JUDITH REED ELÉONORE KISSEL ERIN VIGNEAU

Photo-Reproductive Processes Used for the Duplication of Architectural and Engineering Drawings: Creating Guidelines for Identification

ABSTRACT

The New York Botanical Garden Library's collection of architectural drawings consists of about 130,000 working drawings, dating between 1880 and 1960, containing original drawings on linen and paper and an assortment of photo-reproductive processes. As the Lord and Burnham Collection is a research collection, the prints are of equal value to the originals and must be retained.

Little information on photo-reproductive processes was available from published sources or professional colleagues in the fields of paper and photo conservation. Some sources indicated that these processes, when stored together, might cause degradation to other materials and to each other. Subsequently, the authors began to pursue information regarding identification of these prints, in order to make decisions about segregation and housing.

Information was collected on the description and appearance, synonyms, history and use, technical information, manufacturing data, and details about degradation and storage for 14 photo-reproductive processes. As a result, criteria for visual identification was developed, originally intended for the use of the NYBG conservation staff. Subsequently the authors decided to make the information available for use by people who are responsible for collections of architectural drawings, but who do not have access to sophisticated analytical equipment or facilities. This paper will describe the criteria which have been developed for visually identifying photo-reproductive processes found in architectural archives.

INTRODUCTION

The New York Botanical Garden Library's collection of architectural drawings of glasshouses contains drawings on paper, linen, and tracing paper and a variety of photo-reproductive print processes. During the 1980's, the drawings were transferred to the Library, which now holds title to the collection. It was donated by the Lord & Burnham Corporation, premier designers and builders of greenhouses and conservatories in the United States during the last half of the nineteenth century and the first half of the twentieth century.

The collection had suffered from poor storage conditions while held by the Lord & Burnham Corporation. The drawings arrived at the Botanical Garden stored in old folders; some housed in damaged or inadequate flat files, others simply in unsightly piles. Fortunately, only a few drawings were rolled and most were small enough to be stored flat and unfolded. It became clear that the order of first importance was to provide proper housing for the collection as soon as possible. A grant from the New York State Library Conservation/Preservation Program, several years ago allowed the in-house conservation staff and the Northeast Document Conservation Center to carry out full conservation treatment and rehousing of about 1,000 of the drawings. By the conclusion of this project, the staff had become aware that such labor-intensive, time-consuming efforts carried out on the entire collection would be impractical. Therefore, conservation efforts were redirected toward the more immediate goal of stabilizing and properly rehousing the entire collection.

In order to maintain the original order of the collection, it was decided to retain the numbering system assigned by the Lord & Burnham Corporation. These numbers refer to all the drawings relating to one specific project or building. The same numbering system was used by the Company for its business records and correspondence, materials which are part of the complete Lord & Burnham Collection, held by the Library. Having arrived at this decision, it became evident that all the drawings for a project, whatever the support, medium, reproductive process, or dimension, should be housed together to facilitate research and access.

To provide further access to the collection the Research Librarian, Bernadette Gallery, and the conservation staff designed a preservation and access database, which provides an inventory and finding guide to the collection, as well as recording the various types of supports, media, and processes in the collection, and the future conservation treatment needs of the drawings.

The L&B Collection consists primarily of working and engineering drawings, rather than attractive or artistic renderings. In the late nineteenth century the need for architectural drawing reproductions increased tremendously with the advent of new construction methods, which relied heavily on teamwork and often on the reuse of a basic original plan; skyscrapers, for instance, as well as standardized building units erected in newly developed suburbs. Consequently, major collections of architectural archives often contain a large percentage of prints. Therefore, the photo-reproductive prints, which often indicate changes in original design, are of equal importance to the original drawings and must be retained as an integral part of the collection.

Since the order of the L&B Collection is basically chronological, more and more types of photo-reproductive processes began to show up as the rehousing project progressed. The staff was aware that an alkaline environment, although desirable for storage of the original drawings on paper or cloth, was unwanted for photo processes. Questions began to arise. Would various photo processes cause one another to degrade when in contact? How should the processes be separated from the other drawings and from one another, while still being kept intact as a collection? Polyester film inserts within the alkaline-buffered folders solved the problem of separating the drawings from the prints and isolating the photographic processes from direct contact with the alkaline folders (fig. 1).

However, it required the teamwork of the conservation staff to research the information needed to resolve the other questions. Their varied backgrounds in training and experience complemented one another well, providing a combination of librarian, library materials conservator, bookbinder, paper conservator, printmaker, and photographer.

