Piecing It Together: Analysis and Treatment of a Painted Silk Flag

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Buffalo State
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American Institute for Conservation
50th Annual Meeting, Los Angeles
May 13 – 17, 2022

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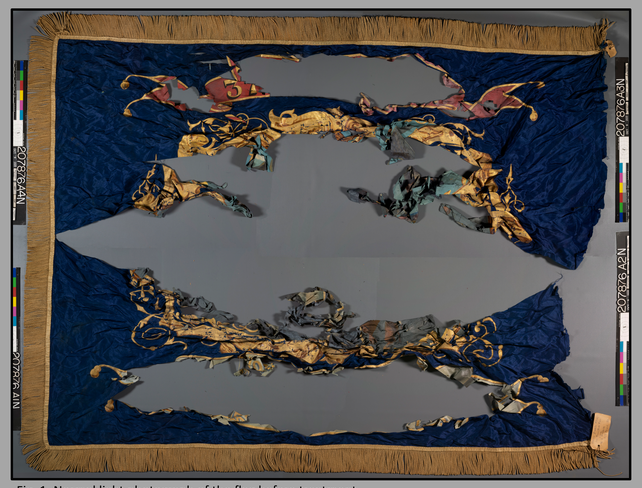


Fig. 1. Normal light photograph of the flag before treatment.

Fig. 2. Normal light photograph of the flag after treatment.

Introduction

A painted Civil War battle flag of the 37th New York Volunteer Infantry Regiment from the Cattaraugus County Museum presented challenges and advantages of bridging both paintings and textiles conservation, providing an opportunity to study past techniques and experiment with new methods. The 5 by 6 foot, two-sided flag was brought to the Patricia H. and Richard E. Garman Art Conservation Department at SUNY Buffalo State College in a severely deteriorated condition with the painted elements fragmented and unrecognizable as an emblematic New York battle flag. The flag was documented with multimodal imaging (MMI) and analyzed with SEM-EDS, XRF, FTIR (ATR and micro), Raman, and py-GC-MS to better understand painted Civil War flag and inform treatment. Treatment protocols developed and conducted include: spot and solubility testing, surface cleaning, stain reduction, humidifying, flattening, efflorescence reduction, and consolidation.

Summary of Condition Issues

- Tears in the silk, through the paint
- Planar distortions
- Rigid, brittle paint
- Flaking in the gold frame
- Fatty acid efflorescence
- Fragments and losses

Figs. 3-5. Left to right, details of tears in the silk and through the paint, flaking and loss in the gold-painted frame, and efflorescence where lettering exists on the reverse.

History and Manufacture

The flag was carried by the 37th Infantry Regiment from 1861 to 1863. During the war, it was captured by the Confederate Army and eventually recaptured by Captain William S. Hubbell. In 1893, Hubbell gifted the flag to the Cattaraugus County Veteran's Association which later founded the Cattaraugus County Museum. The flag appears similar to the 59th and the 127th regimental colors with The New York City Shield of Arms (fig 6). Hundreds of flags were mass-produced during the Civil War. Flags were generally painted with oil or egg tempera and preparatory layers were variable to non-existent. On a two-sided flag such as this, a thin ground layer was applied to saturate the textile and provide a base for subsequent paint which mirrored between sides of the flag.

Fig. 6. Similar painted silk flags of 127th Regiment (left) and 59th Regiment (right). https://museum.dmna.ny.gov/flags/.

Multimodal Imaging and Scientific Analysis

Imaging and analytical techniques used to characterize and identify materials include multimodal imaging (MMI), polarized light microscopy, scanning electron microscopy with energy dispersive spectroscopy (SEM-EDS), and x-ray fluorescence (XRF), Fourier transform infrared spectroscopy (FTIR) (ATR and micro), Raman, and pyrolysis gas chromatography mass spectrometry (py-GC-MS). The imaging techniques complemented the scientific findings by providing clues of the materials present. For example, the fluorescent lead-based ground and gold highlight (also luminescing in IR) and the non-fluorescent and reflective gold in visible and reflected UVA were all estimated through imaging.

