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Ozalids in the Music Library: Life Before Xerox

ABSTRACT

This study investigates the manufacture, history, and conservation treatment options for early photoreproductions found in music libraries, which are colloquially called "Ozalids." As architectural drawing reproductions are called "blueprints" but are not necessarily made by the blueprint process, not all of these "Ozalids" were actually produced by the trademarked Ozalid diazotype process. Based on surveys carried out in the Northwestern University Library and other Chicago-area music collections, "Ozalids"—or, more correctly, non-Xerox photoreproductions—are a diverse group encompassing a range of photoreproductive technologies, including Photostats, mimeographs, diazotypes of several varieties, and possibly other still-unidentified processes. Overall, the diazotype was the best-represented technology and therefore the focus of this research. Despite the former popularity of this copying technique, very little useful information about it is widely available.

Diazotype technology, invented in the 1920s, was the predominant small-run copying method before electrostatic (Xerox) photoreproduction was perfected and popularized in the 1970s. As music scores of this era were often handwritten, there was great demand for a copying method that could exactly reproduce unique manuscripts. The technique was popular not only for music reproduction; numerous diazotypes may also be found in collections of architectural drawings or maps, and in archives that hold office photocopies.

During the collection surveys, preliminary identification was carried out by visual assessment, and Fourier transform infrared spectroscopy was used to characterize materials and to identify and quantify degradation. Diazotypes have a characteristic appearance and aging pattern, including discoloration of the support, fading of the media, and a strong chemical odor. Deterioration is presumed to be caused by outside forces as well as inherent vice due to residual chemicals.

As the original music manuscripts were often written on delicate onionskin paper for use in the reproduction process, many libraries are now left with only the unstable "Ozalids" as unique objects in their collections. As these copies were not produced in large numbers, many "Ozalids" can be presumed to be unique to the collection in which they are found. For this reason, as well as their value as exemplars of a once-prevalent copying technology, they are worth preserving.

Although resources exist for visual identification and basic preservation of this type of object, literature related to treatment is difficult to find. Based on the surveys carried out for this research, typical treatments that may benefit these items include surface cleaning, humidification, tape removal using solvents, aqueous and non-aqueous deacidification, and mending. Protocols were developed to carry out experimental treatments on expendable samples of various types of photoreproduction. The results revealed numerous, easily avoidable pitfalls to common treatments, including bleeding of media during solvent treatment and dramatic sinking of media due to over-humidification.

INTRODUCTION

The impetus for this project was a treatment request for several unidentified paper objects submitted to the Northwestern University Library conservation laboratory. These materials belonged to one of Northwestern Music Library's treasures: a collection of materials related to the avant-garde composer John Cage. The objects appeared to be photoreproductions, but their format was unfamiliar to the conservators, and the treatment possibilities were thus unknown. Given their intrinsic value and delicacy, the objects were not subjected to potentially harmful treatments or testing. They were housed, but it was obvious that more research was needed to identify them.

The input and expertise of the Northwestern music librarians was sought, and the unfamiliar objects were broadly identified as "Ozalids." Like the term "blueprint," which is a blanket term for any architectural plan or reproduction,

Presented at the Book and Paper Group Session, AIC's 40th Annual Meeting, May 8–11, 2012, Albuquerque, New Mexico.

"Ozalid" is used within the music library and publishing community to mean any music manuscript photoreproduction. These objects are common and seem to be found in nearly every music collection. Though many conservators are familiar with architectural photoreproductions, finding information on the history and manufacture of music score photoreproductions, their preservation needs, and their conservation options proved more difficult. This was clearly an area that merited more research.

SURVEY

In order to find and identify these materials, a survey was carried out at Northwestern Music Library to identify, characterize, and assess the condition of the photoreproductions in the collection. Similar surveys were conducted in other Chicago-area collections, including the Chicago Symphony Orchestra's Rosenthal Archives, the University of Chicago Library, and the Newberry Library. Comparing the Northwestern Music Library collection to others was important in order to determine whether Northwestern's collection was representative, and to demonstrate that the research would be relevant to the broader conservation and library community.

