppet. Dirt is present on the surface overall.

The hide substrate is in good condition, with no splits or tears. It is moderately stiff, however, and there are slight undulations throughout the figure. A collagen shrinkage test of the hide was done to give a better indication of the state of deterioration. The temperature range for the hide was well within the normal temperature for undeteriorated limed collagen, both seen here, indicating that the hide is very stable.

The main horn handle has two cracks. The bottom crack, 2 ½" from the bottom, has not broken all the way through. The horn is stiff and it seems to be set into its cracked and slightly distorted position. The second crack is 14" from the bottom and located where the handle passes through the figure's right leg. The horn has broken all the way though and has settled so that there is a large gap between the two pieces.

Figures 11 and 12: cracks in the main horn handle

3. Analysis

A variety of analytical techniques was used to study and characterize the materials that make up the shadow puppet. Specific information was gained about the elements, pigments, and binders in the ground, paints, gilding, and surface coatings on the hide with cross-sectional microscopy, XRF, SEM-EDS, FTIR, Raman spectroscopy, and GC-Mass Spec. The identified materials were then compared to the expected historical materials and those that have been found during analysis of other shadow puppets. The information gained during the analysis helped confirm the construction and materials used in the puppet, as well as informed the conservation treatment

that followed. There were several other specific questions that were important to try to answer during the analysis: the first was to find more information that might help confirm or rule out the date of 1916 as a date of construction; the second was to learn why the pink and red paint are flaking so much worse than the rest of the paint; and the third was to determine when the face and the strip between the feet were repainted.

Eight samples of paint were mounted as cross-sections, examined under the microscope in visible and ultraviolet light, and stained for carbohydrates, proteins, and oils. Most of the samples that underwent cross-sectional analysis had a white ground on the bottom, followed by one or more paint layers or gold leaf, and a thin varnish layer on top. At least three layers of gold leaf were found in one sample. In addition, it's possible to see multiple campaigns of painting on some areas of the puppet, which may be separated by varnish or dirt layers. The additional campaigns do not seem to be haphazard or sloppy; the data suggests that the same materials were used for later campaigns as were for earlier campaigns.

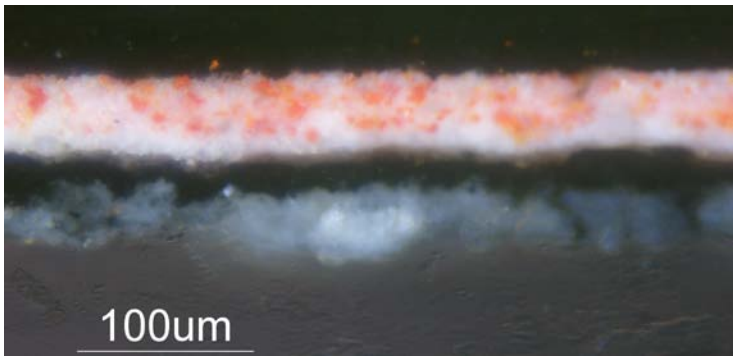


Figure 13: X-S 2, visible light, 300X

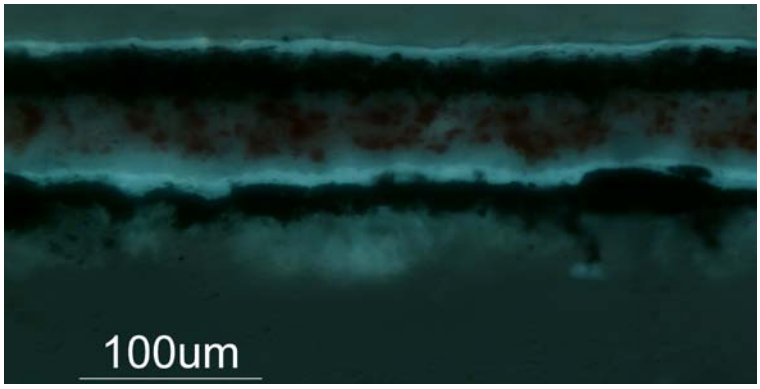


Figure 14: X-S 2, UV fluorescence, BV-2A filter, 300X

X-S 2, seen in figures 13-14, has the following layers, from top to bottom:

