CHAPTER 17

The Illusion of Movement, the Illusion of Color: The Kinemacolor Projector, Archaeology, and Epistemology

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THE KINEMACOLOR PROJECTOR

Produced between 1910 and 1914 by Natural Color Kinematograph Co., Kinemacolor projectors used panchromatized black-and-white 35mm film. The Kinemacolor projector in the Will Day collection at the Cinémathèque Française is 18.5 inches (47 cm) high, 11.4 inches (29 cm) long, and 13 inches (33 cm) wide. The cast iron encasement is inscribed with "Kinemacolor Urban-Smith Patents," after its patent holders Charles Urban and George Albert Smith. Besides the usual shutter, a rotating disc fitted with red and green colored filters is mounted at the back of the machine, between the light and the film gate. An automatic light cut-off behind the disc prevented the heat of the light from burning the gelatin filters when the projector was stopped.

THEORETICAL FRAMING

This chapter explores an archaeological and epistemological approach to Charles Urban's Kinemacolor projector as a machine. Archaeology considers machines as archives. Three types of archives can be distinguished: users' gestures, performance practices, and specific modes of perception—the viewer's perception of a Kinemacolor film resembles no other visual experience. The epistemology of the machine aims at reconstructing the set of concepts that constitute its basis and conditions of possibility. To achieve this, a precise technological description of the apparatus is needed, a description that reveals the perfect coherence of the technical, economical, aesthetic, and political aspects of Charles Urban's enterprise.

THE ILLUSION OF MOVEMENT, THE ILLUSION OF COLOR: THE KINEMACOLOR PROJECTOR, ARCHAEOLOGY, AND EPISTEMOLOGY

Kinemacolor, the first "natural color" process commercially exploited—and with great success—by Charles Urban between 1908 and 1914, has been the object of a revived interest in recent years, from both a historical[1] and archival[2] perspective. Kinemacolor was patented in Great Britain by George Albert Smith in 1906 as "[i]mprovements in and relating to Kinematograph Apparatus for the Production of Coloured Pictures."[3] Patents then followed in the next years in most Western countries. Kinemacolor is an additive, two-color system: black-and-white panchromatic film is shot and then projected through a rotating disc fitted with two colored filters of red and green gelatin. The process thus required the modification of the projectors in every theater wishing to project "natural color" moving pictures. As this arrangement proved to be unsatisfactory, the Natural Color Kinematograph Co., the sole producer of Kinemacolor films set up by Charles Urban in 1909,[4] started selling specific Kinemacolor material[5] in specific projectors in 1910. These projectors,[6] which were designed by Henry W. Joy who had been collaborating with Urban for several years, differed from other projectors in several ways. The specific color shutter was mounted at the back of the machine, between the light source and the film gate. An automatic light cut-off behind the disc prevented the heat of the light from burning the gelatin filters when the projector was stopped. Unlike most of the other projectors of their time, the Kinemacolor machine "was never hand-operated but was always attached to a motor which governed the speed," at least in Great Britain.[7] Its mechanism had another peculiarity: besides the usual dog roller ensuring the intermittent motion of the film, it was equipped with a secondary dog roller "set at a radius to minimize the blow of the main dog roller."[8]

These technical characteristics are linked with the structure of the process. Kinemacolor is based on two fundamental ideas. The first is that color

