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The Way of All Flesh Tones

> I know that my colours are not yours. Two colours are never the same, even if they're from the same tube. Context changes the way we perceive them. I've usually used one word to describe a colour, so red remains red with lapses into vermilion or carmine. How could I be certain that the shade I wanted could be reproduced by the printer? I prefer that colours should float and take flight in your minds.
>
> Derek Jarman

The Heritage of Magic Lantern Slides: Hand-Colouring and Stencil

The first attempts to apply colour manually to the film emulsion derive from the methods normally used for magic lantern slides. Experiments in this direction were made in the United States and France almost as soon as the photographic moving image came into existence. Already in 1895 the Edison Kinetoscope Company had marketed *Annabelle's Dance* – the first of a vast repertory of single-shot views dedicated to the genre of the 'serpentine dance', which Loïe Fuller had made an international rage – in colour versions. Annabelle's white veils were tinted by hand by the wife of Edward Kuhn in the Edison Laboratories at Llewellyn Park, New Jersey, using half a dozen hues, in an attempt 'to simulate the effect of the coloured lights that were projected on the ballerina during her performance on stage'. Early attempts in this direction were also made by Lumière in France and by Robert William Paul in the United Kingdom.

The application of colour was later improved with the use of powerful enlarging lenses and extremely fine brushes. Georges Méliès, more than anyone else, took advantage of the limitations inherent in this practice (it was difficult to follow precisely the contours of people and objects) by producing some of the most fascinating colour films of the early period (Plate 45). *Le Palais des mille et une nuits* (1905) has ample strokes of brilliant dyes, sometimes with a dominant golden yellow, pervading the entire frame and creating an effect similar to tinting; more complex is the colour scheme in *Le Royaume des fées* (1903), in which the variety and density of the hues has no equal among surviving nitrate prints of the early period. The colours in this film have been compared to those of medieval miniatures, not only because of the minute detail and the clever articulation of delicately hued patterns within a tiny

surface, but also because of their effect in locating the story in a realm of mythic atmosphere, deliberately alien to any historical context (although derived from the visual codes of late nineteenth-century books of fables), and by their capacity to enhance the beauty of the settings and the depth of the *trompe-l'oeil* perspective.

In order to reduce the very high costs involved in hand-colouring a film, standardise the product – for obvious reasons, manual application of colour resulted in noticeable differences from copy to copy, affirming the uniqueness of each – and satisfy a growing market demand, systems were devised for mechanical colouring after 1905. (It is worth noting, though, that hand-colouring never disappeared altogether. From the early 1920s and well into the sound period, for example, Gustav Brock would manually apply color with the same system used by Méliès on prints of several Hollywood productions.) The industrial, rather than aesthetic, nature of the innovation is confirmed by the fact that these coloured films originated with Pathé, then a rapidly expanding company whose drive to control all phases of production culminated in 1908 in its policy of 'vertical integration' of the market. The motive underlying the technological breakthrough was clear: guarantee the standardised quality and regularity of the product, therefore enhancing control over the distribution process. More copies, better quality, at lower cost. The areas of the frame to be coloured were cut (by hand or by needles connected to pantographs) onto matrix copies which were then placed on the positive prints; each colour was applied to the film through the outlines thus obtained, with brushes or pads soaked in the appropriate aniline dye (Plates 49, 51 and 52).

Since its early adoption for trick films and *féeries* (*La Poule aux œufs d'or*, 1905; *Aladin ou la lampe merveilleuse*, 1906) whose chromatic effects were still indebted to manual techniques in use at the time, the patented Pathécolour – also known as '*au pochoir*' in France and 'stencil' in English-speaking countries – justified its owners' claims to supremacy in the colour reproduction of reality. It was then that 'cinematography in natural colours' became a criterion of taste in the evolution of moving images, as important as the 'talking picture' (the coupling of colour and sound came to be considered at a certain point as the ultimate goal of film experiments). The principal arena for the innovation shifted from the domain of fiction to non-fiction: authenticity and realism were the main goals in the reproduction of a landscape as it was actually seen: the warm brown tones of the walls of ancient castles, the uniform blue of the sky, the contrast between the green expanse of a meadow and the vivid rose bushes within it, the emerald texture of the sea spangled with the sails of ships. The principle of authenticity was further extended to the myth of historical accuracy and the legitimisation of cinema as an aesthetically elevated subject; the Pathé series 'Film d'Art' and the adaptations from drama and literature produced by the company's 'Film d'Arte Italiana' between 1909 and 1912 displayed a refinement of colour and precision of outline unequalled in the period. Their palette and their audience alike sprang from the appreciation of academic painting. Stencil colouring became infrequent after 1915, but there are extraordinary examples of it up until the mid-1920s (*Cyrano de Bergerac*, Augusto Genina, 1923).

The Aesthetics of Uniformity: Tinting and Toning

It is not known precisely when uniform colouring of the film stock began to be a component of film production. This uncertainty is somehow surprising, since much has been documented and published regarding other colour techniques in an era when the paternity of a discovery was the frequent object of contention, and competing claims were made by the presumed pioneers of this or that device. A plausible explanation for the absence of reliable evidence on chronological priority might be that tinting and toning were adopted by different producers more or less at the same time. It should be emphasised, however, that the introduction of tinting was gradual, and withouth much fanfare. On the basis of surviving films of the era, it seems that it must have been used only rarely until the end of the 19th century; the first significant example of this kind was to be seen in October 1901, when James Williamson's *Fire!* was released, containing footage tinted red to depict the conflagration in an apartment building.