- Thin varnish layer, fluoresces light green-blue in bv-2a filter
- Black paint layer
- Pink paint layer
- White paint layer
- Thin varnish layer, fluoresces light green-blue in bv-2a filter
- Black paint layer
- Grey ground layer

The ground and white paint appear to contain mostly barium sulfate ($BaSO_4$) and zinc sulfide (ZnS), which may suggest the use of lithopone. It is difficult to say definitively that lithopone is present because reference spectra for barium sulfate and lithopone are quite similar in many of the analytical techniques that were used, especially FTIR and Raman spectroscopy. Barium sulfate has been used in connection with paints since approximately the beginning of the 19th century, while lithopone was first produced by John Orr, in England, around 1874. (Gettens and Stout, 96, 125)

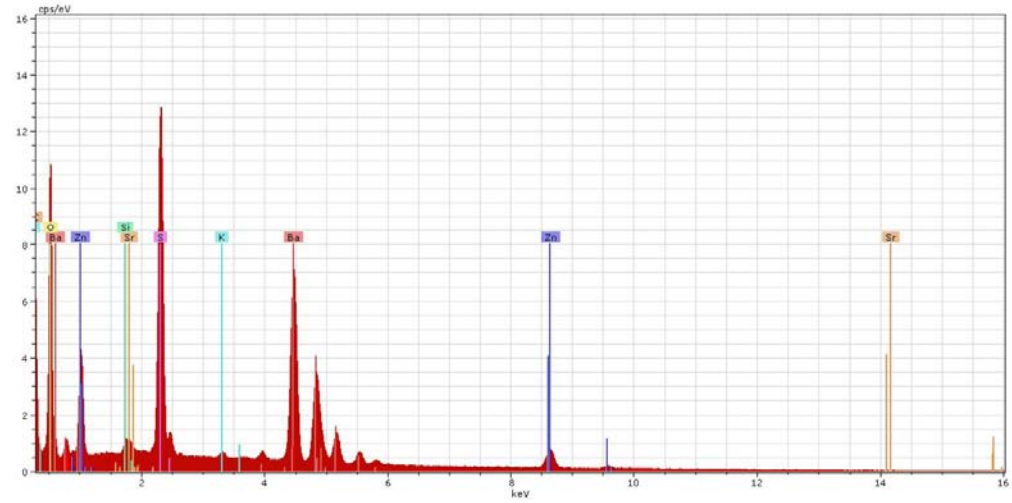
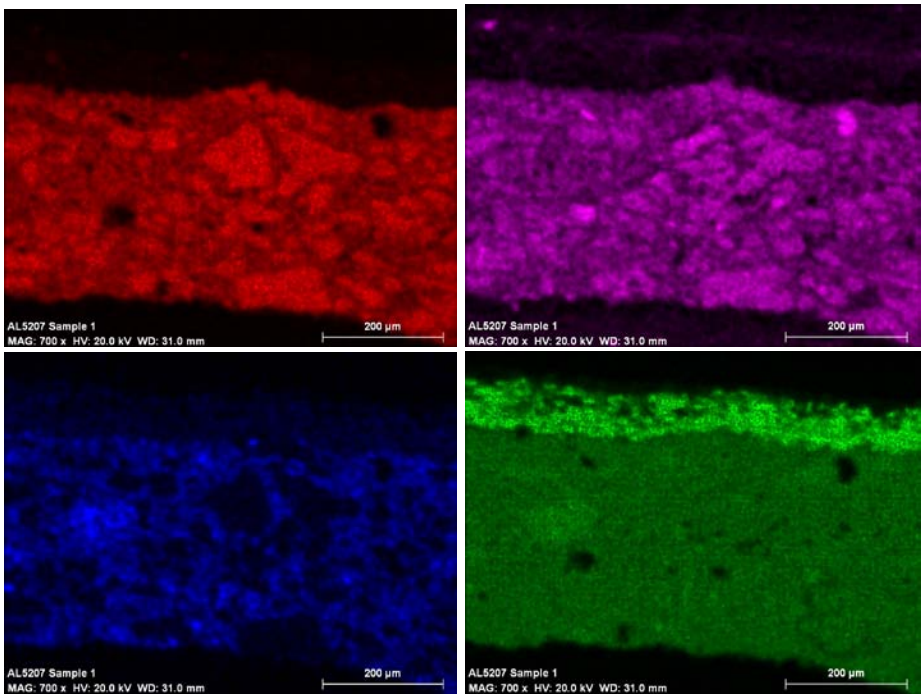


