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A Tale of Two Facsimiles: Incorporating Digital Technology in Conservation Treatments

ABSTRACT

The opportunity to explore digital options for the creation of facsimiles as surrogates for study purposes and as a source for filling image losses was provided by two treatment projects at the Library of Congress. Materials testing was conducted to examine the long-term aging properties of the papers and pigmented inkjet printers. A brief discussion of the testing methods and preliminary results are presented as well as the equipment and software used for image capture and manipulation.

INTRODUCTION AND BACKGROUND

As digital technology advances both in the fields of scanning and printing, the conservator gains tools that might be useful for application in treatment. The creation of facsimiles to act as a surrogate for an object is not new to conservation and always provides fuel for debate. Questions asked during the process include:

How much does it need to look like the original object?

What is important: the aesthetic "feel" of the facsimile, the accuracy of detail, or both?

How long does the facsimile need to last—is it intended to be kept indefinitely and possibly stored with the original objects?

The purpose and use of the facsimile will dictate the aesthetics, handling durability, and long-term aging properties that will be needed for the digital hardcopy. The choice of printer and paper are also affected by whether the entire object needs to be reproduced or only a portion for use as an insert or fill. Two projects during a third-year internship at the Library of Congress provided a chance to explore the digital options for the creation and use of facsimiles both as surrogates and as a source for filling image losses.

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The first project involved the reproduction of twenty-seven Chinese gouache paintings on pith "paper," which had been incorporated into a journal by a young sailor on the U.S. frigate, *The Mississippi*, in the mid-nineteenth century. The paintings were removed from the journal for conservation treatment and rehoused separately. The purpose of the facsimiles for this object is to provide researchers who were mainly interested in the information contained in the journal with reference images rather than the original paintings. The facsimiles need to have good long-term aging properties, as there is the possibility that they will be hinged into the journal in place of the originals. In this case, good reproduction of details was more important than having a perfect aesthetic similarity between reproduction and original. The support paper of the majority of the facsimiles will be a thin Japanese paper (Paper Nao RK19) printed with an Epson Stylus C80 (desktop pigmented inkjet printer) with an interleaf Japanese paper between the object and the printed side (Paper Nao RK17). The inkset for the Epson Stylus C80 is formulated to print on uncoated papers and provides good detail on thin papers.

The second project involved creating large fills for numerous losses in an oversize, late nineteenth-century American chromolithograph poster, which was needed for a traveling exhibition. Fortunately, the Library of Congress had another copy of the poster, which was scanned and these files were used to print out the missing areas and create inserts or fills. In this case, it was important that the fills have surface characteristics similar to the poster. The selected missing areas were printed with an Epson Stylus Pro 5500 onto Epson Archival Matte paper. Time constraints of the project prevented thorough testing of the Epson Archival Matte Paper prior to its use. However, subsequent data suggests the potential for color change and low pH over time. A better choice of paper would have

been the Hahnemühle Photo Rag paper. The present fills will be monitored and replaced if necessary.

Creating valid accelerated aging tests for digital hard-copy can be very difficult, as temperature and relative humidity parameters greatly affect the aging characteristics of certain types of printing supports and inks. Problematic aspects for testing are the proprietary nature of inks and supports as well as rapidly changing technology that quickly makes printers and inksets obsolete. Further complications include looking at color change from exposure to light, atmospheric pollutants, and the temperature and relative humidity conditions chosen for accelerated (dark) aging. Papers being considered for use in creating reproductions at the Library of Congress underwent materials tests, such as color change, fold endurance, and pH after accelerated dark aging, to examine their long-term aging properties. These tests were not meant to be an exhaustive study of the subject, but rather an aid for making decisions in the choice of support and potential incorporation of the facsimiles into an object as an insert or fill. A brief discussion of the testing completed to date follows. Michele Youket conducted the materials testing with assistance from Frank Hengemihle, both conservation scientists at the Library of Congress.