Although anonymous – perhaps simply because not subject to any form of proprietary ownership – the invention spread to all the producing countries with great speed. No statistical analysis of this diffusion has been attempted, but an estimate based on surviving nitrate prints suggests that the technique went through three phases. The first, from 1900 to about 1907, saw the occasional use of tinting and toning. In the second, from 1908 to 1925, the uniform colouring of the film base became a widespread practice. The great majority of films during this time were coloured using one or the other technique, or both combined. This period may be further subdivided into two trends – initially, the frequent use of both tinting and toning; later, the slow decline of toning in the years 1921 to 1925. In the third phase, corresponding to the twilight of silent film, there was an increase in the number of films distributed in black and white, even though tinted films were still common. The decrease in uniform colouring of the film base is in all likelihood connected to at least three concurring factors: the increasing availability of more sophisticated techniques, such as the first experiments in Technicolor; the gradual introduction of panchromatic film, less suited to the general application of colour than the orthochromatic film for which the techniques of tinting and toning were originally designed; the introduction of soundtrack on film in the late 20s (as tinting and splicing would be likely to interfere with the optical cells in the projector).

Surviving nitrate copies of silent films suggest that some form of tinting or toning was employed in approximately 85 per cent of the total production. This estimate does not take into account a practice quite common even in the earliest cinema, that of colouring the intertitles in films otherwise released in black and white. Intertitles tinted at first in blue and later in red (which was customarily done at least until 1914) was one of the distinguishing elements of the Pathé company's products, a device for discouraging bootleg copies. Similarly, Gaumont intertitles were often tinted blue-green.

Tinting and toning films became such a widespread practice that some companies produced brochures and catalogues on the subject (Plate 44). Eastman Kodak was by far the most prolific, issuing no less than five editions of its manual on the tinting and toning of positive film between 1916 and 1927. These are works of great historical value, as they contain not only the chemical formulas used to create the coloured baths but also actual samples of nitrate film coloured in each tint and by each technique discussed. They deal with processes of remarkable complexity, allowing the creation of a vast range of colours that sometimes differed from one another only by subtle variations in density and luminosity, difficult for the untrained eye of a modern observer to identify.

Tinting was implemented in three different ways:

A initially, by applying a coloured varnish on the film emulsion (Plate 46);

B from the early years of the 20th century, by immersing the film stock in an aqueous solution containing the colouring agent;

C towards the end of the silent era, using a pre-tinted stock (a sophisticated instance of this is given by the Sonochrome film, manufactured by Kodak in the late 1920s and promoted through a vague yet intriguing 'philosophy' of correspondence between colours and emotions; see Plate 62).

Toning was achieved through a process where a coloured compound was substituted for the silver of the emulsion without colouring the gelatin of the film. This could be obtained in three ways:

A by direct toning, in which the silver salts are replaced by another coloured metallic compound;

B by toning in two baths, where the silver image is transformed first into a colourless salt, and then into a coloured salt;

C by mordanting, in which the silver is replaced by an insoluble silver salt capable of fixing organic colouring agents.

The three different systems of toning – devised to increase the variety of available colours – cannot easily be differentiated by a cursory examination of the prints from this era. The possibilities offered by toning alone were in fact limited by the number of metals (such as iron, uranium and copper) which would yield colour compounds. With mordanting, however, because some organic compounds can be altered by colouring solutions, the variety of colours that could be obtained was practically equal to the quantity of basic substances available. The introduction of toning by the use of mordants, towards the end of the 1910s, was a response to aesthetic requirements, and to a market which demanded ever more complex and sophisticated colouring effects.

In the direct examination of a piece of nitrate film, a tinted print shows colour-

This chart will aid in visualizing the chromatic relationships of the sixteen Sonochrome tints in the hue cycle. The tints range from NOCTURNE, *a cold violet-blue, to* INFERNO, *a fiery red tinged with magenta. Between these two on one side lie the purples* PURPLEHAZE, FLEUR DE LIS, AMARANTH, *and the purple-pink* CAPRICE, *on the other side the cool blues and greens from* AZURE *to* VERDANTE, *the warm yellows and oranges from* SUNSHINE *to* AFTERGLOW, *and the pinks* PEACHBLOW *and* ROSE DOREE.

Kodak Sonochrome, *c.* 1929. Illustration from *New Color Moods for the Screen*, published by Eastman Kodak Company (George Eastman House).

ing in both the dark and the light areas of the frame, and on the edges of the film (Plate 47). With toning and mordanting, only those areas retaining the silver of the emulsion are coloured. The remaining parts of the frame appear as white, and the edges remain uncoloured (Plate 48). Tinting, toning, and stencil (or, more rarely,

hand-painted) colour may be seen together in the same shot, thus multiplying the creative possibilities of these techniques (Plates 44, 51 and 52). Every individual scene with tinting, toning, or a combination of the two had to be immersed in a separate bath, so the film stock to be treated was wound on reels containing all the scenes to be treated with a particular colour. In most tinted prints and all toned prints, segments with different colours had to be rejoined with splices in every positive print. In a nitrate copy of *The Red Lantern* (Albert Capellani, 1919) held by the Cinémathèque Royale in Belgium there is a scene set in a dance hall where changing effects of light are achieved by fragments in various colours, joined with splices. There are no such splices, however, in nitrate prints of *The Four Horsemen of the Apocalypse* (Rex Ingram, Metro Pictures, 1921) in the shot where a woman sings the 'Marseillaise' while the colour changes from blue, to black and white and then red, alluding to the French flag. In this case, the effect was possibly obtained by consecutively immersing portions of the footage corresponding to the entire shot in different colour baths without cutting the positive print (Plate 50).