The survey was carried out by individually assessing the photoreproductions, excluding apparent Xerox-type reproductions. In some cases a photoreproduction appears to be a handwritten manuscript at first glance, particularly in cases where hand notations have also been applied, so care had to be taken in identifying the objects. The non-Xerox photoreproductions were examined for identifying characteristics including origin, identifying marks, appearance of media and ground, condition, and binding style.

The focus of the survey was the section of the Northwestern Music Library containing theses and dissertations in composition, a section that was known by the librarians to contain a significant number of non-Xerox photoreproductions. This section contained 818 items. Non-Xerox photoreproductions, the majority of which were dated from the 1930s to the 1980s, comprised 37% of this collection. In the local collections surveyed, non-Xerox photoreproductions presented similar appearances, degradation patterns, and identifying marks. Additionally, many of the scores from different collections featured marks from the same Chicago music-binding company, indicating that the scores were bound and probably copied by the same institution.

Existing literature on photoreproductions—books and articles on music librarianship, as well as the literature on identification of architectural photoreproductions—was consulted in order to draw preliminary conclusions. Additionally, identifying marks were analyzed for information on the stages of production, with a focus on the companies that seemed to be responsible for reproduction services. Tracking down information about these companies and their practices was one of the most challenging parts of the research, as most of the companies no longer exist and information about their practices is unavailable.

The available information about photoreproductions was synthesized to make preliminary conclusions about the identity of the "Ozalids." The most potentially misleading finding was that "Ozalid" is the patented name of a diazotype process, as well as the name commonly used by music librarians and cataloguers for all music manuscript reproductions. Many of the surveyed music manuscript photoreproductions did appear to be diazotypes, based on the visual identification described in *Architectural Photoreproductions: A Manual for Identification and Care* (Kissell and Vigneau 1999). Others appeared to be blueprints, Photostats, mimeographs, or unidentified processes.

DIAZOTYPES

Given the results of the surveys, the diazotype process was given further study. This category of photoreproductions is still broad, as items characterized as diazotypes vary widely in date of production, appearance, and condition.

Diazotypes are printed using a non-silver photographic process, utilizing a paper or cloth support that has been sensitized with light-sensitive and alkaline-sensitive chemicals. The support may be sensitized on one or both sides. The treated support is exposed to ultraviolet radiation through a transparent or translucent original object (e.g., a handwritten music score on onionskin paper). A colorless substance is formed in exposed areas. The print is then exposed to ammonia to form an azo dye in image areas, resulting in a positive image in relation to the original. The prints may be processed wet, semi-wet, or dry, using ammonia fumes. The resulting image is embedded in the paper fibers. The sensitizing chemicals and any stabilizers or other additional chemicals remain in the paper, as there is no rinsing step in the copying process (Dinaburg 1964). Diazotypes come in numerous colors including blue, maroon, brown, and black.

The legend behind the invention of the diazotype says it was developed by a German monk who was tired of having to copy everything by hand. He decided to ease his plight by inventing a chemical copying process. The monk approached the nearby chemical supplier, Kalle, for help with supplies, and they provided him with lab space and materials in exchange for patent rights to any of his inventions. The monk developed the diazotype process, which was patented by Kalle as the Ozalid process in 1923 (Sturge 1977). The diazotype, an inexpensive process, quickly became the prevalent small-run copying method of the mid-20th century. Sheet music, architectural drawings, maps, and documents were reproduced using the diazotype process, which remained popular until electrostatic copying superseded it in the 1970s–80s.

Diazotypes have a characteristic appearance and degradation pattern. This includes a strong chemical odor, which is a reminder of the processing chemicals, and a discolored support, especially around the edges. In a single-sided copy, the printed side is usually darkened in comparison to the unprinted verso. In some cases this difference is dramatic. A combination of fading image lines and darkening of the support leads to an eventual reduction in image contrast. If allowed to continue, this loss in contrast could lead to illegibility and difficulty in reformatting.

The causes of this characteristic degradation are not fully understood. Likely possibilities include inherent vice due to poor paper quality and the presence of residual chemicals from the copying process, which may continue to react with or otherwise affect the paper support. For example, the photosensitive processing chemicals can cause edge and fold discoloration (Hawken 1966), and thiourea, used as a stabilizing agent, off-gases sulfur (Price 2010). The residual phenols from diazotype processing also oxidize, causing overall discoloration of the paper support (Price 2010).

