BIRK WEIBERG

Functional Colors: The Varied Applications of Complementary Hues

ABSTRACT: Film scholars in recent years have identified a differentiated landscape of color systems in terms of looks and processes that represent natural color phenomena with increasing fidelity and automation. Here, I propose extending the concept of film colors to techniques that deploy colors in order to produce effects that do not *show* color but *use* it for other means. Stereoscopy and compositing are two applications from the 1920s that employed complementary colors and that were often developed by the same parties that helped create representational color systems. These correlations have, thus far, not been the subject of color studies because research is organized according to the intended applications of techniques and does not follow the work of the technicians and artists. I argue that techniques that use colors for other purposes have been ignored due to a focus on color primarily in relation to human perception and understanding. To extend the scope of research to nonrepresentational applications of color, as I propose, thus implies a methodological critique of the existing discourse on color as being anthropocentric, that is, as ignoring functional relationships of colors that do not relate to humans.

KEYWORDS: technology, color, optical effects, stereoscopy

YET ANOTHER COLOR CONCEPT

The increased interest in the historical colors of motion pictures in recent years has substantially enriched the very notion of color in cinema. However, two basic categories have been described by scholars like Tom Gunning, Paul Read, Richard Misek, and others under varying names. There are, on the one hand, "natural" colors, which are inter alia conceived as "indexical" phenomena that are caused by specific qualities of objects in front of the camera.[1] On the other hand, there is a class of "unnatural" colors.[2] These colors result from processes such as tinting, toning, stenciling, and hand painting that add dyes to monochrome film footage to varying degrees. In his book *Chromatic Cinema*,

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Misek notes the idiosyncratic character of such dyes that originate not from the surfaces of the depicted objects but merely exist on the film strip itself, and he defines such dyes, in a literal sense and in opposition to the notion of representing natural phenomena, as "film color."[3] Increased knowledge of these techniques has facilitated a historical understanding of a development that is much more lavish than an austere transition from black and white to color film and that helped to develop the history of color, which at first glance appears to be one of advances in chemistry, as a subject for the humanities. It does so by pointing out that this history involves many nontechnical factors.

In a further step, Misek commendably extends the domain of colors into the imaginary when he describes technically monochrome images that evoke notions of colors in the audience.[4] I would like to take a similar step in the following essay, though in a quite different direction. I wish to suggest a practical turn in regard to the historiography of film colors that takes account not just of results but also (and with equal scrutiny) of color phenomena that only occur in the course of production and that may no longer be perceivable in the released films. This is the case for anaglyph stereoscopy and color-based compositing, as I will show. One challenge for an approach of this kind is that in most cases the colors I call attention to are no longer accessible and for that reason must be reconstructed by means of other documents. I am only able to put forward a very few physical examples of these transient elements of production. Given that such artifacts were preserved so rarely is likely one reason why our understanding of film colors has been limited to either those found in final products or, as in the case of Misek, to colors in our imagination. Scholarly approaches to color as a technical matter have thus been widely determined by a focus on aesthetic phenomena. In order to distinguish between color as a means and as an end, I suggest calling those colors that are pegged into production techniques *functional colors*. I will contrast *functional* with *aesthetic colors*, as the latter are always conceived in relation to human sensation.[5]

A scholarly bias toward *works* instead of *work* has long privileged victorious techniques over those that did not succeed in providing effective results. This has been contested by a turn toward the practical in contemporary theory that calls equal attention to failed endeavors as they are, despite their failure, nonetheless expressive of broader historical developments. Though scholars who are seen as part of such a movement share a tendency to look at processes while they are still open, there is no consensus about what the practical turn as a method comes down to or even what exactly practice is. The philosopher Theodore R. Schatzki outlines a very general consensus when he writes that "practice thinkers usually acknowledge the structuring and coordinating import of agreements, negotiations, and other interactions, as well as the undergirding

significance of skills and interpretations."[6] According to David G. Stern, a relevant consequence of these assumptions is the questioning of modern categories such as "subject and object, representation and represented, conceptual scheme and content, belief and desire, structure and action, rules and their application, micro and macro, individual and totality."[7] While archaeologists of cinema have displayed what Tom Gunning has called "the chaotic curiosity shop of early modern life,"[8] they have not developed these findings into an integrated inquiry into cinema's technical aspects. This would require a critique of modernism and its strict separation between science and humanities such as has been carried out by scholars of science in close connection with the practical turn.[9] I will come back to possible reasons for this shortcoming in my conclusion but want to focus here on what a practical turn can offer to research on the techniques of cinema.[10]

A viable starting point that transcends the disciplines of sociology and philosophy has primarily arisen from scholarship on the history of science itself. Actor-Network Theory (ANT), as developed by Michel Callon and Bruno Latour, describes epistemic processes as negotiations between scientists and their objects of research and thereof composes historiographies of translations. ANT pays as much attention to failures as to successes and tries to avoid narratives that are oriented toward applications and results of science and technology that only later proved to be successful.[11] I will adopt this approach in looking at the development of film colors in the United States during the 1920s, a decade that probably saw more color systems than any other. This plurality of systems coincides with a plurality of applications as I will show with regard to complementary colors. Applications that do not aim at representing natural color phenomena allocate optical and chemical qualities of complementary colors as open to the utilization for nonrepresentational functions. In the case of the 1920s, these applications comprised analog compositing (or the layering of different images) and stereoscopy.

