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A SURVEY AND EVALUATION OF THE USE OF LIGHT BLEACHING TECHNIQUES FOR PHOTOGRAPHIC MATERIALS

Rachel K. Wetzel

ABSTRACT: Light bleaching is a little studied and often debated conservation treatment technique that can be applied to paper-based photographic materials. The visual results of performing light bleaching treatments can greatly reduce discoloration within the photographic image and its paper base. However the short and long-term effects of its execution are not known. Due to this uncertainty, photograph conservators are hesitant and reluctant to perform such treatments. This survey was designed to interview photograph conservators worldwide on their personal views, concerns and practices in regard to the light bleaching of photographic materials as the first step of an investigative study into the short and long-term effects of light bleaching silver gelatin prints that was conducted at the George Eastman House between 2006 and 2007. The survey was mailed electronically to photograph conservators and consisted of ten simple check-box-style questions. Statistical analysis was performed on the responses to each question and evaluations were made on the numerical values to determine where the greatest area of research was needed on this topic. This paper presents the statistical analysis and discussion of all ten questions from the survey.

INTRODUCTION:

The survey was conducted in the autumn of 2006 utilizing an online questionnaire service provided by Survey Monkey (www.surveymonkey.com). The survey consisted of ten simple check-box-style questions that were designed to gain a general idea of where photograph conservators were employed, if they performed light bleaching treatments (and if they did what were some of the specifics of their methodologies) and finally a question polling general concerns regarding the outcome of light bleaching treatments. The survey was mailed electronically to 122 photograph conservators throughout the world and 111 responses were collected. Statistical analysis was implemented for each question in order to make correlations between the light bleaching practices and the type of employment and training that conservators possess. Each person's response to the survey was kept confidential and will remain so. Due to data collection processes within the survey, the author and the person conducting statistical analysis for this project were able to see each person's individual responses as they were submitted to the online questionnaire. Based on the familiarity of the respondents, some information was used in this paper to further expand the statistical analysis based on geographic location without having proposed that specific question within the survey. Nonetheless, no specific responses were linked to a particular name or place of employment nor will any of the individual responses ever be printed or become public. The following section provides an in depth evaluation based on the responses collected from the survey.

QUESTIONS AND DISCUSSIONS:

Question #1 Type of Employment

In which of the following are you currently employed?

While the largest percentage of active photograph conservators currently are employed by museums, private practice proved to be just as prevalent as a viable means of employment for photograph conservators worldwide. Less than half of the statistical percentage was represented by the remaining three categories (regional lab, educational/university and library/archive). These numbers are, however, proportional to the occurrence of these limited types of places that currently employ photograph conservators worldwide.

Employment Type	Respondents	Percentage*
Museum/Institution	48	41%
Private Practice	39	35%
Regional Lab	6	5%
Educational Setting/University	17	15%
Library/Archive	17	15%

*Douglas Nishimura calculated the statistical data in percentage form found throughout this paper. The numerical values are based on the number of participants who responded per question with statistical error taken into account. In some cases, more than one response was selected per question, so the percentages do not necessarily add up to one hundred percent.

Question #2 Light Bleaching Practice

At your CURRENT place of employment, do you ever perform the following treatments on photographs?

This question was inserted into the survey merely to see how often light bleaching was used as a treatment option by conservators in their current place of employment. Not only would this help to give a numerical value to the conservators practicing this technique but it would also provide information as to which type of employment performed these treatments the most.

Possible Responses	Respondents	Percentage
Light bleaching using natural sunlight	23	21%
Light bleaching using natural sunlight with the addition of Hydrogen Peroxide	14	13%
Light bleaching using an artificial light source	15	14%
Light bleaching using an artificial light source with the addition of Hydrogen Peroxide	10	9%
I do not perform these treatments	83	75%

Question #3 Previous Light Bleaching Practice

At any FORMER place of employment, have you performed any of the following treatments?

While there is a large percentage of people who currently do no perform light bleaching treatments at their place of employment, one third of the respondents have tried it in the past. This question was devised to gain an idea of whether or not the place of employment influenced the frequency of the usage of this treatment.