Causes of degradation unrelated to the copying process include binding or mounting methods and environmental conditions. Examples of the former include two single-sided reproductions glued together, resulting in adhesive staining, and a reproduction glued to an inappropriate secondary support, causing adhesive and acid-related staining. In addition, many of these items are bound with a comb spiral, leading to tearing at the spine, or in pairs guarded with linen tape, leading to adhesive failure at the gutter. These issues may contribute to or exacerbate the deterioration caused by the chemical makeup of the photoreproduction, or may create unrelated deterioration patterns.

PRESERVATION CONCERNS

Given the condition of many music library photoreproductions, it is imperative for collection caretakers to decide whether they are a preservation concern, and to address deterioration problems accordingly. These objects are reproductions, and are not typically high in monetary value. Many collections have chosen to copy and discard, or simply to discard, their deteriorating photoreproductions. Additionally, many collection caretakers are completely unfamiliar with the ongoing deterioration of these objects, which will quietly disintegrate until they can no longer be preserved in original or reformatted form.

There are several arguments in favor of preserving these objects. First, deterioration proceeds within decades. Based on the surveys carried out in music collections, a photoreproduction from the 1940s is almost guaranteed to be in significantly worse shape than a similar item from the 1980s.

Additionally, although they are copies, many of these photoreproductions are copied from delicate originals on transparent paper. The majority of these originals are lost or separated from the reproduction, making the reproduction the effective original. Among the surveyed collections, only the Chicago Symphony Orchestra had retained the onionskin originals, and the thin, transparent paper was tattered and delicate.

Because these scores were usually not published or mass-produced, music library photoreproductions represent rare or unique materials. Many contain hand notations, making them completely unique. Hand-inscribed photoreproductions sent from composers to professors as gifts were found in the University of Chicago Library. In the Rosenthal Archives of the Chicago Symphony Orchestra, conductors and musicians had made numerous hand annotations to the photoreproduction scores. In these cases, original material would be lost if the photoreproductions were lost.

Reformatting may be seen as an acceptable preservation measure in cases where hand annotations are not present or considered unimportant. However, even reformatting can eventually become difficult, as these photoreproductions experience loss in contrast as they deteriorate. These objects are also exemplars of once-prevalent and little-understood copying techniques that are worth preserving in their original formats.

INSTRUMENTAL ANALYSIS

Given the variability and many preservation concerns within the group of music library photoreproductions that appeared to be diazotypes, it was decided to investigate them using instrumental analysis, including light microscopy and FTIR.

Microscopy facilitated comparison of items that were grouped together based on visual inspection. Using a compound microscope, characteristics such as surface texture, line quality, and ground were closely analyzed. It was found that, while some items were similar, others were unexpectedly different, and it was not always possible to predict which items would be similar based on observation with the naked eye alone.

Microscopy also allowed for discovery and exploration of mysterious elements of the photoreproductions, such as the crystalline particles found only in the deteriorated areas of one score. These mysteries should be explored further, and they may provide clues to the deterioration patterns of these objects.

Microscopy provided one of the first clues that there was information in the photoreproductions that wasn't easily organized or interpreted based on the available literature on "Ozalids," diazotypes, and the identification of photoreproductions.

The next step was analysis using FTIR, for which Northwestern University Library conservators relied on the equipment and expertise of Northwestern University faculty, with whom they have a partnership. The result of nondestructive FTIR analysis is a spectrum that can be interpreted to tell what types of molecular bonds are present in the analyzed

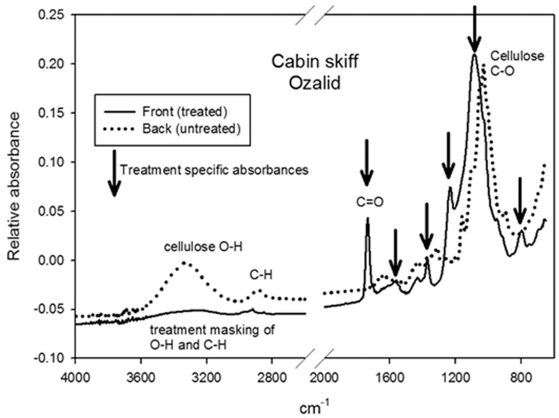

Fig. 1. FTIR spectra of the treated front and untreated back of a diazotype. Image and analysis by Dr. Neal Blair