Figure 15: SEM-EDS spectrum of ground in X-S Sample #1



Figures 16: SEM-EDS Elemental Mapping of ground in X-S Sample #1; Red: barium; Purple: oxygen; Blue: Zinc; Green: sulfur; The maps of these elements show particles corresponding to barium, oxygen, and sulfur, and zinc and sulfur, suggesting that the ground is mostly made up of barium sulfate and zinc sulfide.

Barium and zinc were both identified by large peaks in XRF and SEM-EDS, while sulfur and oxygen were also detected with SEM-EDS. In addition to particles associated with the aforementioned materials, mapping the elements of the ground with SEM identified particles associated with calcium carbonate or calcium oxide and possibly zinc oxide and calcium sulfate. When analyzed with FTIR, several samples contained bands that correspond to calcium carbonate and calcium sulfate, although these materials could be associated with pigments that are natural minerals, like orpiment. Barium sulfate was identified in almost all of the samples analyzed with FTIR, indicating that it is probably the base for most of the paints. In addition, peaks for barium sulfate and/or lithopone were identified in several samples with Raman spectroscopy. The white paint is most likely pigmented with primarily with barium sulfate, while the ground seems to have additional pigments added to the barium sulfate to give it bulk.

The pink and red paint are pigmented with vermilion (HgS), although the pink paint has barium sulfate and zinc sulfide mixed with it to mute the color. Vermilion is found in nature as the mineral cinnabar, and has been used as a pigment since antiquity. (Gettens and Stout, 170) Large mercury peaks were identified with XRF, while SEM-EDS identified peaks for mercury and sulfur in the red and pink paint. Peaks for vermilion were also identified with Raman spectroscopy in all red and pink samples.

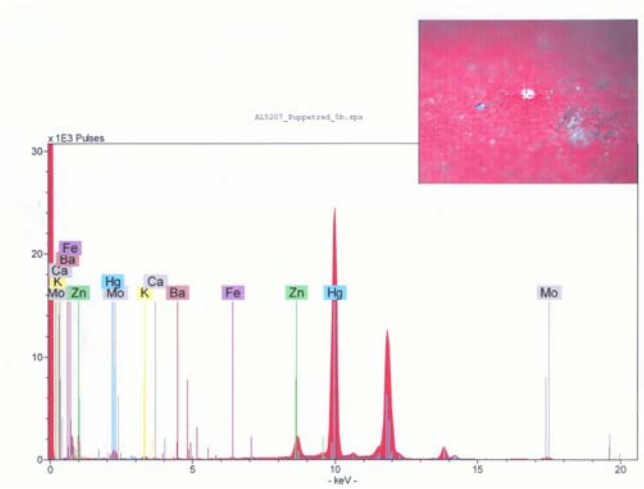


Figure 17: XRF Spectrum of Red Paint, sample 5b; Inset image shows analysis location

The black paint is colored with a carbon-based black. All carbon-based black pigments are derived from the partial burning or carbonizing of a natural gas, oil, wood, or other organic material. (Gettens and Stout, 103) Carbon was identified in the black paint layers with SEM-EDS. After analysis with FTIR, comparison with a reference spectrum confirmed that the black paint is not pigmented with bone black.

The yellow paint appears to be pigmented with both orpiment (As_2S_3) and chrome yellow ($PbCrO_4$). Orpiment has been used as a pigment since antiquity and was widely used in the East. (Gettens and Stout, 135) Chrome yellow began to be produced commercially in the early 19th century. (Gettens and Stout, 107) The two pigments may have been mixed together to obtain a particular color. Peaks for arsenic and sulfur were detected in SEM-EDS. Elemental mapping of the yellow paint in the SEM showed particles associated with both these elements. Small peaks for chromium were identified with XRF. In addition, several peaks corresponding to chrome yellow were found with Raman spectroscopy.