AGING STUDIES OF INKJET SUPPORTS

Unprinted samples of a number of supports (including Epson Archival Matte, Epson Photo Glossy, Hahnemühle Photo-Rag, Harukaze Japanese paper, and Unbe Thick Japanese paper—the two Japanese papers are coated and sold for use with inkjet printers from digitalartsupplies.com) were placed free hanging in a dark aging oven at 70°C and 86% RH for 14 days. These samples were tested for changes in brightness, pH, and fold endurance. The most significant changes in brightness were seen with the Epson Archival Matte Paper (the name is being changed to "Enhanced Matte"), which significantly darkened, especially on the coated side. The only other noticeable darkening occurred with the Unbe Thick. Little change in pH was found for any of the samples; however, it was interesting to note that the pH of the unaged Epson Archival Matte was between pH 4 to 5. The pH of the Hahnemühle paper was just above 8. The fold endurance did not significantly change for any of the samples after aging.

Free-hanging samples printed with the same image using the Epson Stylus Pro 5500 on a variety of supports were placed in a dark aging oven at 70°C and 86% RH for 8 days and visually examined for changes. Several observable changes were seen:

1. Cracking of the coating on the Epson Photo Glossy paper, which probably occurred because the coating was more hygroscopic than the resin coated support.
2. Darkening of the Epson Archival Matte paper (also seen with the unprinted samples.)
3. Ink movement on the printouts on the two types of coated Japanese papers occurred where some condensation drips fell on the sheets; however, it is difficult to tell whether or not this was caused by movement of the coating or movement of the ink alone.

ISO MIGRATION TEST [ISO/CD 15659]

This test is performed by placing a sample with media or color in contact with a stack of ten sheets of Whatman filter paper. Brightness readings are taken on the filter papers in several places before and after aging [*note:* this test is still in the approval stage and has not yet become an ISO standard.] The method was modified to test for potential changes that might occur when the digital hard copies were placed in the nineteenth-century journal in direct contact with the other papers. To this end, printed samples from the Epson Stylus Pro 5500 on Hahnemühle Photo Rag paper as well as unprinted samples were placed in contact with five sheets of a nineteenth-century blued paper that was similar in appearance to the paper in the journal. The sample groups were placed in a dark aging oven at 70°C and 86% RH for 14 days. The results were interesting: the sample in contact with the Whatman filter paper did not lead to noticeable changes in brightness of the filter paper; however, it did cause the nineteenth-century paper to darken, more noticeably in the areas in contact with black and darker blue ink squares. There was no transfer of actual ink between the papers.

A second group of printed and unprinted samples were placed in contact with five sheets of a nineteenth-century, blued paper that was similar in appearance to the paper in the journal. The papers were Hahnemühle Photo Rag paper and a Japanese paper (Paper Nao RK19), both with and without interleaving of thinner Japanese paper (Paper Nao RK17), and the printers were the Epson Stylus Pro 5500 and the Epson Stylus C80. The samples were placed into a dark aging oven at 70°C and 86% RH for 22 days with a similar trend in results as the first test. This additional testing indicated that inclusion of an interleaving Japanese paper (Paper Nao RK17) helped to diminish the darkening effects of the darker inkjet inks. It also showed that the inks of both printers had similar effects on the nineteenth-century paper.

The ISO Migration Tests will be repeated to provide more statistically significant data. Samples to be included in the testing will be printed samples from the Epson Stylus Pro 5500 and the Epson Stylus C80 on both the Hahnemühle paper as well as the Japanese Paper (Paper Nao RK19). Half of these groups will include thinner Japanese paper (Paper Nao RK17) as an interleaving tissue between the sample and the nineteenth-century paper.

Unprinted samples of the papers will also be included. It would also be desirable to age a second, identical group of samples at a higher temperature, under less humid conditions for comparison. More extensive discussion of the testing results and methods will be published at a later date.

OTHER INTERESTING, SOMEWHAT UNRELATED FINDINGS...

