

Noble Metals for the Early Modern Era: Platinum, Silver-Platinum, and Palladium Prints

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Histories of photography usually emphasize the photographers' command of the camera and the resulting pictures while offering little insight into the extensive chemical and technical artistry performed in studios and darkrooms. Research into the materials and methods behind photographic prints, however, can shed light on the aesthetic goals of the photographers and help to determine which properties are the result of artistic decisions and which might be the natural effects of aging. By studying the array of platinum, silver-platinum, and palladium prints in the Thomas Walther Collection, we are given an opportunity to appreciate how photographers in the early twentieth century manipulated materials and chemicals to achieve a quasi-modern aesthetic.

The aesthetic benchmark for many photographers at the dawn of the twentieth century was the platinum print, extolled for its unparalleled artistic qualities and permanence. Alfred Stieglitz (1864–1946) and Clarence H. White (1871–1925), both highly influential photographers and leaders of Pictorialism, a movement championing photography as fine art, praised platinum as the ideal photographic medium for their exhibition prints. Their disciples continued to test the medium for new and unusual effects, exploiting such curiosities as multiple exposures, tone reversal, and solarization, and exploring unconventional compositional elements and abstraction. Highly attuned to the technical craft of their work, they investigated myriad products and chemical modifications to achieve their artistic objectives. Sharing experiences with one another through camera clubs, journals, courses, and public exhibitions, they brought the platinum aesthetic further into the early modern era.

The laborious process of making platinum prints was the model for the silver-platinum and palladium processes that emerged later and sought to mimic its effects. All began with the same steps used to create a gelatin silver print—exposing, developing, and retouching negatives. Platinum papers were coated with a solution of light-sensitive iron salts mixed with platinum salts, which resulted in images made of metallic platinum. Sensitizers for silver-platinum and palladium photographs contained the salts of these metals and other chemical additives.

Photographers could sensitize their own papers, but generally they purchased ready-sensitized papers. The most common support for the platinum image was a plain paper similar to fine-quality letter stationery, which gave the final

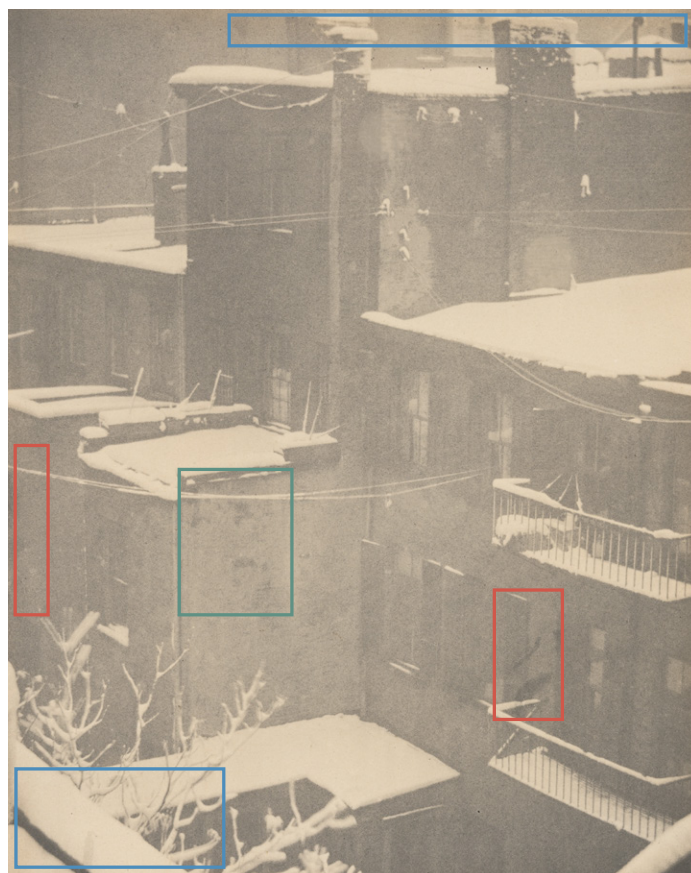


fig. 1 Alfred Stieglitz. *From the Back Window at "291"*. April 3, 1915. Platinum print, 1916, 9 $\frac{3}{4}$ \times 7 $\frac{11}{16}$ " (24.7 \times 19.5 cm). The Museum of Modern Art, New York. Thomas Walther Collection. Gift of Dorothy Norman, by exchange (MoMA 1870.2001). © 2014 Estate of Alfred Stieglitz/Artists Rights Society (ARS), New York. The superimposed rectangles highlight mottling and shifts in tone.

prints a matte and sometimes velvety surface. With such paper, the image material sits within the uppermost paper fibers. The qualities of plain-paper prints are in stark contrast to those of gelatin silver prints, which have an emulsion layer that provides a smooth, often reflective surface. Other papers were chemically modified in a way that produced a variety of surface qualities; some offered a surprisingly lustrous sheen that might lead today's viewer to think, incorrectly, that the prints have a finishing coating or are gelatin silver prints.