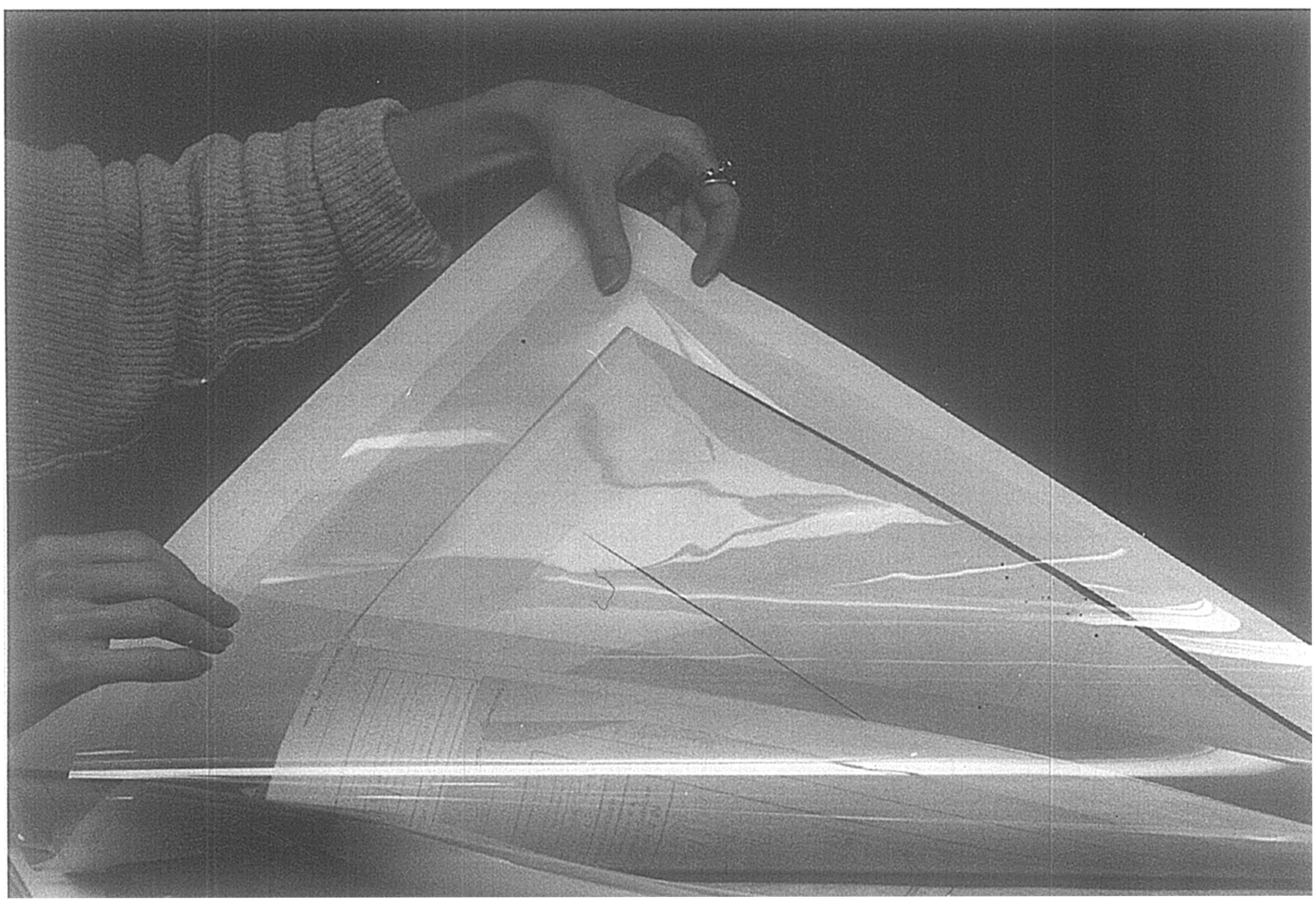

Fig. 1. Multiple layers of polyester film inserts segregate different types of prints from each other and from drawings while keeping all of the plans from an original group intact

A CONSERVATIVE APPROACH: THE DECISION TO SEGREGATE

During the initial project, the conservation staff had identified two blue and white print processes, cyanotypes and diazotypes. When Erin Vigneau began to work on the rehousing project of the L&B Collection prints began to appear which had not been found previously. A brown print with white lines surfaced, as well as a black print with white lines which had a shiny photo-paper like coating. Ms. Vigneau recognized these, from her experience with photography, printmaking, and photo-reproductive processes, as a Van Dyke brown print and a silver based Photostat, respectively. Groups of drawings which contained photo reproductions from the 1950's had several prints with warm brown lines on a dirty white ground. These seemed comparable to diazotypes. The staff confirmed with a practicing architect that these prints were called sepias and were processed and used similarly to diazotypes.