Possible Responses	Respondents	Percentage
Light bleaching using natural sunlight	48	43%
Light bleaching using natural sunlight with the addition of Hydrogen Peroxide	27	25%
Light bleaching using an artificial light source	28	26%
Light bleaching using an artificial light source with the addition of Hydrogen Peroxide	17	16%
I do not perform these treatments	51	46%

Employment	Light Bleaching Practice	Number of Statistical Responses	Statistical Percentages
Museum/Institution	Light Bleach	9	8%
	Don't Light Bleach	39	35%
Private Practice	Light Bleach	17	15%
	Don't Light Bleach	22	20%
Regional Lab	Light Bleach	1	1%
	Don't Light Bleach	5	5%
Educational Setting/University	Light Bleach	6	5%
	Don't Light Bleach	9	8%
Library/Archive	Light Bleach	2	2%
	Don't Light Bleach	16	14%

General information can be obtained from the first three questions regarding the occurrence of light bleaching treatments performed in each of the employment settings. Among the photograph conservators polled, the largest percentage of light bleaching occurs within the private practice sector whereas conservators within the institutional and museum community perform the least amount of light bleaching treatments. In the regional lab, educational/university and library/archive settings there are only a limited number of people who perform light bleaching treatments. Despite the fact that these groups represent the more infrequent places of employment, those conservators who work in these types of jobs tend to perform light bleaching treatments more regularly than those conservators employed in museum/institutional settings.

Question #4 Light Bleaching Techniques

Knowing that light bleaching originates out of the paper conservation field and the paper making industry, how did you learn to apply these treatment techniques to photographs?

Since the field of photograph conservation is relatively small and relies heavily on an apprenticeship method of teaching its pupils, it wasn't surprising that most participants reported learning light bleaching from a fellow photograph conservator. Likewise, an almost equal number of participants reported that a paper conservator taught them these techniques. Of those participants who were taught these techniques by either a paper or photograph conservator, thirty three percent were taught while attending conservation training programs. Additionally, other participants reported they were self taught or learned about light bleaching techniques at a workshop. This question of where the participants learned about light bleaching appears to have some correlation to the frequency in which they light bleach as well as the way they perform these treatments.

Method of Learning	Respondents	Percentage
Taught by Photograph Conservator	56	50%
Taught by Paper Conservator	47	42%
Learned at a Graduate Program	37	33%
Self-Taught	19	17%
Learned at Workshop	16	14%

To further break down the divide between conservators who light bleach and those who do not, comparisons can be made based on the regional location and type of training that a conservator has received that may influence the practice. For example, of the 111 conservators polled, 56

received their training within the United States and Canada and 55 percent of people received their training in other countries. While almost equally divided, American and Canadian trained conservators tended to perform these treatments more frequently. In fact, 44 percent have reported performing light bleaching treatments in the past where as only 17 percent of non-American/Canadian trained conservators have tried this procedure. Perhaps this could be explained better knowing that all of the conservation training programs affiliated with ANAGPIC (The Association of North American Graduate Programs in the Conservation of Cultural Property) teach light beaching techniques as part of their curricula and that a majority of the literature on conservation light bleaching practice has been produced by American or Canadian conservators.

Question #5 Light Bleaching Techniques

On what photographs do you generally perform these types of treatments?

The photographic process most commonly light bleached was the platinum/palladium print. This may be due to the fact it is most similar in structure to traditional paper based works of art that often undergo light beaching treatments. Platinum/Palladium prints are one-layer structures that are not that dissimilar to lithographs, etchings or other types of media applied directly to paper. Therefore it may be easier for photograph conservators to apply what they know about light bleaching these types of paper-based materials to those photographic processes with similar structures. When it comes to photographic processes with an emulsion layer or binder, such as silver gelatin developed out prints and albumen prints, there seems to be a general hesitance to light bleaching. Less frequently light bleached but additionally noted by some participants were collodion prints, salted paper prints and crayon enlargements.

Photographic Process Light Bleached	Respondents	Percentage
Platinum/Palladium	34	31%
Silver Gelatin DOP	28	25%
Albumen	25	23%
Salted Paper Prints	7	6%
Collodion	3	3%
Crayon Enlargements	2	2%

Question #6 Light Bleaching Techniques

When performing light bleaching, which best describes the water source you tend to use?

The most commonly used water source for light bleaching among the participants was deionized water. This statistic can most likely be linked to the large number of program-trained conservators who have taken this survey. Deionized water has been most commonly accepted as a standard water type for treatments in general in the field of conservation. Another large number of participants noted that they performed their light bleaching treatments using distilled water. Additionally, participants added the following water source alternatives for answers: tap water, water from a reverse osmosis system, and water mixtures, such as Ethanol and water and tap and deionized waters combined.