It has been stated so often as to become a cliché that a colour in a motion picture was chosen most frequently for its specific dramatic, atmospheric, or psychological connotation, such as blue for heavenly scenes (as in Robert William Paul's *The ? Motorist*, 1906), or for night-time settings, the transition from blue to yellow or ochre where a character enters a dark room and switches on a light, or red to indicate fire. The utility of this approach to colour is undeniable, but that alone is not adequate to explain the enormous variety of options that were available to filmmakers and their audiences. If it were simply a matter of associating colours with events or such emotional states as hatred or passion, the palette would have been rather limited, if only because the symbolic meanings of colour were never codified or generally agreed upon by the public. In popular wisdom at the turn of the century, yellow was widely associated with compromise and cowardice, yet only rarely used this way in film. In the often-cited instance of *The Lonedale Operator* (David W. Griffith, Biograph, 1911), blue tinting supports the stratagem of the heroine who, in the dim light of a room, holds a monkey wrench in her hand in order to make it seem to the two bandits that she has a gun. It is true that in this case the association of the colour blue with lack of light has more than a conventional value. But this derives from a theatrical tradition, while the philosophy and use of colour in silent cinema also obeyed other criteria, which were not necessarily more sophisticated but certainly made no effort to simulate reality.

One could say: primary colours for primary sensations. But then, if red equates with fire and violence, blue with the sea, with rain and darkness, and green with the natural world, what was done with purple, orange, mauve, and all the intermediary shades (including silvered dark gray toning, often difficult to distinguish from plain black and white) cited in the manuals and recognisable only after close examination of a nitrate print? And why was such a diversity of shades exploited in non-fiction subjects? Production companies tinted and toned their films using the resources at

their disposal. In some feature films, the first reel would show a relatively wide variety of colours, gradually decreasing in the remaining footage. Here, the spectacular display of tinting and toning might be compared to black and white films of the 1920s with Technicolor sequences occurring at critical points in the story, or the concentration of grand scenic and sound effects in the first ten minutes of a feature film.

For the major companies of the 1910s (among them Pathé, Ambrosio, Gaumont, Metro, Cines, Famous Players-Lasky, Nordisk), the use of a gamut of tones was often a point of prestige; to middling and minor companies, colour was an expensive luxury to be used only when necessary (and at times even contrary to the sense of the scene, as we see in the many nocturnal settings tinted in amber yellow). An ochre yellow predominates in the feature films of the poverty row companies, sometimes alternating with blue. Elsewhere, the same colour would be used just to give a feeling of comfort and warmth to the viewing experience. Apparently, one colour was better than nothing, and it would allow low-budget firms to claim that their films were not in black and white after all. By and large, the poorest companies produced films with no colour at all; others avoided colour altogether in certain genres of film addressed to lower-class audiences, such as one- or two-reel comedies of the 1910s, which are largely in black and white.

Tinting and toning in a silent film could also vary according to the time and place of distribution. A company might re-release copies of its films using colours different from those initially distributed, more or less elaborate as circumstances dictated. Once exported abroad, moreover, a film was virtually abandoned to its fate in matters of colour. If the production company sent a second negative to another continent (as was the practice from the early 20th century), it might send recommendations on the tinting and toning, or indicate colour on the blank frames preceding each scene in the negative, but there was no guarantee that the recipient would follow those instructions, and little or no supervision of what was actually done. Local distributors would have the last word in this matter, and determine colour schemes following their own taste or the predilections of their clientele.

'Natural Colour' and its Utopias

At the extreme opposite of the synthesis of reality by means of symbolism and simplification stands the work of those technicians who sought to endow film with the presumed qualities of the human eye. The fact that these efforts came principally from scientists, rather than arising out of the demands of filmmakers – with the notable exception of Cecil B. DeMille – helps to explain their relative detachment from most attempts to control colour for stylistic reasons. Following on from the experiments by James Clerk Maxwell (1831–79) and Arthur-Louis Ducos Du Hauron (1837–1920), at the end of the 19th century, the British photographer, William Friese-Greene undertook a series of experiments to achieve 'animated natural colour pictures'. Although unsuccessful on a commercial level, his pioneering work

laid the theoretical foundations of the Technicolor process. The work of Friese-Greene underwent at least six successive stages:

A installing in both the camera and the projector a disc of glass divided into three equal sectors, each with a filter of one of the three primary colours in the additive synthesis (red, green and blue). This disc was then rotated – at speeds varying between 40 and 70 frames per second – so that each sector of the disc corresponded to a frame filmed and then projected (1898);

B abandoning the coloured disc in favor of a prism located in front of the camera lens and the projector;

C arranging three cameras and three projectors, stacked vertically, horizontally or in a triangle, each fitted with a filter of a primary colour. The film would then be projected at the standard speed of 16 frames per second, but required triple the quantity of film, while exact registration of the three images during projection was extremely difficult to achieve;

D directly tinting alternate frames with two primary colours (red and green), after the film was shot through a rotating disc using alternating filters of these same two colours (1909). According to surviving fragments, a three-colour variation on the same system was experimented shortly afterwards (Plate 58);

E shooting simultaneously two parallel reels of black and white film, each moving in synch with an endless band of transparent celluloid whose empty frames were coloured alternately green, red and blue. After processing, the positives were projected in parallel, with the same two loops of transparent film;

F using the same system of two parallel reels of film, successively shot and projected through rotating colour-segmented discs instead of loops of transparent, coloured film.

All these systems had problems when put into use: the need to speed up projection, which consumed an inordinate quantity of film, the rapid deterioration of the print from this high speed projection, the flickering of the image, and the blurring of contours. In 1911 Colin Bennett tried various means to overcome these defects, registering under the trade mark Cinechrome (1911–25) his system of a lens divided into two sectors for a 70mm film, also divided into two zones, each of a different colour. Claude H. Friese-Greene, the son of the inventor, experimented further with the idea of a rotating filter, pursuing research along the lines initiated in 1897 by the German researcher, Isensee. All of them met with negative results. The solution – developed by Frederick Marshall Lee and Edward Raymond Turner in the London laboratory of Frederic Eugene Ives, copyrighted in 1899, bought in 1902 by Charles Urban, and refined further by George Albert Smith – was essentially a compromise. Smith discovered that the use of just two colours, with a

rotating filter of green and red sectors, could give adequate results without radically modifying the projection apparatus while running the film speed at 32 frames per second.