Ms. Vigneau knew from processing cyanotypes and Van Dyke prints that the two should not be washed in the same final rinsing bath; potassium ferricyanide in the cyanotype chemistry acts as a bleaching agent to the silver contained in the Van Dyke print. This led the staff to the question of whether or not dry cyanotypes and Van Dyke brown prints might affect each other when stored together.

During the rehousing project degradation to drawings on tracing paper, induced by contact with coated and uncoated sepia prints, was noticed. Coated sepias ooze a greasy substance onto the adjacent paper drawings. Uncoated sepias transfer a reddish stain onto nearby documents, which bleeds through several layers of drawings. Viewing these degradations, the staff reasoned that all diazotypes might be affecting contiguous documents by being housed along side them.

Concerned about these mounting questions, Ms. Vigneau began to seek more information on these photo-print processes, but little was available, especially on historical print processes. Even texts which did document the many and varied historical techniques for photoreproduction had little or no concrete descriptions of visual characteristics to use in identification. Photo conservators that were contacted knew only about cyanotypes which were used as a method for reproducing photographic images. The staff did consult with Lois Olcott Price, who is working on a definitive manuscript about early architectural archives, their history, and recommendations for storage and treatment. She has been unstintingly generous in her recommendations and confirmations throughout this research, and solutions to some of the identifications have been worked out together with her.

It was known that some prints had been made with metals and some with dyes, and that some were processed in ammonia or sodium thiosulfate solutions. Many prints in architectural archives are not processed with any archival future in mind, as they are seen as interim stage prints or duplicates. It became apparent that many of these processes were possibly exuding chemical by-products to drawings and other prints. At this point, having little information about these reproductions, Ms. Reed and Ms. Vigneau chose to take the conservative approach and segregate each type of print. Solving the questions about identification, for the purposes of separation, was now an important part of the rehousing effort.

THE RESEARCH COMPONENT

Eléonore Kissel joined the Lord & Burnham project at the start of her Kress Internship in Paper Conservation, when many of the decisions regarding the rehousing of the collection had already been made. She spent the first three months of her internship rehousing the documents, after which she proposed a research project directed towards the identification of the printing processes by which architectural drawings are duplicated. The basis of the project was to be a search of the existing literature, followed by the development of a guidebook, with photographs of prints from the L&B Collection to illustrate the written guidelines for identification. Ms. Kissel began to look for bibliographic references, first in the field of conservation, then in the professional literature available to architects, and finally in historical printing and photography trade magazines and catalogs. It soon became clear that all of these sources would need to be researched in order to find all possible information about these printing processes that had been used to duplicate architectural drawings. Such prints have been thought of throughout their history as merely expendable utilitarian copies and thus have not received as much attention or care as the original drawings from which they were created. Early trade catalogs proved to be a rich primary source for the information being sought.

The staff knew that many other conservators and curators were interested in the preservation of architectural drawings and reproductions. In contacting them for advice, they led the staff to sources they had not been aware of. Ms. Kissel created a database of bibliographic references, to which she added French and Canadian references frequently not found in American publications. By the end of her internship the bibliography had become quite substantial. Visits to institutions in which architectural or design records are housed and conserved, such as the Library of Congress, the American Institute of Architects, and the Canadian Center for Architecture, proved to be informative. A trip to the Frederick Law Olmsted National Historic Site was important and useful, not only because of the span of the drawings collection, but also because of the opportunity to observe the early twentieth century printing equipment still in place at the Olmsted Site.

THE L&B LAB COLLECTION: A PRIMARY SOURCE FOR PHOTO-REPRODUCTIONS

The major problem with the information gathered continued to be the almost complete absence of images or visual descriptions of the reproductive processes. In addition to the unpredictable appearances of the prints themselves, confusion over the nomenclature applied to these printing processes made the research more complex. For example, documents with brown lines on a light background have been called at least half a dozen different names. In addition, the term "blueprint" has been applied, over time, to three distinctly different processes. Even when there was information available about the supports and sensitizing solutions used in the manufacture of reproductions, it was difficult to imagine, short of making an actual photoreproduction, what each print might look like. And even if it could be determined what they would look like immediately after their manufacture, they would look very different a few decades later, having been exposed to light, used extensively, and often housed in less than ideal conditions.