is somewhat akin to movement, so that "persistence of vision"—which was then understood as the basis of the illusion of movement in film—could also be used to synthesize colors: the eyes would blend the three primary colors as they did the successive photographic images, recreating a "natural" color palette as well as continuous motion. As formulated by G.A. Smith in the 1906 British patent, his method "is based upon the well-known principles of 3-colour photography, but use is made of the principle of persistence of vision to effect the necessary superimposition of coloured images."[9] This proposed solution to the "natural color" problem in cinema is far from obvious. In fact, it derives from a 1899 patent by Frederick Marshall Lee and Edward Raymond Turner, a patent which had been bought back by Urban but gave no satisfying result.[10] Whether due to scientific impossibility or limitations of his mechanical constructions, G.A. Smith never managed to produce a working three-color apparatus based on this principle: the three successive color records could not register and superimpose efficiently for the spectator to be able to synthesize colors. So he decided that besides the principle of persistence of vision, another aspect needed to be added to the apparatus: "Compressing the colour records into a less number than three, so as to give the least possible interval of time between successive presentations."[11] In fact, as Urban and Smith later disclosed, both were pleasantly surprised by the quality of the results given by this daring and almost desperate move: instead of the supposedly necessary three colors, only two primary colors—red and green—were used. That should not have worked, but somehow it did. Indeed, Urban was satisfied enough with the results that he decided to patent and exploit this two-color method. As summarized in the British patent: "By my method 2 colours only are recorded, red & green, & these two records are exhibited in such rapid alternation that persistence of vision causes the colours to blend into one view, which appears in approximately correct colours."[12] The secret—and ultimately the curse—of the process lies in the word "approximately."

So how did it work precisely? Additive processes had one advantage: they could use "normal" black-and-white film stock, made sensitive to all colors including red, through the chemical process of panchromatization. For Kinemacolor—as opposed to Gaumont's 1913 Chronochrome process, which was based on different principles—this was an important aspect. In fact, Urban and Smith made the decision from the outset "[t]o conform to the condition that any scheme must be easily applicable to the existing cinematograph machinery, and that the standard film with standard perforations must be used, so that any successful results must be readily adopted by every cinematograph user without much trouble or expense."[13] It was both a technical and a commercial choice: the fact that this additive system required a specially modified projector was to be compensated by the easiness and cheapness of

the modification. Chronochrome needed a specific, three-lens projector that could only exhibit Chronochrome views. In theory, Kinemacolor views could be shown with a usual projector, provided the empty areas of its shutter were equipped with red and green color filters. With projectors of the day, whose shutters were located outside the mechanism, it was a fast and easy manipulation. Therefore, a specific Kinemacolor projector was by no means a necessity.

Using this panchromatized black-and-white film stock, the views were taken with a camera whose shutter had been equipped with color filters. To achieve the required sixteen *images* per second, or—to phrase it differently—to successfully blend the colors for the spectators' eyes, the camera had to run at twice the usual speed, meaning about 30 frames per second (fps). Kinemacolor thus forced one to differentiate between a frame and an image: here, a frame was not an image but only part of one; *two* frames (and the projector) were needed to make *one* "complete" color image. The black-and-white negative thus showed 30 successive color records per second, whose gray densities corresponded alternatively to the red and the green of the scene. On the set, this meant that the exposure length of each frame would be half of what it normally was. Moreover, the filters cut away an important share of the light reaching the film. Thus in practice, Kinemacolor needed bright sunlight, which was only available in the British summertime, or in the warmer countries of the Empire.

As a result of the increased speed, the Kinemacolor projecting system also needed to run twice as fast. This resulted in a significant mechanical effort for both machines and film, as well as problems of a screen illumination that was too low. Thus, if Kinemacolor views were to be projected with a usual machine, it produced such an inconvenience that eventually Urban decided to produce his own equipment, following the specific requirements of his process.

Urban's projector was supposed to run at 30 fps, but also had to support the "normal" speed of sixteen to twenty fps to show black-and-white views: it had been decided from the start that a Kinemacolor projector also had to be able to project the usual standard footage. It thus had to be motor-driven, because hand-cranking would hardly be compatible with these constraints. The wear on the film was diminished thanks to the double dog mechanism, which meant that the film was not entirely motionless when the main pull was given. The double speed also required greater mechanical precision in the construction for it to work efficiently. The filters required that the projector be fitted with a powerful lamp, as the 1910 Kinemacolor equipment catalog indicated: "Upon the quality of the carbons used for Kinematographic Arc Lamps the success of the display very largely depends, especially where the intense currents necessary for Kinemacolor exhibition are dealt with."[14] This in turn required the attachment of an automatic cut-off. Constructed in cast iron,

"[t]he Kinemacolor projector was heavier and more substantially built than conventional machines to reduce vibrations which would otherwise occur during the double speed operation."[15] While this reduced the wear on the machine and film, it also produced a steadier moving image on the screen. Instead of mounting the filters on the shutter, two separate rotating discs were installed, the color disc becoming a different apparatus from the usual shutter and easily removable to switch from Kinemacolor to black-and-white views during the exhibition.