The development and success of the system copyrighted by the Natural Colour Kinematograph Company, founded by Urban after a successful demonstration in 1909 and his acquisition of Smith's shares (Smith being more interested in the scientific aspects of the invention than in its commercial exploitation) were part of a series of business moves. In the form in which it was exploited in the United States and Europe, the Kinemacolor film needed only a single chemical treatment, the panchromatisation of the motion picture stock (achieved by immersing the base in a sensitised solution) in order to make it sensitive to the red end of the spectrum. The Kinemacolor image provided a modest but serviceable chromatic range. Charles Urban exaggerated its capabilities to the point of maintaining that the new process could capture accurately all the colours of the spectrum. Nothing was further from the truth, but the fact that neither journalists nor the general public objected to this claim shows the extent to which audiences were captivated by the images created with this system.

The colour palette in Kinemacolor was in fact rather limited. The reproduction of blue and purple in particular left much to be desired, and required corrections which could be effected by projecting the film onto a light blue screen. Eyestrain was often reported when long films were shown. All the numerous subjects of Kinemacolor were shot in bright sunlight, as artificial light gave disappointing results. Other limitations are clearly visible in surviving prints: green and red predominate, while objects in other colours appear with a brownish cast that gives the whole a pastel tonality, recalling the look of Lumière Autochromes. There is a tendency towards homogenisation of diverse hues and a reduction in the depth of field.

Besides these drawbacks, other basic technological flaws precluded Kinemacolor from becoming the dominant system for natural colour. Exhibitors objected to adjusting their projection equipment every time a Kinemacolor film was threaded into the machine, while producers resented making 1,000 foot reels whose running time only equalled no more than a reel of 500 feet. All in all, Kinemacolor never reached a full integration into the normal exhibition circuit. However widespead, its success was confined to the status of a special attraction for a select audience. In the early 1910s, however, the relative lack of commercial success of Kinemacolor was attributed more to its inherent qualitative shortcomings than to its technical challenges. The competition between Kinemacolor and other rival systems was partially stimulated by a utopian faith in the potential of film technology to achieve 'natural colour', reality 'as it is' being the goal of the cinematic spectacle. An elaborate system launched at this time by Gaumont had this same goal: bringing the spectator to this 'new world' of the image.

Following research undertaken in France by the Établissements Gaumont, the Société Française de Photographie presented on 15 November 1912 a demonstration

of a new two-colour additive system, 'Biochrome', the latest entry into the field of cinematography with 'natural colours'. The response encouraged Léon Gaumont to continue his efforts, and less than a month later to organise another screening, this time before an invited audience at the Gaumont-Théâtre, 7 Boulevard Poissonnière in Paris. The first commercial presentation was in April of the following year at Gaumontcolor in rue du Faubourg-Montmartre.

Within two months, the invention – now christened 'Chronochrome' – crossed the Atlantic, in an attempt to conquer the American market for 'natural colour' cinema, which until then had been ruled by Kinemacolor. The subjects presented in New York in June 1913 were largely those already shown in Europe. An agent of the Eastman Kodak company was present at the screening, since Kodak had produced especially for Gaumont an experimental panchromatic safety-base film, sensitive to the full range of the spectrum, which was destined to overtake orthochromatic emulsion by the end of the 20s. Alone among all the systems hitherto developed, Chronochrome had the advantage of displaying a very rich range of colour while using a film of standard 35mm format.

The system employed a triple lens fitted with three filters (green, red, and blue) for both the camera and the projector, by means of which each black and white image was split into three frames. The three images were projected simultaneously, each through its respective filter, to form a single image (Plate 61). Instead of the usual two- or three-blade shutter, a one-blade shutter was used. The width of each frame was identical to that in conventional films, but its height was reduced from the standard 18mm, thus giving the projected image a panoramic format, with an aspect ratio of approximately 1:1.71. The reduced height of the frame achieved a considerable saving of material, requiring 2.25 times the quantity of film stock used for normal film projection, rather than three times as much, as would have been required for frames of standard dimensions.

The filter corresponding to the central lens was fixed. The green and blue filters were adjustable both horizontally and vertically, in order to keep the three colour images in register on the screen. It was a delicate operation, requiring constant adjustments by the projectionist, and complicated by the distance of the projector from the screen. At first, correct registration demanded the help of an assistant projectionist in the hall, relaying instructions to the projection booth by telephone; later, a technician in the hall would modify the positions of the three lenses by means of an electrical remote device.

Another drawback proved to be more serious and ultimately decisive: Chronochrome could not be shown with a conventional projector, whereas Kinemacolor required only a single adjustment to the projection mechanism, the insertion of a two-blade shutter fitted with filters (green and red). Other disadvantages were shared by both systems. Kinemacolor filters absorbed up to 33 per cent of the light, and required 250 per cent more electric power to achieve a luminosity equivalent to that of a conventional projector. It was even worse with Chronochrome, whose

blue filter alone absorbed almost one third of the available light. Furthermore, both Kinemacolor and Chronochrome had problems with image sharpness. George Albert Smith's positives suffered from blurred contours, particularly noticeable with people and objects in rapid motion. Chronochrome projection tended to suffer from a stereo-parallax effect, as the three lenses projected the image from slightly divergent angles. This was another reason for reducing the height of the frame, so the three complementary images could be positioned closer together. Finally, both systems required twice the amount of footage needed for a conventional film. In this respect, however, Chronochrome had the important advantage of being shot and projected at the standard speed of 16 frames per second, slow enough to make panchromatic film compatible with artificial lighting.