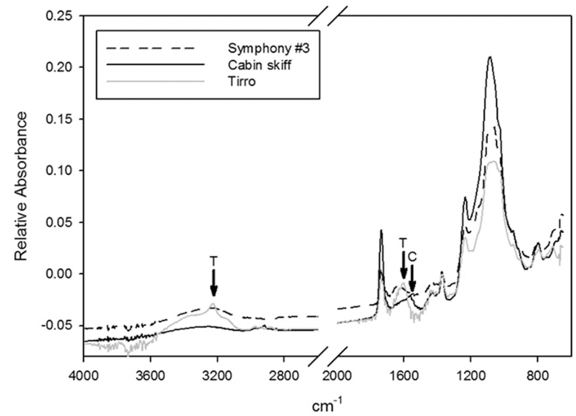

Fig. 2. FTIR spectra of a known diazotype and two music manuscript photoreproductions. Image and analysis by Dr. Neal Blair

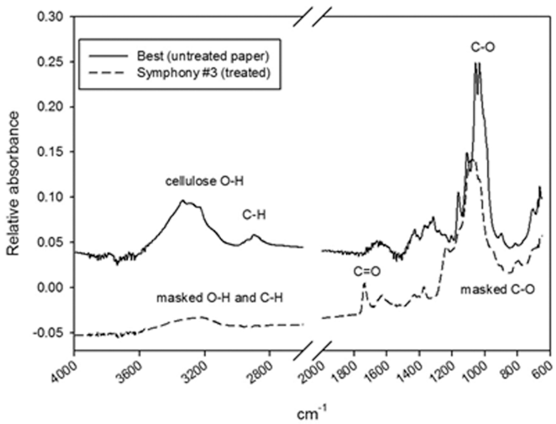

Fig. 3. FTIR spectra of the ground of two music manuscript photoreproductions, showing the difference in the masking of the cellulose spectrum. Image and analysis by Dr. Neal Blair

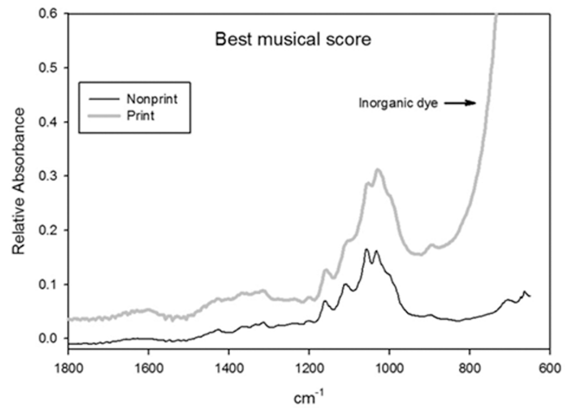

Fig. 4. FTIR spectrum of the image area of a music manuscript photoreproduction, showing the apparent presence of an inorganic material. Image and analysis by Dr. Neal Blair

area of the object. This data can then be correlated to specific substances. The goal of this analysis was to find a signature peak or fingerprint spectrum for the types of diazotypes found in the music collection, or for families of photoreproductions. Objects chosen for analysis included Ozalid-brand diazotype paper, design plans that were known to be diazotypes based on correspondence with the company that printed them, and music manuscript photoreproductions that had been identified as diazotypes based on visual analysis.

Figure 1 shows the spectra from the front and back of a one-sided diazotype; the image and related discoloration were only observed on the front of this object. Interesting elements of these spectra include masking of the cellulose signal on the front, and several signature absorbance peaks. One notable peak is a carbonyl absorbance at 1740 cm^{-1}, which was also observed in several of the music manuscript photoreproductions analyzed. This carbonyl group may belong to an ester, which is found in substances such as cellulose acetate; it may therefore relate to paper treatment.

The results were more complicated than anticipated, as soon became apparent with the comparison of the spectra from known diazotypes with those from music manuscript photoreproductions that had been identified as diazotypes. Objects that had initially been grouped together produced varying spectra, with more dissimilarities between similar objects than expected. Figure 2 shows the spectra from a known diazotype and two scores that had been identified as diazotypes. The spectra have elements in common, but they are far from identical. For example, they share a carbonyl peak at 1740 cm^{-1}, but the cellulose signal is masked to varying degrees in each, and each has significant peaks that are not shared with the others. These results indicate that the objects may not have been created using the same process, or that they may be representative of significant variations within the process.

