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The History and Use of Glycerine in Platinum Printing

Adrienne Lundgren

With the modern methods at command, there are virtually no limitations to the individuality that can be conveyed in the photographic print. These methods are extremely subtle and personal in character. For this reason each individual print has a distinct identity of its own that reflects the mood and feeling of its maker at the time of its production and in consequence, it rarely happens in the case of the modern pictorial photograph, that two prints identically alike are produced from the same negative.

— Alfred Stieglitz

Glycerine has a long history in the practice of photography. Commonly used from the wet-plate collodion era on, it was employed as a modifier to allow the photographer to control the image. Glycerine slowed development and served as a humectant to keep the sensitized collodion binder moist in anticipation of long delays before developing.[1] Glycerine was also used in processes such as gelatin silver to aid in the even drying of prints, to apply bleach locally, and as a local developer, much like its use in platinum printing.[2] It was natural that the Pictorialists would once again experiment with glycerine, exploring the further manipulation of the print in both subtle and extreme ways (fig. 1).

A simple trihydric alcohol, glycerine is the basis of all fats (triglycerides). The structure of glycerine allows for its ready solubility in water. It is a relatively unreactive compound, making it an excellent choice as an additive to photographic formulas in which water is a common solvent for photographic reagents and where contamination must be avoided. Glycerine is also attractive for photographic processes as it is easily washed away, leaving little to no residue; if any does remain, it should not produce future deterioration.[3]

The usefulness of glycerine in the development of platinum images is based on its properties as a dilution medium. It is described in the photographic literature as a "diluent" or a "restrainer," but it could be more accurately described as a "wash-out inhibitor."[4] Glycerine allows for the dilution of the developer without the adverse effects associated with water dilution, as when exposed sensitizer is washed away as developer is poured on the print. When added to the developer, glycerine allows for a more controlled, slower, and therefore more flexible development of the image.

A conventionally processed platinum print is developed by immersing the exposed sheet in an aqueous bath of a potassium oxalate developer. Development of the image occurs almost instantaneously.[5] Even so, some of the exposed platinum salts are washed away by the water-based developer before they can be developed, resulting in a loss of developable image material and thus a loss of overall image density. Further, diluting the developer with water to decrease its strength has the effect of dissolving significant amounts of exposed sensitized salts from the paper before they can be developed.[6]

Diluting the developer with glycerine, in contrast, reduces this effect. Developers diluted with glycerine are more viscous, dramatically delaying the speed of the development. Water's tendency to wash away vulnerable undeveloped salts is reduced, resulting in a final print with more detail and density.

Figure 1. Gertrude Käsebier, *Self-Portrait*, c. 1899. Glycerine-developed platinum print, 15.88 × 12.7 cm. Milwaukee Art Museum, Purchase, Richard and Ethel Herzfeld. This fine example of glycerine-development shows how the technique allows for selective development: some areas of the print are developed, and others are not, permitting a dramatic deviation of the print from the negative.

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A glycerine-diluted developer may be used in several ways:

1. overall, applied either with a brush or in a bath
2. locally, applied with a brush, using various dilutions of developer to control the level of development in particular areas of the print
3. locally, with additives to the developer, as in the case of split-toning with mercuric chloride
4. alone, without developer, applied with a brush to totally prevent development in a particular area.

When applied overall, either hot- or cold-bath platinum papers may be used. All other methods are used only with cold-bath papers.

Overall Application of Glycerine

To apply glycerine overall, a photographer had two methods from which to choose: applying the glycerine-developer solution with a brush or submerging or floating the print in a tray of glycerine-diluted developer.

Unlike local applications (discussed below), the overall brush application involves applying the same dilution of glycerine developer to the entire print. Prints made using either of these overall techniques are virtually impossible to distinguish from conventionally processed prints, either visually or analytically, but examples surely exist due to the effectiveness of the technique.

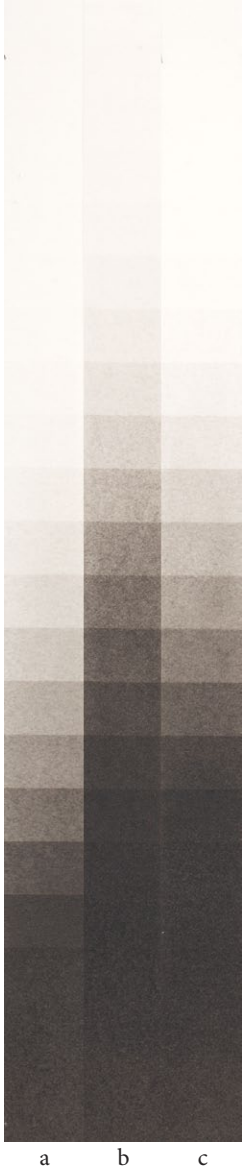
Applying glycerine-diluted developer overall slows the development of a print to allow more time and therefore permit more control as the image forms. It also dilutes the developer while acting as a wash-out inhibitor. Thus the photographer can make adjustments to avoid over- or under-exposure and to create a print with a more continuous tone by producing a finer grain.