The Chronochrome image was of a noticeably higher quality than that of other systems using filters. Two extant short films, known by their English titles *Reproduction of a Bouquet with Ordinary Cinematography* (to be projected without colour filters) and *The Same Bouquet by Chrono-Chrome Gaumont* (both 1913), provide eloquent evidence of the impression this system must have created on the spectator of the period. The definition and the variety of colour is striking, with predominant red, blue, and especially a gaudy green, particularly noticeable in the detail of a lady's hat in *Paris-Fashion: Visiting* (1913). Seen as a whole, the sheer variety of tones is nothing less than astonishing. In the filming of inanimate objects at close range, Chronochrome endows the image with a startling sense of three-dimensionality. In long shots and outdoor scenes this effect is less marked; sunlight tends to give a brownish cast to primary colours, and small objects tend to go out of focus because of the trouble in keeping the three superimposed images in registration.

Handschiegl, the Lithography of Nitrate

The impracticality of systems based on additive synthesis, all of which required special projection arrangements, led the industry to search for alternatives which would present fewer problems for commercial deployment. One symptomatic example of this approach is a solution prompted by Cecil B. DeMille in 1916, which was a fundamental step in the transition from the technology and aesthetics of tinting and toning to the dawn of Technicolor.

The principle of the Handschiegl Process, later also known as the Wyckoff-DeMille Process (probably because the cameraman Alvin Wyckoff actively participated in its development) is an ingenious adaptation to motion picture film of the process of lithography in multiple colours. This technique (devised by Max Handschiegl, a craftsman from St Louis who specialised in lithography and photo-engraving) is by far the most complex system of direct colouring ever devised during the silent era. Starting with a normal black and white print, sequences were chosen for treatment, using a maximum of three colours. This required a separate matrix for each colour chosen. The portion of the film to be coloured was covered

by a masking liquid. Once dried, an internegative was made: the area to be coloured appeared in it as a transparent outline, while the rest of the frame retained the silver salts of the emulsion. Following the principle that the exposed portions of the emulsion are less soluble than the unexposed ones, Handschiegl then immersed the internegative in a tanning bleach in order to fix the exposed portions, solidifying them in such a way that they would not absorb the colouring agent, while the unexposed parts remained viscous and transparent.

After fixing, washing, and drying, the internegative was immersed in a bath with an aqueous colouring solution to tint the transparent areas. After the bath, the internegative was cleaned to eliminate excess colour, so that only the permeable area remained tinted, and was then dried. The matrix thus obtained was run in direct contact with a positive copy of the same segment, under sufficient pressure to transfer the colour from the internegative to the positive. To ensure the transfer of colour, the positive was treated with an emollient solution which moistened the emulsion, allowing it to absorb the colour from the internegative matrix. The internegative was therefore used as a sort of stamp that left its imprint on the positive copy. Because of this – in the same way that a stamp cannot leave a clear impression unless it is reinked frequently – the internegative had to be reimmersed in the dye bath after every two transfers.

The fixing solution for the internegative could not be used indefinitely; after a certain number of copies the internegative began to dissolve, and the colouring solution permeated the entire emulsion, making the internegative of no further use as a matrix. About forty copies could be made successfully with one internegative matrix. Because the area to be coloured had initially been outlined manually – as the covering substance was applied to the master positive by brushstrokes – the entire procedure had to be repeated when preparing a new internegative.

But the Handschiegl process was too cumbersome to be adopted on an industrial scale, in cases where a large number of copies were required for distribution. For the same reason, the system could be used only for relatively brief portions of a film. In fact, the Handschiegl process was employed in about twenty feature films (alone or combined with the Technicolor No. 2 system) from 1916 to 1927, shortly before the death of its inventor. Its swift descent into obsolescence points to another element of incompatibility with mass production: Handschiegl personally supervised the creation of every matrix, and closely monitored all phases of the process.

Thus a craftsman's method, similar to the procedures of a studio for applied graphics, proved unable to meet the industry's demands. The amount of work required by the Handschiegl process was comparable to the labour involved in hand colouring or stencilling film, since the area of the internegative matrix to be coloured had to be traced by hand, frame by frame. The Handschiegl image has the look of early films, but its pastel colours have a much greater transparency and a subtler texture, which gives an atmospheric quality to the scene. While direct colouring appears as imposed upon the objects represented, like a lacquer overlay

altering contrast values and drastically weakening detail, this system seems to coexist well with the photographic image, and to endow it with a liquid softness that is almost tactile. Because of this quality, DeMille and Handschiegl preferred above all to use it for scenes with mutable elements like water and fire: *Joan the Woman* (1916) has a Handschiegl final scene where Geraldine Farrar's body is enveloped in flame and smoke; in *The Ten Commandments* (1923), the Egyptian army, pursuing the Hebrews in the desert, is first obstructed by a barrier of fire, then drowned in the Red Sea where the Pharaoh and his horse are immersed in brilliant emerald foam. No less remarkable is the glowing yellow of a golden tooth in a surviving frame (Plate 55) of Erich von Stroheim's *Greed* (1925). Projected on a large screen, original Handschiegl colour has the power to dazzle the eye in a way that no reproduction can possibly imitate. While it is true that all modern copies of any original colour process reduce its impact, Handschiegl is virtually impossible to duplicate without a fatal loss of its outstanding pictorial attributes. Existing viewing copies make it look like a faded Technicolor, or a hand-coloured film worn out by time; sadly enough, there is no way to fully appreciate it without viewing the original. This makes its rarity and extreme physical vulnerability all the more lamentable, reinforcing as it does the notion of the photographic moving image as a simulacrum of a 'present' lost to our time, witnessed by no one other than the audience of the past.

