

Notes on Dating Photographic Paper

Paul Messier, Conservator of Photographs, Boston, MA

This article is a minor revision of an article submitted to the American Institute for Conservation's *Topics in Photographic Preservation*, 2005. This article also appears on the website of the [Association of Photographic Art Dealers](#) (AIPAD). Unless otherwise noted, images are by the author.

Abstract

This paper presents an overview of techniques and resources for dating fiber-based, gelatin silver photographic paper. This review encompasses some well known practices based on optical brightening agents, manufacturer back printing, and paper fiber identification as well as techniques currently being developed such as the XRF analysis of the baryta layer and identifying paper fiber species and ratios. The paper is intended primarily for conservators and collectors that already possess a basic understanding of the existing literature on the subject, underlying principles of conservation research and the problems inherent in dating 20th century photographs. Within the strict context of the author's perspective, the paper is a general guide to the current state of research. More exhaustive research and / or peer-reviewed journal articles on the topic are either available elsewhere or are in active development.

1.0 Introduction

Knowing when a photographic print was produced has value. For the conservator, print date may carry implications for treatment, display and storage. In the marketplace, print date is probably the largest single variable affecting the price for a photograph. For the collector and curator, establishing a chronology of prints is a key toward understanding the course of a photographer's aesthetic development and the history of the medium. When provenance is lacking, incomplete or disputed, specialists from many spheres are often able to make judgments based on criteria such as state of preservation, markings and paper type. Dating prints in this manner can often be quite accurate though it is highly dependent on the expert interpretation of often subjective criteria. In cases where sufficient expertise is lacking, opinions conflict or when authenticity is questioned such analysis may not be sufficient. Until recently, however, there were no widely accepted techniques for objectively determining the manufacture date of 20th century photographic papers. Beginning in the late 1990's photograph conservators and conservation scientists gained significant ground with the promise of more developments in the near future ([Messier 2000](#) and [2001](#)). This paper examines some of the more useful techniques for dating photographic papers, their strengths and weaknesses, and describes some promising new directions.

2.0 Existing Methods

2.1 Optical Brightening Agents

Optical brightening agents are a special class of dyes used to make materials, especially paper and textiles, appear whiter and brighter. The dyes emit a cool blue white light when exposed to certain wavelengths of ultraviolet radiation. There is strong evidence, including manufacturer records ([Paper Service Division 1951](#)) and independent surveys of reference collections, indicating transition toward brightened paper was underway in the early to mid 1950's with the first substantial use of brighteners occurring in a period between 1955 and 1960. A survey conducted at the author's studio comprising 2,076 black and white, fiber-based, papers of known origin found very few incidences of brightened paper dating prior to 1955 and none earlier than 1950. ([Messier, Baas, Tafilowski and Varga 2005](#)). These few, early, incidences of brightened paper were not precisely dated, but packaging, graphics and image content indicate the papers were manufactured somewhere between 1950 and 1955. During this early transitional period, the commercial availability of brightened paper was quite limited. The same survey indicated that the sustained use of brighteners, with widespread commercial availability, began in the latter part of the 1950's, with roughly 33% of all papers from this period showing optical brighteners. The survey found peak use of brighteners in the periods 1960-1964 and post-1980. In the former time frame 55% of papers contained brighteners. In the latter period 78% of papers showed brighteners. The survey also concluded that brighteners were found predominantly in the emulsion side of papers produced prior to 1960. After 1960 brighteners were predominantly found on both the emulsion side and paper base.



Viewed with near ultraviolet radiation, optical brighteners in this print attributed to Lewis Hine cause a distinctive cool, blue-white glow.

Identification of brightened paper is relatively simple: The print is examined in a darkened room while exposed to near ultraviolet (U.V.) radiation. If brighteners are present the print will emit a distinct blue /white glow. Inexpensive incandescent or fluorescent “black lights” are often suitable for this purpose though these can emit a great deal of blue light that more expensive models might filter. Ultraviolet filtering eye protection should be worn when performing this test especially as darkened room conditions will cause pupils to dilate allowing maximum passage of radiation to the retina.