Adjusting for Overexposed Prints and/or Thin Negatives

Glycerine-diluted developer, when applied overall, allows the photographer to adjust development time to compensate for overexposure of the print. Overexposure could have been deliberate, to allow for highlight detail to emerge from a negative with a long dynamic range, or as an unanticipated result of using a thin negative. When glycerine developer is applied overall, with a brush or in a bath, the rate of development slows, allowing time for the highlight detail to emerge before the darks become too intense. Development can easily be stopped before eliminating shadow detail by gently blotting away the developer or immersing the print in the clearing bath.

The use of a glycerine developer as a remedy for a poor-quality negative was first described by Alfred Stieglitz in 1892 while discussing the processing of the newly marketed cold-bath platinum papers: "In order to increase the brilliancy of a print, say from a flat negative, a little glycerine added to the developer will work like a charm."[7] He later described it as a means of "producing pleasing prints from negatives that would not yield by any other means an even half satisfactory picture."[8] Even prints that have been overexposed to the point of printing out in the frame have been saved by using a glycerine developer, said a later commentator.[9] In fact, overprinting is generally considered to be essential in glycerine development as, said Joseph T. Keiley and Stieglitz, it "ensure[s] the recording of those delicate tones and half tones in the highlights of a picture . . . but which under ordinary circumstances must be entirely sacrificed because their printing would involve overprinting every other part of the picture."[10]

William Willis Jr. (1841–1923), the inventor of the platinum process, also described the control that can be achieved using glycerine in his 1893 presentation to the London Camera Club. Regarding glycerine development, he remarked, "The development of all of the shades begins simultaneously—the highlights quickly reach their full value,



a b c

Figure 2. Platinum step-tablets made by the Photograph Conservation Department, National Gallery of Art. (a) Conventionally developed. (b) Glycerine-developed. (c) Glycerine-developed with a dichromate additive to boost contrast. The glycerine-development process extends the range and yields a slightly more smooth-grained image.

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but the shadows only slowly."[11] Thus the photographer can obtain detail in the highlights and at the same time stop development in the darks to produce a unified print.

Underexposed Prints

Another advantage of overall application of glycerine is that it can compensate for underexposure of the print. Experiments conducted at the National Gallery of Art demonstrated that identically sensitized and exposed prints that were glycerine developed had a longer tonal range than conventionally developed prints (fig. 2), a consequence of the wash-out phenomenon.

In particular, when prints are placed in a tray and the developer is poured over the print's surface, exposed salts are washed away by the force of the water-laden developer before they can be developed, resulting in a loss of potential image material. Developers diluted with glycerine and applied gently with a brush do not have this same solubilizing effect. More of the exposed salts are available for development, and thus the prints have more density overall. In the case of underexposed prints, when glycerine is added to the developer, every exposed site is developed to its full potential, resulting in surprisingly high-quality prints. Adding glycerine to many standard developer mixtures is described in the literature as important to "extend its tonal range"[12] and "undeniably gives richer blacks and a more beautiful quality than is obtained with the normal developer."[13] Indeed, the richness ascribed to glycerine development was considered to equal or surpass the technique of double-printing[14] to achieve the longest possible tonal range. The famed platinum printer Paul L. Anderson (1880–1956) wrote: "Brush-glycerine development extend[s] through every possible photographic scale of gradation from absolute black to the white of the paper. . . . No series of printings can make the black of the fully deposited platinum any blacker."[15]

Finer Grain

Another advantage of using glycerine overall is that it reduces the appearance of image grain. When compared with conventionally developed prints, glycerine-developed prints exhibit a finer particle size and a smoother transition from light to dark.[16] These phenomena are likely due to slower reaction time, which allows activation sites to grow image particles at a more even rate and to capitalize on the retention of the soluble salts. Inversely, users in the late nineteenth and early twentieth centuries complained of the grainy images in prints made with hot-developed

Figure 3. Clarence H. White, *Portrait of Elizabeth Felix with Paperwhites*, c. 1899. Glycerine-developed platinum print, 19.8 × 14.4 cm. Library of Congress, Prints and Photographs Division, DLC/PP 2004:027.2.147. The area of the sign in this print was restrained using a locally applied glycerine. The surrounding image was developed with glycerine-diluted developer.

paper, a direct result of the almost instantaneous development produced at higher temperatures. Anderson commented in his description of the platinum process that if more contrast is desired, "the stock solution can be diluted with an equal amount of glycerine . . . and the print exposed considerably longer than for normal results. The glycerine slows the development markedly." The print is pulled before developing fully, resulting in increased contrast but without "granularity."[17] Willis made the same observation, describing his glycerine-developed print as the best of twenty-two examples, being the most "homogeneous."[18]

