

*Edited and with an introduction by  
Richard Abel*

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# Silent Film

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Library of Congress Cataloging-in-Publication Data

Silent film / edited and with an introduction by Richard Abel.

p. cm. — (Rutgers depth of field series)

Includes bibliographical references and index.

ISBN 0-8135-2225-0 (cloth : alk. paper). — ISBN 0-8135-2226-9 (pbk.)

I. Silent films—History and criticism. I. Abel, Richard, 1941–

II. Series

PN1995.75.S55 1996

791.43'09'041—dc20

95-12437  
CIP

British Cataloging-in-Publication information available

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Rutgers  
University  
Press

*New Brunswick  
New Jersey*

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## The Color of Nitrate: Some Factual Observations on Tinting and Toning Manuals for Silent Films

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*Blanche Sweet, playing the daughter of a station master, stands before two bandits in a train depot. Alone in one of the most isolated spots of the West, she must protect herself and the money that has been left to her charge. Her last chance is to try a stratagem. She turns off the light and hides herself, pretending that the nickel-plated monkey wrench she holds is really a gun, hoping to deceive the burglars in the semi-darkness. Her ruse succeeds. The glint of the metal object in the pale moonlight confuses the tramps, and their hesitation allows time for the girl's fiancé to arrive for the providential last-minute rescue. Such is the happy ending of THE LONEDALE OPERATOR (23 March 1911), the well-known one-reeler by D. W. Griffith, described by the Biograph Bulletin as being "without doubt the most thrilling picture ever produced."<sup>1</sup>*

When viewing most of the existing copies of the film, one is puzzled by the climax of the plot. The tool in Blanche Sweet's hands is easily recognizable, and it seems absurd that her antagonists would fall for the trick. In fact, it is the modern viewer who is deceived. Most reference copies of *The Lonedale Operator* are in black and white and are therefore missing one fundamental detail. When the young woman turns off the light in the original version, the film is suddenly tinted a deep blue, which simulates the darkness of night. This *trompe-l'oeil* effect is pivotal to the plot and renders the heroine's quick-thinking improvisation credible.

From *Image* 34:1-2 (Spring/Summer 1991). Reprinted by permission of the author and *Image*, George Eastman House, 1994. Unfortunately, it has been too costly to reproduce the color illustrations.

Such visual invention was common during the age of silent cinema. As a matter of fact, it was estimated in 1920 that about eighty to ninety percent of all films produced in the United States toward the end of the 1910s were entirely or partially colored.<sup>2</sup> It is not surprising that, given the prevalence of color, most feature film scripts from the silent period contain precise instructions as to which scenes should be colored in order to clarify the narrative or enhance the dramatic situation. These colors had specific connotations: bright red was used for fire or a scene of passion; light amber, when a table light was turned on in a room; green suggested an idyllic rural life; and so on.

How can we begin to reconstruct the color in these early films when they are preserved in black and white and the technologies of tinting have long since disappeared?

Fortunately, primary documentation on this aspect of film production does exist. Technical manuals provide some of the best information. Volumes were published in France, Germany, and the United States in the late 1910s and throughout the 1920s, containing instructions on the techniques of film tinting during the silent era. Most of these books, published by the producers of film stock (Eastman Kodak Company, Gevaert, and Pathé), are preserved in the Richard and Ronay Menschel Library at George Eastman House. They contain not only technical information on the coloring systems used at the time by the motion picture industry but also include sets of illustrations made of actual pieces of original nitrate film. Through these fragments, it is possible to study in detail how production companies developed a true aesthetics of color.

The oldest known manual with color illustrations has no date on the title page, but it was probably distributed around 1916 by the Eastman Kodak Company of Rochester, New York, under the title *Tinting and Toning of Eastman Positive Motion Picture Film*.<sup>3</sup> This hardcover volume contains 31 pages and eight cardboard tables with forty-five double frames of 35mm nitrate film, arranged according to coloring technique and the shade of dye used. The success this book enjoyed with its specialized audience, along with the steady improvement of these techniques, led Eastman Kodak to produce three further editions of this work in 1918, 1922 (reprinted in 1924), and finally in 1927, at the twilight of the silent period.