STEREOSCOPY

Broadly defined as the automatic reproduction of binocular vision, stereoscopy is at least as old as photography itself, and scholars have repeatedly championed the idea that it has actively promoted the technical developments of photography and motion pictures.[12] Nonetheless, stereoscopy is also a concept that cinema has (re)discovered several times, and stereoscopic movies continue to be presented to us as novelties right up until the present day.[13] In his history of 3–D cinema, Ray Zone describes a "novelty period" that lasts from 1838 to 1952.[14] This long time span also indicates that because stereoscopy depends on the resources of other applications, it constantly interacted with other fields, and

that infrastructure, financing, and knowledge could not yet be acquired on its own terms. This precariousness also affected the definition of stereoscopy itself. Joshua Yumibe has pointed out that representational color systems at the beginning of the twentieth century were often described as stereoscopic. Here he suggests that single elements within the frame acquired a plasticity that made them stand out from the ground due to the partial application of dye.[15] To refer to such an effect as stereoscopic means that as part of a general striving toward realism, two distinct aesthetic concepts, the mimesis of natural colors and the mimesis of three-dimensional space, were not yet clearly separated in regard to the means that were deployed. This indefiniteness of technical processes (the uncertainty about how to do something) was accompanied by an insufficiency of definition (the question of what is color, stereoscopy, etc.).

One reason why stereoscopic images remain in a state that is precarious and persistent in equal measure is that they are relatively easy to record but much more difficult to display. To place two cameras next to each other with their lenses mimicking two human eyes and to expose two photos or films is a relatively straightforward process. But how can they be displayed to those eyes individually—especially as part of a collective experience? One event that provides an insight into the problems of presentation is the promotional screening of the stereoscopic feature film *The Power of Love* on September 27, 1922, at the Ambassador Hotel Theatre in Los Angeles.[16] Harry K. Fairall, the creator of the movie, not only produced and photographed the six-reel drama but also developed the stereoscopic technique for it. Fairall was an independent cameraman who had been working on stereoscopic cameras for several years. However, his first camera design with two lenses was still supposed to provide its operator with an effective viewfinder.[17] This device then evolved into a camera that captured two slightly shifted perspectives on two synchronous films. Fairall's work during that period remains invisible to us mainly due to his position as an industry outsider and, of course, because his project would eventually fail. Fairall's stereoscopic cinema only surfaced when he teamed up with Elliot Sparling, another outsider, who coproduced the movie and also performed in it.[18] Reports of the event differ slightly but all suggest that Fairall used two projectors to show the films superimposed on a single screen. In order to enable the viewers to perceive the two perspectives with one eye each, Fairall colorized the two prints red and green and handed out the now-iconic glasses with the corresponding colors. The usage of this anaglyph system, as it is called, was not original but was well-known in still photography. It consists of the overlaying or encoding of a stereoscopic image pair in complementary colors, usually red and green, and their decoding by means of color filters in front of the spectators' eyes, and dates back to the mid-nineteenth century. The term itself was coined in

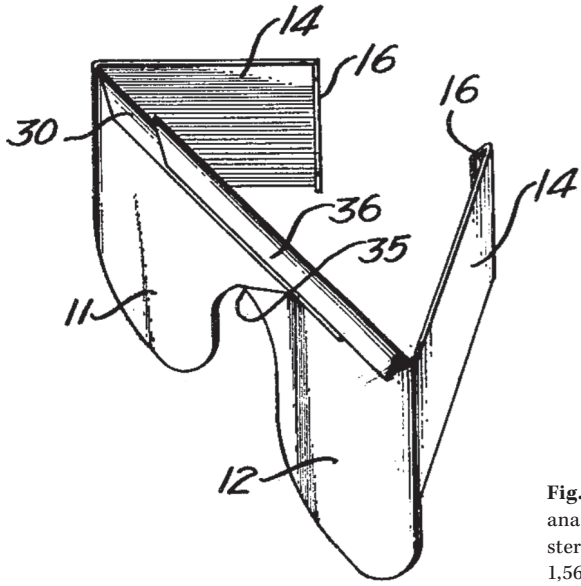

Fig. 1: Fairall's version of the anaglyph glasses needed to watch stereoscopic movies. (US Patent 1,562,319)

1893 by Louis Ducos du Hauron and literally means "again–sculpture"—that is, transforming a flat image back into a sculptural object.[19] What is puzzling about Fairall's adoption of the technique is that, according to a contemporary report, he apparently not only used complementary colors for presenting the film but had also shot the film with corresponding filters in front of the two lenses.[20] Technically, this is not required for stereoscopy but could be a misguided borrowing from natural color systems of the time that used double-lens cameras to capture discrete spectrums of light on monochrome stock by filtering. Regardless of whether the article documents a misunderstanding by the inventor or the reporter, it indicates that the different applications of complementary colors were not yet clearly distinguished at that time.