Before and after Technicolor: Additive and Subtractive Processes, 1911 to 1928

The various efforts to create films in colour which could be exploited commercially on a large scale gave rise to a period of aggressive competition (mostly among the United States, United Kingdom, and France) between processes which each in turn emerged, enjoyed an ephemeral public life, and then sank into oblivion. This pattern, whose chronology covers the period from 1911 to 1928, is among the most exciting and at the same time frustrating in the history of cinema, as most of the physical evidence on the subject appears to be lost. We have the theoretical rudiments of these techniques, but not the actual experience of what the films and their colours were like. This handicap should not lead us to ignore or denigrate these processes. They played a formative and decisive role in the evolution of colour, and we must at least try to formulate a set of reasonable conjectures about them. From this standpoint, a substantial part of the history of colour in silent film has not been written yet. Much research is needed on the processes described below and their operating principles.

A brief digression on colour terminology is necessary before describing these systems. In the additive synthesis process, a colour image is produced by black and white images made and then projected through colour filters (green, blue and red) and superimposed one upon the other. In the moving image, the same effect is produced by projecting the images through different colour filters in rapid succession.

In the subtractive synthesis, objects absorb certain wavelengths of light in the visible spectrum, and reflect others, which the eye perceives as colours. In the resulting coloured film, the colours that appear on the screen are those which have been filtered – that is, subtracted – from the entire spectrum of white light. A complete picture obtained through this process is a combination of partial images in yellow, magenta, and cyan.

Colorgraph (1911–seqq.), a subtractive synthesis process – the first of its kind known to date – created by Arturo Hernandez-Mejia for coloured film stock. The key elements of the system were the creation of two negatives, one exposed through a red filter, the other through a green filter; the reversal of two successive frames one on top of the other (a device that would prove decisive in the development of Technicolor); and the idea of printing the film with the emulsion on both sides. The images from the two negatives were reproduced one on each side of the positive, and then tinted or toned a blue-green on one side and a red-orange on the other.

Panchromotion (1913), the first system (additive, in four colours) among many created by William van Doren Kelley at the beginning of a 22-year career that influenced the development of colour cinema as much as did the inventors of Technicolor. The principle behind Panchromotion was similar to that of Kinemacolor, but the rotating disc used for shooting and projection was divided into sections of red-orange, blue-green, blue-violet, and yellow, each separated by a small transparent segment.

Warner-Powrie Color (1914–seqq.), a three colour additive system developed by J.H. Powrie from a photographic colour process and later perfected with financing from the Warner Brothers Research Laboratory. A 47mm panchromatic negative, divided into 900 longitudinal lines per inch and tinted with the three primary colours, was run horizontally in the camera and the printer (the oversize frame covered about four times the area of a standard 35mm frame). A positive print, also striped with very fine lines running lengthwise, was run vertically in the developer. In order to achieve a correlation between the 47mm negative and the 35mm positive, the printer would be fitted with reduction lenses for the negative. The horizontal lines of the negative and the vertical lines of the positive intersected at 90 degrees; the image was projected through a filter that reproduced the grid thus obtained.

Berthon/Keller-Dorian/Kodacolor (1914–28), additive systems derived from an invention copyrighted in France in 1909 by R. Berthon, a specialist in astronomical optics. The film base was transformed into a lenticular surface, which functioned like a net of microscopic lenses in front of a lens fitted with a filter having three vertical sections of red, blue, and green. In 1914, A. Keller-Dorian registered a system that gave a lenticular structure to cinematographic film, a patent which

the Eastman Kodak Company acquired in 1915, in order to to introduce it on the amateur 16mm market under the name of Kodacolor .

Brewster Color (1915). Following the premises of one of William Friese-Greene's systems, this two-colour subtractive process required that two reels of film be printed in parallel through a lens fitted with a prism that split light in two directions, through red and green filters respectively. The two negatives were then printed on a positive coated with emulsion on both sides, tinted green on one side and red on the other. In 1935, after the success of Technicolor, Brewster Color introduced a three-colour system with the addition of yellow tinting, with no success.

Douglass Color No. 1 (1916), a two-colour additive synthesis system developed by Leon Forrest Douglass. The camera held two reels of film, with a mechanism that intermittently moved two frames at a time. On one reel, every other frame was filmed through a red filter; on the other, through a green filter. In both reels every second frame was unfiltered. The two negatives thus created were printed onto a single positive with alternate images from each of the camera negatives, and projected at 32 frames per second with a shutter equipped with red and green filters, similar to that used in Kinemacolor.

Kodachrome (1916), a two-colour subtractive synthesis process conceived by J.G. Capstaff on behalf of Eastman Kodak. *Concerning One Thousand Dollars* (1916) was the first experimental short produced to verify the quality of the image created by a camera fitted with two lenses (one above the other) with green and red filters. The latent colours of every pair of frames were matched when printed on reversal film stock (negative, transformed into positive) with two emulsions, tinted blue-green on one side and red-orange on the other (Plate 54).

Prizma No. 1, No. 2, No. 3 (Kelley, 1917–18). The first Prizma system, based on additive synthesis, used a rotating disc similar to the one designed for Panchromotion, but instead of having small uncoloured segments between the four filters, each had colours whose intensity grew and then diminished. In the second system the colours were reduced to three, as in Kinemacolor, but calibrated to produce softer tones, and the disc was made for easy installation on Simplex and Powers projectors, the most widely used machines of the period. With the third system, derived from the principle of subtractive synthesis, the rotating disc was eliminated altogether, and the frames of the positive copy were treated with alternating primary colours; the film could then be projected on any standard apparatus.