The example of the Eastman Kodak Company manuals was followed by at least two other manufacturers of nitrate film stock. In Belgium and Germany, Agfa Gevaert distributed a table of illustrations containing a small number of film samples,<sup>4</sup> as well as a manual whose contents are similar to those in the Eastman Kodak books. Another volume, published in Paris in 1926, *Le film vierge Pathé* had wider distribution in Europe; only a relatively small section of the Pathé text deals with film coloring, but the three foldout cardboard tables of

illustrations with 107 individual nitrate frames are the most complete ever published.

These books, together with a handful of other primary sources, constitute the basis of our knowledge of a relatively neglected topic in the study of early cinema: the effects achieved by coloring film stock.<sup>5</sup> Before the acceptance of Technicolor in the mid-1920s, there were four basic techniques of film coloring: hand coloring, coloring by stencil, tinting, and toning. A fifth method, mordanting, can be considered a modified version of the toning process. Other early attempts at additive color processes, such as George Albert Smith's Kinemacolor (1906-1908) and Gaumont's Chronochrome (1912), never moved from the experimental stage into the commercial market. Therefore the study of these four techniques yields an understanding of the basic technology of color during the silent era.

### Hand Coloring

The earliest known example of a hand-colored motion picture is *Les Dernières Cartouches* (Georges Hatot, 1896-97). It was produced by the Lumière Brothers not long after their Cinématographe premiered on December 28, 1895, at the Grand Café in Paris.<sup>6</sup>

In this early film, the color was applied directly onto the print. This required a special bench fitted with an aperture the size of a single frame. The image was lit from below, viewed through the magnification of a lens, and advanced frame by frame by means of a foot pedal. An aniline dye was spread over the frame with a tiny brush. When the foot pedal was pressed, the next image appeared, and the worker repeated the same strike of color until the scene was finished. The film was then rewound, and another worker would begin to color another area of the film with a different dye.

A trained hand could move the brush rhythmically and very rapidly. The major problem was the fact that the spot of color had to follow the movements of the figure across the frame. It was also important to ensure that the shape and intensity of the brushstroke remained constant.

The films colored with such systems often had—and still do, insofar as they have been preserved—the flamboyant beauty of medieval miniatures. However, the production of these hand-tinted films could never be organized on an industrial basis. The cost of producing colored prints was only partially justified by the demand of the exhibition market. Thus, for some time, the most expensive films were sold in both black-and-white and color versions, especially in France.<sup>7</sup>

## Stencil Coloring

In 1906 coloring by hand was gradually replaced by a mechanical system, similar to contemporary techniques of wallpaper and postcard color printing. This system, known as "stencil coloring," had two distinct steps. The first required cutting a different stencil for each color. These stencils were then used in a machine that automatically applied the color to the positive print.

Typically, a film required three to six stencils. At first, the cutting was done manually, using a cutting edge or a sharp needle on each frame. It was a difficult and time-consuming operation, but its advantage was that it needed to be done only once for each color to be applied. The stencils were then immersed in hypochlorite, which functioned as a degelatinizing agent. This treatment permitted the color to be applied more easily, without scratching the final print, or shrinking or embrittling the stencil.

Manual cutting rapidly became obsolete in favor of a semiautomatic device similar to a sewing machine, with the cutting needle operated by an A.C. electromagnet. At least two patents for this system are known. In a further stage of development, the technician no longer cut the matrix directly but worked instead on a parallel bench with a reference print. The area to be stenciled was traced with a stylus connected through a pantograph to a cutting needle that followed the identical contours on a strip of raw film stock. To ensure that the stencil cut precisely matched the actual shape of the area to be colored, the cutting needle worked only when the stylus was touching the film. A late development of this technique, relatively common around the mid-1920s, involved the use of a series of enlarged images instead of a reference print. These methods were widely used until the end of the silent period.