Fairall tried to protect his stereoscopic system with a number of patents. Two of them are especially relevant here in regard to colors and both were filed in the context of the screening at the Ambassador Hotel. The first one covers his version of the glasses, or goggles as he called them (fig. 1). The basic idea, of course, was to have two filters in red and green for the two eyes. Fairall's patent is only special due to its simple design, which involves two stampings of colored celluloid or a similar material being assembled into frameless glasses.[21] The second patent is more difficult to appreciate, as it contradicts the practice that was reported at the screening. It covers the usage of a single, double-coated film strip that has prints from the two source films in complementary colors on both sides.[22] Fairall describes in detail the advantages of such a two-color

film compared with a double projection. The fact that he still used double projection, however, suggests persistent problems with the implementation of this idea. Fairall's inability to expedite a commercial method of projection also obstructed any regular distribution of *The Power of Love* despite positive reactions at the Los Angeles screening and several others that followed throughout the country in the months afterward. A nonstereoscopic version was released in July 1923 under the title *Forbidden Lover* through Selznick.

The problems Fairall had with the combined print are especially notable since in the patent text he declares that the duplitized film stock with photographic emulsion coated on both sides of the film base is not part of the invention but "manufactured and regularly sold by the Eastman Kodak Co."[23] Double-coated film stock was otherwise used for two-color subtractive color processes that had been known for a decade at this point. Kodak had reacted to the emerging market for natural color processes and introduced duplitized film stock in 1920.[24] Thus, the patent does not cover any original technique but merely Fairall's appropriation for an alternative application that he did not even manage to implement. A subsequent patent, which he filed in 1925, fails to clarify what had initially caused problems with the production of anaglyph release prints. In it, Fairall adheres to his original idea of conforming the two films but he replaces the duplitized film with two separate film stocks of half thickness that have to be cemented.[25] By comparison with the earlier concept, this frail design appears to be a step backward, and it can be assumed that the patent does not document an actual advance in Fairall's practice but instead is strategically intended to establish a safe legal base for the exploitation of stereoscopy in any form. But just like printing on duplitized film stock, the second method is also an adaptation of a natural color system, in this case Technicolor No. II, which used the cementing of individually developed color separation prints as an alternative to duplitized film stock and was introduced in 1922.[26] All in all, none of the technical solutions that Fairall offered—whether they were operational or remained conceptual—can claim originality as such. What Fairall understood, though, is that complementary color techniques were available for alternative applications.

By calling our attention to the gap between a technique and its applications, Fairall's course of action also demonstrates that it is debatable whether we can speak of invention as a distinct event. Instead, it can only be understood in relation to processes of definition that often precede and outlast technical developments. The notion of invention as a distinct event that marks what is then conceived as the birth of a technique, of course, has been contested ever since materialist historiography of cinema pointed out the dialectical frictions within the medium's history.[27] John Belton critically advanced this method by

Fig. 2: Prizma II print with visible color fringes from *Sunshine Gatherers* (1921). (Photograph by Barbara Flueckiger, Timeline of Historical Film Colors, Library of Congress)

elucidating the often-complex motives of the involved parties for the implementation of a technique such as, in his case, wide-screen cinema.[28] Science and technology studies, on the other hand, have taken a more radical approach by analyzing the process of definition itself, as Wiebe E. Bijker has demonstrated in his study on the introduction of fluorescent light.[29]

The first technique that Fairall presented, with duplitized film and mordant dye toning on both sides, closely resembles subtractive color systems from the time, especially the then-popular Prizma II (fig. 2). While Fairall, based in Los Angeles, failed to adopt this technique for his needs, Prizma founder William Van Doren Kelley, based on the East Coast, also became involved in stereoscopic cinema. Accounts of this development are contradictory, which makes a precise reconstruction of events difficult. But besides Kelley, three others were involved: William T. Crespinel, a color expert who worked for Prizma until 1923; Jack F. Leventhal, a craftsman who was associated with animator Max Fleischer; and Frederic E. Ives, a camera engineer. Crespinel recalled in an interview that at the time when Leventhal suggested that they should produce stereoscopic movies, Crespinel himself had just left the declining Prizma and found that the color business was practically dead on the East Coast.[30] The two men then asked Ives for help with the camera and Kelley for help with anaglyph prints on duplitized film. Crespinel should have had all the knowledge that was required to create these prints, as it was practically the same process as for Prizma II: two individual films are printed on both sides of a film strip and