All those specificities made for a very expensive machine, which was entirely coherent with Charles Urban's marketing strategy. Urban positioned his Kinemacolor projecting outfit at the higher end of the cinema production. According to him, "marketing its aesthetic, scientific, educational and high cultural values"[16] meant producing non-fiction films that were to be shown in luxury theaters, properly equipped so that spectators could enjoy high-quality projections. The resulting high admission prices were part of his plan to attract the higher classes to the new medium. The 1910 Kinemacolor equipment catalog mentions that the complete "Kinemacolor projecting outfit, suitable for exhibiting both monochrome and Kinemacolor pictures" would cost £10,000. Interestingly, this comprehensive set included an "optical lantern, for lantern slide projection,"[17] which shows that a 1910 typical—or even high-level—projection booth not only contained solely one film projector but also a magic lantern. That is quite revealing of the composition of the screening programs of the time, at least in Great Britain.

Thus, besides its characteristics—shape, mechanical structure, weight, price—the Kinemacolor projector system represented a whole set of practices. As the philosopher of technology Gilbert Simondon wrote, "What lies in machines is human reality, human gesture fixed and crystallized in functioning structures."[18] As solid as gestures are evanescent, machines are archives of actions and procedures. Preserving a Kinemacolor projector is preserving the complex arrangement of technical, economical, and aesthetic elements that was the Urban system, as it could be conceived only around 1910. It also means preserving precious information regarding the projection practices of the time, the organization of screenings, as well as the precise visual quality of the viewer's experience.

A machine is not only an archive of its users' gestures; it preserves, at least as a potentiality, what it is meant to produce. The Kinemacolor projector is an archive of a very specific, peculiar mode of perception. It enabled the first "natural color" system exploited on a wide scale, which in itself makes it rather interesting: the study of its reception at the time in trade journals or general criticism is rich with information on the medium's relation with color and indexicality.[19] Admittedly, it is a rather unique process. Firstly, being based

on only two primary colors, it produces a singular color palette, lacking deep blues as well as pure whites. Strikingly, this has rarely been singled out in general criticism: the *Variety* comments on Kinemacolor films throughout 1913, for instance, had only the highest praise regarding the luxuriousness of the colors. Competitors, of course, were quick to emphasize the defects of the process, while technicians and specialists remained skeptical regarding the idea, even though they did recognize the surprisingly pleasing quality of the result, despite the theoretical absurdity of the principles.[20]

In addition, Kinemacolor produced a second singular visual specificity, thus described by Frederick A. Talbot in 1912:

> Another disconcerting feature which has aroused considerable comment in the public mind is the apparent duplication of the outlines of figures near the camera. The most uninitiated observer cannot fail to see the outlines in green and red, as if the superimposition is out of register. "Fringing," as this defect is called, is difficult to eliminate in many instances, and although often it is only momentary, it is decidedly distressing.[21]

The two color records constituting the base for the synthesis of "natural" colors are in the Kinemacolor process exposed *successively* and not simultaneously. This implies that color records of moving objects, being at different positions in the image on each frame of the shot, cannot possibly superimpose adequately. That was particularly true of the figures placed close to the lens, as the interval between two successive positions in the image of each frame was the greatest in this case. It was a structural defect of the apparatus and could not be eliminated. Consequently, each motion on the screen was emphasized with the apparition of more or less pronounced red or green fringes. As Herbert T. Kalmus, founder of Technicolor, amusingly formulated:

> Since Kinemacolor photographed the color components by successive exposure, it was nothing for a horse to have two tails, one red and one green, and color fringes were visible whenever there was rapid motion.[22]

Among commercially exploited processes, Kinemacolor was the only process that presented such visual conditions. Again, reading the general criticism of the time leads to the stunning conclusion that this rather annoying commercial "defect" of the system was left unnoticed by almost all film critics. The "considerable comment" mentioned by Talbot was in fact practically restricted to discussions among technicians and to the promotional discourses of Kinemacolor's great rival, Pathé, the leader of the market of color film with their mechanical stencil process.