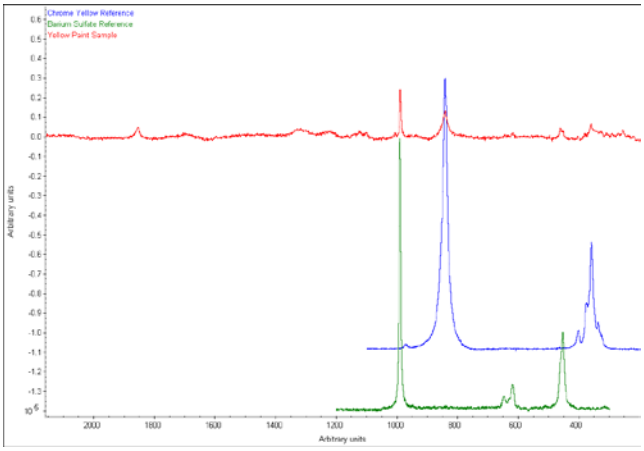
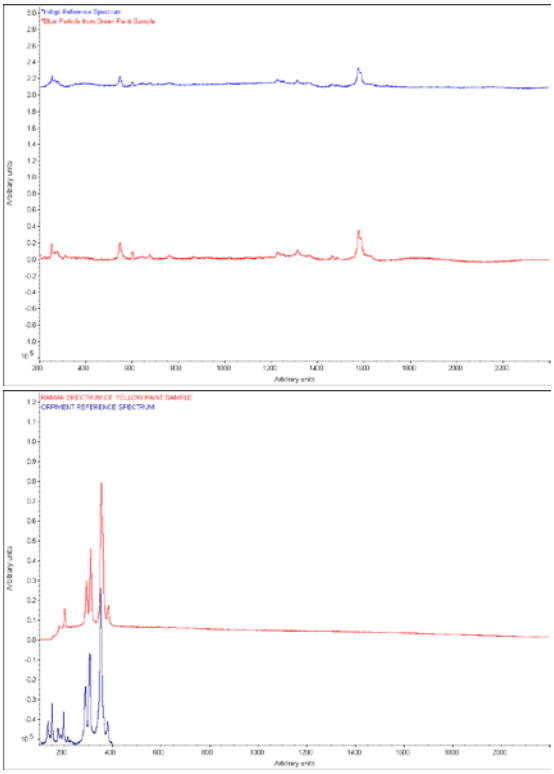


Figure 18: Raman spectrum of yellow paint sample (run 1); Red: sample (laser power 1%, 4 scans at 30s each); Blue: Chrome Yellow; Green: Barium Sulfate

Neither the green nor the blue paint were identified until they were analyzed with Raman spectroscopy. XRF, SEM-EDS, and FTIR were unable to identify any element or compound responsible for the coloring. When the green paint was examined under the microscope in the Raman spectrometer, however, both blue and yellow particles were identified. The blue particles showed multiple peaks consistent with indigo ($C_{16}H_{10}N_2O_2$). The yellow particles showed multiple peaks consistent with orpiment. When the blue paint was analyzed with Raman spectroscopy, it was identified as indigo as well. Indigo is a blue dye that comes from different plants of the genus *Indigofera*. The plants were grown all over the world, although the largest populations were in India and China. Since



Figures 19 and 20: Raman spectra of blue and yellow particles in the green paint sample; Top- Red: blue particle in sample (laser power 1%, 4 scans at 30s each); Blue: Indigo reference (reference courtesy Chris Cole); Bottom- Red: yellow particle in sample (laser power 0.5%, 1 scan at 10s); Blue: Orpiment reference

1900, most indigo has been produced synthetically. (Gettens and Stout, 120)

The binder has not been fully identified. Staining of the cross-sections with Alexaflour 488 showed a positive reaction for proteins in the ground of several of the samples. When analyzed with FTIR, most of the samples had bands that matched with a protein. A glue was used as a reference, although this is representative of a wider range of proteins and does not confirm that the binder is a glue. Of the five paint samples analyzed with protein analysis in GC-MS, two came back as likely matches for egg, based on the lack of hydroxyproline in the amino acids that were separated out. Two of those five samples were also analyzed for lipid content and although both stearic and palmitic acid were identified, no azoleic acid was identified, which suggests that the binder is not an oil. Therefore, in three of the five samples, no binder could be identified. There are several possible reasons for the lack of information about the binder; the first is that it could possibly be some type of gum, for which analysis has not been performed. The second, more likely, reason is that there was not enough binder present in the paint samples to be analyzed.