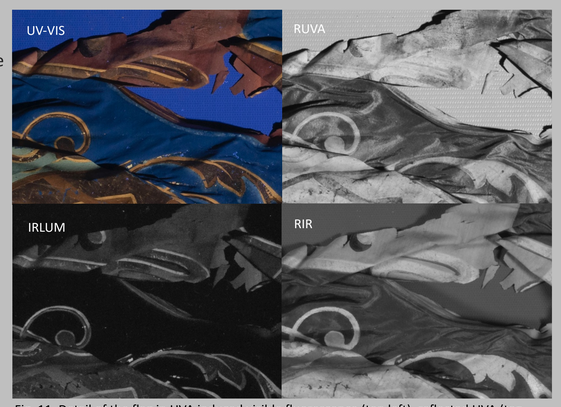
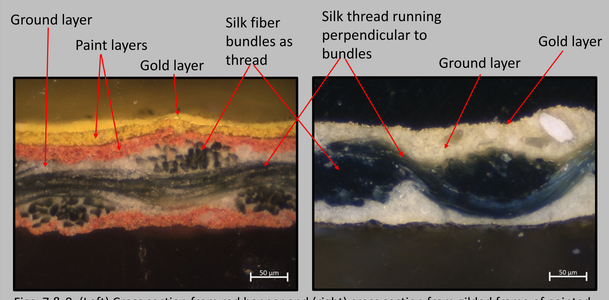
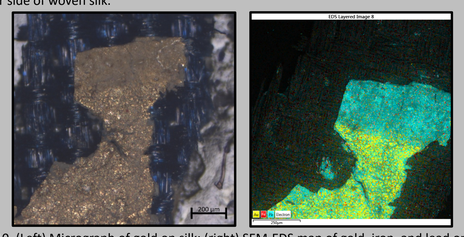


Fig. 11. Detail of the flag in UVA induced visible fluorescence (top left), reflected UVA (top right), IR luminescence (bottom left) and reflected IR (bottom right) conditions.



Figs. 7 & 8. (Left) Cross section from red banner and (right) cross section from gilded frame of painted on either side of woven silk.



Figs. 9 & 10. (Left) Micrograph of gold on silk; (right) SEM-EDS map of gold, iron, and lead on gold on silk.

Table 1. Summary of Layer Location, Materials and Methods of Analysis.

Layer	Identified Materials	Methods
Textile	Prussian blue-dyed silk	MMI, Microscopy, XRF, FTIR
Fringe	Weighted silk wrapping	XRF
Ground	Lead white, Barium sulfate	MMI, SEM-EDS, Raman
Binding medium	Aged oil (linseed oil)	FTIR, Py-GC-MS
Red paint	Vermillion	MMI, XRF, SEM-EDS
Yellow under gold	Chrome yellow	Raman
Gilding	Gold	MMI, XRF, SEM-EDS
Glazing over gold	Lead-based paint	XRF, SEM-EDS
Efflorescence	Lead stearate & palmitate	FTIR, Py GC-MS, SEM-EDS

Testing and Treatment

1. Dry cleaning
2. Spot testing
3. Stain reduction
4. **Humidification**
5. **Flattening**
6. **Efflorescence reduction**
7. **Consolidation**

Fig. 12. Humidified and flattened fragments during testing.

Efflorescence Reduction

A Staedtler eraser pen was used to mechanically remove efflorescence (fig.13). It was reduced by gently rubbing over the surface in one direction, while lightly pinning the paint fragment on either side of the working area with two fingers. This way, small areas could be worked on while protecting any crack edges from catching. The crumbs were removed with a lightly damp swab.

Fig. 13. Initial testing of removing fatty acid efflorescence with a Staedtler eraser.

Consolidation

To reattach fragments, BEVA "eyelashes" were custom made in several colors by pulling most warp threads from a polyester organza, leaving 1 -3 threads behind and dabbing it with diluted BEVA. The eyelashes were then cut out, aligned with 1 or two long threads running along the crack, and adhered with a heated tacking iron (figs. 14, 15).

Fig. 14. Applying custom made BEVA eyelashes.