The platinum and platinum-related mediums often produced a gray and black (neutral) image hue, but a sepia

coloring was also common. Photographers, however, could manipulate certain variables while exposing and processing the sensitized papers to produce a remarkably wide range of color gradations and image qualities to suit their individual tastes. According to Pictorialist and technical authority Paul L. Anderson, “The manufacturer’s instructions can be regarded as a starting point for the pictorialist, who will amplify and modify them in order to obtain the effects which he desires.”¹ Photographers could alter the moisture content of sensitized papers before exposing them, for instance, which would affect the image hue and level of graininess.² They could also modify the sensitizer or developer by using additives such as mercury or chromium, or by adjusting the developer’s temperature or diluting it with water, all of which would impact their images’ appearance. Finally, photographers could retouch prints to diminish flaws, coat them with waxes or varnishes to enhance brilliance and provide some degree of protection, and mount them to present them to their best advantage.

PLATINUM PRINTS

Silver prints, which date from the beginnings of photography, in 1839, had a significant disadvantage: they tended to fade. William Willis Jr. (1841–1923) created a more permanent system by developing the first practical platinum-print process. He called his first commercial platinum paper the Platinotype, which in 1879 he began marketing through his Platinotype Company of London and its sister company,

Willis & Clements of Philadelphia. His advances in platinum-related photographic processes can be tracked by way of his six patents, copious articles, and advertisements in photography journals.

Willis’s success with Platinotype prompted other manufacturers—including Eastman, Ilford, Geveart, and American Aristotype—to market their own versions of platinum papers, as well as gelatin silver and collodion silver papers that mimicked the characteristic velvety appearance of platinum prints. Competing companies offered dozens of products that provided artists with a variety of paper colors, surface textures, and image hues. The ever-expanding assortment of products and techniques posed a constant challenge to photographers, who explored each new material’s possibilities in their quests to perfect the effects they desired. Artists took great pains to adapt their darkroom methods in this changing landscape.

Stieglitz championed platinum as early as 1887 and called it the “prince of all processes.”³ His 1915 work *From the Back Window at “291”* (fig. 1) epitomizes the classic platinum print: it has a soft, near-neutral image hue and the smooth, matte surface of plain paper.⁴ Platinum was the only metal revealed in X-ray fluorescence analysis (XRF). No additives, such as mercury, were used to affect the tone of the image. The low density of the image is an artistic interpretation of the low-contrast snowy scene; Stieglitz may have achieved this effect by using diluted developer.⁵ The image tone is influenced to a small degree by the color of the



fig. 2 Gertrude LeRoy Brown. Max Weber. 1914–16. Platinum print, 1914–16, 8 ½ × 6 ¼" (20.7 × 15.6 cm). The Museum of Modern Art, New York. Thomas Walther Collection. Gift of Thomas Walther (MoMA 1640.2001)

fig. 3 Detail of the top and right edges of Brown's Max Weber, which show a slight misalignment between two separate negatives printed in contact with each other to achieve the double portrait.



fig. 4 John P. Heins. Untitled. c. 1919. Platinum print, c. 1919, $4\frac{13}{16} \times 3\frac{13}{16}$ " (12.2 × 9.7 cm). The Museum of Modern Art, New York. Thomas Walther Collection. Gift of Thomas Walther (MoMA 1693.2001)

paper (off-white) and what appears to be slight staining. The print is lighter overall than another print from the same negative that is in the collection of the National Gallery of Art (NGA) in Washington, D.C.; this inconsistency between the two prints might be due to differences in their exposure or development times. The irregular mottling just below the center (fig. 1, green box) is present in both prints, and therefore is original to the negative. But the darker mottling seen in the Walther Collection print at the left edge and lower right (fig. 1, red boxes) is not present in the NGA print, nor is the shift from a neutral gray toward a warm tone at the top edge and lower left corner of the image and paper base (fig. 1, blue boxes). Subtle variations such as these are commonly seen in hand-processed prints.

Notable figures in art and photography, including those from Stieglitz's circle, came to teach at the Clarence H. White School of Photography in New York, which White founded in 1914 and which became the most significant photography school in the city in the first half of the twentieth century. Anderson and leading Cubist painter Max Weber provided the basics in theory and practice. Guest lecturers included accomplished platinum printers,

such as Gertrude Käsebier, F. Holland Day, Karl Struss, Margaret Watkins, Anton Bruehl, and Paul Outerbridge, all of whom played influential roles in advancing platinum as a preferred medium of photographic artists. Students worked with both commercial and hand-sensitized papers and mastered countless chemical manipulations to control contrast and hue.⁶

Photographs by White School student Gertrude LeRoy Brown and students-turned-lecturers John P. Heins and Bernard Shea Horne embody the archetypal matte, deep-charcoal-gray platinum-print aesthetic. Their uniformity in paper color, surface texture, and image hue suggests the influence of White and Anderson. The photographs might be printed on the commercial papers recommended on the school-supply list given to students, which included Platinotype Company papers on white, smooth stock in heavy or extra-heavy varieties.⁷

To create the highly unusual portrait *Max Weber* (1914–16; fig. 2), Brown placed two negatives together—one bearing a full-figure view of Weber, and the other a three-quarter view of his head—and printed from the combined negatives. Evidence of this composite approach can be found at the corners and edges of the print (fig. 3), where slight misalignment between the images is visible. A deliberately disorienting and enigmatic print by Heins (fig. 4) combines silhouettes and cast shadows with unusual architectural elements. There are no comparable images in Heins's oeuvre, and how exactly he made it is unknown. These two prints, likely done as school assignments, are excellent examples of the unpredictable nature of chemical additives on image tonality. Although they were made using different materials—the Heins image is platinum, whereas the Brown image contains both platinum and mercury—they have similar near-neutral hues.