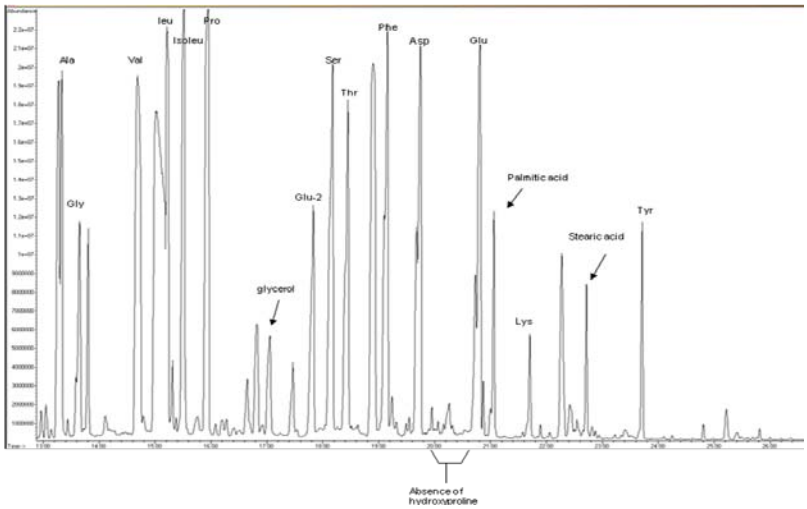


Figure 21: Gas Chromatogram of red paint sample; protein analysis

Regardless of this, there appears to be at least some type of egg binder present in some of the paint on the puppet. Egg can be used as a binder for paints in the form of a whole egg, the egg white, or the egg yolk. The FTIR spectrum of egg white is very typical of protein spectra. Egg yolk, however, has additional oil components, besides the protein components that are in the white. The oil components in the yolk show up in FTIR as carbonyl bands around 1700-1750 cm^{-1} and taller, more pronounced C-H stretching bands around 2800-3100 cm^{-1}. (Derrick, et al, 183) In an attempt to analyze the binder without any interference from the pigments, two paint samples were soaked in dimethylformamide. The material that was extracted was analyzed with FTIR. The resulting spectra appear to have bands from both protein

and oil components. This could suggest that egg yolk was used, however, it cannot be confirmed, as egg white and yolk are virtually indistinguishable when analyzed with GC-MS.

In the entry for egg tempera in Gettens and Stout, it is suggested that when pigments containing sulfur are used with an egg emulsion, they can decompose by combining with nitrogen and sulfur in the egg to form hydrogen sulfide. (Gettens and Stout, 18) Pigments containing sulfur include both the vermilion and orpiment that were found on the puppet. This may be a possible reason that the red and pink paint, and to a lesser extent, the yellow paint, are so unstable and flaking so badly. If time allowed, it would be informative to perform GC-MS on several more samples to more definitively identify the binder and to determine if the binder is identical in the paint and ground.

Samples of the varnish were taken from areas where it had pooled in the perforations cut out of the hide substrate. It was analyzed with FTIR and seems to consist mainly of a proteinaceous material. A reference spectrum for egg white was used as a comparison, but this could be substituted with other types of protein, as well. Although this does not specifically identify the varnish used, it does suggest that it is a protein-based varnish, instead of a natural resin or synthetic varnish.