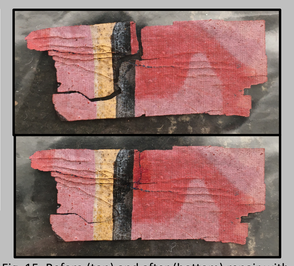
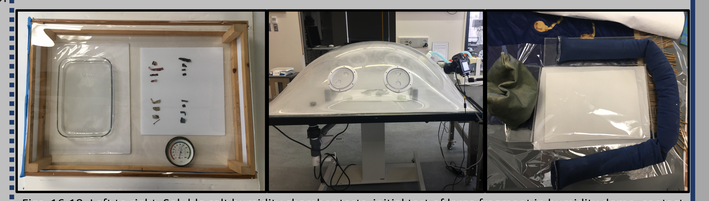


Fig. 15. Before (top) and after (bottom) repair with gold, black and red BEVA eyelashes .

Humidification

Humidification was a critical component of treatment as the painted and unpainted blue silk exhibited drastic differences in mechanical properties, requiring careful consideration of treatment approaches. Several humification approaches were tested to incorporate the interface between the brittle paint and the unpainted silk. Tests included humidification in a soluble salt RH controlled humidity chamber, various timed intervals of increased humidity exposure, and contact humification. Lengthy humification tests (some over 6 hours) exhibited little success due to the extreme hydrophobicity of the paint (figs. 12, 16-18). Contact humidification using Gore-Tex and moisture reservoirs (blotter or Tekwipe) proved more successful by exposing the silk and paint to vapor in varying time intervals. This method controlled and reduced the time the silk was exposed to moisture separately from the paint and avoided tidelines by custom-shaping the Tekwipe. Between 1 and 6 hours of humidification made the flag pliable enough to be flattened under plexiglass and moderate weight.



Figs. 16-18. Left to right, Soluble salt humidity chamber tests, initial test of large fragment in humidity dome, contact humification of the silk .

Stubborn areas where the paint and the silk could not be humidified separately required a lifted Gore-Tex and Tekwipe system to avoid contact with the silk (figs.19, 20). This was achieved by propping plexiglass and Ethafoam blocks upright on either side of the section and draping Gore-Tex over the center with edges to spare. The Gore-Tex was pulled moderately taut as magnets secured the edges around the plexiglass, ensuring it did not touch the silk. The area was covered overall with Mylar and left to humidify for 17 hours, resulting in relaxed paint and zero tidelines.

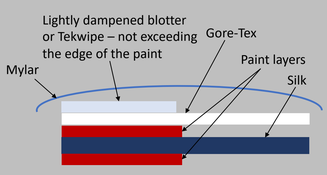


Fig. 19. Diagram of contact humification method over the paint and the silk.

Fig. 20. Side view of raised Gore-Tex humidification in area of stubborn paint.

Conclusions

The painted Civil War battle flag of the 37th New York Volunteer Infantry Regiment was analyzed by MMI, FTIR, XRF, SEM-EDS, Raman, and Py GC-MS. The analysis indicated the materials and pigments present, highlighted the manufacturing process, informed the understanding of condition issues and the subsequent treatment. Successful humidification, reduction of efflorescence and flattening treatment protocols were established. Based on the findings of this study and the protocols developed, the treatment of the 5 by 6 foot two-sided silk flag will continue. Visual compensation will be assessed at a future date when a better understanding of the remaining fragments is known (fig. 21). Finally, the flag will be encapsulated with dyed or painted nylon bobbinet netting and mounted for exhibition at the Cattaraugus County Museum.

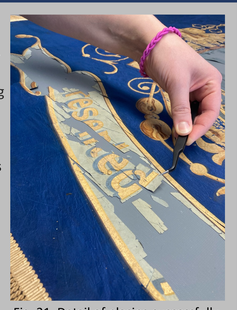


Fig. 21. Detail of placing successfully flattened fragment within the flag.

Acknowledgements

- Emily Hamilton, Jiuan Jiuan Chen, Deborah Trupin, Nancy Pollak, Sarah Stevens, Rebecca Ploeger, Glennis Rayermann, and Theresa Smith
- Brian McClellan, Curator, Cattaraugus County Museum
- The Garman Art Conservation Department- Faculty, Staff, Class of 2022 and Class of 2023
- Fellowships and Educational Funding: Kress Foundation Scholarship, Andrew W. Mellon Foundation Fellowship, National Endowment for the Humanities Fellowship, Buffalo State College Tuition Scholarship, Garman Family Art Conservation Fellowship, Balbach Family Art Conservation Fellowship, Marianne Vallet-Sandre Art Conservation Fellowship, Linton Vincent Tuition Scholarship

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