Four prints by Horne (MoMA 1702.2001, 1703.2001, 1704.2001, and 1705.2001) exemplify the highly finished work of an accomplished artist. The prints were skillfully executed, with a near-neutral hue on plain warm-white paper, and carefully mounted for display. Through XRF, all have been identified as platinum prints with mercury.

In his 1917 book *Pictorial Photography: Its Principles and Practice* Anderson discusses the effects of using mercury in developer:

*A slight increase in warmth of tone is secured by using a hot developer, and commercial papers may be obtained in which the sensitizing has been such as to give sepia prints. The writer, however, prefers to use the black papers and secure warmer tones by modifying the developer, since the shadows of a print on sepia paper are apt to look rather thin and uninteresting, whereas very desirable rich effects of any desired warmth may be obtained on the regular black papers. The addition of a slight amount of bichloride of mercury to the developer produces a warm black, and further additions may increase the warmth of color up to a full sepia.*⁸

Anderson's writings provided the technical fundamentals for countless American Pictorialists and reflect his bias toward platinum and palladium: "For contact work platinum—or its newer equivalent, palladium—is probably superior to anything else, but many workers prefer one or another of the various silver papers, which, though possessing the advantage of not requiring sunlight for printing, have neither the scale, the surface quality nor the permanence of platinum."⁹

A DEPARTURE FROM PLATINUM: SATISTA

At the beginning of World War I, platinum metal was needed for military use and thus access to it was limited. Its price rose accordingly and the availability of platinum photographic papers declined.¹⁰ The Platinotype Company responded to the dearth of platinum by developing new photographic products that incorporated the more readily available and less expensive precious metals silver and palladium.

In 1914 the Platinotype Company introduced a paper called Satista, which combined a relatively small amount of platinum with silver.¹¹ Satista was sold at a price closer to that of silver papers and produced neutral-hued images that were considered indistinguishable from platinum prints. The journal *Photo-Era* predicted that "workers will forsake Platinotype and use Satista (the image in which is only partly platinum), as the results are almost identical,"¹² and Willis & Clements advertised that "the prints are absolutely permanent."¹³ Satoid, a variant of Satista that provided

sepia tones, was offered in 1916.¹⁴ In 1917 the company's palladium-based Palladiotype came on the market.¹⁵ Both Satista and Palladiotype were adopted as alternatives to platinum, but photographers never embraced them as equal to that medium, since, among other reasons, the products were more expensive than gelatin silver, could be inconsistent, and their permanence was doubted.

A fascinating example of a print made on Satista paper is *Porch Railings, Twin Lakes, Connecticut* (1916; fig. 5) by Paul Strand (1890–1976). Strand was a young protégé of Alfred Stieglitz. The two artists exchanged ideas and shared information on the latest practices involving fine prints during the 1910s and '20s, and both printed on Platinotype, Satista, and Palladiotype. Today, *Porch Railings* displays a split-tone, brown-and-gray image instead of the neutral black-and-gray one it would originally have had. The extensive and highly visible neutral-hued areas of retouching would have initially matched the tone of the print, and thus show that the print has faded (the retouching medium being more stable than the photographic image). Over time, the print's darker tones have turned a pale sepia-gray, while the gray low-middle tones have become lighter but remain neutral in hue (fig. 6). This fading and chromatic shift are distinctive aging characteristics of the Satista process and the result of an inherent flaw in the chemistry that was not anticipated at the time Satista prints were made. The reasons for such deterioration are not entirely known, but it is speculated that the silver component may fade and shift in hue toward brown, while the more robust platinum component maintains its neutral hue.¹⁶

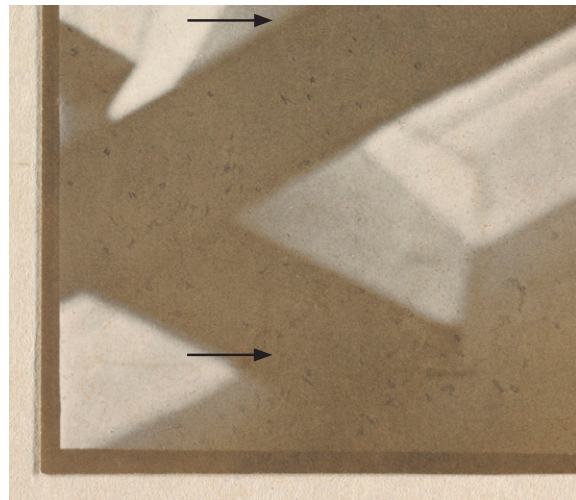


fig. 5 Paul Strand. *Porch Railings, Twin Lakes, Connecticut*. 1916. Silver platinum print, 1916, 12¹⁵/₁₆ × 9¹¹/₁₆" (32.8 × 24.6 cm). The Museum of Modern Art, New York. Thomas Walther Collection. Horace W. Goldsmith Fund through Robert B. Menschel (MoMA 1865.2001). © Aperture Foundation Inc., Paul Strand Archive