It is for this reason that the staff turned mainly to the L&B collection for actual examples of prints which have been subject to heavy use and poor storage conditions. Over time, they identified and isolated fourteen different types of prints, produced between the mid-nineteenth century and the 1980's. The names of these appear below:

Aniline prints	Pellet prints
Cyanotypes	Photostas
Diazotypes	Sepia prints
Electrostatic prints	Silver halide prints
Ferrogallic prints	Spirit duplicating (hectographs, machine made)
Gel-lithographs	Stencil duplicating (mimeographs)
Hectographs, (handmade)	Van Dyke prints

For each process the following information was collected: trade names and commonly used nomenclature; history and use of the process (with probable dates); supports and chemicals used in the manufacturing process; subsequent changes in the reproductions over time; and the means for preventing further degradation by using the appropriate housing procedures.

The staff had discovered, through daily handling of the prints during the rehousing effort, and through data compilation, several instances in which it was detrimental to house different processes together. To give only a few examples:

1. Diazotypes off-gas phenolic by-products, which are harmful to other types of documents as well as to themselves.

2. Diazotypes are frequently developed with ammonia fumes; they continue to off-gas alkaline vapors which may affect documents which are alkaline-sensitive. Some documents may be sensitive because of their constituent materials, others because they have become highly acidic over time; e.g., cyanotypes ("blueprints") and Pellet prints are made of two pigments, Prussian Blue and Turnbull Blue, that may turn brown if housed in a closed alkaline environment; in the case of a flood, acid/base reactions may occur if a highly acidic document, such as a ferrogallic print, is housed with a diazotype.

3. Diazotypes manufactured after the 1930's may contain thiourea (used as a stabilizing agent) and should not be housed in contact with silver based photographic prints. Thiourea, a sulfur containing product, may cause the deterioration known as "silvering" or "mirroring" on silver based prints such as Photostats. Note, however, that this alteration could also be due to poor environmental conditions, in particular a polluted, sulfur-containing atmosphere.

These discoveries reinforced the validity and importance of the conservative approach to housing that had prevailed since the beginning of the project; when in doubt, isolate to eliminate the risk of contact degradation. However, in order to isolate and reduce risk, the questions of identification needed to be solved. It was important that simple, visual and tactile criteria be established. The authors wanted to enable the Library staff, and people with architectural drawings and prints under their care, to be able to identify the process used to produce the prints if they took the time to examine them closely. Conclusive identification would allow proper housing to be provided and promote the best chance for the long term preservation of the archive.

CRITERIA FOR IDENTIFICATION

As Ms. Kissel's research progressed, she and Ms. Vigneau became more adept at identifying the processes that were found in the L&B collection. They found that there were specific traits, marks and characteristics which could be consistently observed and compared during investigations. As the research was compiled into the document which has become *A Manual For The Identification Of Architectural Archives Reproductions*, a glossary of terminology was created to explain the methodology. How could the procedure followed in investigations be described? The successive paragraphs detail the many indicators used to identify a print through visual inspection.

First, what is the *nature of the support?* Is the print support paper, cloth, or plastic film? Some processes were produced only on paper, or only on linen, and some were made on a variety of supports.

An early indicator is the *color of the image line*. Even though two prints with white backgrounds and blue lines appear very similar, they may be different processes and can potentially harm each other if housed together. To correctly identify two like processes with blue lines on a white ground one must look at the nature of the image line. By viewing the lines close up, through a magnifying loupe, variations in the two types of blue lines can be seen. A Pellet print, will have a deep Prussian blue line with a hard edge. The line in a diazotype will be softer and hairier, with the characteristic ability to copy a soft pencil line with consistency.

Lines can appear to be sitting upon the surface of the support or imbedded into the fibers, making them appear as if dyed. The line of the Pellet print will appear as if the fibers are stained, that the color is imbedded in the paper, whereas the lines of the diazotype will subtly seem to be resting on the surface. Diazotype lines are created from aniline dyes and will not be raised above the surface like a paint line but the color will not sink deeply into the fibers of the paper.

In contrast, lines in wet processed ferrogallic prints and aniline prints will be so deeply imbedded into the paper that they will appear almost as if they are below the surface. This is due to the acidic development process that they go through, where the opening action of the acid on the cellulosic fibers (paper or linen) drives the chemical lines deep into the support. In addition, ferrogallic and aniline images often have lines and ground of such a close value that the overall image is of very low contrast.