Upon inspection of glycerine-developed prints, however, the images sometimes appear grainier than other prints. This appearance may be a consequence of the development being so restrained that it is incomplete (fig. 3). In these cases, the glycerine has held back development and restrained image formation, and, due to

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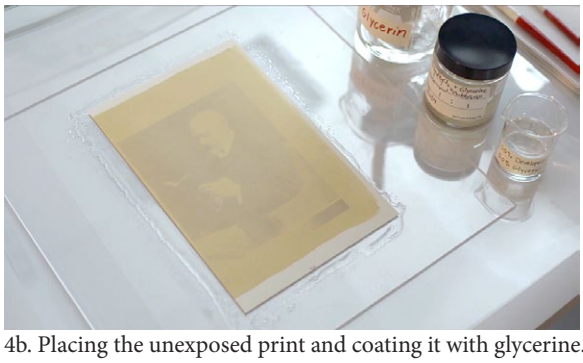
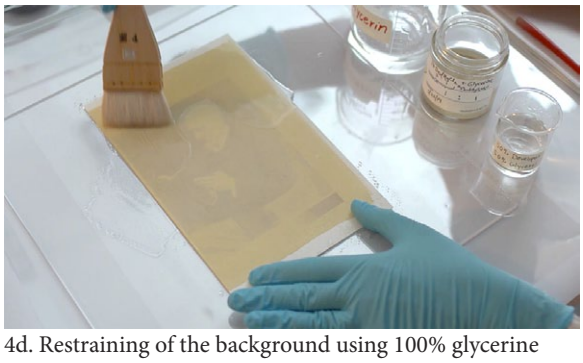
4a. Coating the glass with glycerine.



4b. Placing the unexposed print and coating it with glycerine.

4c. Blotting the print.



4d. Restraining of the background using 100% glycerine as a resist.

4e. Developing the image using locally applied developer.

uneven penetration of the developer through the glycerine layer, the development had taken place only in small, localized areas. These localized areas can become quite pronounced, resulting in an appearance similar to graininess. However, if the developer is left long enough to allow it to reach the paper evenly, the glycerine developer produces a finer and more homogeneous image grain.

Local Development

The use of localized applications of glycerine and glycerine-diluted developer can be recognized by the dramatic visual alterations they produce in the image. The four main effects are localized tone adjustment or intensification, vignetting, preferential development, and split-toning. Keiley and Stieglitz explained that local glycerine development allows the photographer to "impress upon his work the stamp of his feeling for the subject treated. . . . The manipulator [is] enabled to reclaim his print from the rigid bondage of hitherto unalterable renderings of values recorded . . . and to introduce his own conception of the values, tonal quality, feeling and artistic effect of the theme under treatment."[19]

Glycerine can be applied to localized areas of the print using a brush. The process is as follows and is shown in figure 4. First the print is adhered to clean piece of glass, usually by coating the glass with pure glycerine and then placing the exposed print on the glass (figs. 4a, 4b). The print is then brushed overall with pure glycerine to saturate the fibers evenly and further adhere the print to the glass (fig. 4c) so that chemicals are prevented from staining the back of the print. The print is then blotted overall to remove the excess glycerine (fig. 4d). Local masking and/or developing variations or combinations thereof may then be performed to achieve the desired effects.

Tone Adjustment

Local adjustment of tone, sometimes referred to as localized intensification, is the least commonly found use of glycerine in the literature but one that can lead to dramatic effects. Two reported methods for locally intensifying prints are mentioned. One, described as "moonlight effects," employs a glycerine-developer solution with a potassium ferricyanide additive. This technique is recommended for use in printing dramatically lit landscapes, such as cloudscapes or sunset views.[20] By adding ferricyanide, platinum and cyanotype image material are

Figure 4. Steps for producing a "preferentially developed" glycerine-developed print.

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produced simultaneously in the same print.[21] Using this technique, Prussian blue is deposited overall; it is especially visible in the highlights but also adds a blue tone to the darks (fig. 5).[22]

Potassium dichromate, commonly referred to in the literature as bichromate, is the more commonly described developer additive used to modify tones. Applied locally in water or water-glycerine solutions, a dichromated developer results in a high-contrast image with diminished highlight detail. Baron Arthur von Hübl (1853–1932) stated, "An image is first wetted completely with glycerin, and then diluted developer is applied with a brush on the parts which need the most emphasis. . . . [For] images of greater brilliance, dilute the developer with 4–6 parts water, or add 2–5 per cent potassium dichromate 1:100 to the normal solution."[23] The addition of the dichromate intensifies the blacks of the print, adding contrast (see fig. 2[c]).[24]