In practice, this technique has some drawbacks. Chief among these is that it requires a moderate level of experience and interpretation (Baas 2001). In some cases paper can appear “bright” under U.V. but lack the distinct blue-white glow of brightened paper. Blue light emitted by the U.V. source and reflected by the print highlights of the paper base can sometimes be confused with the blue-white fluorescence characteristic of optical brighteners, especially when brighteners are present in low concentrations. Brighteners can also fade with time, especially upon exposure to light and U.V. radiation.

From the evidence cited above and elsewhere, the presence of optical brightening agents is a clear indication of post 1950-55 production. However a finding that a print lacks brighteners is of little use for the purposes of dating. A substantial minority of papers produced after the mid 1950's did not contain brighteners. In addition to the chemical breakdown of brighteners by normal environmental factors (like the exposure to light) brighteners can be masked by the addition of other colorants, coatings and be destroyed by commercially available chemical compounds. Despite these limitations, the finding that questioned prints attributed to Man Ray (1890-1976) and Lewis Hine (1874 -1940)

contained brighteners was key in exposing these major authenticity scandals ([Robinson 1997](#); [Fessy 1998](#); [Vincent 1998](#); [Falkenstein 2000](#); [Woodward 2003](#)).

2.2 Paper Fiber Identification

The discovery that an analysis of the base paper for photographic prints held potential for the dating of 20th Century photographic papers also owes to work performed on questioned Man Ray and Lewis Hine photographs. In the case of Man Ray, this work was performed by the Felix Schoeller Company in 1997. Schoeller, an important supplier of baryta-coated base paper, found Man Ray prints submitted for analysis not only contained optical brightening agents but mixtures of hardwood and softwood consistent with papers the company produced in the 1950's to 1970's ([Felix Schoeller, Jr. Company, 1997](#)). For Hine, samples from questioned prints were gathered by this author and assessed using optical microscopy by Walter Rantanen of Integrated Paper Services in Appleton, WI. Rantanen identified fiber source (hardwood species vs. softwood species) and method of chemical processing (sulfite vs. kraft). These results were compared to a reference collection containing hundreds of dated prints assembled by Rantanen ([Rantanen 2000](#); [2001](#)). This work revealed some broad trends that are extremely useful in dating photographic papers. To summarize the findings: Papers in the early part of the century used fibers mostly derived from textiles, either cotton or flax. A transition toward the use of solely softwood bleached sulfite took place in the 1920's. By the 1930's papers contained almost exclusively softwood bleached sulfite. By the late 1950's mixtures of softwood bleached sulfite and hardwoods became more common. Initial uses of hardwood kraft fiber are seen in the 1970's. Also in the 1970's alpha grade cellulose, usually mixed with softwood bleached sulfite, begins to appear. The finding that many of the questioned Hine prints contained hardwood bleached kraft, was a strong indication that they could not have been produced during Hine's lifetime.

A minor drawback of this technique is that it requires the removal of a minute sample of paper fibers (about half the head of a pin) taken from the edges or reverse. For mounted prints, obtaining a sample can be quite challenging, especially as cross contamination from mounting papers can muddle results and interpretations. The microscopic identification of fibers and pulp processing technique requires high levels of specialized training and experience. In practice, the greatest drawback in the present technique is when results indicate 100% softwood bleached sulfite since this fiber mix is consistent with papers produced over a very broad range of dates, from the 1930's to the present.

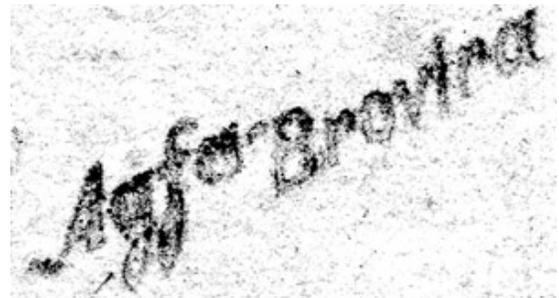


A mix of softwood bleached sulfite and hardwood kraft. Photo Credit: Walter Rantanen, Integrated Paper Services.

2.3 Back Printing

In some cases manufacturers applied inked logos and other information on the reverse of their papers. Though there are some exceptions, back printing is consistently used only on Agfa papers and on the longstanding Velox brand produced by Eastman Kodak.

