Moving Image and Sound: Basic Issues and Training

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Gasparcolor: Technicolor's German Counterpart

In an age where technical innovations seem to happen by the minute, it might appear that technology did not evolve as rapidly during the twentieth century. However, things are not always what they seem historically; for the purpose of this paper, it is important to note that between 1905 and 1930 there were over twenty-five color film processes that were invented and invested in (at great expense), only to never catch on (with the exception of Technicolor). Gasparcolor, on the other hand, was caught in a no man's land of being just as good as Technicolor (if not superior), but never quite taking the foothold of the former process. This no man's land that Gasparcolor tried to make it in was also fraught with geopolitical strife and steep business competition, which will be detailed later on.

Gasparcolor has its roots in a monopack process for color still photography called "Katachromie", first described in 1905 in *The British Journal of Photography*. Invented by Karl Schinzel, it involved coating a glass plate with dyed emulsion layers. The top layer was yellow and sensitive to blue light, the middle, cyan-dyed sensitized to red, the bottom magenta-dyed and sensitized to green. Immersing the developed negative in hydrogen peroxide and having it decomposed by the developed silver was to release oxygen, destroying the dyes and allowing the silver to be removed, resulting in a positive full color image. However, it was "pointed out that it would […] be next to impossible to prevent bleaching of the dye in the non-image areas. […]

Whether workable or not, here is the first suggestion for coloured image making by catalytic dye destruction."[1]

After various attempts over the years, it appeared that a Hungarian chemist, Dr. Bela Gaspar, had solved the problem of controlled dye-bleaching by 1930, in Berlin, Germany. He utilized a group of reducing agents that would only destroy the dyes only in the presence of the silver (specifically, the image area). His reagents, grouped together, contained labile hydrogen, "which can therefore form simple or complex silver salts, a […] requisite for the Gaspar dye-bleach solution."[2] Among the several listed in Gaspar's patents was acid thiourea. Dr. Barbara Flueckiger elaborates as to how this particular chemical was used: "[T]he gelatin emulsions were dyed before exposure. After development the dyes were bleached with acid thiourea with the silver serving as a local catalyst for the reaction."[3]

Dr. Gaspar perfected his process between 1930[4] and 1932[5], unveiling it in fall 1933 at the Third International Farb-Ton-Kongress (Color Music Congress), devoted to visual music. In this he was aided by Oskar Fischinger, an experimental artist and animator. As biographer William Moritz notes, Fischinger had become known as "the wizard of Friedrich Street", for his ingenuity in realizing new technical processes for use in creating visual effects for the cinema (Friedrich Street was the center of the film industry in Berlin at that time). Fischinger, in addition to creating tests to showcase the Gasparcolor process, built a camera specifically for shooting film to be printed on Gasparcolor stock. Fischinger's camera was engineered with a shutter mechanism synchronized to a wheel of three filters (blue, green, and blue) for each record. The

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[1] Adrian Cornwell-Clyne, *Colour Cinematography*. Third Edition (Revised and Expanded). Chapman and Hall, Ltd. London, 1951 (419).
[2] Cornwell-Clyne, 420.
[3] Barbara Fleuckiger, "Gasparcolor or Gaspar Color", Historical Timeline of Film Colors. http://zauberklang.ch/filmcolors/timelineentry/1264/. Retrieved November 12, 2015.
[4] Roderick T. Ryan, *A History of Motion Picture Color Technology*. Focal Press, London and New York, 1977 (213).
[5] Moritz, "Gasparcolor: Perfect Hues for Animation." October 6, 1995.

exposure of the three records worked as such: the shutter mechanism would engage the selected filter (say blue) for a specific record (magenta) upon exposure. This process would be repeated two more times, with the shutter mechanism engaging the successive filters to align with their respective negative records.[6] From there, the three negatives would be developed into separation positives directly using step-by-step contact printing (exposing the negative to a light source and thereby creating a fixed relief image on raw positive stock). This differed from Technicolor in bypassing the interpositive-internegative workflow common to making commercial prints available. It also allowed "accurate control of contrast should some modification of the original negatives be desirable." [7]

The final print on Gasparcolor stock was an involved process, since the dye-bleaching process rendered it a reversal process[8] (creating a direct positive instead of a new negative, interpositive, or internegative). The printing process was carried out using a light green safe light as opposed to the standard red light.[9]