Vignetting

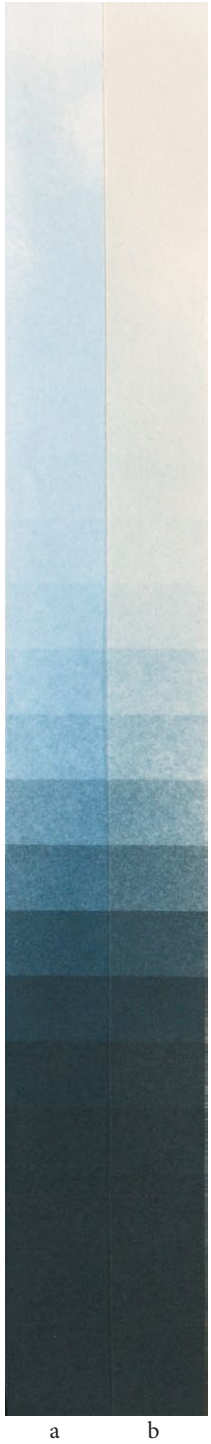
Vignetting is the total elimination of portions of the negative, usually around a figure or face. In platinum printing, vignetting is achieved by applying pure glycerine in localized areas to totally arrest development. In such cases, glycerine acts as a resist to prevent the infiltration of the developer in specific areas. This use of glycerine is often done in conjunction with the use of a mask during printing. Vignetting with glycerine was first mentioned in 1897[25] but was best described in *Photo-Miniature* in 1899: "To obtain a vignette with even gradations, print with a mask slightly larger than the image required. . . . When the printing is almost completed, remove the mask and allow the print to finish. Before developing, cover the part over which the mask has been with glycerine, then apply the [glycerine-] diluted developer . . . starting at the center of the image and carefully working toward the edges" (see fig. 4e).[26]

This technique was used widely among studio portrait photographers at the time but was also used to great effect by art photographers such as F. Holland Day (1864–1933), Gertrude Käsebier (1852–1934), Joseph Keiley (1869–1914), Francis Watts Lee (1867–1945), Alfred Stieglitz (1864–1946), and Clarence H. White (1871–1925). Vignetting can be easily identified by the elimination of information around the image, often with a feathered edge between the image and the nonimage areas (fig. 6).

Preferential Development

The most commonly described use of glycerine for platinum printing is preferential development, a technique that allows the photographer to "dodge and burn" by controlling the level of development rather than the level of exposure during printing. The conventional method of dodging and burning was achieved by locally blocking or directing the light as it strikes the sensitized paper. Preferential development is performed by applying various glycerine-diluted developers with a brush to various portions of the print according to the desired level of development required. It allows areas to be emphasized or deemphasized at will. The glycerine-developer solutions varied: 100% glycerine, 75:25 glycerine:developer, 50:50 glycerine:developer, 25:75 glycerine:developer, and 100% developer. These solutions would be arranged in separate bottles and applied with separate brushes to individual areas of the print. Subtle effects with very gradual transitions could be created by using a careful progression from one dilution to the next. More dramatic effects could be achieved by abruptly switching from dilute to strong solutions. These would emphasize the hand-applied and brushed-on nature of the process (fig. 7).

Clarence H. White's *Portrait of Elizabeth Felix with Paperwhites* (see fig. 3) is an excellent example of the subtlety that can be achieved with preferential development.



a b

Figure 5. Platinum step-tablets made by the Photograph Conservation Department, National Gallery of Art. (a) Unaged print. (b) Aged print. These step-tablets show the effects of adding ferricyanide to the platinum developer. The blue tone is commonly referred to as "moonlight effects." Note the loss of blue in the aged sample (b).

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In an effort to reduce the prominence of the placard next to the figure, White applied a weaker glycerine-developer solution to it. In the area of the figure, a stronger developer solution was used.

Joseph T. Keiley's print *Indian Head* (fig. 8) demonstrates the extraordinarily painterly effect that can be achieved with the use of a brush-applied developer, creating the photographic equivalent of a watercolor or ink-wash drawing. "Here one finds," said one practitioner of this technique, "an almost unlimited scope for artistic and individualistic interpretation of the subject. . . . Accentuating here, subordinating there . . . obliterating superfluous portions, he works much as does the creative painter. Those who are familiar with the use of the brush in watercolor or in oil will be rewarded with success."[27]

6a 6b

Figure 6. Joseph T. Keiley, [*unidentified male sitter*], c. 1895. Library of Congress, Prints and Photographs Division, PR 13 CN 1985:647.112, 113.

6a. Platinum print with a glycerine vignette, 17.7 × 11.2 cm.

6b. Platinum print from negative shot at the same sitting, without a glycerine vignette, 4.1 cm × 10.9 cm.

Split-Toning with Mercuric Chloride

Perhaps the most innovative use of glycerine development was first announced in a 1900 special edition of *Camera Notes.*[28] In "Improved Glycerine Process for the Development of Platinum Prints," Keiley and Stieglitz described using glycerine to create platinum prints with two distinct tonalities. This technique expanded on the previously described approaches to local glycerine development by adding mercuric chloride to the range of developers:[29] the greater the concentration of mercury in the developer, the warmer the image tone. By applying the various developers with separate brushes, those with mercury and those without, a broad palette of warm and cool tonalities could be achieved in the same print.