While some superficial differences are evident in the typefaces, size and positioning of the Kodak back printing it is uncertain how much value these observations have when it comes to dating photographs. This author is just starting a methodical chronology of Velox and other back printing on Kodak papers and any useful results from this exercise might be a year or two away. A preliminary find is that the single word "Velox" with no other graphic embellishments was used to mark papers manufactured in



"Two part" backing printing used by Agfa prior to the late 1950's.

the United States dating from the late 1920's to the late 1940's. After 1950 or so, back printing on Velox stacked the words "Kodak / Velox / Paper." The three stacked words were used at least until the mid 1960's. Another finding is that Kodak papers manufactured in England, and probably elsewhere, had completely different typefaces and back printing styles.

The Agfa company was much more consistent in its use of back printing. While not every paper in the Agfa line carries back printing many do. When present, Agfa's markings can sometimes be used to establish a rough date of production. ([Agfa-Gevaert 1997](#); [Auer 1999](#)). Prior to the late 1950's, Agfa identified its papers using two words comprising the manufacturer name and the brand name such as "Agfa Brovira," "Agfa Portriga," "Agfa Lupex" etc. Following the late 1950's use of the brand name was dropped, leaving the one word "Agfa." Aside from dropping the brand name in the late 1950's, Agfa changed typefaces, added and subtracted quality control markers and other graphic elements over time. A chronological compilation of this information would be a tremendously useful, though the author knows of no such resource.

On the whole, the use of back printing for dating papers is of limited use since comparatively few papers show any manufacturer applied markings. Though relatively rare given the entire population of photographic papers it is a remarkable fact that many of the questioned photographs attributed to Man Ray and Lewis Hine, purportedly made in the first part of the 20th century, were found to contain the one word "Agfa" marking on the reverse clearly indicating the papers were manufactured after the late 1950's.

2.4 General Limitations

The use of optical brightening agents, paper fiber identification and manufacturer back printing comprises the "state of the art" for dating photographic papers circa 1999 and continues to be an effective aid for settling many cases when the origin of a print is unknown or in dispute.

While tremendously useful, these techniques have certain flaws and gaps. An important defect in the overall methodology is that it provides the date of paper manufacture and not print date. This consideration may occasionally cloud results for photographers that hoard expired papers in their freezer for decades but it is of greatest concern for the deliberate production of fakes using old paper stock. Not simply a hypothetical threat, a patient and highly skilled worker can produce acceptable prints on very old paper stock. ([Gold, 2001](#)). As stated, another defect is that results often encompass extremely broad date ranges. While useful for discriminating between a 1930's and a 1970's print, for example, determining a manufacture date within ten or twenty years is often impossible.

3.0 New Directions

3.1 Reference Collections of Photographic Paper

As the techniques listed above were being developed, it became increasingly clear that reference collections of photographic paper would be at the foundation of any future refinement of the existing methodology and had the potential to open entirely new directions for future research. The problem in the late 1990's was there seemed to be no such thing as a widely accessible, adequately documented, reference collection of photographic papers. For example, the collection in the possession of Walter Rantanen, which proved critical for the initial stages of paper fiber analysis, contained dated samples but lacked information on manufacturer, brand and finish.

To address this gap, this author began amassing a collection of unexposed photographic paper in original packaging and manufacturer sample books. As of this writing the collection has grown to over 2,700 papers and is catalogued by manufacturer, brand, date, surface finish, weight, base thickness, color and presence of optical brightening agent. As the collection continues to grow, plans are taking shape to make it available to researchers as broadly as possible. Owing to the source of papers, mostly internet auction sites like eBay, the collection is heavily weighted toward papers available in North America. There remains a need for the creation of similar collections, especially for European and Asian papers. Aside from the inherent value of documenting and preserving the methods and materials used by photographers in the 20th Century, the promise of this and other reference collections is that future research will be significantly more refined, making possible subtle distinctions between manufacturer, brand and date. The research techniques mentioned in this section are some of the initial and most promising proposed projects developed using well-characterized reference collections of photographic paper.



Samples of dated photographic paper in the author's collection used to assess a print of unknown origin.

