



## On Screen and in Living Colours: Vision and Early Colour Photography

Rachel Lee Hutcheson

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Nearly a century of standardization has rendered colour stable and distant as an everyday perceptual experience: colour photographs on digital screens or as print reproductions are unremarkable. Yet the radical instability of colour once seemed like the most viable way to photographically reproduce it. This article considers how early 'natural colour' photography in the first decades of the twentieth century formed in relation to nineteenth-century conceptions of human colour vision. These now obsolete technologies, like Frederic Ives's Krömsköp, draw our attention to the confounding place of colour as projective, a sensation of the world, and one experienced by the human observer. So-called natural colour technologies drew upon and employed the relational quality of colour in their functioning to create images that look mimetic but were also thought to function like colour vision — they produced a colour image 'naturally'. The article offers a panorama of scientists, theorists, photographers, and devices united by natural colour and the now unfamiliar photographic practices and display techniques that emerged alongside it.

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Neither produced by us alone nor an exclusive property of the world, [colour] belongs to the intersection, the mutual greeting of human and universe. Neither subjective nor objective, we might call it projective: a projection of the world into our sensoria and of our sensations onto the world.<sup>1</sup>

In 2022 I visited the exhibition ‘**Olafur Eliasson: Nel tuo tempo**’ at the Fondazione Palazzo Strozzi in Florence (October 2022–January 2023). Many of Eliasson’s works can be described as both immersive and experiential. Indeed, the exhibition title ‘Nel tuo tempo’ or ‘In your time’ alludes to the spatial and temporal aspects of viewing the artworks. By emphasizing the non-conceptual, perceptual capacities of the body, the works in the exhibition centred the immediate sensations of the viewer in real time. The exhibition restaged many of Eliasson’s well-known pieces, including *Room for one colour* (1997; 2022). In this installation, yellow light completely saturated the architectural space. Beyond illumination however, the colour seemed to have its own presence, its own material weight in the air and I was subordinate to it. The high walls and ceiling of the palatial room closed in as the coloured light overwhelmed my vision. My skin and hair drained of colour. Incredibly, the cobalt blue sweater I was wearing appeared ashen, the colour completely sapped from it. The longer I remained in the room, the more I struggled to identify colours as they appeared to be, and what I knew them to be. *Room for one colour* is an artwork that foregrounds the projective quality of colour. Through this disorienting experience, viewers become conscious of the sensorial relationality that unites the sensing being to the world.

The popularity of installations like Eliasson’s supposedly contrasts with the contemporary everyday image world mediated by highly standardized colour systems for reproduction across print, electronic, and digital media.<sup>2</sup> Contemporary digital screen colour, in particular, is characterized by liquid crystal displays in which the colours are cool, clean, and phantasmagorically ‘immaterial’, mediating and remediating reality in its image.<sup>3</sup> Unlike the immersive and immediate experience of *Room for one colour*, colour mediated by digital interfaces seems to distance it from the ‘real world’; it becomes merely an aspect of the screen image. Digital photographs of the installation highlight the difference between the perceptual experience of colour and its mediation on the screen (Fig. 1). Human perception is now secondary in the algorithmic paradigm marked by high levels of automation, technical inscrutability,

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<sup>1</sup> Sean Cubitt, *The Practice of Light: A Genealogy of Visual Technologies from Prints to Pixels* (MIT Press, 2014), p. 112.

<sup>2</sup> Sean F. Johnston, *A History of Light and Colour Measurement: Science in the Shadows* (Institute of Physics Publishing, 2001), pp. 171–82. The industrial colour standards were mainly established in 1931 by the Commission Internationale de L’Éclairage (CIE).

<sup>3</sup> ‘Cool’ here simply refers to the blue light emitted by digital screens.



Fig. 1: Olafur Eliasson, *Room for one colour* (1997), monofrequency lights, dimensions variable. Installation view: Olafur Eliasson, 'Nel tuo tempo', Fondazione Palazzo Strozzi, Florence, Italy, 2022. Photo: Ela Bialkowska, OKNO Studio. Courtesy of the artist; Fondazione Palazzo Strozzi, Florence; Angsuvarnsiri Collection; neugerriemschneider, Berlin; Tanya Bonakdar Gallery, New York/Los Angeles © 2022 Olafur Eliasson.

and 'stunning digital colors' that are notably 'bright, and high visibility'.<sup>4</sup> Automated software and digital colour systems have created a controlled environment made up of numbers and compression that do not allow for direct manipulation or experience of colour. For some critics, digital colour is endemic to a control society; it is a system 'used to manage and discipline perception and thus reality'.<sup>5</sup>