7a 7b

Figure 7. Francis Watts Lee, [*unidentified female sitter*], c. 1900. Library of Congress, Prints and Photographs Division, PR 13 CN 2015:052.509, 510.

7a. Platinum print, 20.1 × 14.6 cm. This print illustrates the effects achieved through preferential brush development.

7b. Platinum print from the same negative, 21.9 ×16.7 cm. This print, from the same negative, was developed conventionally.

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Figure 8. Joseph T. Keiley, *Indian Head*, 1898. Platinum print, 19.8 × 14.5 cm. The Metropolitan Museum of Art, Alfred Stieglitz Collection, 1933, 33.43.187, www.metmuseum.org. The glycerine-diluted developers were applied at various strengths, resulting in a photograph that evokes an ink wash or watercolor.

According to Keiley and Stieglitz, the developer solutions might include the following, but any combination may be used:

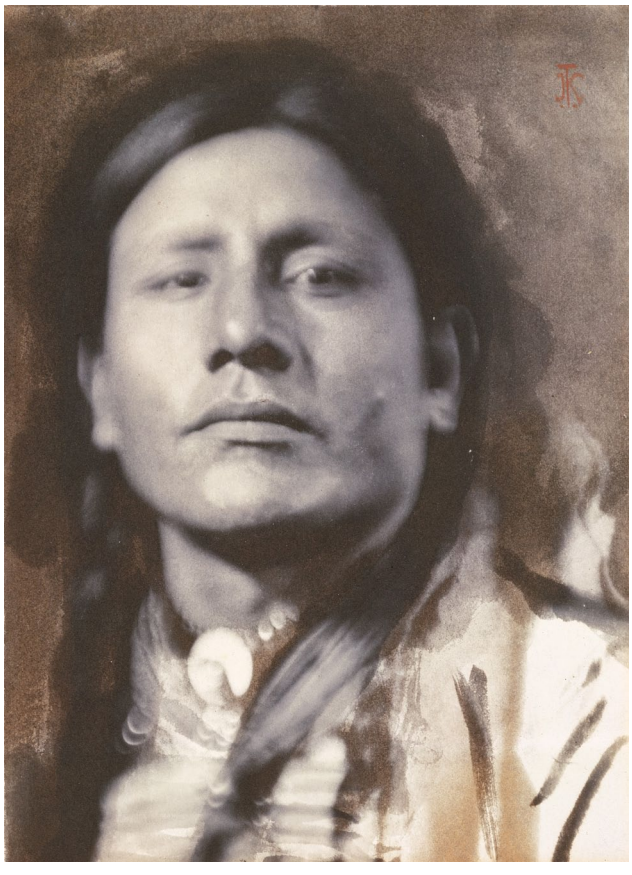
two dilutions of the potassium oxalate developer

- pure developer
- developer mixed with equal parts glycerine

three different mercuric chloride solutions

- mercury bichloride in water (saturated solution)
- developer with mercuric chloride (various concentrations)
- glycerine–mercuric chloride–developer (various concentrations).[30]

The mercuric chloride solutions are used in localized areas of the print to obtain a warm brown tone. The warmth of the tone is directly proportionate to the amount of mercuric chloride in the solution. Plain potassium oxalate and glycerine developers are used in areas where a neutral tone is desired. The developers are applied with separate brushes to avoid cross-contamination, as even the smallest amount of mercury in the developer solution will shift the tone from neutral to warm (fig. 9).



The development of an image using this technique can take anywhere from "fifteen to fifty minutes," said Keiley and Stieglitz.[31] One challenge they identified is that "mercury is a very uncertain quantity and rarely reacts in the same way twice, so one must use it with great caution."[32] One advantage of the process is that the resulting image has two tonalities. In addition, areas where the mercury is applied have an increased tonal range and a very fine grain, further emphasizing the contrast of one part of the print to the other.

The use of this technique is well illustrated by examining various prints from the same negative, as seen in prints

Figure 9. Joseph T. Keiley, *Sioux Chief,* 1898. Platinum print, 19.3 × 14.1 cm. The Metropolitan Museum of Art, Alfred Stieglitz Collection, 1933, 33.43.174, www.metmuseum.org. The dramatic tonal shift from a very rich warm background to a neutral black tone is achieved with locally applied developers of varying composition. The cooler areas were developed with standard potassium oxalate developer diluted with glycerine, while the warmer tones were achieved by adding mercuric chloride to the glycerine-diluted developer.