3.2 Quantitative X-ray Fluorescence Spectroscopy of Baryta Coatings

This ongoing study, conducted principally by Dusan Stulik, Senior Scientist at the Getty Conservation Institute in collaboration with the author, relies on measuring the elements barium and strontium found in the baryta layers of photographic papers. Completed in 2004, the initial phase of the project centered on the creation of thin film standards containing known concentrations of barium and strontium. Using the standards for instrument calibration, X-ray fluorescence spectrometry (XRF) is used to measure concentrations and derive ratios of barium to strontium. Initial stages of the project established that concentrations of barium and strontium are very uniform across the plane of a single sheet of photographic paper. Concentrations of these elements were also found to be consistent across multiple sheets of photographic paper randomly selected from the same commercial package. ([Stulik and Messier 2004](#)). While these results show that barium and strontium levels are the same for a given brand of paper made during a certain time period, quantitative XRF data also show some significant differences emerge across manufacturers, date, brand and surface finish. These data indicate that baryta coated photographic paper produced over time differs enough in all determined analytical parameters that quantitative XRF can provide important clues needed for the development of a future provenancing methodology ([Stulik, Kaplan, Miller, Miller and Messier 2005](#)). As of this writing, this working hypothesis is being put to the test. Stulik and his team at the Getty have finished a systematic quantitative XRF assessment approximately 1,000 samples of photographic paper of known origin. Once the analysis of these data is complete, a baseline of XRF data will exist against which papers of unknown or questioned provenance can be compared.

3.3 Paper Fiber Analysis: Species Identification and Ratios

Existing techniques used for dating photographic papers by fiber analysis have focused on broad categories based on fiber source, such as rag, softwood and hardwood and method for chemical pulp processing such as sulfite and kraft. Based on a reference collection containing hundreds of dated samples, the present stage of development remains extremely useful for dating photographic papers. However further refinements are possible and needed, especially to address the apparent monolithic use of softwood bleached sulfite used from the 1930's to the 1960's and in diminishing quantities up until the present.

A logical step is to catalog the use of different wood species over time. An expert such as Walter Rantanen can usually identify common wood species used in the manufacture of photographic paper. Such species include softwoods like spruce/hemlock, white red and Scotch pine, and Douglas fir as well as hardwood species such as maple, alder, basswood, birch, beech and cherry. When fibers of different species and chemical processing history are present, the different fibers can be counted to determine mix percentages. This level of specificity applied to a highly characterized

reference collection could identify important trends showing how different manufacturers acquired pulp from different sources over time. The conservation department of the Museum of Modern Art, New York, is taking an active interest conducting a project along these lines in collaboration with Rantanen and this author. Like the quantitative XRF research, the goal of this project is to establish a chronological baseline comprising upwards of a 1,000 papers of known origin.

4.0 Conclusion

While the research outlined in this paper is designed to be useful for dating photographic papers of unknown origin, the implications are far greater. These projects, and indeed any other project focus on characterizing 20th Century photographic papers, have tremendous potential to raise the level of scholarship across a number of related disciplines. With time, these and other techniques can be harnessed to provide meaningful insights into the selection and use of photographic papers by individual photographers and how these decisions were reinterpreted over time. This type of technical analysis in support of art historical research is common for other media but is fairly rare for photography. The general lack of catalog *raisonne* studies is a case in point ([International Foundation for Art Research 2004](#)). There is more information on papers used by Rembrandt and Goya, for example, than for any of the 20th century masters like Weston, Modotti, Lange and Kertesz. With sustained effort this deficit can be addressed with prints by these photographers and others categorized into sets and subsets by date, paper manufacturer, brand, and finish. This work will yield a tremendous benefit by helping to understand how the expressive intentions of these artists were made manifest through their choices, use and manipulation of materials.

Pursuing these goals as vigorously as possible will, of course yield some important side benefits especially when it comes to photographic prints of questioned authenticity. As stated earlier and discussed in depth elsewhere in this volume, there is a clear potential for using old paper to make new prints. Placed in a wider context of art fraud, this type of menace is nothing new. Self-proclaimed “master faker” Eric Hebborn used chronologically appropriate papers, drawing materials and techniques to produce fraudulent Old Master drawings ([Hebborn 1992](#)). Such fakes are difficult to identify using the customary battery of analytical techniques as physical and chemical anachronisms simply do not exist. Threats like these make the need for materials-based catalog *raisonne* studies all the more emphatic. The development of a technical catalog of a photographer’s work will allow meaningful insight into which papers were used with which negatives over time. Faced with this higher level of understanding, or its potential, a determined fraud using old paper would need exactly the right old paper in terms of manufacturer, brand, finish, date and a host of other criteria. Combined with the limitations of making a credible looking print on rare, vintage, unexposed paper, the potential for success would be greatly diminished.