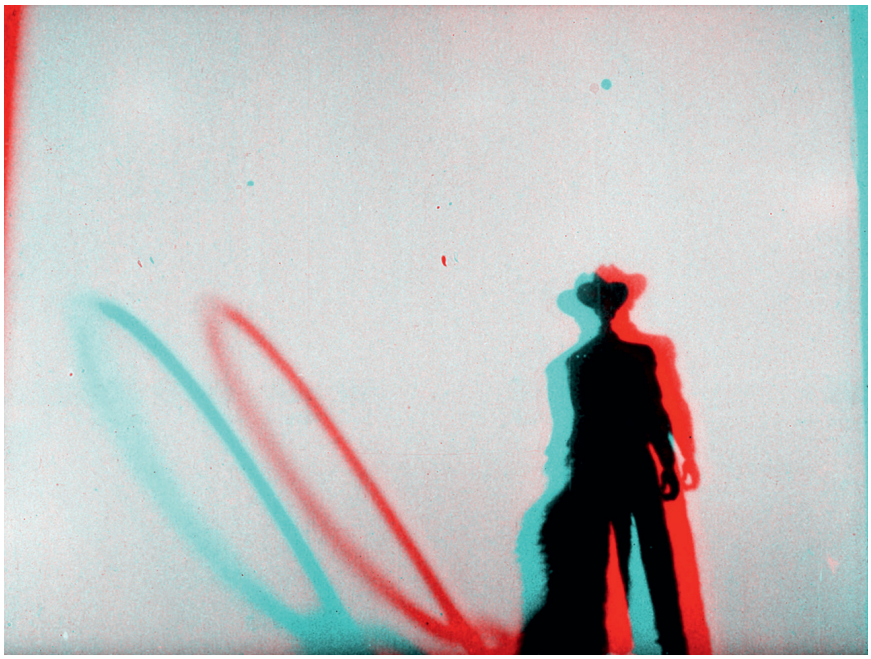

Fig. 3: Stereoscopic test with shadows by William T. Crespinel and Jacob Leventhal, ca. 1924. (3-D Film Archive)

then one side is toned red and the other green. The only difference lies in the content of the two source films, which no longer show separated color ranges but instead show discrete perspectives. According to Ray Zone, Kelley helped in this regard with the selection of dyes for the prints.[31] However, it is astonishing that Crespinel fails to mention that Kelley himself had already presented his own stereoscopic films in December 1922, the so-called *Plasticons*,[32] while it was only in 1924 that Leventhal and Ives exhibited their *Plastigrams* and later *Stereoscopiks*. Crespinel's involvement in both cases remains as unclear as is the relationship between *Plasticons* and *Plastigrams*. All of these films were shown in the Broadway theaters of Hugo Riesenfeld who also had a lasting effect on their gimmicky style. Unlike Fairall's *The Power of Love*, the stereoscopic movies on the East Coast were merely a succession of visual gags that tried to shock the audience (fig. 3). These effects wore off easily and in their sixth and final production, *As You Like It*, Leventhal-Ives found another use for the complementary colors. The film starts in monochrome and at the end asks the audience to put on the red-green glasses and choose either a happy or a sad ending simply by closing their left or right eye. The two films that are embedded in the two-color print no longer show different perspectives but

alternative endings.[33] When considered alongside the case of Fairall, these examples document that the same group of people used their expertise in color processes for three entirely different purposes that are usually described as three discrete histories, namely the histories of natural color, stereoscopy, and interactivity—and we will see one more.

These early attempts at stereoscopic movies all ended abruptly. In May 1926, Leventhal presented a bitter summary to the Society of Motion Picture Engineers, where he concluded that there was no hope for 3-D movies (as they came to be called upon their resurrection in the 1950s).[34] At the same time, Crespinel followed the color business to Hollywood where he started to work for Prizma's successor, Harriscolor. After a few months he was approached by Fairall, who was still tinkering with his stereoscopic system—now as an employee of the Binocular Stereoscopic Film Company.[35] This company had been founded the previous year by actor-director William Worthington, his son-in-law the director Rowland V. Lee, and other partners.[36] Crespinel, however, had developed the same skepticism toward stereoscopy as Leventhal and convinced Worthington and Lee to work on color instead. The company they founded and that would enable Crespinel to develop an advanced version of the old Prizma II was Multicolor. A network that was originally established for a stereoscopic venture was thus realigned toward color, and Multicolor's first patent was filed jointly by Fairall and Crespinel.[37] The arrival of Multicolor was also pivotal as the system no longer required special cameras. The accessibility that accompanied earlier concepts and that enabled alternative applications started to disappear in favor of natural color as the sole application of the underlying techniques.

COMPOSITING

When Prizma folded in 1923, another employee of the company headed directly for an early retirement in sunny California. As vice president of Prizma, Carroll Dunning had worked on yet another application that in his opinion might benefit from colors: analog compositing or the combination of distinct image layers. Compositing always requires some kind of matte that defines which parts of an image should be used or not used in combination with others. The established method in monochrome cinematography was to extract this information from differences in brightness by placing actors in front of black velvet curtains and printing the footage with very high contrast. Though widely known and used by many people in the industry, the process is usually associated with Frank D. Williams who offered it as a contractor in the early 1920s when it was basically the only way to produce traveling mattes. But luminance alone proved to be too fragile to provide a reliable solution here. Color, on the other hand, could offer a