Long before contemporary digital screens, late nineteenth- and early twentieth-century natural colour technologies mediated colour under the term *naturalism*; that is, their colours were convincing to human sensory perception and understood to correspond to the appearance of external reality. The term *natural colour* referred to photomechanically recorded colour in technologies that emerged in the 1890s. The term also demarcated it from the many other available colour methods, including colour printing, hand-colouring, or the tinting of photographs. The colours produced by digital or analogue reproduction technologies like photography and film are essentially irreconcilable with the perceptual capabilities of the human sensorium, but that is not to say that colour technologies are somehow inhuman, artificial, or merely standardized against the privileged human subject's direct experience of the external world.<sup>6</sup> Media theory emphasizes that the human being is always in mutual interaction

<sup>4</sup> Carolyn L. Kane, *Chromatic Algorithms: Synthetic Color, Computer Art, and Aesthetics after Code* (University of Chicago Press, 2014), p. 2.

<sup>5</sup> Ibid., p. 211.

<sup>6</sup> Cubitt, p. 114.

with technologies, and that media exert their own agencies.<sup>7</sup> We should therefore consider technologies of colour production and reproduction as operating with the human observer, producing new relationalities and possibilities. Rather than rely on binaries that oppose an essentialized human against technology, reify analogue against digital technology, or construct a deterministic media genealogy, I seek to establish the contingency of colour technologies in the specific historical conditions by which certain discourses and practices became dominant, if only temporarily. From natural colour to digital screens, this is a media archaeology ‘without teleology, of resonances rather than precedents’.<sup>8</sup>

This argument is geographically circumscribed with a focus on Western European and North American visual culture. The first part of the article lays the groundwork by tracing the development of subjective vision and colour vision science in the nineteenth century. The subsequent sections provide examples that branch from subjective vision into technological devices, popular aesthetic discourses, and photographic techniques. The article offers a panorama of scientists, theorists, photographers, and devices united by natural colour. Although the argument is presented largely chronologically, the sections offer overlapping narratives that reveal the transformative effects of colour and its conceptualization in the visual technology, popular culture, and society of Western modernity.

### Subjective vision

The genealogy of colour technologies I am tracing spans the long nineteenth century, from colour vision theories to the early natural colour photography and film. *Natural colour* was a term widely applied to describe new chemical-mechanical colour technologies that emerged at the turn of the twentieth century.<sup>9</sup> It opposed all previous

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<sup>7</sup> Brian Larkin, ‘The Cinematic Milieu: Technological Evolution, Digital Infrastructure, and Urban Space’, *Public Culture*, 33.3 (2021), pp. 313–48, doi:[10.1215/08992363-9262849](https://doi.org/10.1215/08992363-9262849).

<sup>8</sup> Sudhir Mahadevan, *A Very Old Machine: The Many Origins of the Cinema in India* (SUNY Press, 2016), p. 13.

<sup>9</sup> Early references to ‘natural colour’, ‘natural-colour’, or photography ‘in natural colours’ emerge in advertisements and the press related to new photographic (and then filmic) technologies in American and British publications such as the *Photographic Times*, *American Photographer*, *Wilson’s Photographic Magazine*, *Photographic Quarterly*, and especially, the Monthly Supplement on Colour Photography of the *British Journal of Photography*. For an overview of early colour in the history of photography, see *Three-Colour Photography around 1900 – Technologies, Expeditions, Empires*, ed. by Hanin Hannouch, special issue of *PhotoResearcher*, 37 (2022); *The Colors of Photography*, ed. by Bettina Gockel, with Nadine Jirka and Stella Jungmann (De Gruyter, 2020), doi:[10.1515/9783110661484](https://doi.org/10.1515/9783110661484); *Color Mania: The Material of Color in Photography and Film*, ed. by Barbara Flückiger, Eva Hielscher, and Nadine Wietlisbach (Fotomuseum Winterthur, 2020); Nathalie Boulouch, *Le ciel est bleu: une histoire de la photographie couleur* (Éditions Textuel, 2011); and Michel Frizot, ‘A Natural Strangeness: The Hypothesis of Color’, in *A New History of Photography*, ed. by Frizot (Könemann, 1998), pp. 411–29. An extensive catalogue of the colour photographs in the collection of the Royal Photographic Society at the Victoria and Albert Museum in London can be found in Catlin Langford, *Colour Mania: Photographing the World in Autochrome* (Thames and Hudson/V&A, 2022).