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by Keiley (fig. 10). These prints, believed to be early experiments of this process, have pronounced brush marks. The transition from warm to neutral tones is not subtle, a feature that may have been exacerbated by subsequent deterioration of the areas developed with a mercury developer.[33] Later prints, however, such as *The Averted Head* (fig. 11), show just how effectively Keiley mastered this technique, leaving virtually no sign of transition between the warm and cool areas.

The idea that one could achieve two separate tonalities in the same print was unheard of before Keiley and Stieglitz published their article in *Camera Notes*, and it created a revolution in photography. This technique paved the way for split-toning in a variety of photographic processes in addition to platinum, including lantern slides and gelatin silver prints. Considering the success of this experimental process in yielding a two-toned image, it is not surprising that Stieglitz exhibited the two prints that he featured in the special glycerine edition of *Camera Notes—A Sketch in Platinum* and *Experiment in Mercury and Oxalate*—as well as other glycerine-developed platinum prints "in two colors," at ten exhibitions between 1899 and 1903.[34]

Deterioration

Despite the platinum print's reputation as a permanent process, current research reveals that some are prone to fading. Glycerine-developed platinum prints, in particular, were described as being more prone to deterioration than conventionally developed platinum prints. However, the deterioration associated with these prints may be due to a misunderstanding of the process as a whole.

The most common deterioration associated with glycerine development has been observed in vignetted prints (fig. 12). This deterioration is described by Dusan Stulik and Art Kaplan as a dark area surrounding the image: "Old glycerin-developed platinotypes exhibit a darker halo in the area covered by glycerin."[35] This darkening has been attributed to the hygroscopic nature of the glycerine itself, which, when trace amounts remain in the paper, can lead to paper degradation or incomplete clearing and washing of the print. However, this conclusion is inconsistent with the highly soluble nature of glycerine and the process used to make glycerine-developed prints.

The practice of vignetting relies on the ability of glycerine to block development. The greatest amount of pure

10a

10b

Figure 10. Joseph T. Keiley, [*unidentified female sitter*], c. 1895. Library of Congress, Prints and Photographs Division, PR 13 CN 1985:647.107, 108. Both prints were developed with the split-tone method. The areas with the most fading (orange-yellow tonality) were developed with a mercuric chloride–rich developer. Volatilization of the mercury in the image over time leads to dramatic fading and a tonal shift from brown to yellow.

10a. Platinum print, 16.4 × 10.5 cm.

10b. Platinum print from the same negative, 15.9 × 9.6 cm.

Figure 11. Joseph T. Keiley, *The Averted Head*, 1899. Platinum print, 16.5 × 10.5 cm. The Metropolitan Museum of Art, Alfred Stieglitz Collection, 1933, 33.43.179, www.metmuseum.org. This image shows the very subtle transition in tone that can be obtained when split-toning with glycerine-diluted developer. The glycerine allows for the elimination of a line between the plain developer and the mercuric chloride developer.

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Figure 12. L. Alman, [*unknown female sitter*], c. 1900. Glycerine-developed platinum print, 14 × 10.1 cm. Courtesy of the Image Permanence Institute, Graphic Atlas.

glycerine is applied to the area farthest away from the subject. Figure 12 illustrates that the least degree of staining is apparent in the perimeter of the print, where the greatest amount of glycerine would have been applied. In contrast, the developed image area around the sitter displays the greatest amount of staining. Thus, the staining is in inverse proportion to the areas of the print to which the most glycerine would have been applied.

Preliminary studies have shown no correlation between the use of glycerine and the retention of iron salts or acidity in the paper related to the clearing and washing of prints.[36] Comparisons of conventionally processed and glycerine-developed prints show that they actually age similarly. The vignetted areas of glycerine-developed prints, in which little or no platinum is present, display less staining than areas where platinum resides. This contrast of platinum-free areas and platinum-rich image areas, unique to vignetted prints, can make these prints appear to be in worse condition than their more uniform counterparts.

Another reason that glycerine prints may appear deteriorated is the expectation that prints should appear even in color and density across the image. However, one of the great attractions of the glycerine process is the possibility of creating images composed of painterly brush marks that result in varied strength and coloration. While these variations may now appear as odd or even faded, they are likely the consequence of the deliberate actions by the photographer. In fact the print may not have changed significantly since leaving the studio.