There were also special printers built to accommodate two-color (blue and red) and three-color stock (blue, red and yellow). The two-color printer had two light sources through which two positives were run simultaneously, and printed onto double-sided stock (two emulsions), blue onto a red dye emulsion, and red onto cyan (blue) dye emulsion. Three-color printing involved two passes: the first one ran two positives through the gate at the same time. A green positive was printed onto a magenta-dyed emulsion using blue filtered light; red, a cyan-dyed emulsion with blue filtered light. The second pass involved printing the blue positive onto the yellow-dyed emulsion with red filtered light. On a standard film printer two passes were needed

[6] Moritz, "Gasparcolor".
[7] Cornwell-Clyne, 423-424.
[8] Flueckiger "Gasparcolor or Gaspar Color".
[9] Cornwell-Clyne, 424.

for two-color and three for three-color.[10] This arbitary color record - emulsion dye assignation is worth noting; Gaspar had realized early on that the layers could not optically be sensitized to their complementing dyes (a blue positive record could not be printed on blue emulsion with blue filtered light). This and the physical/chemical characteristics of the stock distinguished it from Technicolor, and resulted in "brilliant and stable colors."[11]

The processing began by washing the positives (two minutes). They were then developed in the following mixture: metal (12 ounces.), anhydrous sodium sulfide (17 pounds 13 oz.), hydroquinone (5 lbs. 1 oz.), sodium carbonate (11 lbs. 4 oz.), and potassium bromide. (2 lbs. 8 ½ oz.). These were mixed in 74 gallons of water at a temperature of 65 degrees Fahrenheit with a gamma range of 2-2 for nine minutes (three for each positive). After another two minute wash, the developed positive image would be fixed onto the designated emulsion layer. The formula contained 6 lbs. of hypo (to start removal of the traces of silver halide) and 6 ½ oz. of sodium metabisulfite in 2 gallons of water for nine minutes.

After the first fixation, the dye-bleach/destruction would be done. Utilizing acid thiourea to destroy the dyes proportionately to the developed silver halides, the positives were bleached using: 17 lbs. 8 oz. thiocarbamide 12 lbs. potassium with chrome aluminum, 7 lbs. 8 oz. hydroquinone, and 565 centiliters (concentrated) of sulfuric acid in 25 gallons of water for eleven minutes at 68 degrees Fahrenheit. The washing this time around was increased to nine minutes, after which the films were bleached in 25 lbs. of copper sulfate, 25 lbs. of sodium chloride, and 284 centiliters (concentrated) of hydrochloric acid in 25 gallons of water for five and a half minutes; the sodium chloride was specifically transformed from metallic silver to facilitate removal of the silver entirely during the second fixation. [12]

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[10] Ryan, 214-215.
[11] Flueckiger, "Gasparcolor or Gaspar Color".
[12] Cornwell-Clyne, 425 and Ryan, 215.

Sound on film was the norm by the 1930s, and Gasparcolor was no exception to this. Gaspar accounted for this by incorporating redevelopment of the optical soundtrack in color (after bleaching, the soundtrack area would be nothing but silver chloride). A narrow wheel was attached to the printer for this purpose, and was necessary to avoid printing the sound record as a pure dye image (!).The redevelopment formula consisted of 10 grams metal, 120 g anhydrous sodium sulfite (same as the initial developer), 30 g hydroquinone, 50 concentrated centiliters of sodium hydroxide (with 40% solution), 10 concentrated centiliters of a substance called "Nekal", and 200 g of Dextrin in 400 concentrated centiliters of water for one minute. A second fixation of six minutes would remove the remaining silver halide with 6 lbs. of hypo and 6 ½ oz. of potassium metabisulfite in 2 gallons of water, to be washed for seven minutes and left to dry out. From these, prints would be struck for use in a standard 35 or 16mm film projector (depending on the gauge used to shoot the original negatives). [13],[14]

A final Gasparcolor print (two or three-color) was double-coated: a magenta dye emulsion sensitive to blue light, a yellow dye emulsion sensitive to red light, and a 35 mm nitrocellulose base (or acetate for 16mm). On the bottom of the base (both 16 and 35mm) was a cyan dye emulsion sensitized to blue light. To avoid exposure to blue light from processing the magenta dye, the red sensitive yellow emulsion acted as a buffer.[15],[16] For two-color prints, the stock was reversal emulsion on both sides of the base, blue dye on the top, and red-yellow combined on the bottom.[17]

[13] Cornwell-Clyne, 424-425
[14] Cornwell-Clyne, 424-425 and Ryan, 213.
[15] Ryan, 213-214.
[16] Flueckiger, "Gasparcolor or Gaspar Color".
[17] Ryan, 214.