After checking the image line, look at the *color of the background*. Is it white, dirty white, blue, green, tan? In identifying some prints, such as aniline prints, this one element, a green background, can be enough to point you to a conclusive identification.

Another clue in successfully differentiating prints is the *appearance of the ground*. Prints may have a flecked, dirty white ground or a smooth white background on which the image lines appear. A background with a faint, even colored tone, may also be found; one likely example is the ground of a Pellet print. The residual tone from the sensitizing solution of diazotypes will remain on the image/recto side because the print is not rinsed in its processing. The verso will remain an unstained, uniform white (fig. 2). The difference between the toned recto and the white verso is a good indicator, along with other clues, in the conclusive identification of diazotypes.

Another characteristic to observe closely is the *appearance of the surface*. The fibers of a paper support can change when a print has been aqueously processed. Prints that have been processed by vapors alone retain their original calendered surface while those that have been through one or several wet baths will have a more raised surface appearance, the fibers of the support having expanded and contracted in processing. One of the reasons that diazotypes are still one of the most commonly used copying processes is that, by using an essentially dry development process, the scale of the copy remains identical to the original. Prints which are photomechanically produced such as gel-lithos and hectographs will also be found to have a hard calendered surface typical of a support which has not been through a wet step in its development.

Along with these signs, the *condition of the support* can provide valuable information when trying to identify a print. Ferrogallic prints are often brittle and degraded from the acidic developing bath to which they have been subjected. A See-Bee (or C.B.) print, which has a hard black line deposited on the surface of a coated linen support, may also appear degraded, due to an alkaline bath used in its processing. These clues, along with descriptors, such as the color of line and ground, type of support, and appearance of line, can add up to a conclusive identification.

When removing photoreproductions from the storage conditions in which they may have resided for many years, *characteristic degradations* to the prints themselves, or to adjacent materials, may be observed. It is important to be aware of these degradations and to record them. They may augment the other indicators and determine the final analysis. Diazotypes frequently exhibit an edge discoloration, caused by the residual phenolic products, which oxidize and cause the paper support to discolor. A yellowing is present, more pronounced along the edges of the print, and occurs only on the image side where the sensitizing solution was applied. Degradation to adjacent drawings can be a clue in the identification of sepia prints. Uncoated sepia prints impart a reddish pink discoloring onto contiguous tracings. Sepia prints, impregnated with waxy products for increased transparency, create greasy looking stains on adjacent drawings (fig. 3). Both of these forms of contact degradation can migrate through several layers of nearby tracings.

Misleading factors in identification include odor and dates on prints. It is true that some documents have a strong characteristic odor, especially diazotypes which are processed in ammonia vapors and not washed afterward, however, the staff found that the smell can transfer to almost all neighboring documents, making it hard to discern which of many prints may be the original culprit. The *date* which appears in the reproduction is often a misleading factor in identifying a print. Unless the date is written onto the front of the print or a stamp of receipt with a date is present (perhaps on the verso), the date written on the original drawing, which is reproduced in the print, could possibly be years apart from the time the print was made.