Such a complex system required the employment of highly specialized personnel. Several weeks of training were necessary to make sure that the technician could prepare the stencils in the most precise and effective way. Even then, the most skilled worker could not cut more than 3 feet of stencil an hour. Despite the fact that a stylus and a pantograph allowed for the use of raw stock, thus avoiding the degelatinizing process, it was periodically necessary to stop and verify the result. Moreover, when substantial portions of the frame were to be cut, manual cutting was still preferred. In such cases, alternate frames were cut from two separate stencils, because a single stencil would have been too fragile for repeated use.<sup>8</sup>

The second phase in the stencil coloring process, the application of color, was almost completely mechanical. In most coloring machines, a sprocket system matched the matrix to the black-and-white print. All the copies of a particular scene were joined and matched with the stencil, which rotated in a continuous loop. The aniline dye was then spread on the film

by a loop of velvet moving in a direction opposite that of the advancing film. This band was fed past a rotating brush immersed in a tank of dye; the amount of dye transferred from the rotating brush to the velvet band was adjustable depending on the depth of the brush in the tank. In order to ensure uniformity, the velvet band colored three frames at a time.<sup>9</sup> As the film was rewound immediately, apparently no drying time was needed. If a mistake was made, the color could be washed out, leaving the base ready for another treatment.

This system was used throughout the 1920s<sup>10</sup> and survived until the dawn of the sound era. Less than 2 years after the invention of the stencil system, however, this method was combined with other techniques of film coloring, nowadays summarized under the terms *tinting* and *toning*. The earliest example I have found of this use of combined techniques is a nitrate fragment from a Gaumont film presumably made around 1908, tentatively identified as *Roi Midas*.<sup>11</sup>

## Tinting

Tinting is a method of applying color to the surface of the film without altering the physical structure of the emulsion. Two details characterize a tinted nitrate print: the entire picture is colored uniformly, and the area around the perforations is also colored.

The oldest method of tinting is nothing more than a variation on the hand-coloring technique. Instead of applying the color to a portion of each frame, the whole print was brushed with color. This method can be recognized by the varying density of the dye on the print. An early example can be seen in the fragment of an unidentified Gaumont film. The distinctive shape of the frame and perforations, as well as other written evidence, indicates that this film may have been produced in late 1902 and certainly predates 1905. This demonstrates that the first attempts at tinting positive film stock in western Europe were made quite early.<sup>12</sup>

In most tinted films produced during the silent era, the color was applied on the emulsion side of the film, most often using aniline dyes in a solution of water. Aniline dyes are coal tar-based synthetic dyes that are water soluble and, unfortunately, light fugitive. Dyes were sought that would not affect the stability of the gelatin layer and were sufficiently stable to withstand the effects of heat and light from repeated projection.

Only carefully processed prints would yield a relatively permanent tint. Films to be tinted had to be printed with slightly more contrast. A rotating chassis system, tanks, or vertical tubes were used for applying the color. This last system was thought to provide the best control over the uniformity of the tint.

In some cases, it was even possible to provide a gradual transition from one color to another (for example, from blue to amber, in order to show the coming of daylight). Such a delicate operation, however, had to be supervised manually and always remained an exception. Usually, the transition from one tint to the next was abrupt and entailed splicing together two separate strips of film.<sup>13</sup>

When tinting was combined with other coloring techniques, for example, with toning or stencil coloring, technical difficulties often occurred. Since toning always preceded tinting, the process of tinting the film stock could sometimes alter the toning dye substantially. These inconveniences led the Eastman Kodak Company and Pathé to manufacture and distribute a new kind of tinting stock during the 1920s. Besides ensuring very uniform tinting, this stock proved to be very stable when immersed in fixing, toning, and mordanting baths. Furthermore, the colors were not altered by the heat and light of projection equipment, not even after several dozen screenings. In 1926 Pathé offered a choice of nine raw film stocks for tinting.