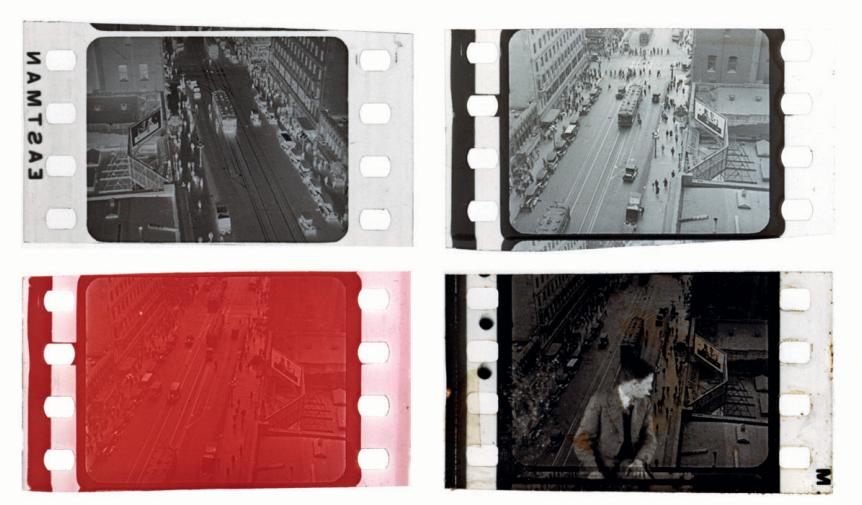

Fig. 4: Frames from the production of a Dunning shot: original camera negative, positive print, tinted plate positive, and final composite positive. (Earl Theisen Collection, Margaret Herrick Library, Academy of Motion Picture Arts and Sciences)

far more suitable means of distinguishing between foreground and background. Both methods were first used in still photography, and the incremental progression from monochrome to color in that field can be best traced in the work of German engineer Hans Goetz, who filed international patents for his inventions in the early 1920s and was regularly mentioned as a point of reference when color-based compositing was discussed in Hollywood.[38]

What came to be known as the Dunning process works as follows: a background plate is shot in the normal way on black and white, and a positive print from it is then toned yellow or orange. On the studio stage, actors and partial sets are lit in the same yellow-orange light in front of a blue background. The camera is bipacked with a regular panchromatic negative and the tinted plate positive in front of it.[39] Both films come into direct contact at the camera gate. The plate, which covers the blank negative, is neutral to the yellow light that is reflected from the live action but makes a contact print wherever it is struck by the complementary blue light. The result is a composite negative that does not require any special processing but can be developed and screened the same way as regular footage. The process was used in connection with color pairs other than orange-blue but they always had to be complementary in order to produce the desired effect (fig. 4). Color here never appears for the audience but is employed for a specific function, namely to distinguish between foreground and background.

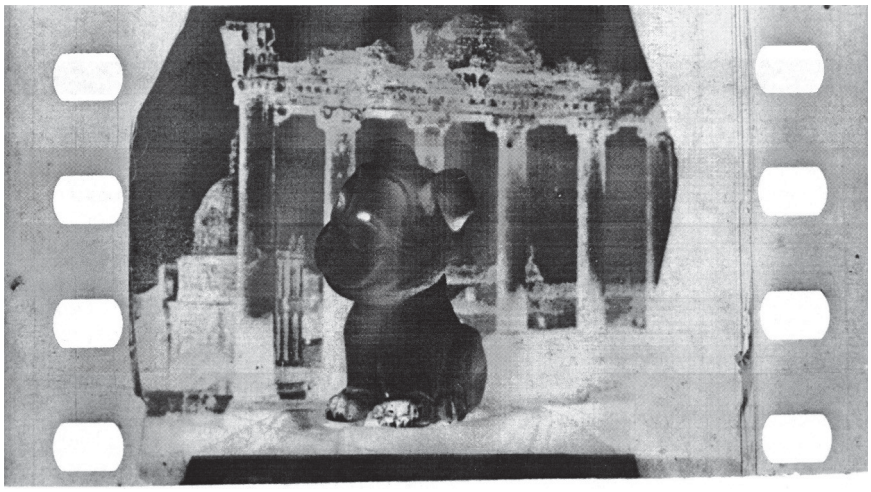

Fig. 5: While the early test with Dodge Dunning's sister walking in the Colosseum has been lost, this composite negative with a pet dog in front of the Roman Forum right next to the Colosseum is likely the oldest surviving Dunning shot. (Earl Theisen Collection, Margaret Herrick Library, Academy of Motion Picture Arts and Sciences)

As mentioned before, in his Prizma days Dunning had unsuccessfully experimented with the idea of reusing the concepts of complementary colors and toning. Legend has it that Carroll Dunning's son Dodge picked up his father's idea in 1924 when he was only seventeen years old. The first successful attempt was a composite shot that showed Dodge's little sister walking through the Roman Colosseum (fig. 5). Carroll Dunning then used his industry network to provide his son with a small lab at FBO Studios (later RKO and today part of the Paramount lot) on Gower Street in Hollywood. The process was apparently used from 1925 in Robertson-Cole productions at FBO, and a first patent was filed in April 1926.[40] In 1928, when FBO became RKO, the Dunnings started a regular business with the process and offered it as contractors. What followed was a few successful years that led to their name being associated with the process, which was also conceived and used by others, right up until the present day. After the end of the "Dunning process" as a product due both to the introduction of rear projection and to legal conflicts, father and son turned back to natural colors with the rollout of Dunning Color just as Crespinel and Fairall at the Binocular Stereoscopic Film Company left 3–D in favor of Multicolor.