There were other unexpected findings as well. Figures 3 and 4 show the spectra of one score identified as a diazotype. The spectra indicate lack of surface treatment and presence of an inorganic dye, elements that are incompatible with the diazotype process. In Figure 3, the ground of this score is compared to the ground of another score identified as a diazotype, showing the first score's more apparent cellulose peaks, which indicate a lack of surface treatment. In Figure 4, the printed area of the score appears to feature an inorganic dye or pigment, which is inconsistent with organic azo dye. Notably, none of the items analyzed—neither known diazotypes nor those printed on Ozalid-brand paper—showed a peak corresponding to an azo bond, which would be expected in an azo dye.

This analysis raised questions about whether any of these objects are diazotypes, and how to characterize and group this family of photoreprographics. Though instrumental analysis was conducted in order to get to know these photoreproductions better, it made the conservators and scientists realize that they might not understand the objects as well as they thought. The FTIR method seems to be promising for fingerprinting photoreproductions, but more work is needed to link copying processes and chemistry to spectra. This is an area of research that could take years to untangle, and would require extensive analysis of many more objects.

CONSERVATION TREATMENT TESTING: METHODOLOGY

The next phase of research was to explore conservation options and develop treatment protocols. If these photoreproductions could not be fully understood, at least their treatment options might be defined more completely. The most typical kind of music manuscript photoreproduction, which had been identified as a diazotype based on visual analysis, was chosen as the focus for testing.

Expendable samples representative of known types were gathered, including architectural diazotypes, Ozalid-brand diazotype paper, blueprints, electrostatic prints, and Photostats. In addition, several music scores that appeared to be diazotypes were procured. Gathering the samples was one of the most difficult parts of the project. Testing would be destructive, so collection materials could not be used. Music score photoreproductions are usually owned by institutions such as libraries, so very few were being offered on sites such as eBay. Furthermore, most people cannot identify this type of photoreproduction and do not know what types they have in their collections, even if they are willing to offer any old music scores that are up for deaccession. Luckily, a music publisher and an archivist came forward, both of whom were familiar with the types of photoreproductions found in music libraries and were willing to donate deaccessioned scores.

Repeatable tests were developed to replicate useful common treatments, including surface cleaning, tape removal using solvents in liquid and vapor form, passive humidification, aqueous and non-aqueous deacidification, and mending:

- Surface cleaning was tested using white PVC erasers and vulcanized rubber sponge erasers.
- Solvent use was tested both through direct application and through use of a vapor chamber for 30 minutes. The solvents tested included deionized water, ethanol, acetone, and toluene.
- Humidification was tested in a passive humidification chamber for periods of one hour, six hours, and 24 hours.
- Reaction to alkalinity was tested using directly applied deionized water alkalized with ammonium hydroxide to pH 9 and 11, and with deionized water alkalized with calcium hydroxide to pH 9.
- Non-aqueous deacidification was tested using a Bookkeeper spray system belonging to Northwestern University Library. Because the alkalizing agent in this product is activated with humidity or moisture, deionized water was applied to the tested portion of the sample directly following the Bookkeeper spray.
- To test for reaction to mending, the samples were torn and mended using wheat starch paste on Japanese paper, remoistenable tissue made using BookMaker's A4M methylcellulose on Japanese paper, and heat-set tissue made using Lascaux 498 on Japanese paper.

In all of the tests, the samples were examined for changes in appearance, including surface disturbance, color shift, and bleeding, feathering, fading, or sinking of media.

CONSERVATION TREATMENT TESTING: RESULTS

Testing demonstrated that vigorous surface cleaning of the music score photoreproductions could be risky. Although the surface appeared unchanged to the naked eye, a small amount of media did appear to come off on the eraser. This could be a calculated risk when treating soiled material.

Results indicated that, like known diazotypes, the music score photoreproductions were sensitive to moisture. Extended humidification times of six or 24 hours caused feathering and sinking, and direct application of water caused bleeding and tide lines.

The music score photoreproductions showed varying reactions to solvents, with one overarching theme: treatment with toluene, in liquid or vapor form, caused no feathering and only slight tide lines. Treatment with acetone or ethanol was much more dangerous, causing major tide lines in the case of liquid application, and feathering in the case of the acetone vapor chamber.