One type of glycerine-developed platinum print is, however, susceptible to severe image deterioration and staining: the split-toned prints produced with mercuric chloride in the developer. Tests performed at the National Gallery of Art demonstrate that prints produced with platinum and mercury show a marked loss in density and range after artificial aging (fig. 13).[37] This loss is due to the fact that platinum does not form an amalgam with mercury, thus leaving the mercury free to sublimate at or higher than room temperature.[38] This phenomenon is most apparent in prints processed with higher concentrations of mercury in the print developer.[39]

X-ray fluorescence spectroscopy (XRF) reveals that the loss in density in platinum prints developed with mercury is not related to loss in platinum image material but solely to the loss of mercury in the print. The result of the loss of mercury is an image that reverts from its warm tonality to

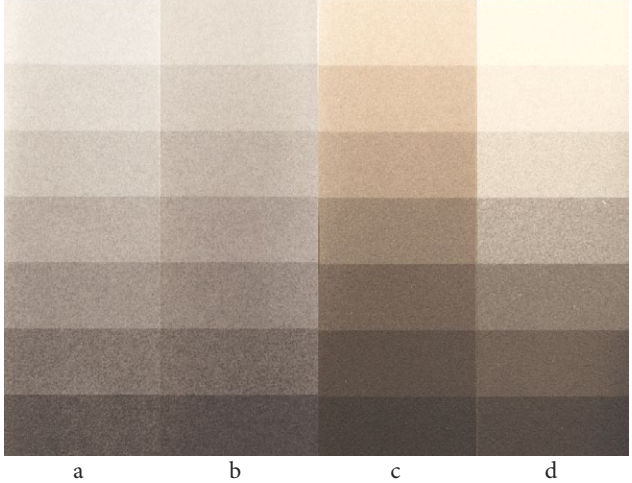

Figure 13. Platinum step-tablets made by the Photograph Conservation Department, National Gallery of Art. (a) Developed without mercury before aging. (b) Developed without mercury after aging. (c) Developed with mercury before aging. (d) Developed with mercury after aging. The mercury-developed prints exhibit both fading and a tonal shift from warm to neutral. The platinum levels remain the same as the mercury volatilizes, resulting in a grainier image, similar to that of the platinum prints developed without mercury.

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Figure 14. Joseph T. Keiley, [*unidentified female sitter*], c. 1895. Split-toned glycerine-developed print, 16.3 ×10 cm. Library of Congress, Prints and Photographs Division, PR 13 CN 1985:647.128. The image shows a significant loss in the warm mercury-toned background.

the cool tone of platinum and appears much grainier than before aging. Furthermore, prints with very little platinum and a substantial proportion of mercury can become so faded that they appear light orange or yellow in the image areas.[40] In prints where the image is split-toned, the loss of density in the mercury-rich areas causes a shift in image contrast: the denser, platinum-rich areas call attention to the image fading, thus emphasizing the uneven appearance of the print (fig. 14; see also fig. 10).

Further exacerbating the unstable tendencies of mercury-processed prints are contemporaneous recommendations that prints developed with mercury should be cleared using one-half of the normal concentration of hydrochloric acid.[41] These recommendations were meant to preserve the warm image tone of the mercury particles that would be dissolved in a highly acidic clearing bath and washed away (fig. 15). Therefore, platinum images made with mercury, even if thoroughly processed, were cleared to only half the level of normal prints. In the case of split-toned prints, where the aesthetic goal was to achieve a contrast between the warm and neutral areas, the prints were likely often pulled from the clearing bath even earlier so as to retain the warmest possible hue. The effects of the acid bath, even at one-half the concentration, is evident almost instantly.[42] It is very likely that a large number of these prints now suffer from the effects of poor clearing and the resulting retention of stain-producing iron salts.

Palladium and mercury form an amalgam, which stabilizes the mercury in the print to a large degree. While mercury-processed palladium prints exist in collections, no palladium prints split-toned with mercury have been identified. By 1917, when palladium became a popular replacement for platinum photographic papers, the technique of split-toning had fallen out of fashion.[43] Furthermore, no references in the literature for the use of this technique or to glycerine development of palladium prints were found during this study.

Due to their highly unstable nature, split-toned prints in good condition are rare. Why some prints have not experienced the expected loss of mercury remains unclear. Regardless, mercury-processed and split-toned prints should be housed individually. Cold storage is recommended to prevent the further sublimation of the mercury and resulting loss of image and the possible contamination of adjacent photographs.

Conclusions

The use of glycerine in the development of platinum images began at the beginning of the Pictorialist movement. Glycerine development solved many of the problems associated with producing a fine print, but more dramatic and artistic uses became the focus of the technique, especially after 1900. Locally developing prints using glycerine provided a theatrical departure from the original negative, allowing for painterly expression and handwork, which became key aspects of Pictorialism. It is noteworthy that each one of these prints is individually hand-produced and therefore unique. These prints represent the pinnacle of handcraft in creating photographic prints at the time, and they should be regarded as central to the progression of photography from a documentary science to an artistic medium.

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Figure 15. Bradley Lance Moore, *Calder Pointing,* 2015. Platinum prints, each 17.2 × 8.9 cm. Private collection. Note that when a mercury-developed print is cleared in the standard concentration (1:60 hydrochloric acid) (figs. 15a, 15b, 15c), a significant loss of the mercury-developed warm tone results (compare 15b to 15d). This problem is reduced by diluting the clear by half, but the effectiveness of clearing is also reduced (compare 15c to 15e).

15a. Platinum print tray developed with potassium oxalate, cleared 1:60 hydrochloric acid:water.