fig. 6 Detail of Strand's *Porch Railings, Twin Lakes, Connecticut*, showing image hues of neutral gray (upper arrow) and warm sepia-gray (lower arrow). The specks in the sepia-gray area are retouching marks, which indicate that the image (originally darker) has faded and shifted from a neutral to a warm tone. The gray tones have remained neutral.



fig. 7 Paul Strand. *Porch Shadows*. 1916. Reproduced in *Camera Work*, no. 49/50 (June 1917). © Aperture Foundation Inc., Paul Strand Archive

Another Satista print by Strand, *Porch Shadows* (1916)¹⁷—which is a companion print to *Porch Railings* and is similar in size, format, and presentation—was reproduced as a photogravure in the final edition of Stieglitz's journal *Camera Work* (fig. 7). Stieglitz took great pains to reproduce the works of art in *Camera Work*, using the finest photogravures to translate the appearance of the works into ink.¹⁸ The reproduction may be the best evidence of how the Satista print might have appeared in its original form. Perhaps Strand's influence prompted Stieglitz to write, in December 1916, to Alfred Clements of Willis & Clements in Philadelphia:

*As for the Satista papers, I am going to try them out. I am a pretty busy man and I have to steal the minutes for my photographic experiments. I am so at home with platinum, having used it since 1883, virtually to the exclusion of anything else, that I hate the idea of having to find a substitute. Still I am going to try the Satista papers to see what they will do.*¹⁹

The following year Stieglitz tried his hand with Satista. Among his 1917 Satista prints is a portrait of none other than the young Paul Strand.²⁰

JAPINE

In 1906 the Platinotype Company introduced Japine Platinotype. Willis coined the term “Japine” to describe a new line of print products with a paper surface that resembled parchment and that was completely different from the surface of conventional plain-paper prints.²¹ This surface was not an applied coating but the result of a chemical modification of the paper itself.²² Willis described the process in his 1913 patent, saying that the paper was “treated on each side with sulfuric acid sufficiently strong to attack the paper . . . the aim being to get a film of altered paper.”²³ The chemical treatment caused the uppermost layer of paper fibers to form a thin crust, which provided a surface that could range from matte to glossy. The Platinotype Company referred to Japine papers in many ways to draw attention to their special qualities and to differentiate them from the plain papers offered by their competitors. In one advertisement, for instance, the company described Japine papers that provided the “half glossy ‘egg shell’ surface met with in some carbon prints” and that produced images with shadows that were “not dull, but rich and lustrous.”²⁴ Previously, the only option for enhancing the surface of a plain-paper print was by coating it with substances such as gelatin or wax to “restore the brilliance which the print has when wet.”²⁵ Sometimes even Japine prints received such coatings, as a means of further enhancing their surface qualities.

The Platinotype Company's original version of Palladiotype was a sepia Japine paper with a surface likened to that of vellum. The company soon offered the papers in black and warm black and with matte and semi-matte Japine surface choices.²⁶

Both Stieglitz and Strand printed on Japine papers during their careers. Characteristic attributes of Japine Palladiotype can be seen in two of the artists' portraits of their wives: Stieglitz's *Georgia O'Keeffe: A Portrait* (1918; see fig. 10) and Strand's *Rebecca* (1922; fig. 8). Both prints have the subtle sheen of semi-matte Japine, which could be mistaken for a superficial coating or a layer of sizing, and have developed fine cracks. Such cracking is common among Japine prints—usually occurring along the prints' edges and not infrequently in their interior areas (fig. 9)—and thus can be treated as evidence of a Japine surface. The cracks in the O'Keeffe portrait are extremely minor compared to those in many of Stieglitz's other Japine Palladiotypes, and are located primarily at the sides of the print, where the paper was trimmed before being exposed.

The Stieglitz print is warm black on a heavyweight buff-colored paper (fig. 10). It may be one of the Japine Palladiotype prints that O'Keeffe described in 1978 as being “on a beautiful parchment paper.”²⁷ The print is in excellent