The Gasparcolor process resulted in "a large number of very beautiful release prints"[18]. This number was crippled in the beginning, however, by two factors. The first was Fischinger's camera, which proved to be problematic: the shutter-filter mechanism could only shoot at 72 frames per second in real time (48 frames more than the standard 24). This hindered any use of Gasparcolor for live-action filming, and relegated it to single-frame shooting only. The density of Fischinger's filters compromised the speed of exposure for the low-sensitivity negative stock, so 21 seconds were required to shoot each frame for each negative record *before* developing into separation positives, mandating one minute and one second to be spent shooting one frame for a final three-color print (42 for two-color).[19] The second issue was the susceptibility of the double-coated film stock to scratching that would make the color of the emulsion layers visible[20]

This did not deter the success of Fischinger's experiments with audiences at the Color-Music Congress. From there, he began making abstract animated films for realization as Gasparcolor prints. The first film was called *Kreise* (Circles), which appeared in December 1933 as a signal film for Tolirag, an advertising firm.[21] Set to the music of Richard Wagner, *Kreise* build on Fischinger's deftness with visual abstraction set to music, while enhancing it with a restrained palette of orange, blue and green circles that overlap in color combinations resulting in subtle pinks and yellows. The vibrant black background against which they are placed speaks to the strengths of both the Gasparcolor stock and the nitrate used in its manufacture.

In spite of (and perhaps because of) its limited audience, "Gasparcolor became the supreme filmstock for animation in the 1930s and early 1940s used in films by many of the great artists of that period."[22] However limited the audience, the reach of the process extended to no

[18] Cornwell-Clyne, 419.
[19] Moritz, "Gasparcolor".
[20] Flueckiger, "Gasparcolor or Gaspar Color".
[21] Moritz, "Gasparcolor".
[22] Moritz, "Gasparcolor".

less than six European countries during the 1930s: Germany, France, the Netherlands, Great Britain, Hungary, Czechoslovakia, Denmark and Austria.[23] In the Netherlands, Hungarian George Pal began creating his stop-motion Puppetoons for realization through Gasparcolor. Like Fischinger, he made advertising films for such companies as Philips Radio (*The Ship of the Ether*, 1935). Pal's jaunty and malleable figures are constructed from simple geometric shapes (ovals, rectangles, squares, circles). Blue is the predominant color in Pal's visual design, used to give a dreamlike quality to the narrative of the film (a fantasy world inside a Philips radio extolling its virtues) His technique of replacement animation (one sculpture for each frame) is appealing, and exploits Gasparcolor's ability to project colors in a stable and subtle manner, and rises to the challenge posed by a miniature glass ship that is the film's centerpiece. *Allegretto*, Fischinger's 1936 abstract film, shows the process at its zenith. Set to a jazz composition by Ralph Rainger, Fischinger creates electrifying visual music to match. His color scheme exploits Gasparcolor's ability to exhibit the value (brightness and darkness) of the colors within the frame; Fischinger's palette uses varying hues of the same colors in a manner reminiscent of Abstract Expressionism, light green diamonds coexist with looping circles against a darker green background, while brown and cream white rectangles pulse rhythmically in and out of the frame. William Moritz writes that this and Fischinger's *Radio Dynamics* (1943) are as a swan song for Gasparcolor proving […] that this system could yield extremely subtle and extremely brilliant color imagery."[24]

By 1936, though, Gasparcolor seemed to be ready to break into wider use outside of animation, thanks to an employee in Dr. Gaspar's ranks: Adrian Klein, technical director of Gasparcolor in London, England. "A great deal is likely to be heard of Gasparcolor film in the

[23] Flueckiger, "Gasparcolor or Gaspar Color".
[24] Moritz, "Gasparcolor".

immediate future," he wrote in a 1936 trade magazine article detailing the process.[25] Klein's devotion to the process and broadening its use resulted in him designing a prism to supplant Oskar Fischinger's unwieldy and inflexible shutter-filter camera and allow for shooting at 24 frames. Prior to this, he had designed and patented a "Prism Block" geared to take still photographs with three different color records. However, as he noted himself, "No motion picture has been constructed to accommodate the prism, nor is it likely to be."[26]

Working with British optical firm Bellingham and Stanley Ltd. to create it, Klein designed a complex prism in 1935 for Gasparcolor. Registered as E.P. (English Patent) 459,664, it was contained in a black case with three camera lenses mounted on it for each color separation negative record and mounted on the back of the camera. To describe the way light was absorbed and reflected by the prism, it is important to break it down carefully:

- Two semi-reflecting and transmitting surfaces (A and B in Klein's diagram) divided two component beams from each other and [formed] a third beam.
- Three internal surfaces (E, F, G) reflected the beams in the same direction in equal paths of light.
- The metal coated part of surface A, as part of a six-sided component prism (1) would reflect the beam and create a total internal reflection off an opposite surface (C) to this prism.
- From surface F, triangular prism 5, the beam would be reflected *out* of this combination. This beam, when transmitted is reflected by surface H, triangular prism 2 onto the metal coated part of surface B, rhomb 3, and divided again.