Water Source Used	Respondents	Percentage
Deionized	34	31%
Distilled	23	21%
Tap	16	14%
Reverse Osmosis	1	1%
Ethanol/Water Mixture	1	1%
Tap/Deionized Mixture	1	1%

Training Type	Deionized		Distilled		Tap Water	
	Participants	Proportion	Participants	Proportion	Participants	Proportion
Taught by paper conservator	18	10%	10	5%	7	4%
Taught by photograph conservator	25	11%	14	6%	11	4%
Self-Taught	10	4%	6	2%	5	2%
Taught at training program	18	8%	9	4%	3	3%
Taught at workshop	8	4%	5	2%	5	1%

Question #7 Light Bleaching Techniques

When performing light bleaching, which of the following apply to your water source?

Of the participants polled who cited that they perform light bleaching treatments, very few made any adjustments to the water source when light bleaching. As stated in several paper conservation research studies about light bleaching and hydrogen peroxide, the most effective pH for chemical action to occur is between pH 9 and 10. Additionally, paper conservation studies recommend adding a buffer to the water bath to help maintain paper strength. Yet, most participants work with a neutral pH water source. The following chart exemplifies the breakdown of conservators who make adjustments to their water sources.

Water Adjustment	Deionized		Distilled		Tap	
	Respondents	Percentage	Respondents	Percentage	Respondents	Percentage
Adjust Alkalinity with Calcium Hydroxide or Other	13	8%	7	6%	4	4%
Adjust water to a specific pH	13	8%	13	12%	7	6%
Make no adjustments to the water	10	9%	7	6%	6	5%

Question #8 Light Bleaching Techniques

As a whole, do you find light bleaching treatments to be satisfactory or successful?

Of the survey respondents who light bleached photographs, most found their treatments to be successful most of the time regardless of the process treated (silver gelatin DOP, albumen or platinum/palladium). The perceived success rates of performing light bleaching treatments on platinum/palladium prints were somewhat higher than those for silver gelatin or albumen photographs. A small percentage of participants found light bleaching treatments to always be successful for platinum/palladium prints whereas only one respondent found them to never be successful. This may be linked to the fact that this process is most similar to traditional paper based objects and those who have more light bleaching experience with paper objects may tend to feel more comfortable with one layer structures. When emulsions are introduced to the structure, the risk of performing these treatments becomes greater for differential expansion and contraction from the paper base, hence explaining why the statistical values may be lower for the processes

that contain emulsions or binders. While not as commonly light bleached, a large proportion of respondents found light bleaching treatments on silver gelatin and albumen photographs to be successful most of the time.

Success Rate	Silver Gelatin DOP		Albumen		Platinum/Palladium	
	Respondents	Percentage	Respondents	Percentage	Respondents	Percentage
Always	0	0%	1	1%	6	5%
Most of the time	20	18%	16	14%	22	20%
Occasionally	6	5%	8	7%	7	6%
Rarely	3	3%	4	4%	0	0%
Never	2	2%	1	1%	1	1%
Don't Light Bleach	64	72%	65	73%	59	68%

Question #9 Light Bleaching Techniques

Roughly state the first time you performed the following treatments.

According to paper conservation literature, the first citation of publications explaining a light bleaching treatment occurred in 1980, though it is likely this technique was used as early as the 1970s. Only a few respondents reported trying light bleaching with natural or artificial light in the 1970s, which would correspond with the fact that there were not many photograph conservators in practice then as there are today. The use of hydrogen peroxide first appears in light bleaching treatments in the 1980s utilizing both natural and artificial light. In the 1990s the number of respondents performing light bleaching treatments outdoors significantly increases. The rate of those utilizing artificial light remains fairly constant over time as well as those adding hydrogen peroxide to their bleaching baths. In the 2000s, the number of conservators attempting light bleaching treatments with either natural or artificial light sources plateaus but there is a significant increase in the use of hydrogen peroxide in the water bath to increase the bleaching effects.

Light Bleaching Technique	1970s		1980s		1990s		2000s	
	Respondents	Percentage	Respondents	Percentage	Respondents	Percentage	Respondents	Percentage
Sunlight Bleaching	4	4%	13	13%	22	19%	14	13%
Sunlight Bleaching With H_2O_2	0	0%	9	8%	10	8%	15	14%
Artificial Light Bleaching	2	2%	13	13%	13	11%	14	13%
Artificial Light Bleaching With H_2O_2	0	0%	6	5%	5	5%	8	6%

Question #10 Light Bleaching Concerns

What are your concerns for the short and long-term stability of photographs that have been light bleached?