4. Treatment

The treatment steps for this project address several key condition issues. The first step, to minimize any further loss of paint during the following steps, was to stabilize the very unstable, cracking, flaking, and lifting paint, followed by cleaning the painted surface. Another major part of the treatment will be to repair the break in the main horn handle that is on both sides of the puppet. This can't be done until both sides of the puppet are consolidated, however, because the best way to situate the puppet during this step may be in the vertical position, and a great deal of paint may be lost if it's not consolidated first. The last steps include reattaching the loose threads tying the main horn handle to the puppet body, tying the secondary handles to the hands with a dark brown linen thread, and completing some level of inpainting. The extensive nature of this treatment required that it be performed over several years. While testing and a treatment

protocol were completed this year, the second half of the paint consolidation and the repairs of the horn will be completed next year.

Before treatment began, testing was performed on different solvents, adhesives, and cleaning methods. A variety of solvents, from polar to non-polar were tested in order to find one that would slightly relax the paint without dissolving it, so that the paint could be set down during consolidation without further cracking. The more non-polar solvents were not effective at relaxing the paint, while water softened the ground too much. Ethanol successfully relaxed the paint while keeping the softening of the ground to a minimum.

Next, three adhesives, Aquazol 500, Butvar B-98, and BEVA 371, were tested to use as consolidants, with the criteria that they have good affinity for paint and hide, particularly in their strength and degree of flexibility. Among those tested, both Aquazol 500 and Butvar B-98 worked equally well. The only problem was that both adhesives were more shiny than the surface of the puppet. One solution to this problem was to simply be sure to remove all excess adhesive on the paint surface. Another solution was to work with the adhesive so that it was less glossy. Fumed silica was added to both Aquazol and B-98 to lessen the gloss. B-98 in ethanol with fumed silica was chosen as the adhesive for the paint consolidation, as the gloss was noticeably reduced.

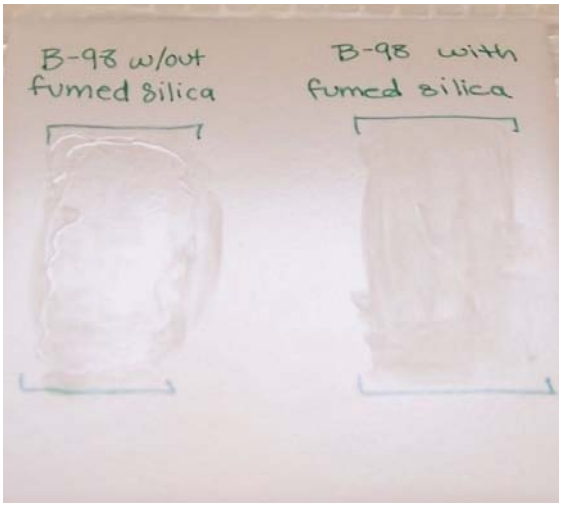


Figure 22: Adhesive tests on B-98 to reduce gloss

Table 1: Adhesive tests

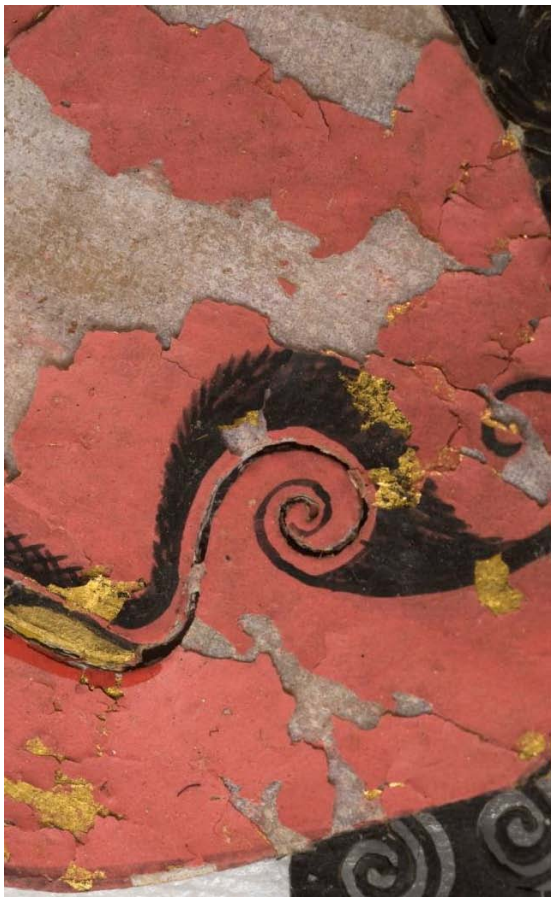
Adhesive	**Observations**
BEVA 371	Paint was too brittle to be set down; it cracked under light pressure
7% Aquazol in ethanol	Paint was soft enough to be set down; no discoloration; left surface shiny
7% Butvar B-98 in ethanol	Paint was soft enough to be set down; no discoloration; left surface slightly shiny
7% Aquazol in ethanol with fumed silica (1/2 tsp added to 30 mL)	Decreased shine slightly; still too shiny; remains slightly tacky over time
7% Butvar B-98 in ethanol with fumed silica (1/2 tsp added to 30 mL)	Decreased shine a noticeable amount