As presumed diazotypes, music score photoreproductions were expected to be sensitive to alkalinity, as diazotypes are known to discolor more quickly in an alkaline environment. The music score photoreproductions did show increased bleeding and color shift when alkaline water was applied.

It was assumed that non-aqueous spray deacidification with Bookkeeper would be disastrous for these alkaline-sensitive materials. However, the samples that were treated with Bookkeeper did not react to water any differently than the sample that was not treated with Bookkeeper, nor did they discolor overall. Given the difficulty of identifying many photoreprographic processes, it can be assumed that some music score photoreproductions or similar materials will be inadvertently treated in mass-deacification projects, and this should not be a major concern. While the long-term effects are unknown, and deacidification with Bookkeeper may seem to be excessively risky, no immediate ill effects of treatment with Bookkeeper were evident in testing.

Many basic treatments did not show any negative effects. A one-hour period of passive humidification did not cause any feathering or bleeding. Mending with paste, remoistenable tissue, and heat-set tissue was successful and resulted in no sinking or color shift.

The treatment experiments indicated that some pitfalls are easily avoided. Extended humidification of more than an hour or two can be dangerous, as can the application of liquid water, alkaline water, and water vapor. Toluene was the safest solvent to use, causing less damage than ethanol or acetone. Of course, testing is always important, but these guidelines could be a starting point for a conservator faced with the unknown.

CONCLUSIONS

As should be apparent, the conclusions for this research so far contain almost as many questions as answers. Many of the conclusions are affected by complications that arose during the project. First, the companies that produced diazotypes and other pre-Xerox photoreproduction technologies no longer exist, and there are few living experts on their production or chemistry. The known chemistry of diazotypes is variable and complex, which makes it difficult to test or easily categorize music library photoreproductions that appear to be diazotypes. Literature on the visual inspection and identification of architectural photoreproductions may not be fully applicable to music score photoreproductions, meaning that their characterization may be more complex than originally expected.

The primary conclusion is that, given the high prevalence and low recognition of this type of material in music collections, educating the conservation and library communities about these photoreproductions is the only way to preserve them. This would include steps as simple as informing collection caretakers that these items exist and have unique preservation concerns. Further steps would include developing cataloguers' knowledge and ability to correctly identify the objects so they can be readily found and recognized in the collection. Of course, conservators working with these types of materials should be able to recognize and address the needs of a deteriorating or damaged music manuscript photoreproduction.

In order to preserve this type of object, collection managers will need to be convinced of the importance of these unique musical artifacts, and collection caretakers must be trained to recognize and roughly identify photoreproductions in the music library, as well as to address their preservation and conservation needs. Most important for the conservation community, this study shows that treatment methods can be developed even without absolute identification. Most conservators are too busy to research every item that comes across their bench, and unrecognized objects may be simply returned untreated, or treated using insufficient information. Knowing which basic treatments are possible and advisable will be a very simple step to providing better care for music library photoreproductions.

NEXT STEPS

Given the still-mysterious identity of some "Ozalids," the next steps for this project could include exploration of the little-researched realm of pre-Xerox office copying. Experimentation with instrumental identification and characterization of photoreprographic materials could help increase understanding of these objects, and could lead to discovery of accurate low-tech identification techniques. Finally, preservation and conservation treatment protocols could be further developed and codified for the most common types of music library photoreproductions.

ACKNOWLEDGMENTS

This work would not have been possible without the generous help of many people, including Susan Russick, Northwestern University Library special collections conservator; Scott Devine, head of the Northwestern University Library Preservation Department; and Dr. Neal Blair, professor of Civil and Environmental Engineering at Northwestern University. The Northwestern Music Library and Preservation Department, the University of Chicago Preservation Department, Frank Villella of the Chicago Symphony Orchestra's Rosenthal Archives, Scott Landvatter of the University of Chicago, Gary Galvan of the Free Library of Philadelphia, Steve Schaffner of Schaffner Music Publishing, and the American Institute of Conservation are thanked for their generosity in moving this project forward. Finally, the foundational research of Lois Olcott Price, Erin Vingeau, and Eléonore Kissel made this project possible.

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