Kinemacolor is thus a rather strange, theoretically and perceptually complex process. On the visual level, the experience of viewing a Kinemacolor film remains quite unfamiliar to the contemporary spectator, even though its peculiarity may have been eroded by a digital transfer. Today, the specific color palette highly depends on the principles and methods adopted for the restoration; but the limited color range of the palette produces an unusual filmic universe, with an almost dreamlike quality. To that is added an uncertainty of lines, a trembling of photographic contours which has no equivalent in any other visual apparatus.

The interest of the Kinemacolor visual experience is not only purely perceptual or sensual: to the epistemologically inclined, those fringes are theoretically captivating. What a Kinemacolor screening allows the spectator to see is the *photogrammic interval*: the viewer is able to experience the cinematic principle as a work in progress by actually seeing the series of photograms and intervals behind what is usually understood or presented as a flow of continuous movement. Disregarding the question of color realism, one begins to see something entirely different: instead of "natural color," one sees the fundamental interval at the heart of the cinematic apparatus, manifested as red and green flashes all over the screen.

Making use of "persistence of vision" to synthesize color as well as movement, the Kinemacolor system assumes that color and movement share enough qualities to be synthesized by the same principle, thus revealing a basic epistemological assumption of the color cinema apparatus. The hypothesis of this kinship is somehow confirmed by the machine, in the sense that it *works*. The equivalence between color and movement appears as the basis of what is shown, a basis whose strangeness we must learn to rediscover. As Colin Bennett noted:

> Thus, in the case of Kinemacolor, the willing member of the audience is treated to not one, but two separate and complete illusions, for whereas the black and white exhibitor merely makes you believe you see movement which is not there, the Kinemacolor operator does the same for the perception of colour also.[23]

Color is not inscribed on the celluloid itself; it is created through the projection performance. Thus color, "natural" though it may be, can be described here as an "illusion." But in this system, the simultaneous representation of both color and movement apparently becomes too difficult for the machine to handle. If color is synthesized through movement, then movement tends to turn to color, and moving objects, in effect, gain color fringes.

From a historian's point of view, Kinemacolor may be described as an

exemplary failure in the evolution of "natural color" in cinema. Nevertheless, its influence on the evolution of the cultural status of film in the transition era may also be considered strong, as has been argued by Eileen Bowser:[24] the fact that it enjoyed several years of success could substantiate such a view. But beyond the study of the particular context of its commercial exploitation, the analysis of the Kinemacolor projector in itself as well as its uses and its genesis can provide much information on the history of cinema as modes of performance and perception, and on its epistemological history. The machine, as an archival trace, is a testament to what it meant to be a projectionist and to what spectators *saw* in the theaters of the 1910s. It also exposes the theoretical framework in which cinema was conceived at that time, the network of concepts that were thought to provide a solution to the problem of natural color in cinema,[25] and a certain epistemological moment in the evolution of the apparatus. That "persistence of vision" could be believed to enable the synthesis of color as well as movement is surprising even today. Watching that equivalence uncover the photogrammic interval *at work* is another surprise—an unwanted feature of the apparatus that today becomes one of its most fascinating consequences. The findings of an archaeological and epistemological approach can then make us resituate the apparatus within another context: that of experimental installations working at the "structural" level of the medium. In 1975, media artist Paul Sharits created SHUTTER INTERFACE: four colored film loops were projected simultaneously, the images partially superimposed on the screen. For Sharits, the constant colored flicker and transformation of hues were meant to show the spectator one precise movement: that of the shutter.[26] His installation was meant to demonstrate that the interval between the photograms is something that the spectator *does* see. This is exactly what the Kinemacolor projector was already doing in the 1910s, in an entirely different context.