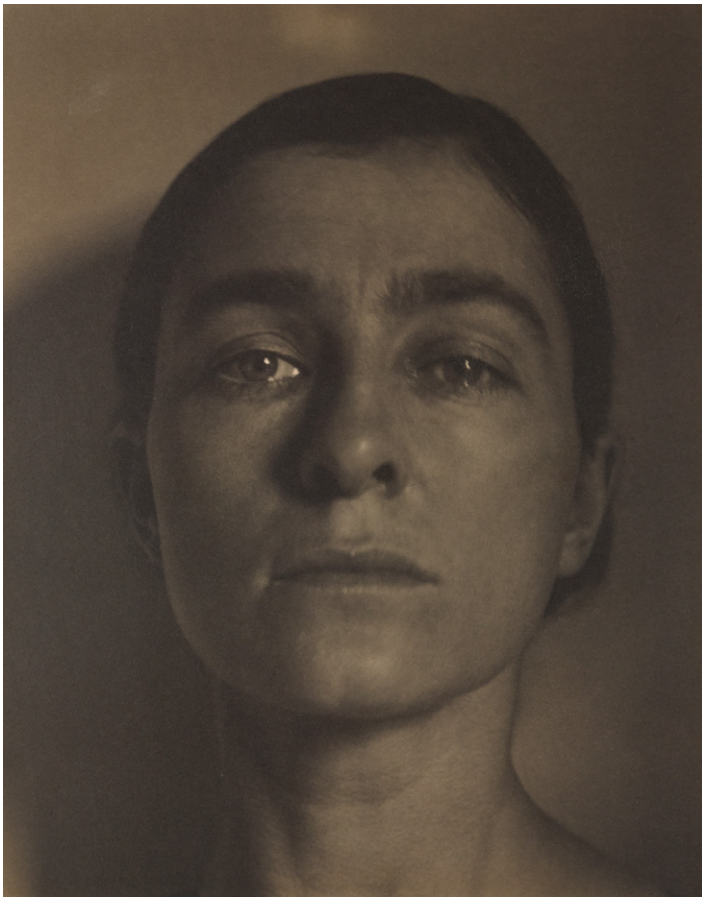


fig. 8 Paul Strand. *Rebecca*. 1922. Palladium print, 1922, 9 $\frac{9}{16}$ × 7 $\frac{5}{8}$ " (24.3 × 19.3 cm). The Museum of Modern Art, New York. Thomas Walther Collection. Gift of Thomas Walther. (MoMA [1866.2001](#)). © Aperture Foundation Inc., Paul Strand Archive

fig. 9 Detail of Strand's *Rebecca*, showing fine cracking in the surface of the print.

condition, with only very minor staining (at the lower right and left corners) and no apparent fading. There are no extant notes by Stieglitz specifying the exact chemical formulations he used to chemically process his prints, but XRF analyses indicate that mercury is present in this one.

An inscription on the mount reads, "Treated by Steichen—6/50," which refers to chemical treatments performed by Edward Steichen in 1950, at O'Keeffe's request, to reduce unacceptable stains on the palladium prints in Stieglitz's possession at the time of his death.²⁸ A graphite-pencil border surrounds the print on the mount, likely drawn by O'Keeffe's assistant Doris Bry, who traced the prints on the mounts as a means of recording their exact placement before removing them to be treated by Steichen (fig. 11).²⁹ After being treated, the prints were returned to their original positions on the mounts.

Strand's *Rebecca* is a very dark print, in mostly warm-black hues, and was printed on a semi-gloss, buff-colored paper that is most likely Japine Palladiotype. The non-image borders and the entire verso seem to be slightly stained, which may indicate the presence of residual processing chemicals. Nonetheless, this print is in fine condition. Strand's Japine prints generally have less cracking than those by Stieglitz. He was able to prevent a certain amount of cracking by managing the humidity in his

working environment. In a letter to a fellow photographer, Ned Scott, he explained:

Now I will tell you my notions about platinum paper which I think are right—both you and Stieglitz are wrong—as regards cracking—There are two factors related—one the age of the paper and whether the cans even before opening have been kept away from heat. Two, the climate you open and print in—There is no doubt in my mind that steam heat raises hell with the paper—Out west, as I wrote you, I had very little trouble—Here I have had none—as during the rainy season it has been quite damp.... Literally I haven't had a single crack in Mexico.³⁰

EDWARD WESTON'S PALLADIUM PRINTS

The California artist [Edward Weston](#) (1886–1958) began formally studying photography in 1908, during the peak of platinum photography. His early exhibition photographs, like those of his more seasoned East Coast peers, were made on platinum and palladium papers; he continued to work in platinum until 1924 and in palladium until 1926. He eventually switched entirely to gelatin silver paper, declaring "no more Palladio for lack of money."³¹

Three palladium prints by Weston in the Walther Collection (MoMA [1903.2001](#), [1904.2001](#), and [1910.2001](#)) share a distinct warm-brown image hue; XRF reveals the



fig. 10 Alfred Stieglitz. *Georgia O'Keeffe: A Portrait*. 1918. Palladium print, image: $9\frac{9}{16} \times 7\frac{3}{8}$ " (23.6 × 18.7 cm). The Museum of Modern Art, New York. Thomas Walther Collection. Grace M. Mayer Fund (MoMA 1871.2001). © 2014 Estate of Alfred Stieglitz/Artists Rights Society (ARS), New York

fig. 11 Detail of Stieglitz's *Georgia O'Keeffe: A Portrait*, showing print edge and pencil mark on mount.

presence of mercury. Like Stieglitz and Strand, Weston purchased products from the Platinotype Company, and these prints were likely made on matte-surfaced Palladiotype. But subtle inconsistencies in the prints—due to numerous variables, including the aging of the materials—make it impossible to identify the exact products he used.