The next two steps in the treatment would be to remove the excess adhesive and surface clean the puppet, combining these two steps if possible, in order to limit interaction with the still fragile paint. Various methods that were tested were small cotton swabs and small polyurethane swabs dampened with ethanol, but with both those options, there was a concern that they would catch on the paint and cause more loss. During a visit, Ellen Pearlstein, from the UCLA/Getty Conservation Program, presented a new option, consisting of small cotton swabs wrapped with Teflon tape to create a very smooth surface. The Teflon tape is porous enough to absorb and gently release small amounts of solvent. In addition, the smoothness of the Teflon greatly decreases the possibility of the swab catching on the paint surface.

Figure 23: Removing excess adhesive and cleaning surface with Teflon covered swabs

The paint consolidation and surface cleaning treatment steps proceeded in the following manner. A small area of paint was relaxed with ethanol, delivered on the tip of a brush. Then, a solution of 7% Butvar B-98 with fumed silica was fed under the lifting paint and into the cracks. The solvent was allowed to evaporate for approximately five minutes, which was determined to be the correct amount of time to wait to ensure that the adhesive was tacky enough to adhere the paint properly. Then, the lifting paint down was set down with a bamboo skewer through a sheet of silicone release Mylar. Once at least five days had passed, excess adhesive was removed and

the surface of the paint was cleaned using cotton swabs covered with a layer of Teflon tape and dampened with ethanol.



Figures 24 and 25: Before and after consolidation and cleaning of the face

The consolidation and cleaning were completed on the first side of the puppet during this year, after which it was turned over to examine and evaluate the condition of the opposite side. The paint is in similar condition, with perhaps even more loss, and will require a very similar treatment next year.

Figures 26 and 27: After consolidation and cleaning side 1; Before treatment side 2

5. Conclusion

This project was a combination of historical research into the use and construction of Javanese shadow puppets, and the scientific analysis and treatment of a specific shadow puppet from the University of Pennsylvania Museum of Archaeology and Anthropology. Javanese puppet theatre has a long history and still plays a large role in Javanese society today. Not only is the appearance of the puppet from the University museum very comparable to the typical Javanese style, the scientific analysis has also shown that this puppet was constructed with very traditional materials and methods. The colorants found in the paint are all typical of Javanese puppets. The dates that these colorants were first used do not contradict a date of construction of 1916, but unfortunately, they do not give me a better idea if this date is correct or not. The puppet was

probably repainted during its use- as is normal to do with puppets that are being used often in plays.

The treatment protocol for this puppet was developed after completing testing on a range of consolidation and cleaning materials. The consolidation and cleaning that were accomplished greatly stabilized the puppet and markedly improved its appearance, which will make the puppet more accessible to researchers when it is returned to the University museum after its full treatment. A treatment plan has been laid out for the next phases of the treatment which will be completed by students in the upcoming years. Finally, it is hoped that the information gained during all aspects of this project will be beneficial to the University museum for the rest of their collection of shadow puppets.

Acknowledgements

The author would like to thank the large number of people who were extremely helpful with this project. The many conservators and professors in the WUDPAC Program were very supportive and generous with their time, especially Bruno Pouliot, and the scientists in the Winterthur Scientific Research and Analysis Laboratory, including Catherine Matsen, Dr. Joe Weber and Dr. Jennifer Mass. The conservators at the University of Pennsylvania Museum were very helpful with providing background information on their collection of puppets and a special thanks goes to them for allowing this project to begin.

