Further Researches in the Preservation and Conservation of Letterpress Copybooks

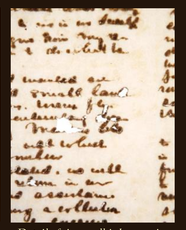
LAURA DELLAPIANA, PAPER CONSERVATOR laura.dellapiana@gmail.com
NORA LOCKSHIN, SENIOR CONSERVATOR, SMITHSONIAN INSTITUTION ARCHIVES lockshinn@si.edu

Smithsonian Institution Archives

INTRODUCTION

Spencer Fullerton Baird

One of the letterpress copybooks under examination



Detail of iron-gall ink corrosion in the letterpress copybooks

- Research project: develop a new method for the conservation of 80 letterpress copybooks of Spencer Fullerton Baird (1823-1887 CE), preserved in the collections of the Smithsonian Institution Archives (SIA) Record Unit 00053.
- Conservation challenges: severe iron-gall ink corrosion and ink fading, transparent and brittle papers.
- Previous research: 2010/2011, Smithsonian Postgraduate Fellow Beth Antoine analyzed condition across the copybooks, and experimented with antioxidant behaviour of Tetrabutylammonium Bromide (TBABr) on samples (see Beth Antoine, Book and Paper Group Annual 30, 2011).
- Three new research questions:

1. STABILITY OF ANTIOXIDANTS IN SAMPLES STUDY - What are the long-term effects of treating copybooks with non-aqueous anti-oxidants Tetrabutylammonium Bromide (TBABr) and 1-ethyl-3-methyl imidazolium bromide (EMiMBr)?

2. ADHESIVES STUDY - Consolidation with adhesives and stabilizing mends during the antioxidant treatment is of practical concern to prevent further loss. Which adhesives could be applied? How will in-situ mends be applied and behave during treatment?

3. PRACTICAL HANDLING - Is it possible to apply the same methods in order to handle pages of letterpress copy books in which the ink corrosion has caused tears and missing areas?

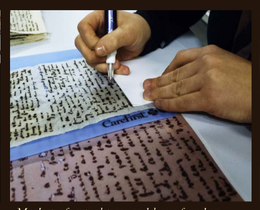
MATERIALS

- Antioxidants: Tetrabutylammonium bromide (TBABr); 1-ethyl-3-methyl imidazolium bromide (EMiMBr)
- Sizing agents: 1% v/v Klucel G in ethanol; 1% w/v gelatine in water : 20%-30% v/v ethanol; 1% w/v TRI-Funori™ in water : 20% v/v ethanol; 1% w/v isinglass in water
- Adhesives: 4% w/v Klucel G in ethanol solvent-set tissue and heat-set tissue; 2% - 5% - 7% and 10% w/v isinglass in water solvent-set tissues; 4:1:1 water/Avanse MV100/Plextol B500 heat-set tissue; Plextol B500 solvent-set tissue; 0,5 – 3% w/v gelatine in water solvent-set tissue
- Papers: Original, unused, blank papers sampled from volume 4 of Baird's books (principally flax, cotton, some containing wood, some containing jute and/or hemp); Mockups for original letter copypress copies: made from "Silk Natural" (vendor: Talas, Inc.) (gampi, in sheets, impregnated with solution of glycerol in DI water)
- Inks: (see Antoine 2011 for full ingredients); #1-Iron gall ink (tannic acid) + sugar; #2-Iron gall ink (tannic acid) + aniline; #3-Iron gall ink (gallic acid); Three inks created to imitate original letterpress copybook inks

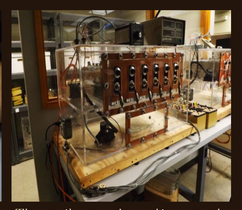
TBABr formula

EMiMBr formula

Creation of the mockups



Mockup of actual tears and losses found on copies, using perforating pen developed at NYPL (see Owen-Weiss, AIC Meeting 2014 Poster Session).



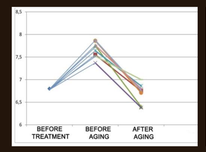
The tensile strength machines at the Smithsonian Museum Conservation Institute

STABILITY OF ANTIOXIDANTS IN SAMPLES STUDY

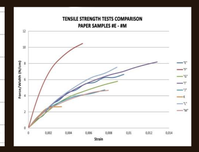
Two blank sheets cut from volume 4, both written upon in cursive loops using inks #1, #2 and #3. Tetrabutylammonium bromide (TBABr) and 1-ethyl-3-methyl imidazolium bromide (EMIMBr) were applied separately on both sheets, followed by Bookkeeper® and different sizing agents. A total of 30 strips (each one with a different combination of inks and conservation materials) were tested for migration of iron (II) ions, pH values, CIE L*a*b* values, and tensile strength before and after aging.
Eighteen mockups were made by tracing the writing pattern of an actual copied letter onto Silk Natural paper with inks #1, #2 and #3. The mockups were treated with two different sizing agents: 1% w/v gelatine in water : 20% v/v ethanol (the most promising sizing solution experimented on the paper strips) and 1% w/v Klucel G in ethanol (the most promising sizing solution identified by Beth Antoine in 2011). The mockups were tested for migration of iron (II) ions, pH values, CIE L*a*b* values before and after aging.