Although Weston disdained the practice of retouching photographs,³² his photographs do display evidence of such work. It seems the majority of this retouching was performed on the negatives, with only minor adjustments made on the prints. Several areas of Weston's *Steel: Armco, Middletown, Ohio* (1922; fig. 12) appear to have been retouched, including an area along the power lines in the lower left of the image (fig. 13). It is unlikely that these light spots arose from bleaching; while silver prints can be selectively bleached for the purpose of retouching, it is extremely difficult and impractical to bleach platinum and palladium prints, not only because of their complex chemical nature but also because the image rests within the uppermost fibers of the paper rather than upon a forgiving emulsion. It is possible that the print was originally neutral in hue and gradually discolored over time; an ingredient in the retouching solution may have protected the areas from shifting toward sepia. It is also possible, however, that the print was originally sepia and the solution caused the retouched areas to shift toward gray. Other platinum and palladium prints by Weston exhibit similar inconsistencies, about which there are similar uncertainties.

What role mercury played in determining the original color of this print is unclear, as is its impact on the long-term stability of palladium prints.³³ Research under way at the NGA indicates that the permanence of platinum and palladium prints was affected when chemical additives were used in the sensitizer and developer, and that some prints made using such additives look different today than they initially did.

Weston's photographs *Tina* (1924; MoMA 1906.2001) and *Cloud, Mexico* (1924; MoMA 1910.2001) are in outstanding condition: no fading or staining is evident. Like *Steel*, however, *Tina* bears neutral-hued areas of retouching, in the upper torso of the figure, that suggest the print may have originally been more neutral in hue.

Weston made an important discovery regarding the influence of his paper stock on his prints, and soon after he made *Cloud, Mexico* he abandoned buff-colored paper in favor of a white support. In a 1925 journal entry, he wrote:

*One so easily gets into a rut. Why I have not used the white stock palladio before can only be answered by admitting myself addicted to buff from years of professional usage. And to use a tinted stock is a form of affectation near to "artiness." The white stock is clean, direct, unpretentious: it presents unveiled all the negative has to give. It reveals the best of a good negative and exposes the worst of a bad. There is no hiding behind a smudge of chemical color.*³⁴

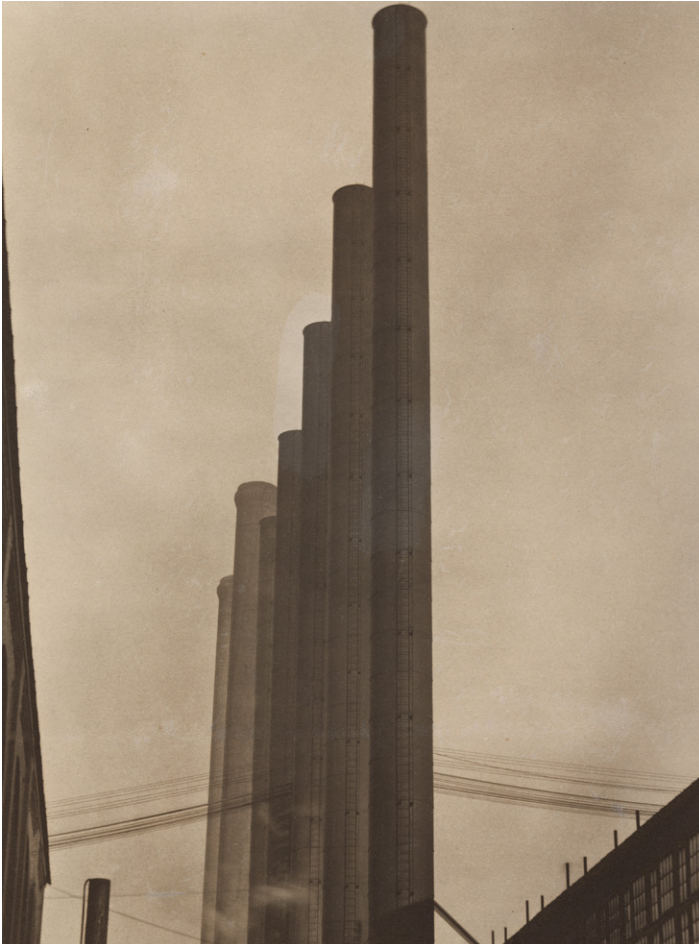
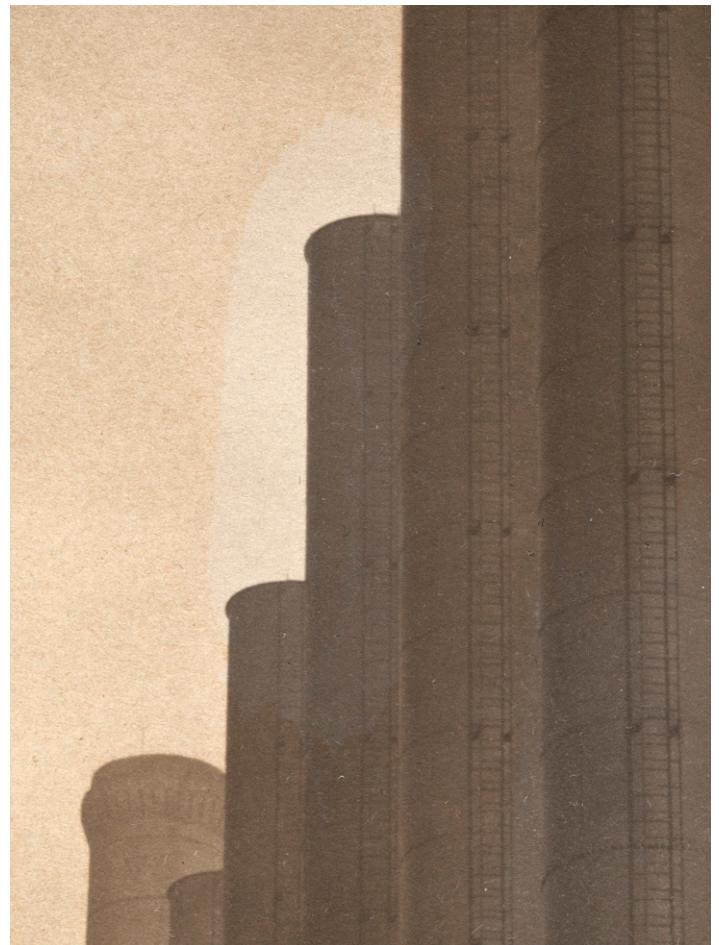