The Dunnings were not the only ones who tried to use colors for compositing. At Famous Players-Lasky the former printmaker Max Handschiegl and cinematographer Alvin Wyckoff filed patents in 1916 for a process of partial application of color to an otherwise monochrome film.[41] Handschiegl advanced

the process after he started his own plant in 1922 and applied it until his early death in 1928. What is less known is that he worked in parallel on a replacement for the monochrome Williams process for compositing using colors. His first application in this connection in January 1923 was still quite similar to the Williams process and did not yet use colors.[42] But in September 1925 he submitted an improved version to the Patent Office that was based on complementary colors. The patent figures show a character (a wood nymph as Handschiegl calls her) in front of a red background. The light is split by a semitransparent mirror and filtered red and green respectively. The red film is developed with high contrast as a matte. The green film provides a still-unexposed background that can be filled by contact printing with the matte as a cover for the foreground action.[43] This patent was filed more than half a year before Dunning's and three months before an application by Paramount's Roy Pomeroy that is similar to Dunning's.[44] The splitting of light in the camera is a concept that was also used for color films and shows yet another transfer of technology from one field to another.

By all accounts, Handschiegl had separate partners for his two fields of business. His color printing process was merged into William Van Doren Kelley's fresh start Kelley Color, while for compositing his partner was former director Ray Smallwood. It is doubtful whether his compositing process was ever applied commercially. When Handschiegl entered into a legal dispute with Frank Williams, who eventually also tried to update his own process with colors, the latter claimed that Handschiegl's patents did not cover functional practices.[45] In the end, neither Handschiegl nor Williams was successful with their processes. Effectively, they were unable to compete with Dunning and Pomeroy because they had higher technical requirements and needed more time to deliver results. Despite their commercial and technical failure, the very fact that Handschiegl and to a lesser extent Williams used their knowledge for different but highly connected fields can be seen as a further argument for developing an integrated history of cinematic practices that does not distinguish from the outset between individual applications. This applies especially to the Dunnings, who used their knowledge at different times for natural color and compositing.

CONCLUSION

As I have tried to show, color in American cinema in the 1920s was more than a transition from applied to natural colors, a trajectory that has dominated previous scholarship in the field. Both the parties involved and the techniques that were used moved between entirely different applications that were not restricted to colors that are visible to the audience and signify profilmic colors, including alternatives that regarded colors as means toward other ends beyond what I

have termed aesthetic colors. In order to understand the development of natural color systems, one has to acknowledge that for most people who worked on them and who diversified their businesses by using color in any way that promised to be profitable, these applications were not exclusive. The two main alternatives were anaglyph stereoscopy and compositing with color-driven self-matting. The idea of using colors to let audience members individually choose their preferred narrative, as tried out by Leventhal-Ives, might be more of an oddity than a viable option for future movies but still supports the argument that complementary colors can have varied applications in cinema. As such, they are simultaneously both color and something else due to their openness to interpretation. In the cases of compositing and stereoscopy, space is translated into color: with the Dunning process, we have seen a space that is conceptualized as foreground action and background environment and the depth of which is represented by the duality of complementary colors. Anaglyph stereoscopy works differently, employing colors to combine two horizontally displaced perspectives into a single image that can later be translated back to its two sources.

What made these translations possible is that the participants regarded colors first and foremost as functional and only secondarily as aesthetic. For the moment, they conceived colors as structural differences that are looked at not (as is the case in the humanities) in relation to what they *are* for us but in relation to the question of what they can *do* in order to reach an aim that does not necessarily have to be related to the onscreen representation of color at all. Looking back at the different color concepts I referred to at the beginning, it occurs to me that they are deeply anthropocentric insofar as they are confined to color as a phenomenon that is perceived by humans. Such a constraint does not correspond to the historic events, as I have tried to show. It is precisely the comprehensive agency of colors that qualifies them for what Latour has described as technical mediation, that is, mutual appropriations that deny their participants stable identities in favor of the metastability of the emerging networks.[46] Andrew Pickering has analyzed this "reciprocal tuning of people and things"[47] in the context of the development of synthetic dyes in the late nineteenth century. And he identifies these colors as nonhuman agents that helped to create the industrial laboratory, a setting that cannot be reduced either to academic science or technical workshops and that features a new relationship between humans and things. In regard to film colors in the 1920s, we are able to discern that the agency of colors can fulfill nonrepresentational functions and thus may be completely concealed from the eyes of the audience. An alternative definition of functional colors could therefore be that they can play different roles within the division of labor in the film industry. Film scholars have for a long time acknowledged and studied these structures but limited their

understanding to human agency within them.[48] But in the course of automation, the human workforce is often replaced by mechanical structures, as is the case when the tedious frame-by-frame creation of mattes by hand is replaced with self-matting on the basis of color differences. Aesthetic or representational colors, on the other hand, carry forward in all their complexity an already-long history of colors in art and theory. Hence, it strikes me that the acknowledgment of functional colors would not only contribute original photographic and cinematographic processes to the history of color but that in their telic and autonomous significance they can also stand for a technical culture that still needs much more attention from the humanities.