### Toning

A more sophisticated range of color variations could be obtained through toning. The print was immersed in a chemical bath that substituted a colored compound for the silver in the emulsion. This dyed only the darker areas of the image, leaving the rest of the gelatin completely transparent. It is, therefore, easy to identify a toned print by the fact that the perforated edges are not colored and the light parts of the image appear white.

The toning dye was a colored metallic salt. Toning was accomplished either in a single dye bath (direct toning) or in two baths. In the latter case, the silver of the emulsion was replaced first by an uncolored salt, then by a pigmented salt. The original photographic image had to be extremely sharp; any haziness or nebulosity could jeopardize the final result.

Mordanting, or dye fixing, was a variation of the toning procedure. The silver emulsion was replaced by a nonsoluble silver salt. The metallic salt itself had no color or was very dimly colored; it acted as the mordant, fixing the pigment. The intensity of the final color was proportional to the amount of the mordanting material, which in turn corresponded to the original quantity of silver in the emulsion.

In a print colored by mordanting, as in a toned print, the transparent parts of the image are white, and the margins of the film have no color. This rule is particularly useful in identifying the processes involved in those nitrate prints colored with a system combining tinting with mordanting or

toning; tinting leaves its traces around the perforation, while toning is visible only on the image.

### Archival Implications

The 1922 edition of the Eastman Kodak tinting and toning manual cautioned that toning and mordanting were not advised for films that were to be preserved for a long time, because a chemical alteration of the emulsion was considered inevitable and the results were impossible to forecast. Therefore it was suggested that high-quality reference prints in black and white be made before a valuable film was altered by toning or mordanting. And indeed, many of the original colored versions of films have already been lost.

By and large, film archives today are forced to preserve duplicates of early films in black and white, both for financial and practical reasons. Even without considering the huge cost of restoring a film in color, the fact remains that current technology has proved unable to avoid the progressive decay of color film stock, even under the best possible conditions of preservation.

When color restoration is attempted, film archives usually follow one of two possible strategies. The most common approach is to reproduce the original tints and tones on a modern color negative. The result can be relatively satisfying, but technicians agree that the reproduction obtained is not completely faithful to the original. The materials employed at the beginning of the century (the nitrate bases and dyes) have a unique appearance that cannot be reproduced. A second and more rudimentary strategy involves reproducing tinted scenes by printing on color stock from black-and-white negatives, using a color filter. This system has the obvious practical advantage of not requiring the printing and preservation of a master color negative. The result, however, is not accurate in its color reproduction, as the tints obtained are usually rather cold and too bright. Furthermore, this solution cannot be used at all when the original print has any kind of toning, stenciling, or mordanting.

A few film archives<sup>14</sup> in the forefront of film restoration are trying to reproduce the actual techniques employed during the silent period, using machines and dyes that approximate as closely as possible those utilized in the early years of the century. The results obtained so far are tentative, and the work is extremely time-consuming. Given the current situation, with an overwhelming amount of nitrate film needing preservation and the relative lack of available time, money, and human resources, only a fraction of silent film will be restored according to these criteria. But there is little doubt that, following this direction of research, film restoration can acquire

a scientific status comparable to the practices already established in other disciplines, such as painting and architectural restoration.

For those who work in the restoration of moving images, the importance of the original tinting and toning manuals is self-evident. Film archivists are often at a loss in knowing how a silent film looked at the time of its release. These books provide an extraordinary amount of primary evidence that is otherwise unavailable. All the volumes offer precise information about the chemical formulae used in order to prepare the dyes, the timing and methods of their use, the technical problems arising from inaccurate treatment of the film, and the possibilities of combining different coloring methods on the same positive print. Without these manuals, the ambitious enterprise of recreating the original techniques would be impossible.