fig. 12 Edward Weston. *Steel: Armco, Middletown, Ohio*. October 1922. Palladium print, 1922, 9³/₁₆ × 6⁷/₈" (23 × 17.4 cm). The Museum of Modern Art, New York. Thomas Walther Collection. Gift of Thomas Walther (MoMA [1903.2001](#)). © 1981 Center for Creative Photography, Arizona Board of Regents

fig. 13 Detail of Weston's *Steel: Armco, Middletown, Ohio*, showing evidence of retouching.

fig. 14 Detail of Weston's *Steel: Armco, Middletown, Ohio*, showing neutral-hued streak.



Weston's comment regarding the "smudge of chemical color" refers to the yellow stain of unexposed sensitizer that is seen in prints that have been incompletely cleared or washed. Such staining could be immediately apparent on a photograph printed on white stock, but if buff- or cream-colored paper was used, it may become visible only over time, darkening with age. Weston foretells a problem that would haunt photographers, collectors, and conservators for years to come. Photographers followed the (sometimes imprecise) manufacturers' instructions, the advice of experts, and published formulas, but ultimately had to rely on visual observation to judge the thoroughness of the clearing and washing. This "smudge of chemical color" could become evident in time, discolor the paper, and influence the overall tone and longevity of the print. While the predominant color of the three Weston palladium prints is sepia, several neutral-hued areas appear in the sky of *Steel*, particularly clearly to the left of the smoke stacks (fig. 14). It is unknown whether these changes should be described as fading or staining.

It is difficult for today's scholar to ascertain the exact methods by which a platinum, silver-platinum, or palladium print was made without contemporaneous notations regarding the materials and processes used to produce it. Such records are exceedingly rare. The appearance of a print may change over time: the materials and processes used to make the print and the conditions in which it was stored and displayed can influence chemical stability. The image may shift in hue and fade, the paper may darken, and the surface may degrade.

Sophisticated analytical instruments in the hands of a knowledgeable scientist can shed light on the nature of the materials present in a print, but science alone cannot explain exactly how the qualities of a photograph came to be. Period technical and artistic literature provides long-forgotten information on photographic materials and practices and the aesthetic goals of the artists. Conservators, historians, and scientists must work together, sharing knowledge and observations, in order to form a more complete understanding of these works of art and of how to preserve them in as close as possible to their original state.

