

A SUN BLEACHING PROJECT

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Two broken sets of discolored plates from the 18th Century provided an opportunity to explore sun bleaching effectiveness in both calcium hydroxide and magnesium bicarbonate baths and to compare the effectiveness of June vs. October exposure.

As a book restorer, I seldom become involved in any paper procedures more complicated than the straightforward washing, deacidifying and mending required by book blocks and single leaves.

Last summer, however, a client asked whether I could do anything to "improve the appearance" of a set of plates from Chambers' The Garden of Kew of 1780. As a broken set in their badly discolored state, they were of little commercial value (perhaps \$15.00 each plate). The plates showed the typical overall discoloration of age with some having a particularly dark, blotchy appearance. There were no tide lines indicating water damage, no extensive "foxing", and no sign of mold damage.

As the pH throughout the set measured 4.5-5.0, it seemed certain that simple washing and deacidifying would benefit them to some extent. It also seemed a good opportunity to see how effective sun bleaching might be. After discussing this with the client, four plates were selected for a trial run; two paired plates had the general overall discoloration and two were of the more extreme blotchy type. The results were impressive. While simple washing and deacidification lightened them considerably, it did not satisfactorily remove the blotchy discoloration. Sun bleaching did, leaving the paper clean but with a natural color instead of the dead white appearance that characterizes the various chemical bleaching procedures. As a result, it was decided to go ahead with a sun bleaching project on the rest of the set.

At this point, the client produced a second set of eight Turpin floral plates for the same treatment. This set proved that sun bleaching could equally satisfactorily remove tide line staining, "foxing" spots, and mold discoloration. Most interestingly, it could do this without apparently affecting the edge gilding present on the set. This last fact is of great

significance for book restorers as it means that one should be able to remove, wash, bleach, and replace individual pages, plates or sections without disturbing any extant edge gilding.

The paper of the Turpins was particularly pure and showed none of the "oatmeal" effect observed in the Chambers set. Undoubtedly this "oatmeal" effect was due to impurities in the paper itself, but whether they were actually darkened by exposure to the sun or simply became more noticeable as the paper lightened was difficult to determine. Certainly they were more noticeable when the paper was wet due to general translucency but receded sufficiently when the paper dried so as not to be a consideration.

Up to that point, all of the sun bleaching of both the Turpin and Chambers plates had been done in a magnesium bicarbonate bath as described by Keiko Keyes' paper on alternatives to chemical bleaching in the Preprints of the 1980 Cambridge conference. With both magnesium bicarbonate and calcium hydroxide deacidification methods in use in the shop, the question arose of using the latter in the sun bath. After determining with Keiko Keyes that she had not tried the calcium hydroxide, it seemed an ideal opportunity to run some concurrent tests using both solutions. As the Chambers plates would be sold separately, any slight differences that might appear would not be of any consequence.

As a result, three sets of four plates each were sun bleached, each time placing two in the calcium hydroxide bath and two in the magnesium bicarbonate. Noting the high pH of the calcium hydroxide, an attempt was made to equalize the two solutions by diluting the calcium hydroxide more. The calcium hydroxide was diluted with water 1:11 and the magnesium bicarbonate 1:5 so that both baths had the initial pH in the range of 8.0-8.5. The volume, temperature and other conditions of the two were kept as identical as possible.

The preliminary treatment for all of these plates was also identical. They were "wetted down" with an alcohol/water bath, given two cold water and one hot water rinses, (each of a half hour duration,) which seemed to remove most of the soluble discoloration. The plates were then placed outside in two plastic pans, side by side, which were covered with Plexiglass. Sponges at the corners elevated the Plexiglass to prevent condensation that would interfere with the exposure.

After all three sets had been successively bleached, the conclusion was that the bleaching in both baths had been completely effective in removing

the discoloration. If there were any differences at all, the calcium hydroxide bath appeared to work even faster and leave the paper even lighter than the magnesium bicarbonate. Some variance in result however seemed to be due to intrinsic factors in the papers themselves. In spite of the fact that all of the plates were from the same book and appeared to be on the same paper, undoubtedly various lots of paper had been used. Attempts to pair the plates as to water-marks and engravers used did not prove definitive; marginal variances occurred even within the same bath.

In the course of the experiment certain differences between the two baths themselves were repeatedly observed although their significance was difficult to evaluate:

1. The pH of the calcium hydroxide fell off rather rapidly, dropping from an 8 range to a 6.5-7.0 range over the course of the day, presumably due to oxidation and/or to more effective neutralization of the remaining acids in the paper, while the magnesium bicarbonate stayed relatively stable in the 8 range.
2. The "wetting down" of the paper occurred much faster and more thoroughly in the magnesium bicarbonate bath. These papers sank and appeared much darker throughout while the papers in the calcium hydroxide seemed to float and appeared whiter. Presumably this had to do with the effect of calcium on the celulous fibers as explained by Margaret Hey (i. e. not causing the fibers to swell as much therefore leaving them less porous). This observation was not 100% consistent and once again may have had more to do with the individual papers initial sizing or subsequent treatment, or other inherent qualities, but it was still generally noteworthy.
3. The temperature of the two baths did not remain the same over the course of the day. As the temperatures rose in the sun, the calcium hydroxide bath stayed several degrees cooler than the magnesium bicarbonate. At one point after three hours in the full sun, there was as much as a 4 degree difference. This might be explained by the darker papers in the magnesium bicarbonate bath absorbing the heat while the lighter papers in the calcium hydroxide reflected it.
4. The color of the bath solution often did not remain the same. The magnesium bicarbonate bath frequently picked up a pink tinge while the calcium hydroxide remained white, or perhaps slightly yellow. No color difference was discernible in the final papers however.

An attempt see whether the last two differences (of temperature and color) could be explained by the solutions alone was made by soaking one set overnight when the sun could not be a factor. No changes in either temperature or color were observed in either solution.

The above testing was done the last two weeks of June while the sun was at its strongest. The sets were left in their baths for varying lengths of time depending on the availability of the sun. There was a tendency to leave them in for the maximum time available during the course of the day to be sure to achieve maximum result without running the risk of a second immersion. Difficulty in judging the final dried color of paper while still wet further supported that tendency. In some cases however, when no color change was noted within an hour, the papers were removed. With the three comparative sets, the time length varied from three to five hours with maximum bleaching occurring in all cases.

Due to an unusually rainy, sunless summer, eight plates were still left to be bleached in autumn which gave an opportunity to compare the effectiveness of the June sun with that of the October sun. In this case, for comparison's sake, all bleaching was done in a magnesium bicarbonate bath with the usual preliminary treatment. It became apparent that while the same bleaching results could be obtained using the October sun, the process was much slower and often required a second five hour exposure to insure that all of the dark staining was removed. Unfortunately the conditions were not completely parallel: At least half of this October exposure time was not in direct sun but only in open shade. Also the temperatures of the October bath solutions averaged 20 to 30 degrees below that of June. These differences undoubtedly played a role but circumstances prevented making them more consistent. In conclusion, having experienced in the course of this project the full gamut of direct sun, open shade and overcast conditions (as well as rain and snow) it became clear that all were remarkably effective but in descending order of rapidity.

In passing, the effect of the washing and bleaching on the sizing and handling properties of the paper was noted. While there was an appreciable change, it seemed to occur at the washing stage rather than at the bleaching stage.