Preservation and restoration are urgent tasks. Cellulose nitrate is a very unstable material whose estimated life barely reaches 100 years, according to the most recent scientific research. The phases in the process of decomposition are, sadly, well known in film archives. The cellulose base becomes brittle and shrinks so much that it cannot be projected anymore; the photographic emulsion fades; reels develop a layer of brown powder on the surface, then become so sticky that it becomes impossible even to rewind the film, and the image is lost. In the last stage of decay, nitrate film is reduced to a potentially explosive crystallized mass.

It is likely that within a few years, these tinting and toning manuals will be the only primary resource available for anyone trying to understand silent film's aesthetics of color and how it was shaped by a technology that was extremely complex for such a young industry.

But the same effects of nitrate decomposition are beginning to be apparent on the individual frames of nitrate preserved within these manuals. Even under the best storage conditions, the nitrate frames in these books are bound to disappear eventually. Fortunately, the samples of films contained in the Eastman Kodak and Pathé manuals have barely reached an early stage of decomposition. Most of their original beauty is still intact. If it is not possible to guarantee their existence for an indefinite future, we can at least undertake an accurate study and reproduce some of their characteristics. This is a scientific challenge and an ethical issue that involves the expertise and commitment of librarians and film archivists alike.

#### NOTES

1. *Biograph Bulletin*, 23 March 1911. Reproduced in *Biograph Bulletins, 1908-1912* (New York: Octagon Books, 1973), p. 284.

2. Richard Koszarski, *An Evening's Entertainment: The Age of the Silent Feature Picture, 1915-1928*, volume 3 of *A History of the American Cinema*, (General Editor, Charles Harper) (New York: Scribner's, 1990), p. 127.

3. See the illustration on page 169 in Douglas Collins, *The Story of Kodak* (New York: Harry N. Abrams, 1990).

4. A copy is available in the film collections of the International Museum of Photography at George Eastman House.

5. The most widely used source on this topic is still Roger Manvell, ed., *The International Encyclopedia of Film* (London: Michael Joseph, 1972), containing a summary in four pages of the color techniques in use from the beginnings of cinema to 1960. Another useful reference tool is Steve Neale's *Cinema and Technology: Image, Sound, Colour* (London: Macmillan Education/The British Film Institute, 1985), pp. 109-58, with its two chapters on color in the silent period. The main focus, however, is the Technicolor system, developed from 1916 by Herbert Kalmus, Daniel Comstock, and Barton Prescott with the collaboration of Leonard Troland, Joseph Ball, and Eastman Weaver (see F. E. Basten, *Glorious Technicolor* [London: A. S. Barnes, 1980], and Robert A. Nowotny, *The Way of All Flesh Tones, A History of Motion Picture Color* [New York and London: Garland Publishing Co., 1983]). The most recent book on the subject was written in Germany by Gert Koshofer, *Die Farben des Films* (Berlin: Wissenschafts-verlag Volker Spiess GmbH, 1988) in cooperation with the 38th International Film Festival of Berlin; the quality of its illustrations is nothing less than outstanding as far as representing the color techniques used between World War I and II is concerned, but all information on pre-Technicolor techniques is squeezed onto a few pages. A more accurate idea of the complexity of early color techniques developed by the film industry can be drawn from the research of Harold Brown, a former curator of the National Film Archive in London. His conclusions have been summarized in an unpublished paper entitled "An Account of the Hand and Stencil Coloring Processes." I gratefully acknowledge Mr. Brown for having provided me with a copy of the original text. The only published version is available in Italian: "Tecniche di colorazione a mano e a pochoir," *Griffithiana*, 10:26-27 (September 1986), 72-73.

6. The Lumière catalog number of *Les Dernières Cartouches* is 745, but the numbering does not correspond necessarily to the chronological order in which the films were made. See Georges Sadoul, *Lumière et Méliès* (Paris: Lherminier, 1985; first published in 1964 and 1961 by Seghers as separate books, *Méliès* and *Lumière*), p. 137.

7. A good example is *Le Royaume Des Fées* (Star-Film, 1903). An original print of this film is held in the nitrate vaults of the National Film Archive in Berkhamstead, England.