NOTES

1. Paul L. Anderson, *Pictorial Photography: Its Principles and Practice* (Philadelphia and London: J. P. Lippencott Co., 1917), p. 144.
2. The moisture content of photographic paper could be altered by steaming the sheet, by allowing it to acclimatize to a local environment, or by placing it in a tightly sealed container with a desiccant or a piece of moist blotter paper.
3. Alfred Stieglitz, "The Platinotype Process and the New York Amateur," *American Amateur Photographer* 4 (April 1892):153–55.
4. After his student days, Stieglitz used only commercial platinum papers rather than sensitizing his own papers. See Julia Thompson, "Chronology of Processes and Techniques," in Sarah Greenough, *Alfred Stieglitz: The Key Set* (New York: Abrams, 2002), 2:943.
5. Alvin L. Coburn, "A Few Hints for Platinotype Workers," *Camera Craft* 5, no. 6 (October 1902):235–38.
6. Other print processes were taught as well. See Clarence H. White School of Photography brochures from 1914 in the Clarence H. White Collection, Princeton University, N.J., and from 1922 to 1923 in the Amon Carter Museum Archives, Amon Carter Museum of American Art, Fort Worth, Texas.
7. "Clarence H. White School of Photography Photographic Problems" (1923), Margaret Watkins Fonds, McMaster University Libraries, Hamilton, Ontario.
8. Anderson, *Pictorial Photography*, p. 150.
9. Anderson, *The Fine Art of Photography* (Philadelphia and London: J. P. Lippencott Co., 1919), p. 260.
10. "The Platinotype Paper Shortage," *Photo-era Magazine* 3, no. 4 (April 1916): 208.
11. "Satista Printing Paper," *The British Journal of Photography* no. 2,816 (April 24, 1914):331.
12. Carine and Will A. Gadby, *Photo-Era* 36, no. 1 (January 1916):146–47.
13. *Amateur Photographer's Weekly* 4, no. 83 (February 6, 1914):131.
14. See "A Sister to 'Satista' — 'Satisoid,'" *The Photographic Dealer* 30, no. 238 (March 1916):100–101; and "The Photographic Printing Processes," *The Photo-Miniature* 13, no. 154 (October 1916):412.
15. "Palladiotype," *The Amateur Photographer & Photographic News* 65 (March 19, 1917):180.
16. MoMA and the National Gallery of Art are currently investigating this phenomenon; results were presented as part of the October 2014 symposium "Platinum and Palladium Photographs" at the Smithsonian National Museum of the American Indian in Washington, D.C. See also Lisa Barro, "The Deterioration of Paul Strand's Satista Prints," *Topics in Photographic Preservation* 10 (2003):37–54.
17. The Art Institute of Chicago, acc. no. 1949.885.
18. *Camera Work* no. 49/50 (1917).
19. Letter from Alfred Stieglitz to Alfred Clements, December 26, 1916, Yale Collection of American Literature, Beinecke Library, Yale University, New Haven, Conn.
20. See James Enyeart, Adelaide B. Anderson, Steven J. Perron, D. K. Rollins, and Quintus Fernando, "Non-destructive Elemental Analysis of Photographic Paper and Emulsions by X-ray Fluorescence Spectrometry," *History of Photography* 7 (April–June 1983):99–113. This print, *Paul Strand*, owned by the Center for Creative Photography in Tucson, Ariz., is inscribed in Strand's hand, "Photo of Paul Strand by Alfred Stieglitz / 1916 or 17 / faded Satista Print."

21. See Constance McCabe, Matthew L. Clarke, Christopher A. Maines, Lisa Barro, Silvia A. Centeno, and Anna Vila, "An Initial Investigation into Japine: William Willis's Proprietary Paper," *Topics in Photographic Preservation* 15 (2013):27-33; and Clarke, McCabe, and Maines, "Unraveling the Modified Surface of the Photographic Paper 'Japine,'" *Analytical Methods* 6 (2014):147-55.
22. Captain Owen Wheeler, *Photographic Printing Processes* (London: Chapman and Hall, 1930), p. 138.
23. William Willis, patent for improvements in or relating to photographic printing and paper, UK, no. 20,022, September 4, 1913.
24. Platinotype Company advertisement, *The Amateur Photographer*, August 21, 1906, p. xiv.
25. Anderson, *Pictorial Photography*, pp. 152-53.
26. McCabe et al., "An Initial Investigation into Japine," pp. 27-33.
27. Georgia O'Keeffe, introduction to *Georgia O'Keeffe: A Portrait by Alfred Stieglitz* (New York: The Metropolitan Museum of Art, 1978), n.p.
28. See Douglas Severson, "Alfred Stieglitz's Palladium Prints and their Treatment by Edward Steichen," *Journal of the American Institute for Conservation* 34, no. 1 (1995):1-10; and Douglas Severson, "'Treated by Steichen': The Palladium Prints of Alfred Stieglitz," *Art Institute of Chicago Museum Studies* 31, no. 2 (2005):74-79. The National Gallery of Art is investigating the exact nature of Steichen's treatment, which is currently unknown.
29. Doris Bry, interview with the author, November 2001. The results of research on Steichen's chemical treatment of Stieglitz's palladium prints will be included in a forthcoming National Gallery of Art publication.
30. Letter from Paul Strand to Ned Scott, October 1, 1933, Ned Scott Archive (www.thenedscott-archive.com). Thanks to Norm Scott for sharing these letters. Observations regarding cracking apply equally to Japine Platinotype and Japine Palladiotype. "Steam heat" is radiator heat from a steam boiler, which is actually a very dry heat.
31. Edward Weston, journal entry, April 6, 1927, in Nancy Newhall, ed., *The Daybooks of Edward Weston*, vol. 2, *California* (Millerton, N.Y.: Aperture, 1973), p. 13.
32. Steve Siegel, "A Great American Photographer," *The Morning Call* (December 20, 2009), http://articles.mcall.com/2009-12-20/features/4495867_1_weston-s-portraits-dody-weston-thompson-photographer-s-work.
33. In-depth technical study of these photographs is ongoing as part of a National Gallery of Art research initiative.
34. Edward Weston, journal entry, December 23, 1925, in Newhall, *Daybooks of Edward Weston*, vol. 1, *Mexico* (Millerton, N.Y.: Aperture, 1973), p. 143.

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