This question was perhaps the most interesting and useful of all of inquires in this survey. Overall, there is general trepidation towards light bleaching photographic materials due to lack of published research on the subject directly focused towards photographic materials. The answer choices in this part of the questionnaire were comprised of potential risks to performing light bleaching treatments on photographic materials. Many of the polled respondents added further reasons for their apprehension towards this treatment. The greatest concern among participants of the survey was the deterioration to or the potential changes that could occur to the binder or

emulsion layer of the photographs, which would explain why light bleaching was more predominantly used for one layer structures such as platinum/palladium prints rather than multiple layer structures. Deterioration of the paper substrate was the second highest concern for photographs undergoing light bleaching treatments. Loss of degree of polymerization and blistering of the paper comprised the main concerns when light bleaching paper-based materials and knowing that many of the participants of the survey were taught by paper conservators how to perform light bleaching treatments simply reinforces the fact that this concern appeared high on the list. Apprehensions that light bleaching may cause silver mirroring to occur or reduce silver density in the case of gelatin and albumen photographs was another dominant theme. Following those responses, there were several issues of long-term stability of light bleached photographs including increased susceptibility to silver mirroring and yellowing (color reversion) in the future. Of those polled, there was little concern about light bleaching treatments causing staining or uneven surface appearances. In addition to all of the aforementioned concerns, a significant number of respondents stated a general objection to wet treatment of any kind for photographic materials.

Light Bleaching Concern	**Respondents**	**Percentage**
1. Deterioration/change in emulsion (gelatin/albumen)	86	77%
2. Deterioration of paper substrate	55	50%
3. Oxidation of image material/silver mirroring	45	41%
4. Decrease in silver density	43	39%
5. Deterioration of baryta layer	40	36%
6. Increased susceptibility to future yellowing	35	32%
7. Increased susceptibility to future silver mirroring	32	29%
8. Staining	25	23%
9. Other	23	21%
10. General objection to wet treatments	53	47%

CONCLUSIONS:

This survey was conducted as an initial investigation into general practices and concerns that photograph conservators have about light bleaching treatments. Also it was intended to provide a foundation on the areas of this treatment technique that would be best studied in a long-term research project about light bleaching techniques applied directly to photographic materials. The results were more informative than anticipated, exemplified by the overwhelming response to the online questionnaire and the subsequent emails that resulted after the survey. This confirmed the need for further research on this topic. While this questionnaire covered only the fundamentals of this treatment practice, it served as a basis for a more intensive study on the short and long-term effects of light bleaching treatments on emulsion based photographic images, which should help the understanding of this treatment technique applied to silver gelatin prints.

The main conclusion that can be drawn from the statistics generated using the online survey is that approximately seventy-five percent of photograph conservators do not actively use light bleaching as a treatment technique to reduce overall yellowing and/or stains. While there is a larger percentage of people who have tried this technique in the past (a little less than half of the conservators polled), its current usage has diminished. A general stigma seems to exist among those who do not practice this treatment technique as well as among those who have in the past that the potential risks outweigh the possible results that can be gained. The decision not to use this treatment method is based on a long list of potential damage or deterioration that can occur to the photograph from light bleaching including making the paper substrate and emulsions weaker, causing changes in the silver image material and putting the photograph at an increased susceptibility to deterioration in the future. The same concerns were expressed by those

participants who currently perform these types of treatments, with the largest percentage of those conservators employed in private practice. Of the photographic processes listed, platinum/palladium prints were the most common photographs to undergo light bleaching treatments. Silver gelatin DOP photographs and albumen prints seemed to have a similar occurrence of treatment yet less than platinum/palladium due to their multiple layer structures and easily disturbed emulsion layers. Regardless of the photographic process, those practicing these treatment techniques shared a general inconsistency about their working methodologies. The primary explanation for this is the lack of research available which would define standards for this treatment by stating which water source to use, which temperature and pH is optimal, what is the proper length of exposure time, how much hydrogen peroxide to use, etc. Evidence is clear that more research needs to be developed in this area before any safe methods of light bleaching can be defined. While many of the general anxieties associated with this treatment technique indeed have merit, the lack of research on this subject has inhibited it from being utilized to its full potential, as it often can be a viable treatment option for damaged, discolored, water damaged or stained photographic materials. The short and long-term effects have yet to be determined, but it is hoped that additional research in this area of photographic treatment will promote its use in the future.

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