The significance of this work and its potential cross-disciplinary application highlight the need for building a credible, substantial and permanent body of literature. Whenever possible, reports on the initiatives outlined in this paper will be submitted to the peer-review process and appear in the permanent conservation literature such as the *Journal of the American Institute of Conservation*. Ideally work on these and other future projects should be collaborative and, to the extent possible, coordinated; involving data sets and samples shared across multiple collecting institutions. Just as building a permanent literature and shared body of knowledge should be a priority, there remains a need for an effective forum where the issues of dating provenance and technical studies can be discussed in a broader context. The AIPAD symposium, held at the Metropolitan Museum of Art in 2001, provided a useful model bringing together conservators, dealers, collector and curators. A sustained forum for the exchange information among these and related constituencies would be extremely beneficial.

- *Paul Messier, 2005*

Paul Messier's Boston-based private practice specializes in the conservation treatment and historical analysis of photographs. For more information visit <http://paulmessier.com> .

5.0 References

Agfa-Gevaert. 1997. Determining the age of Agfa paper stock, letter to Werner Bokelberg. April 18, 1997.

Auer, J. 1999. Personal communication. National Technical Manager, Agfa Consumer Imaging Products, Ridgefield, NJ.

Baas, V., 2001. Optical brighteners in photographic papers. Conference presentation, Association of International Photography Art Dealers, New York, NY.

Felix Schoeller, Jr. Company, 1997. Analysis of Man Ray samples, letter to Werner Bokelberg. May 26, 1997.

Falkenstein, M., 2000. The Hine question. ARTNews 99(5): 210-13.

Fessy, E., 1998. Magnificent Man Rays too good to be true. The Art Newspaper June: p.8.

Gold, J., 2001. Investigation of Methods used to Misrepresent the Conditions and the Age of Photographs. Conference presentation, Association of International Photography Art Dealers, New York, NY.

Hebborn, E., 1992. Master Faker, the forging of an artist. London: Pan Books.

International Foundation for Art Research, 2004. Authenticity Issues in Photography. International Foundation for Art Research Journal 7 (2): 20-53.

Messier, P., 2000. Toward a methodology for dating pre & post 1950 photographic prints. Conference presentation, Photographic Materials Group of the American Institute for Conservation meeting, Philadelphia, PA.

Messier P., 2001. Methodology of dating photographs relative to 1950. Conference presentation, Association of International Photography Art Dealers, New York, NY.

Messier, P., V. Baas, D. Tafilowski and L. Varga., 2005. Optical brightening agents in photographic paper. Journal of the American Institute for Conservation, 44 (1): 1-12.

Paper Service Division. 1951. The use of fluorescent dyes as brighteners for photographic paper. Eastman Kodak Company, Rochester, NY.

Rantanen, W., 2000. The use of paper analysis in dating photographic prints. Presentation, Photographic Materials Group of the American Institute for Conservation meeting, Philadelphia, PA.

Rantanen, W., 2001. Using optical microscopy to date photographic papers. Conference presentation, Association of International Photography Art Dealers, New York, NY.

Robinson, W., 1997. Man Ray forgeries exposed. Artnet Magazine: www.artnet.com/Magazine/news/robinson/robinson12-2-97.asp (first published December 2, 1997, accessed August 15, 2005).

Stulik, D and P. Messier, 2004. Quantitative XRF study of baryta coated photographic paper. Photographic Materials Group of the American Institute for Conservation meeting, Portland, OR.

Stulik, D., A. Kaplan, D. Miller, G. Miller and P. Messier. 2005. Study of Baryta Coated Silver Gelatin Photographic Papers: Chemometrics Approach, Photographic Materials Group of the American Institute for Conservation meeting, Vancouver, British Columbia.

Vincent, S., 1998. Duped. Art & Auction, February: p 80.

Woodward, R.B., 2003. Too much of a good thing photography, forgery, and the Lewis Hine scandal. The Atlantic Monthly 291(5): 67-76.