Notes

1. Tom Gunning, "Colorful Metaphors: The Attraction of Color in Early Silent Cinema," *Fotogenia* 1 (1994): 249–55.
2. Paul Read, "'Unnatural Colours': An Introduction to Colouring Techniques in Silent Era Movies," *Film History* 21, no. 1 (2009): 7–46.
3. Richard Misek, *Chromatic Cinema: A History of Screen Color* (Chichester, UK: Wiley-Blackwell, 2010), 12.
4. An example Misek gives is a scene in *Go West* (1925) in which Buster Keaton's character wears a devil costume that provokes a herd of cattle due to its red color, a color that the audience thus learns of but cannot actually see. Misek, *Chromatic Cinema*, 2.
5. To understand aesthetic in its most basal, etymological meaning disregards the concept of taste that Lothar Baumgarten had introduced in the eighteenth century and that has been central to most aesthetic theories since then. But whether we conceive aesthetic in regard to physical sensation or judgment, for both concepts a human addressee is essential.
6. Theodore R. Schatzki, "Introduction: Practice Theory," in *The Practice Turn in Contemporary Theory*, ed. Theodore R. Schatzki, Karin Knorr Cetina, and Eike von Savigny (London: Routledge, 2001), 14.
7. David G. Stern, "The Practical Turn," in *The Blackwell Guide to the Philosophy of the Social Sciences*, ed. Stephen P. Turner and Paul A. Roth (Wiley Online Library, 2003), 185, doi:10.1002/9780470756485.ch8.
8. Tom Gunning, "'Animated Pictures,' Tales of Cinema's Forgotten Future," *Michigan Quarterly Review* 34, no. 4 (1995): 469.
9. Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, NJ: Princeton University Press, 1985); and Bruno Latour, *We Have Never Been Modern* (Cambridge, MA: Harvard University Press, 1993).
10. For a critical account of the problematic role of technology within film studies, see Benoît Turquety, "Toward an Archaeology of the Cinema/Technology Relation: From Mechanization to 'Digital Cinema,'" in *Technē/Technology*, ed. Annie van den Oever (Amsterdam: Amsterdam University Press, 2014), 50–64.
11. Michel Callon, "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay," in *Power, Action, and Belief: A New Sociology of Knowledge?*, ed. John Law (London: Routledge & Kegan Paul, 1986), 196–233; John Law and Michel Callon, "The Life

and Death of an Aircraft: A Network Analysis of Technical Change," in *Shaping Technology/Building Society: Studies in Sociotechnical Change*, ed. Wiebe E. Bijker and John Law (Cambridge, MA: MIT Press, 1992), 21–52; Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, MA: Harvard University Press, 1987); and Bruno Latour, *Aramis, or the Love of Technology* (Cambridge, MA: Harvard University Press, 2002).

12. H. Mark Gosser, *Selected Attempts at Stereoscopic Moving Pictures and Their Relationship to the Development of Motion Picture Technology, 1852–1903* (New York: Arno, 1977).

13. In fact, the periodic (re)discovery of stereoscopy must be seen as a reminder of the nonlinear trajectories of media technology. Throughout the history of cinema, stereoscopy has been (re)introduced roughly every thirty years since the 1920s and, in the case of its re-emergences, apparently in reaction to other media: in the 1950s the rise of television, in the 1980s home video, and in the 2010s when the Internet became a vital entertainment channel.

14. Ray Zone, *Stereoscopic Cinema and the Origins of 3-D Film, 1838–1952* (Lexington: University Press of Kentucky, 2007), 1–2.

15. Joshua Yumibe, *Moving Color: Early Film, Mass Culture, Modernism* (New Brunswick, NJ: Rutgers University Press, 2012), 78.

16. "Stereoscopic Picture Shown," *Film Daily*, September 30, 1922.

17. Irvine Clarke, "Doings in Los Angeles," *Moving Picture World*, January 30, 1915.

18. The screening at the Ambassador Hotel was preceded by small and mysterious ads in trade journals that read "Coming Soon. Perfect Pictures. Neither screen nor stage—but life's window," where "Perfect Pictures" is both Sparling's recently founded production company and the promise of a new movie experience. See, for example, *Exhibitor's Trade Review* 12, no. 13 (August 26, 1922): 868.

19. Julius F. Sachse, "The Anaglyph," *Photographic Times*, December 21, 1894, 403–6; and William Marder and Estelle Marder, "Louis Ducos Du Hauron (1837–1920)," *History of Photography* 18, no. 2 (June 1994): 134–39, doi:10.1080/03087298.1994.10442339.

20. "Wearing Red and Green Spectacles to See Stereoscopic 'Movies,'" *Scientific American* 128, no. 2 (February 1923): 105, doi:10.1038/scientificamerican0223-105.

21. Harry K. Fairall, Goggles, US Patent 1,562,319, filed September 30, 1922, and issued November 17, 1925.

22. Harry K. Fairall, Double emulsion film, US Patent 1,595,295, filed August 29, 1922, and issued August 10, 1926.

23. Ibid., 1.

24. J. I. Crabtree, "The Motion Picture Laboratory," *Journal of the Society of Motion Picture and Television Engineers* 64, no. 1 (January 1955): 21.

25. Harry K. Fairall, Method of making stereoscopic film, US Patent 1,744,459, filed December 22, 1925, and issued January 21, 1930.

26. Richard W. Haines, *Technicolor Movies: The History of Dye Transfer Printing* (Jefferson, NC: McFarland, 1993), 4–7.

27. Jean-Louis Comolli, "Technique and Ideology: Camera, Perspective, Depth of Field," in *Cahiers Du Cinéma*, vol. 3, 1969–1972, *The Politics of Representation*, ed. Nick Browne, trans. Diana Matias (1971; repr., London: Routledge, 1990), 213–47.