Bibliography

Artal-Isbrand, Paula. Head Objects Conservator, Worcester Art Museum, Worcester, MA. Email correspondence, 4/18/09.

Breslin, D. 2007. *Technical Study of a Painted Hearth Brush from the Winterthur Museum Collection,* A Technical Study for ARTC 672, 673. Winterthur/University of Delaware Program in Art Conservation.

Derrick, M.R., D. Stulik, and J.M. Landry. 1999. *Infrared Spectroscopy in Conservation Science,* Los Angeles: The Getty Conservation Institute.

Dion, J. 2002. "The Treatment, Examination, and History of a 19th Century Painted Leather Fire Bucket from Portsmouth, New Hampshire," in *Twenty-Eighth Annual ANAGPIC Student Conference, Student Papers*. Cambridge, MA: Straus Center for Conservation.

Djajasoebrata, A. 1999. *Shadow Theatre in Java: The Puppets, Performance, and Repertoire,* Amsterdam: Pepin Press.

Dorge, V. and F.C. Howlett, eds. 1998. *Painted Wood: History and Conservation, Proceedings of a symposium organized by the Wooden Artifacts Group of the American Institute for Conservation of Historic and Artistic Works and the Foundation of the AIC, held at the Colonial Williamsburg Foundation, Williamsburg Virginia, 11-14 November 1994,* Los Angeles: Getty Conservation Institute.

Eastaugh, N., V. Walsh, T. Chaplin, and R. Siddall. 2004. *Pigment Compendium: A Dictionary of Historical Pigments,* Oxford: Elsevier Butterworth-Heinemann.

Gettens, R.J., and G. Stout. 1966. *Painting Materials,* New York: Dover Publications, Inc.

Gowers, H. 1975. “The Conservation of Javanese Shadow Puppets,” in *ICOM Committee for Conservation 4th Triennial Meeting, Venice 13-18 October 1975, Preprints*. Paris: International Council of Museums.

Kaplan, L. 2002. “Conservation Through Investigation: Uncovering the Story of a Japanese Ceremonial Doll,” in *The Textile Specialty Group Postprints, Papers Delivered at the Textile Subgroup Session, AIC 30th Annual Meeting.* Washington, D.C.: Textile Specialty Group of the AIC.

Kubick, L. 2008. Examination and Condition Report on Javanese Shadow Puppet, ACP# 1124b, Written as a study assignment during the organic block of the first year of the Winterthur/University of Delaware Program in Art Conservation.

Martin, J. 1998. “Microscopic Examination and Analysis of the Structure and Composition of Paint and Varnish Layers,” in *Painted Wood: History and Conservation, Proceedings of a symposium organized by the Wooden Artifacts Group of the American Institute for Conservation of Historic and Artistic Works and the Foundation of the AIC, held at the Colonial Williamsburg Foundation, Williamsburg Virginia, 11-14 November 1994.* Dorge, V. and F.C. Howlett, eds. Los Angeles: Getty Conservation Institute.

Moffat, E.A, P.J. Sirois, and J. Miller. 1997. “Analysis of the Paints Used to Decorate Northern Plains Hide Artifacts during the Nineteenth and Early Twentieth Centuries.” *Journal of the Canadian Association for Conservation.* Volume 22. Canadian Association for Conservation.

Morris, T. Objects Conservator, Asian Art Museum, San Francisco, CA. Email and telephone conversations, February 2008.

Scott-Kemball, J. 1970. *Javanese Shadow Puppets*, Great Britain: Shenval Press.

Shah, M. and J. Solz. 1999. “Javanese Puppets: The Examination and Conservation of Two Traditions,” in *Papers Presented at the Twenty-Fifth Annual Conference of ANAGPIC*, Buffalo, NY: Art Conservation Department, Buffalo State College.

Solz, J. 1998. Conservation Report on Shadow Puppet, Accession# 29-91-180, ACP# 1000c, Winterthur Museum.

UCLA Museum of Cultural History, University of California, LA. 1963. *Asian Puppets: Wall of the World*, Los Angeles, CA: University of California.