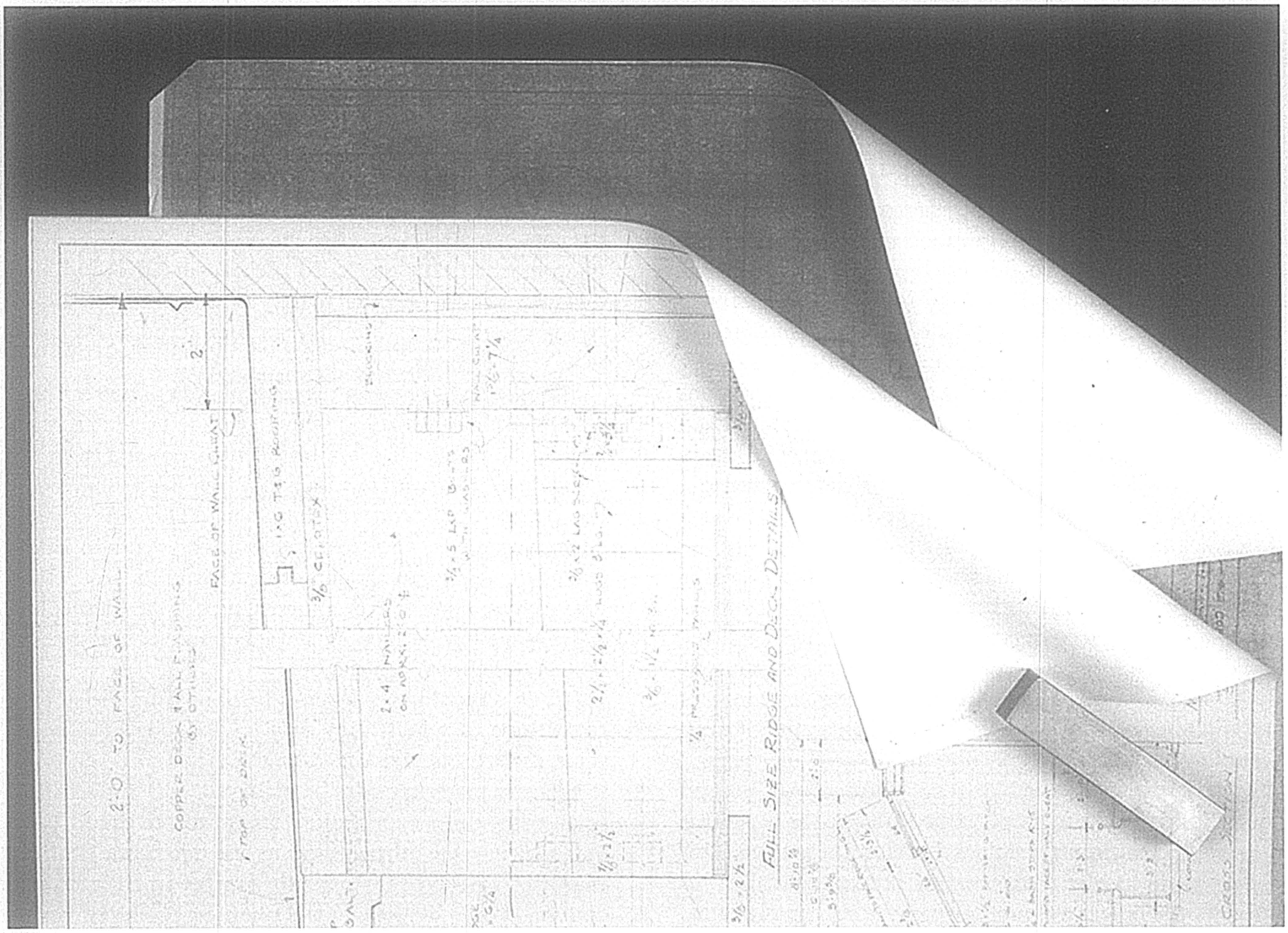

Fig. 2. Two diazotypes showing the distinct difference between the residually toned recto and white verso

The date of the original drawing allows us to determine only that the print was made *after* that date but not necessarily *on* that date.

Stamps that may be found on the verso include manufacturers trade names for photo print processes and may be used as an additional tool in the identification of a document. Names found on prints have included whiteprint, dyeline, ordoverax, rectigraph, and brownline, among others. The research completed by the authors attempts to cover as many trade names and industrial vernacular terms as possible. Often common names, such as blueprint and brownline, have been used in the trades to refer to different processes. Trade names written and stamped are not always conclusive but can add to the many clues used to make an identification. One specific patented diazotype paper, Ozalid, includes a chemically manufactured watermark (fig. 4), which is an explicit mark to use in identifying it as a diazotype.

In review, a list of the basic criteria is as follows: nature of support, color of ground, color of line, nature of line, nature of ground, surface appearance, condition of support, characteristic degradations (to prints themselves and to adjacent documents), manufacturer's stamps and trade names, and the misleading indicators of odor and dating. It must be stressed that no one factor can be used in making a conclusive analysis. A detailed description of the process, historical information about it, its manufacture and its subsequent changes and degradations should be considered before determining a final identification.

A MANUAL FOR THE IDENTIFICATION OF ARCHITECTURAL ARCHIVES REPRODUCTIONS

The aforementioned criteria were developed over a period of more than a year while the staff rehoused and surveyed 58,000 drawings and prints. The manual containing this research was originally created for the use of the conservation staff during the rehousing of the remaining approximately 72,000 drawings. Investigation sometimes led the staff to correct or revise decisions about identifications that had been made previously. The conservation survey database allowed them to backtrack through