[25] Adrian Klein, "The Gasparcolor Process", in *International Photographer*, vol. 8, no. 5, June 1936 (6).
[26] Cornwell-Clyne, 528

- This portion was reflected out of that combination by surface G, rhomb 3. The transmitted beam would be totally reflected off surface D, rhomb 4, and reflected out the combination by surface E.
- Three beams would emerge parallel to each other off surface Y and perpendicular to surface X, with three glass distance-pieces 6, 7, and 8 ensuring equal light paths.[27]

Klein's prism was used to (almost) successfully shoot *Colour on the Thames*, in 1936. Proudly stating "Filmed in GASPARCOLOR" in the opening credits, the viewer is treated to shots of life on the Thames River. While Klein's ingenuity and persistence should be applauded, a consistent framerate eluded him; some shots show the boatmen moving jerkily or at a faster speed than the usual 24 frames.

For all its forward strides, Gasparcolor's commercial prospects were doomed almost from the beginning. While the Fischinger tests were being shown in autumn of 1933, Adolf Hitler came to power as Chancellor of Germany. Gaspar, being of Jewish extraction, opted to leave Germany, only maintaining a satellite business office in Berlin run by his associates there. In London in 1934, he began full scale operations with Klein as his technical director. Klein took particular pains to change his surname to Cornwell-Clyne as a means of disguising his German ancestry (despite being born in England).The Gasparcolor laboratory in Britain also contracted with Gevaert in Belgium[28] to manufacture Gasparcolor stock in 16 and 35mm.

Throughout this upheaval, Technicolor was becoming the rage in the United States and beginning to take a foothold in England. Technicolor had the advantage over Gasparcolor in that it manufactured its cameras and film stock in house. Gaspar's reliance on outside vendors proved to cripple his process, as was proven by the outbreak of World War Two and the invasion of

[27] Cornwell-Clyne, 539-541.
[28] Moritz, "Gasparcolor".

Belgium by German forces. The Nazi-owned Agfa seized control of Gevaert, and upon banning the manufacture of film stock for companies in enemy territory, imprisoned or executed many scientists there who were associated with Gaspar,[29] plagiarizing his German patents for their Agfacolor process. The London laboratory continued to create prints from the remaining stock through 1939, and was eventually destroyed by wartime bombing, causing the negatives of many films to be lost.[30]

In the meantime Dr. Gaspar fled England. Arriving in Hollywood as a refugee, the trade journal *American Cinematographer* rejoiced: "For a number of years we in Hollywood have heard, in trade-paper news items and occasional all-too brief abstracts from foreign technical papers, of a three-color process […] which was being used in pre-war Europe's film centers. Shortly before the start of the conflict, the first examples of George Pal's 'Puppetoons,' screened under the auspices of the Academy of Motion Picture Arts and Sciences, gave us our first glimpse of Gasparcolor on the screen. The results even then indicated that if the process were brought to America, there might well be a new and worthy contender in the three-color field."[31]

With a manufacturer for his reversal stock in place (Hollywood Colorfilm Company)[32], Gaspar established operations in Hollywood. He even got in touch with George Pal (whom had emigrated as well) and tried to revive the Gasparcolor-Puppetoons combination that had worked so well in Holland.