Inked blank sheet before the treatments

Inked blank sheet: strips after the treatments



pH values: after aging only two treatments maintained a pH above 6.8



Tensile strength evaluation

IRON IONS TESTS: In general, before treatment, the amount of free iron ions in the three inks, detected by the use of chelating test strips, was very high, both in the strips and the mockups. The results of treatments with TBABr and EMiMBr were similar. The samples treated with sizing agent 1% w/v gelatine in water : 20% v/v ethanol showed the best results in reduction of iron (II) ions after aging. The same samples were tested with chelating test strips before and after aging, and the comparison of the results showed that the strips treated with the antioxidants but without any sizing agent were effective in reducing the amount of iron ions after the application, but not over time.

pH: The average pH of the blank sheets from volume 4 before treatments and accelerated aging was 6.8, as determined by flat surface contact electrode. The treatment with TBABr/EMiMBr and Bookkeeper® raised the pH to 7.4 and 7.6 respectively, and the combination with sizing agents was able to improve the average pH to values near 8: the best results were obtained with TBABr/EMiMBr + Bookkeeper® + 1% w/v gelatine in water : 20% v/v ethanol (pH 7.75 and 7.87 respectively); and TBABr/EMiMBr + Bookkeeper® + 1% w/v TRI-Funori™ : 20% v/v ethanol (pH 7.55 and 7.86 respectively). However, after accelerated aging all the pH values fall to below 7, and only a few treatments were able to maintain a pH above 6.8. This last was the pH value of the paper before treatment: TBABr/EMiMBr + Bookkeeper® + 1% w/v Klucel G in ethanol (pH 6.86 and 7 respectively); and EMiMBr + Bookkeeper® + 1% w/v gelatine in water (pH 6.8).

CIE L*a*b*: The colorimetric variations of the inks before and after the treatments and before and after aging were characterized by the same trends both with TBABr and EMiMBr, and the majority of the ΔL*, Δ a* and Δ b* had values Δ≤1 overall, indicating a minimum change, which can be visually observed.

TENSILE STRENGTH: The results were evaluated against control samples, considering that an increase in strain (elongation) and an increase in force at breaking indicates an overall improvement, an increase in strain and a loss of force indicates an increase in flexibility, and a loss of strain and a loss of force indicates ineffective or detrimental effect. For every set of strips, the samples treated with the antioxidants, Bookkeeper® and sizing with 1% w/v gelatine (with or without the addition of ethanol) showed the best results in enhancing the tensile properties of the paper of the Baird letterpress copybooks. The second most promising result was obtained with TRI-Funori™ sizing. In general, the treatments with TBABr resulted in a more consistent and uniform strain for all the kinds of inks, in comparison with the treatments with EMiMBr .

ADHESIVES STUDY

The solvent-set and heat-set tissues described in "Materials" were applied on paper strips cut from a blank sheet from volume 4. The strips were used to evaluate the enhancement of the tensile strength of the paper with the different adhesives, in comparison to a control strip, not treated.
The most promising materials were then further tested for their tensile properties on strips of Whatman paper. Finally, the solvent-set and heat-set tissues were applied on squares of Silk Natural paper (12 x 12 cm), artificially aged for 40 hours at 90°C and 50% RH.
All the adhesives were also examined under ultraviolet (UV) long wave light; as shown in Antoine 2011, UV light can be used to enhance faint or faded inks in letterpress copybooks affected by ink-fading, and we wanted to see what additional effect the adhesives might have on legibility if applied in patches or whole linings.