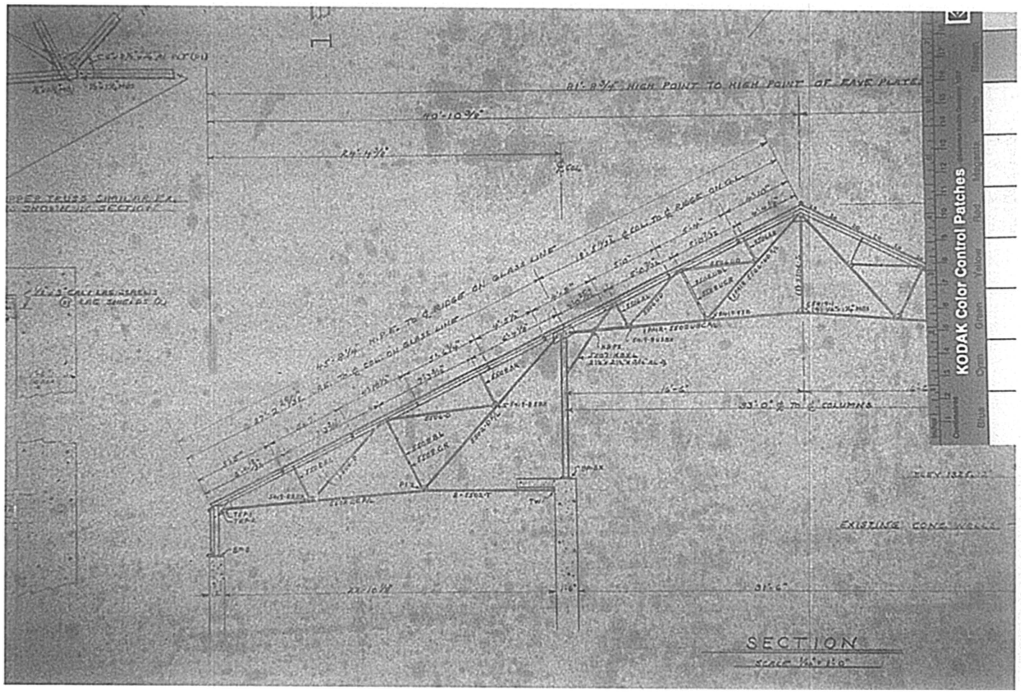

Fig. 3. A tracing which, when removed from its original housing, exhibits typical greasy stains due to contact with an adjacent waxed sepia print

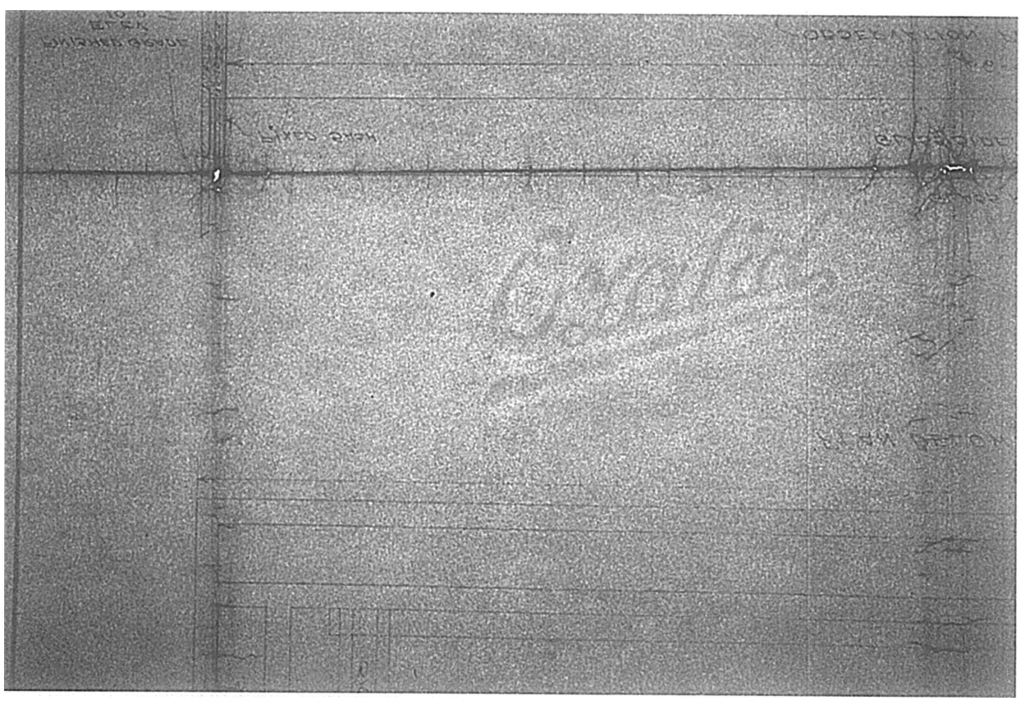

Fig. 4. One of the "Ozalid" watermarks, photographed while backlit

FLOW-CHART FOR THE IDENTIFICATION OF

ARCHITECTURAL ARCHIVES REPRODUCTIONS

OF DRAWINGS AND DOCUMENTS

1. Nature of Support:

Paper or linen:	2.
Plastic film:	31.