But this wasn't Holland. The Technicolor process had engulfed the commercial film industry in the United States, and Pal, under contract to Paramount Pictures for Puppetoons, was

[29] Cornwell-Clyne, 419.
[30] Moritz, "Gasparcolor".
[31] Alvin Wyckoff, "Gasparcolor Comes to Hollywood", in *American Cinematographer*, vol. 22, n. 11, November 1941 (510).
[32] Wyckoff, "Gasparcolor Comes to Hollywood", 511.

required to realize them using Technicolor, whom they had a contract with.[33] Put simply, Gasparcolor did not have a chance with the rival process so firmly entrenched. In 1944[34], Bela Gaspar sold off his remaining patents to Technicolor and 3M.[35] He maintained a laboratory in Hollywood, developing color dye processes and techniques for other companies.[36] Aspects of the process emerged in the 1950s as part of the Cibachrome/Ilfochrome reversal process, but for all intents and purposes, Gasparcolor had had its day.[37]

The films that survived the war did so by dint of conscientiousness on the parts of their respective makers or film archives, for example, Oskar Fischinger. He took excellent care of his nitrate prints, shielding them from the usual chemical decomposition and fire hazards wrought by poor handling. Preserved by the Center for Visual Music in cooperation with the Library of Congress and the Fischinger Trust,[38] they burst with the vibrance that Gasparcolor rightly brought to Fischinger's abstractions. It is sadly fitting that his final film in Gasparcolor, *Radio Dynamics*, contains absolutely no sound, as though mirroring the silence with which Gasparcolor disappeared.

[33] Moritz, "Gasparcolor".
[34] Flueckiger, "Gasparcolor or Gaspar Color".
[35] Moritz, "Gasparcolor".
[36] Jack Alicoate, ed. *The 1949 Film Daily Year Book*. The Film Daily, New York, 1949 (589).
[37] Flueckiger, "Gasparcolor or Gaspar Color".
[38] Flueckiger, "Gasparcolor or Gaspar Color".

Bibliography and Suggested Sources

Alicoate, Jack, ed. *The 1949 Film Daily Year Book*. The Film Daily, New York, 1949.

This book lists Gasparcolor's headquarters in Hollywood as late as 1949, which gives an idea as to Bela Gaspar's activities after 1944. Obtained through Internet Archive.

Cornwell-Clyne, Adrian. *Colour Cinematography*, Third Edition, Revised and Enlarged. Chapman and Hall Ltd. London, 1951. Written by the former technical director of Gasparcolor's British laboratory before the Second World War, this text is difficult to find, but a valuable resource in terms of describing the development and printing formulas for Gasparcolor reversal stock. Also of value is Clyne's description and diagram of the prism he designed for manufacture by Bellingham and Stanley in 1935 for use in live action shooting for Gasparcolor.

Flueckiger, Barbara. "Gasparcolor or Gaspar Color", Historical Timeline of Film Colors. http://zauberklang.ch/filmcolors/timelineentry/1264/. Retrieved November 12, 2015.

This web resource is perfect for those unable to readily obtain a copy of *Colour Cinematography*. It includes a brief description of the dye silver-bleaching process along with a gallery of film frames photographed by Dr. Flueckiger from original nitrate prints. Also includes links to Gasparcolor films that have been digitized and made available online, either in part or in whole.

Klein, Adrian. "The Gasparcolor Process", in *International Photographer*, vol. 8, no. 5, June 1936, pages 6-7.

This article on the Gasparcolor process is a worthwhile read, not just for Klein's intimate knowledge of the process, even in this brief article (as Adrian Cornwell-Clyne, he would write the first edition of *Colour Cinematography* the year this was published). Of note is his mention of the color prism he used in shooting *Colours on the Thames*, for

those having a hard time obtaining a copy of *Colour Cinematography*. Obtained through Internet Archive.

Moritz, William. “Gasparcolor: Perfect Hues for Animation”, October 6, 1995. Reprinted on the Fischinger Trust website. http://www.oskarfischinger.org/GasparColor.htm Retrieved November 12, 2015.

Presented as a lecture by Oskar Fischinger biographer Moritz at the Louvre in Paris, France, this essay gives a good timeline of Gasparcolor’s use and market base as a film stock for animation. It also details the particulars of the camera Fischinger built for Gaspar, the difficulties engendered by its use, and the political and business factors that led to Gasparcolor’s demise.

Ryan, Roderick T. *A History of Motion Picture Color Technology*. Focal Press, London and New York, 1977.

Gasparcolor’s developing formulas are reprinted here from Cornwell-Clyne’s *Colour Cinematgoraphy*. Useful as an alternate resource, and provides a useful description of the differences between printing two and three-color Gasparcolor prints.

Wyckoff, Alvin. “Gasparcolor Comes to Hollywood”, in *American Cinematographer*, vol. 22, no. 11, November 1941, pages 510-511.

Worth reading to research what happened to Gaspar when he arrived in the United States after fleeing Europe, and how he was able to have Gasparcolor stock after Gevaert was annexed by Agfa, as well as a document of the “cult” that had grown around Gasparcolor amongst industry insiders. Obtained through Internet Archive.