Gilmore Color (1918) of Frederic Eugene Ives, a two-colour additive system. The frames of a standard 35mm film were divided longitudinally into two equal sectors, and the two corresponding images were recorded vertically through a green and a

red filter. The two images were then projected through their respective filters and superimposed so as to form a single image.

Polychromide (1918), a two-colour subtractive synthesis process, patented in England by Aron Hamburger. The positive film bore emulsion on both sides (bipack), and was printed with two different negatives, one orthochromatic, the other panchromatic (a subsequent patent substituted a single bipack negative for these), then toned red-orange on one side and blue-green on the other.

Kesdacolor (Kelley, 1918), a two-colour system based on subtractive synthesis. The positive had emulsion on both sides, with vertical stripes of green and red complementary to the stripes of the opposite side. The film could be projected at the standard speed of 16 frames per second, without any modification of the projector.

Douglass Color No. 2 (1919). The two negatives of the Douglass Color system No. 1 were printed on a positive. In this updated version of the process, rather than projecting the frames through red and green filters, both latent images were printed and then dye-toned on the same frame, one in contact with the emulsion side, the other with the base. This meant that the positive film had a layered emulsion.

Prizma (Kelley, 1919–23), a two-colour subtractive synthesis patent. The positive, printed from a negative created by a camera equipped with a rotating filter, had two emulsions, uniformly coloured blue-green on one side and red-orange on the other. *The Glorious Adventure* (Vitagraph, 1921, still extant) by J. Stuart Blackton was the first feature-length film 'in natural colour' to enjoy some commercial success in the United States and United Kingdom.

Zoechrome (1920), additive process invented in the United Kingdom by T.A. Mills, based on the printing of a positive film with one full-aperture frame and three smaller images arranged in a triangle on the next frame, each filmed and subsequently projected through a different colour filter.

Kelley-Color (1924), a two-colour subtractive synthesis process. Little information is available on this system. Apparently, its main advantage over Kelley's earlier systems was that the film bore an emulsion on one side only, reducing the risk of scratching during projection.

Spicer-Dufay (1925) resulted from the collaboration of Spicers Limited, a paper manufacturer, and the French photographer Louis Dufay. Its essential feature – an image divided into a large number of semi-microscopic primary elements, each provided with a minuscule colour filter – is similar to the operating principle of the

Lumière Autochrome plates. After languishing during the twilight of silent films, Dufaycolor had noticeable commercial success from the mid-1930s.

Kelley Color Films No. 1, No. 2, No. 3 (1926–28), hybrids of the Handschiegl process, whose films were printed at the Kelley laboratory. In broad terms, the positive was made of consecutive frames in black and white, blue-green, and red-orange. After Max Handschiegl's death on 1 May 1928, Kelley briefly tried out two other systems. In the first, the film alternated a black and white frame and a frame with red, green, and blue superimposed; in the second, three separation negatives were printed on a single emulsion which was then subjected to toning.

Color Film Process (1927) of A.G. Waddingham (Color Cinema Productions), a two-colour subtractive system similar to Polychromide. A bipack negative, with orthochromatic emulsion for the green and panchromatic emulsion for the red, was printed onto a positive, also a bipack, the two sides toned blue-green and red-orange respectively.

Towards an 'Invisible' Technology: The Origins of Technicolor

Names, dates, patents, film coated with one or two emulsions, filters, tinting and toning. Despite the scarcity of original footage pertaining to these experiments, film historians should be discouraged from considering the few well-documented systems (such as Chronochrome or Kinemacolor) as representative of the whole spectrum of possibilities explored at the time. A truly exhaustive inventory of colour processes in silent cinema still waits to be made; meanwhile, the refinement of research methodologies brings to light previously unexplored sources, testifying to the existence of obscure pioneers endowed with fertile imaginations but little or no sense of business (Plates 59 and 60). The same caution should be applied to the assessment of the early years of the most influential colour process of the classical Hollywood era: Technicolor, the arbiter of taste for the film entertainment industry in the years following the advent of sound. Three of the four Technicolor systems created by Herbert T. Kalmus and his associates from 1915 – the founding date of the Technicolor Motion Picture Corporation – to the advent of sound are extensively documented, yet barely known in terms of accessible motion picture footage.

It is difficult to judge, for example, the merits of the Technicolor Process No. 1 (1916), the only one based on the principle of additive synthesis, achieved here by running two reels in parallel before two lenses and two filters (red and green), using a single light source split by a prism. A projector with two lenses equipped with filters superimposed the two complementary images using a complex (and difficult to regulate) registration device. Critics who saw *The Gulf Between* (Wray Physioc, 1917) were torn between admiration and puzzlement, very much as they had been with Kinemacolor. It is impossible to verify their views by direct examination, since no nitrate print of *Way Down East* (D.W. Griffith, 1920), apparently the second and

last fiction feature film with sequences made with the system, is known to survive with its Technicolor sequences (for the record, it could even be that no print of the film was ever made with this process, as Griffith had the habit of announcing projects that would never see the light.)

The merits of Technicolor Process No. 2, the first subtractive system designed by the company, are hardly easier to appraise. A single negative was exposed to light separated by a prism as the negative was drawn intermittently through the mechanism, exposing two frames at a time. Following the principle of Arturo Hernandez-Mejia's Colorgraph (patented in 1916 but conceived five years earlier), every other image was reversed with the bottom edges of the two frames in contact (Plate 28). The latent red frames were then printed on one roll of film, the latent green ones on another. The two positives were glued together and tinted, respectively, red and green.