8. A detailed description of these systems can be found in J. Marette, "Les procédés de coloriage mécanique des films," *Bulletin de l'Association Française des Ingénieurs et Techniciens du Cinéma* 7 (1950) 3-8.

9. Some technical drawings of the machines used for stencil coloring are reproduced in Esperanza Londoño's unpublished dissertation "Pour une histoire de la couleur au cinéma" (Paris: Université Sorbonne Nouvelle [D.E.R.C.A.V.], 1985).

10. The film collections of the International Museum of Photography at George Eastman House hold a print of *Cyrano de Bergerac*, made by Italian director Augusto Genina in 1923, that is extensively colored with the stencil system.

11. This fragment is now preserved at the Davide Turconi Archives, Pavia, Italy. The source of the tentative title is the catalog of the Josef Joye Collection in Zürich, where the material was found. It is reproduced in Paolo Cherchi Usai, *Una passione infiammabile. Guida allo studio del cinema muto* (Turin: UTET, 1991), Table of Colors, illustration 12.

12. The available evidence indicates that tinting and toning techniques were introduced in American films later. An analysis of the surviving nitrate prints shows that tinted and toned prints were far less common in the United States than in Europe. To my knowledge, tinting and toning remained a relatively uncommon technique in the United States until 1910, used only for the most ambitious projects. The exception to this is the production of the Vitagraph Company of America. The co-founder of Vitagraph, J. Stuart Blackton, often expressed his interest in new developments in coloring techniques for film, as is demonstrated late in his career with the films he produced in the United Kingdom such as *The Glorious*

*Adventure* (1922). An example of tinting in a Vitagraph split-reel before 1910 is *Princess Nicotine* or *The Smoke Fairy* (1909).

13. An early and outstanding case of gradual transition from one tint to another is the 1906 version of Pathé's *La Vie et la Passion de Notre Seigneur Jésus-Christ*. Many copies of this film exist. An original nitrate print is preserved in the film collections of the International Museum of Photography at George Eastman House.

14. For example, the Československý Filmový Ústav in Prague and the Cineteca Comunale di Bologna. Some of the foremost specialists in film restoration have discussed similar issues at the first school for film restoration ever established on a permanent basis in Bologna, under the auspices of the Cineteca Comunale di Bologna. See also Ray Edmondson, "Towards a Philosophy of Film Archiving," *FIAP Bulletin* 41-42 (1991), 6-7.

## The Sound of Silents

We know that silent cinema was never actually silent—or that great movie palaces had large permanent orchestras with their glorious musical directors. Local cinemas might not be able to afford that level of lavishness, but they too would have at least a small ensemble. And so on down the "social" scale to the roadshow with a lone pianist, a necessary part of the performance even, as *The Picture* reminds us, in the Australian outback. We know quite a lot about the kind of music that was played. Special scores for screenings of blockbusters like *Birth of a Nation* in the major cities; a standard repertoire of classical music in more downmarket cinemas; whatever the pianist could play elsewhere. Mood music basically, making the images more emotionally intense, heightening the drama, providing a sense of complicity. It was there to support, confirm, and reinforce. If the musical director of the *Empire* didn't like the score sent along with the film or if the orchestra couldn't manage it, he was at liberty to substitute something else that he thought would be suitable, and as cinema progressed he frequently did.

Music was, then, an essential ingredient of the cinema. But if sound is considered only on this level, it becomes merely subordinate to the images it was supposed to fit. What I would like to do, using the films of Abel Gance as examples, is to shift the reference, to examine sound as one of the major determinants of silent cinema.

Gance, it could be argued, is an exception, a privilege given a relatively free hand and copious resources by his producer to experiment with new techniques. Certainly he was more than most of his contemporaries and was able to draw on the remarkably skilled team of technicians. But if, by the early 1930s, he was acknowledged as the great master of French cinema, it was not as an innovator but as a filmmaker who blurred the distinction