28. John Belton, "CinemaScope and Historical Methodology," *Cinema Journal* 28, no. 1 (1988): 22–44, doi:10.2307/1225015.

29. Wiebe E. Bijker, *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change* (Cambridge, MA: MIT Press, 1995).

30. William A. Crespinel, "Pioneer Days in Colour Motion Pictures with William T. Crespinel," *Film History* 12, no. 1 (2000): 57–71; on the abrupt end of Prizma, see Robert A. Nowotny, *The Way of All Flesh Tones: A History of Color Motion Picture Processes, 1895–1929* (New York: Garland, 1983), 184–85.

31. Zone, *Stereoscopic Cinema and the Origins of 3–D Film*, 119.

32. Kelley continued to work on stereoscopic processes, as a patent application from 1924 shows. The method covered by the patent application, however, concerns the recording of stereoscopic shadows and not the photography of real subjects. William Van Doren Kelley and Dominick Tronolone, Stereoscopic picture, US Patent 1,729,617, filed July 24, 1924, and issued October 1, 1929.

33. "Presentations," *Film Daily*, October 8, 1925; and "The Big Little Feature," *Exhibitors Trade Review* 18, no. 21 (October 10, 1925): 39–40.

34. Jack F. Leventhal, "The First Use of Stereoscopic Pictures in Motion Picture Theaters," *Transactions of the Society of Motion Picture Engineers*, no. 26 (1926): 34–36.

35. His double-emulsion patent was granted at the same time and already identifies him as an assignee of the company.

36. "Lee in Camera Company," *Film Daily*, November 9, 1925, 1.

37. Harry K. Fairall and William T. Crespinel, Method of producing a color positive for use in a colored motion picture, US Patent 1,897,369, filed August 17, 1927, and issued February 14, 1933.

38. Hans Goetz, Improvements in the production of photographic silhouettes and combination photographs, GB Patent 147,621, filed July 8, 1920, and issued October 10, 1921; Hans Goetz, A new or improved process of producing photographic silhouettes, GB Patent 169,233, filed June 16, 1920, and issued September 16, 1921; and C. Dodge Dunning, "Composite Photography," *Transactions of the Society of Motion Picture Engineers* 12, no. 36 (September 1928): 975–79.

39. Panchromatic film stocks that, unlike orthochromatic ones, are not only sensitive to blue and green light were sold for competitive prices by 1926–27, which is another reason why color-based compositing prevailed at that time. Similar to the duplitized film stocks mentioned above, panchromatic films were developed for a different purpose and then appropriated. Loyd A. Jones and J. I. Crabtree, "Panchromatic Negative Film for Motion Pictures," *Transactions of the Society of Motion Picture Engineers* 10, no. 27 (January 1927): 131–78.

40. Carroll Dodge Dunning, Method of producing composite photographs, US Patent 1,613,163, filed April 17, 1926, and issued January 4, 1927.

41. Alvin Wyckoff and Max Handschiegl, Art of coloring cinematographic films, US Patent 1,303,836, filed November 20, 1916, and issued May 13, 1919; and Alvin Wyckoff and Max Handschiegl, Machine for and art of coloring cinematographic films, US Patent 1,303,837, filed November 20, 1916, and issued May 13, 1919.

42. The difference was that Handschiegl suggested directly exposing two negatives and making a matte from one of them. Max Handschiegl, Process of making double exposure, US Patent 1,840,669, filed January 2, 1923, and issued January 12, 1932.

43. Max Handschiegl, Double exposure process, US Patent 1,860,737, filed September 30, 1925, and issued May 31, 1932.

44. Roy J. Pomeroy, Method of making composite photographs, US Patent 1,673,019, filed December 19, 1925, and issued June 12, 1928; and Dunning, Method of producing composite photographs.

45. Frank D. Williams, Production of silhouettes for composite motion pictures, US Patent 1,955,993, filed November 3, 1931, and issued April 24, 1934; and Frank D. Williams, Composite picture mat, US Patent 2,024,081, filed August 30, 1932, and issued December 10, 1935.

46. Bruno Latour, *Pandora's Hope: Essays on the Reality of Science Studies* (Cambridge, MA: Harvard University Press, 1999), 84–92.

47. Andrew Pickering, "Practice and Posthumanism: Social Theory and a History of Agency," in *The Practice Turn in Contemporary Theory*, ed. Theodore R. Schatzki, Karin Knorr Cetina, and Eike von Savigny (London: Routledge, 2001), 172.

48. Janet Staiger, "Dividing Labor for Production Control: Thomas Ince and the Rise of the Studio System," *Cinema Journal* 18, no. 2 (1979): 16–25, doi:10.2307/1225439.

Birk Weiberg is research associate at Zurich University of the Arts. He has published articles in books and journals on the aesthetics and history of photographic images, media arts, and contemporary arts. He was a visiting scholar at the California Institute of the Arts and a junior fellow at the IKKM at the Bauhaus University in Weimar, Germany. In 2014, he received his PhD in art history from the University of Zurich with a dissertation on the history of optical effects in Hollywood and is currently working on the publication of his thesis.