Adhesives on squares of Silk Natural paper after aging

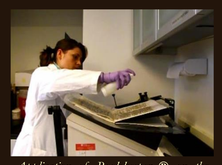
Examination under UV light after aging

The most promising adhesives identified with the test were: 2% w/v isinglass in water solvent-set tissue, that showed the best increment in strain and force; 0,5% w/v gelatine in water solvent-set tissue; and the 4:1:1 DI water/Avanse MV100/Plextol B500 heat-set tissue. Some of the adhesives showed particular behaviours after aging and under UV light, and that must be taken into consideration in planning a conservation treatment. After accelerated aging, some of the adhesives applied on the squares of Silk Natural paper showed a yellowing and cockling effect. Moreover, examining the adhesives under UV light, it was possible to see that the 4:1:1 DI water/Avanse MV 100/Plextol B500 tissues were fluorescing. According to the tests described above, the best solvent-set/heat-set tissues that can be applied during a conservation treatment on letterpress copybooks are the following:

- 2% w/v isinglass in water solvent-set tissue: this tissue is particularly thin and strong. Since it must be reactivated with a 50% water - 50% ethanol solution, it cannot be used with aniline inks, soluble in ethanol.
- 3% w/v gelatine 3% in water solvent-set tissue: this tissue is thicker and weaker than the previous tissue, but it has been demonstrated that gelatine can stabilize the iron (II) ions migration of iron gall inks. Moreover, this tissue must be reactivated with a 70% ethanol - 30% water solution, and it is very useful for local repairs also because the drying process is really quick.
- 4:1:1 water/Avanse MV100/Plextol B500 heat-set tissue: this tissue does not require any solvent to be reactivated and it is ideal to repair areas with inks sensitive to water or ethanol, such as aniline inks.

PRACTICAL HANDLING

Two gatherings of full-size samples from two Baird letters were created on Silk Natural paper sheets treated with glycerol solution. The samples were written with inks #1, #2 and #3 and artificially aged for 5 days at 90°C and 50% RH, then tears and losses were created, the sheets were combined to create bifolia and were sewn together in pamphlets. The two gatherings were treated with the most promising combinations of antioxidants using a book suction machine.



Application of Bookkeeper ® on the book suction machine during the tests

It was found that the pages of the mockups gatherings, even where severely damaged with interstitial tears, could be turned individually by taking advantage of the electrostatic properties of a Mylar/Melinex sheet, brushed against a copied leaf. The time required to treat one page (with the application of a full lining) was 10-15 minutes (quicker if it was possible to use ethanol-based solutions, slower if it was necessary to use water-based solutions). With practice the process may certainly be quicker. Between the treatments, during the drying process, it is possible to take advantage of the humidity of the paper to adjust folds, and maintain position of small fragments. It is always better to sustain every page with a thin support such as a non-woven porous textile. In this case Reemay (r) was used, but Tekwipe or other could work.

RESULTS

1. If combined with deacidification with Bookkeeper ® and sizing with 1% w/v gelatine or 1% w/v TRI-Funori™, the antioxidants TBABr and EMiMBr are effective in stabilize degraded inks of letterpress copybooks and their behaviour is very similar. The antioxidants alone are very effective at enhancing the pH and stabilizing the migration of iron (II) ions, but are not effective over time. However, it is necessary to test the solubility of the inks extensively before any treatment.
2. Due to the nature of letterpress copybook papers, solvent-set tissues or heat-set tissues could be applied via spray/brush or reactivated with an iron. For solvent-set tissues, the suction machine should be on low while the reactivation solution is applied and then increased until dry. For heat-set tissues, it is better to turn off the suction machine during the use of an iron. The most promising tissues are 2% w/v isinglass in water solvent-set tissue (reactivation with a solution 50% water/50% ethanol), 3% w/v gelatine in water solvent-set tissue (reactivation with a solution 30% water/70% ethanol), and 4:1:1 water/Avanse MV100/Plextol B500 heat-set tissue.
3. Using a suction table and turning the pages gently with Mylar sheets, it is possible to effectively stabilize pages of letterpress copybooks affected by severe tears and losses.

CONCLUSIONS AND FUTURE STUDIES

At the end of the project, it was possible to answer the three major research questions related to the conservation of Baird's letterpress copy books. The results of this research project will help the conservators of the Smithsonian Institution Archives in planning a stabilization and digitization project for the 80 letterpress copybooks of correspondence of Spencer Fullerton Baird, second Secretary of the Smithsonian Institution. It will be possible to study the content of the letters and also further investigate the creation process of letterpress copybooks. Moreover, the findings will help archivists and conservators of other institutions in the U.S.A. and abroad in preserving this kind of archival collection.

One of the original Baird letters copied in the volumes, recently acquired by SIA

ACKNOWLEDGMENTS

This project was made possible thanks to the Smithsonian Office of Fellowships and Internships, the Smithsonian Institution Archives, and the Smithsonian Museum Conservation Institute, particularly Dr. Dawn Rogala (co-supervisor), Dr. Gwénaëlle Kavich, and Ms. Nicole Little.

AUTHORS

LAURA DELLAPIANA
Postgraduate Fellow in Conservation of Museum Collections at the Smithsonian Institution Archives between September - December 2015.

NORA LOCKSHIN
Senior Conservator at the Smithsonian Institution Archives, supervisor of this Fellowship research project.