The Toll of the Sea, directed by Chester M. Franklin for Metro Pictures, was officially premiered in New York on 26 November 1922. The judgment of contemporary critics and the wisdom of hindsight agree: the copy restored by the UCLA Film and Television Archive shows a tidy and stable image, with brilliant red and orange tones, but with a certain tendency towards brown in the greenery of outdoor scenes, and a blurring of the finest details and distant objects. Despite this, Technicolor No. 2 was superior to all two-colour subtractive systems of the time, and the advantage of not requiring special projection apparatus ensured it such immediate success that the company was at first unable to keep up with the demand for release prints. Twenty-eight feature films and at least six shorts were made with this system. At least one third of them survive, often visible only in black and white prints. In the others, printed by more recent methods that barely approximate the originals, the colour has so deteriorated that (at least until a more adequate restoration methodology is found) it is impossible to pass judgement, other than to state that the colour sequences have more of a decorative than a dramatic effect, and are to be found in those spectacular scenes that could most benefit from the 'luxury' of colour, like the episode of the masked ball in *The Phantom of the Opera* (Rupert Julian, 1925) and the fashion parade in *Irene* (Alfred E. Green, 1926).

The trouble with the second Technicolor process became apparent soon after the release of *The Black Pirate* (Albert Parker, 1926). The adhesiveness and shrinkage of the two lengths of film glued to each other would cause the base to curve, making it difficult to keep the film in focus. The problem was eliminated only in 1928 with Technicolor Process No. 3, first seen in the release copies of *The Viking* (R. William Neill, 1929). Kalmus went back to the first additive synthesis Technicolor system by creating two separate negatives, each in a primary colour, exposed simultaneously by means of a prism splitting the light from the camera's single lens. Instead of using the two negatives to print a positive directly, however, the improved process involved the production of two positive matrices with a thicker emulsion. After receiving their respective primary colours, these positives were

then pressed in succession upon unprocessed film stock with an especially absorbent emulsion (very much like lithographic matrices, as with the operating principle of the Handschiegl process) with the utmost attention to achieving perfect registration of the two monochromatic images. Further progress would be attained soon afterwards with the three-colour Technicolor Process No. 4 (1930), but the concept introduced by its immediate predecessor was revolutionary in itself: there were no more positives with two emulsions, nor lengths of film to be glued together. The Western race drama *Redskin* (Victor Schertzinger, 1929; see Plate 57) was already a Technicolor film in the 'modern' sense of the term. Its warmth of tone and subtle control of colour saturation were critical to the notion of a smoother, more versatile palette whose overall effect seemed finally to transcend the technological rationale of the process. Viewers of *The Viking* and *Redskin* would complain of blue skies sometimes tending towards green, uneven flesh tones, details that were 'not quite true'. But these were matters of taste, not function. For cinematic colour had already achieved its first goal: to make 'invisible' the technology that produced it.

A Note on Imaginary Colour

Understanding colour in aesthetic terms means confronting the ontological problem of its permanence and transformation. In this respect, film analysis does not much differ from the interpretation of canvases, frescoes, miniatures and handcrafted objects. What makes the difference is the chronological pattern of colour decay (Plate 53), its scale, and our perception of it. Indeed, fewer moving images of the silent period will be experienced in their original colours in the years to come, but that is not the only problem. At stake is our awareness of colours, our memory of their previous state, and the sense we are able to make of the ongoing shifts affecting the appearance of a film. We know very little about the colours of Erich von Stroheim's *Greed*, as no restoration project can use original positive prints from the full-length 1924 version. Stanley Kubrick's *The Shining* was released more than fifty years later, yet those who viewed it in 1980 no longer find the same brilliancy in the golden tones and the contrasts of yellow and red in prints which are only twenty years old. Colour in the moving image is the most unstable component of an inherently ephemeral medium; anything we can say about it comes from a contradictory mediation between memory and present visual experience.

The dilemma is all the more striking when applied to the first years of cinema. Our knowledge of colour in silent films is largely derived from a treasured misconception that we are accustomed to accept without question: tinting, toning, colouring by hand or stencil, first and second Technicolor are loosely translated in the duplicates struck by preservation laboratories into systems radically different from the original techniques. Projection equipment has changed, too. Light sources bear no resemblance to those employed in the early 20th century. Faced with the reality of colour decay in modern film stock, film archives have duplicated in black

and white reference prints the vast majority of surviving films made with colour before 1930, thus still further altering the viewer's perception of silent cinema. Improved restoration methods and the introduction of low-fade motion picture stock has revived the ambition to preserve colour film, but the underlying premise of this renewed interest is as deceptive as not preserving colour at all. From a cultural standpoint, colour film preservation (as much as film preservation in itself) is a necessary, interesting mistake.

Such awareness does not exempt us from an even more challenging paradox. Much as we may know that a certain colour once existed in a silent film, we must also acknowledge that it is now virtually impossible to experience its actual rendering on the screen. As time goes by, the entity slowly mutates into an imaginary object, a creation of the mind. We collect the few surviving fragments, the apparatus, the chemical formulas, the memoirs of the technicians who designed the systems, the opinions of those who saw them at work. Whatever remains of the moving images made with these systems is drifting out of reach, and we are left with the option of explaining their oblivion, or reinventing them according to our own predilections and constraints. Have we the right to create a system of aesthetic judgment from all this? If the object of this judgment is not the evidence itself but its reincarnation (be it arbitrary, or the product of a dominant technology), how can we give it a meaning, and to what end?

Further Reading

Colour in Pre-cinema

For an overview of the literature on colour and optical devices prior to the photographic moving image, see the bibliography on pre-cinema at the end of Chapter 5.

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Kodacolor

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A bibliography on the restoration of films in colour is provided at the end of Chapter 3.

The quote from Derek Jarman on p. 21 is taken from first American edition of *Chroma* (Woodstock, NY: The Overlook Press, 1995, pp. 42–3).