Photographic Activity Tests [ISO14523:1999(E)] (PAT) were conducted for a few samples. The PAT is broken down into two parts, colloidal silver and gelatin stain. The only samples that passed the colloidal silver portion were the unprinted Hahnemühle Photo-Rag paper, Paper Nao RK19, and Paper Nao RK17. The Epson Archival Matte and Epson Photo Glossy papers as well as a printed sample from the Epson Stylus Pro 5500 on the Hahnemühle Photo-Rag paper failed. The gelatin stain part of the test was passed by all of the papers and the printed sample. A printed sample from the Epson Stylus C80 on Hahnemühle Photo-Rag will be included in future PAT tests.

In order to create samples to visually demonstrate why dye-based inks are not a good choice for long-term facsimiles, a group of printouts from an Epson Stylus Photo 1270 dye-based inkjet were placed free hanging into an aging oven at 70°C and 86% RH for 8 days. The interference of atmospheric pollutants was not studied. These printed, aged samples were compared to a group of samples aged at 70°C and 50% RH for 4 days. One interesting finding was that the dye-based samples aged very differently at the different RH. At the lower RH, the inks on the glossy papers significantly lightened in appearance and there was no evidence of migration of color within the coating. At the higher RH, the inks did not lighten; however the colors migrated out through the coating.

EQUIPMENT AND SOFTWARE USED FOR IMAGE CAPTURE, MANIPULATION, AND PRINTING

- A Phase One FX scanning back was used with a 4 x 5 camera body to capture the images.
- Monaco EZcolor was used for developing custom profiles for the papers and printers.
- Adobe Photoshop 6.0 was used for image manipulation.
- The pigmented inkjet printers used for printing the samples and facsimiles were the Epson Stylus Pro 5500 and the Epson Stylus C80.

TOOLS USED IN ADOBE PHOTOSHOP TO MANIPULATE THE IMAGE

- Files were saved in Photoshop format (.psd) to retain applied layers, making it easier to undo the manipulation steps.
- Black and white points were set for each image using a Kodak grayscale included in the scan by applying a *Levels Adjustment Layer*.
- Images were brought up to full size by squaring the image, followed by cropping either to the edges of the object (pith) or the edges of the printed image areas (chromolithograph) and increasing the *Image Size* to the original size. The chromolithograph file was divided into thirds to keep file size under control, maintaining only the full height of the image to adjust the size. *Note:* It is important to make sure that the *Resample Image* box is unchecked to maintain the quality of the file so that when the image size is adjusted, the resolution of the image will automatically adjust to prevent Photoshop from artificially creating pixels to compensate.
- The rubber stamp tool was used to "inpaint" damage from the good copy of the chromolithograph after creating a new *Layer Via Copy*. *Layer Via Copy* was also used with the *Unsharp Mask* tool for both projects to bring back some depth and crispness of the images that was lost during the scanning process.

SUGGESTIONS FOR OTHERS

- Knowledge of scanning, Adobe Photoshop (full version), and color management is necessary for incorporating digital technology into conservation treatments.
- Consultants can be brought in to assist with these types of projects.
- High resolution scans of the original object will produce the most satisfactory facsimiles.
- Always include some sort of grayscale and color target with the object being scanned to make color matching more accurate and save time manipulating the image. For the purposes of these two projects a Kodak Grayscale was sufficient to allow the image manipulation to be completed.
- One important thing to note is that the pigmented inkjet inks have a slight problem with metamerism so the best results would be obtained by making final color decisions under the same lighting conditions that the image will be viewed in for exhibition.

CONCLUSION

These two projects provided an opportunity to incorporate digital technology into conservation treatments. In both cases the appearance of the facsimiles and their application to the overall treatment were very satisfactory. It was found during testing that inkjet papers and printers need to be carefully selected due to a wide variation of aging properties. Thus some consideration must be given as to the whether or not these techniques can be appropriately

incorporated into an object as a fill or insert. To provide more information for making these decisions, the long-term aging properties of digital hard copy and potential testing methods were explored to examine the effect that these materials might have on adjacent original materials. Additionally, the two treated objects can be examined periodically for changes caused by the digital hard copy facsimiles or applied fills.

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