2. Paper or Linen: Color of Line (image):

White (negative image):	3.
Blue	7.
Dark brown	10.
Light brown	16.
Purple	17.
Pink	20.
Black or gray	21.
Green or yellow	30.

3. White Lines: Color of Ground:

Blue	4.
Brown	5.
Black or gray	6.

4. White lines on Prussian Blue ground. Blues can vary somewhat in intensity and hue.

CYANOTYPE

5. White lines on a cool brown ground. Found on paper only.

VAN DYKE - NEGATIVE ("brownprint")

6. White lines or gray areas on black or dark gray ground. Print surface smooth, paper fibers hardly visible. Image embedded in emulsion layer at surface. Found on paper only.

PHOTOSTAT - NEGATIVE

7. Blue Lines: Color of Ground:

White (possible edge discoloration)	8.
Green	9.

8. Blue lines (of a variety of hues: from purple-blue to green-blue) on a flecked, dirty white ground. Possible yellowish discoloration on sensitized image side. Image lines soft; folds and marks from original reproduced as well as image lines. Hard calendered surface, paper fibers not raised, typical of dry processing.

DIAZOTYPE (Blue)

OR

Prussian Blue lines on a white ground. Clean, uniform ground, possibly with overall faint blue tone, or light blue streaking. Hard image lines, embedded into the fibers of the support. Matte surface with raised paper fibers, typical of wet processing.

PELLET PRINT (Positive Cyanotype)

Fig. 5. Page of the flowchart from *A Manual for the Identification of Architectural Archives Reproductions*

hundreds of groups of drawings and re-segregate prints which had been mistakenly housed together. It is their hope that others will be able to benefit from these investigations and mistakes and use their experiences to aid in the ability to care for collections of architectural drawings.

The staff began to share information related to their research by answering inquiries sent to them by colleagues. They also gave hands-on workshops to curators, conservators, technicians, and archivists dealing with architectural drawing reproductions. Contemporaneously Ms. Kissel and Ms. Vigneau prepared the manuscript for *A Manual for the Identification of Architectural Archives* Reproductions which they hope to publish in the near future. It is designed for individuals who care for architectural records collections but do not have access to sophisticated analytical facilities. Using low magnification, the visual criteria devised should assist in the identification of many prints which may be found in architectural drawing collections. However, several duplicating processes were in use for very short periods of time, and a mystery print is likely to be found in every collection. Most commonly used historical printing processes are included in the manual, as well as some techniques currently in use for duplication. Several processes are still being investigated in the hope of finding concise information which will lead to accurate identification and care. The manual will be illustrated with color reproductions of prints, both general views and details. Again and again, the most limiting factor in the research was the lack of illustrations as well as written descriptions with which to compare the prints found in the L&B collection.

Figure 5 shows a section of the flowchart, which will appear in the Manual, designed for the identification of the prints. It uses simple questions that can be answered just by looking at the print, such as: "what is the nature of the support," "what color is the line," and "is the ground spotless or does it seem dirty," etc. The Manual will use color reproductions to illustrate each process to aid the user in identification.

CONCLUSION

The authors firmly believe that the proper identification of photo-reproductive prints, and the knowledge of their constituent elements, is a crucial component of every aspect of the preservation of architectural collections: records storage, access, exhibition, duplication and conservation. Knowing what elements a print consists of determines its use and care; it is thus a responsibility of every collection manager or conservator to understand how reproductions are produced and should be cared for. They are frequently the only documents that still relate to destroyed or damaged architectural structures.

ACKNOWLEDGEMENTS

The authors would like to thank Mr. John F. Reed, Director, NYBG Library for his support, Lois Price for her expertise and advice, and Wendy Gogel and her staff from The Frederick Law Olmsted Historic Site for their cooperation in testing our research. The research was made possible in part through a grant from The Samuel H. Kress Foundation which supported a six month educational internship in which Ms. Kissel participated.

JUDITH REED
Conservation Librarian
New York Botanical Garden Library
Bronx, NY 10458-5126

ERIN VIGNEAU
Conservation Assistant
New York Botanical Garden Library
Bronx, NY 10458-5126

ELÉONORE KISSEL
Paper Conservator
49, Quaí des Grand Augustius
75006 Paris FRANCE