15b. Print developed overall with 10% mercuric chloride in oxalate, cleared 1:60 hydrochloric acid:water.

15c. Split-toned print with glycerine, figure mercuric chloride 10% and background potassium oxalate, cleared 1:60 hydrochloric acid in water.

15d. Print developed overall with 10% mercuric chloride in oxalate, cleared 1:120 hydrochloric acid in water.

15e. Split-toned print with glycerine, figure mercuric chloride 10% and background potassium oxalate, cleared 1:120 hydrochloric acid in water.

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Notes

The epigraph is from Stieglitz 1902, 825.

1. [Pritchard] 1881, 191.

2. Stroebel and Zakia 1993, 645; [Tennant] 1918, 62; Ponting 1905, 2–3.

3. For the appeal of glycerine as a photographic additive, see Sutton 1858, 209. It should be noted, however, that residual glycerine in the paper could retain water, resulting in increased hydrolysis-related reactions. Nevertheless, due to its solubility in water, it is very likely that glycerine would be thoroughly removed during processing and washing.

4. Mike Ware, e-mail correspondence, November 2011, regarding glycerine-incorporated developers. Ware described the principle of "wash-out inhibitor."

5. See Caroline Minchew, "A Step-by-Step Guide to Platinum and Palladium Printing," in this volume.

6. Ware, e-mail correspondence, November 2011.

7. Stieglitz 1892, 391–92.

8. Keiley and Stieglitz 1900, 221.

9. [Tennant] 1902, 163.

10. Keiley and Stieglitz 1900, 223.

11. Willis 1893, 171.

12. Keiley and Stieglitz 1900, 221.

13. Zimmerman 1913, 74.

14. Double-printing is a technique in which a single print is sensitized, exposed, processed, and then sensitized again, exposed, and processed. The layering of the platinum yields richer results. See Vasilios Zatse and Constance McCabe, "Irving Penn's Platinum-Palladium Prints," in this volume.

15. Anderson 1917, 154.

16. [Tennant] 1899, 342.

17. Anderson 1917, 149.

18. Willis 1893, 171.

19. Keiley and Stieglitz 1900, 221–22.

20. [Tennant] 1899, 343.

21. That the chemical reaction is with residual iron salts in the print was confirmed in a communication with Mike Ware, July 2015.

22. This technique was re-created in the Photograph Conservation Department, National Gallery of Art. Preliminary results in dark aging (70°C, 75% RH for 4 weeks) show that "moonlight" prints undergo tremendous fading upon artificial aging and do not appear to regenerate in dark.

23. Hübl 1895, 79–80.

24. Anderson 1917, 149.

25. Hinton 1897, 81.

26. [Tennant] 1899, 343.

27. Phillips 1908, 127.

28. Keiley and Stieglitz 1900, 221–26.

29. While split-toning is discussed in the literature as being done only with mercuric chloride, it can in theory be done with any additive that alters the tone of the image, such as gold chloride or potassium ferricyanide.

30. Keiley and Stieglitz 1900, 222.

31. Keiley and Stieglitz 1900, 223.

32. Keiley and Stieglitz 1900, 225.

33. See Matthew L. Clarke, "Characterization, Degradation, and Analysis of Platinum and Palladium Prints," in this volume.

34. Blyberg 2002, 949–71. Sarah Greenough believes that neither print is extant. Personal communications, October 2014.

35. Stulik and Kaplan 2013, 39.

36. Adrienne Lundgren, "The Deterioration of Glycerine Developed Platinum Prints" (third year research project, Winterthur/University of Delaware Program in Art Conservation, 1999).

37. This phenomenon is discussed in detail in Clarke "Characterization, Degradation, and Analysis of Platinum and Palladium Prints," in this volume.

38. Mike Ware, "The Technical History and Chemistry of Platinum and Palladium Prints" (paper presented at the symposium, "Platinum and Palladium Photographs: Technical and Aesthetic History, Connoisseurship, and Conservation," National Museum of the American Indian, Washington D.C., October 22, 2014), and personal communication on that date.

39. See Clarke, "Characterization, Degradation, and Analysis of Platinum and Palladium Prints," in this volume.

40. Clarke, "Characterization, Degradation, and Analysis of Platinum and Palladium Prints," in this volume.

41. Keiley and Stieglitz 1900, 225.

42. Observations by the author on making split-toned and mercury-toned images.

43. It should be noted that palladium prints are, in general, warmer than platinum prints. However, when mercuric chloride is used in combination with palladium, the image material becomes more neutral, likely due to the formation of the amalgam that increases the image particle size. Thus, if split-toned palladium images exist, it is likely that the neutral areas would contain more mercury than the warm areas (this is the inverse of what in seen in platinum images). Conversations with Mike Ware, October 2014, and observation of samples in the Photograph Conservation Department, National Gallery of Art.

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