forms of hand-applied methods of painting, tinting, or toning colour in photography or film. These camera-recording colour processes include a litany of now obscure photographic and filmic devices. Some examples include three-colour composite systems like the *Ives Krömskōp* (1893), *Lumière Trichromie* (1895), and *Sanger-Shepherd Process* (1903), as well as glass-plate processes such as the *Autochrome* (1907) and even colour film like *Kinemacolor* (1908). These processes created colour images through techniques of filtering light, not through the production of a print object. Viewing was circumscribed by a range of devices and conditions, including projectors for public display or specialized enclosed viewers for individual consumption, with the addition of natural or artificial light. Akin to the construction of stereoscopic images, which capitalized on subjective vision to create the illusion of three-dimensionality, so-called natural colour formats induced the body to produce colours through colour separation principles and filtering techniques.<sup>10</sup> They underscored the fact that colour was not a fixed material property but rather a relational and sensorial one.

Natural colour photography emerged from a shared epistemology in nineteenth-century human vision studies.<sup>11</sup> At the intersection of physics and physiology, human colour vision problematized the long-standing Newtonian theory of colour and was part of the shift from objective vision modelled on the camera obscura to subjective physiological vision.<sup>12</sup> Johann Wolfgang von Goethe's *Zur Farbenlehre* (1810) argued that the appearance of colour was not fixed but instead always imbricated with the viewing subject and environment. Goethe begins his study with physiological colour, a foregrounding of the subjectivity of vision that is in direct opposition to Isaac Newton's *Opticks* (1704) and the privileging of colour as belonging a priori to an object. Physiological colours, in particular, were produced by the body and belonged 'to the subject — to the eye itself'.<sup>13</sup> Physiological colours were vital because they 'direct our attention to the laws of vision, and are a necessary preparation for future observations on colours. They show that the eye especially demands completeness, and seeks to eke out the colorific circle in itself.'<sup>14</sup> With this, Goethe proposed that every colour had an opposite, and together these pairs created 'harmony'. For Goethe, the eye was active; it was both productive and responsive.

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<sup>10</sup> Johnathan Crary, *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century* (MIT Press, 1992), p. 62.

<sup>11</sup> Kim Timby, 'Colour Photography and Stereoscopy: Parallel Histories', *History of Photography*, 29.2 (2005), pp. 183–96, [doi.org/10.1080/03087298.2005.10441370](https://doi.org/10.1080/03087298.2005.10441370). Timby describes the shared historical background of colour and stereography but she focuses on the production and superimposition of multiple images for colour and stereoviews, whereas I am considering more specifically the technique of filtering as essential for this epistemology.

<sup>12</sup> Crary, pp. 69–73.

<sup>13</sup> Johann Wolfgang von Goethe, *Theory of Colours*, trans. by Jeremiah Harman (Murray, 1840), p. 1, emphasis in original.

<sup>14</sup> *Ibid.*, p. 28.

This radical change in visuality undermined the stability of subject–object relations and produced a new kind of modern observer essential to the continued abstraction of vision into measurable and quantifiable characteristics in the twentieth century.<sup>15</sup> Colour in mass culture also became modern by undergoing a process of quantification and standardization to make it amenable to industrialization and mass production. This is most evident in the establishment of an international colour standard for print, photography, film, and later television industries in 1931 by the Commission Internationale de L'Éclairage (CIE).<sup>16</sup> Situated between the human vision response and physical measurements of light waves, the CIE standards largely abandoned the perception of the observer and situated colour more definitively as a physical property.<sup>17</sup> The science of colorimetry was formed within the debate between colour as a physical phenomenon and the perceptual effect of colour. The division was between physics and psychology or psychophysics: 'the psychologists' efforts to determine inner mental relationships between stimuli and perceptions contrasted with the physicists' goal of employing the visual response to measure external phenomena.'<sup>18</sup> The psychological view approached the work of physicists in the nineteenth-century work of Gustav Fechner, Wilhelm Wundt, and Francis Galton. In contrast, the physicists wanted to focus on the properties of colour that could be rendered in numerical form, even if it meant simplifying or idealizing human vision.

The CIE standard observer was based on the statistical averaging of a few colour matching experiments. In effect, the demand for numerical definitions of colour idealized and normalized human vision for practical applications. The physical properties of colour were only connected to human visual perception via an abstracted, artificial 'standard observer' constructed from a table of numbers representing the response of a typical eye to the three reference colours (red, green, and blue).<sup>19</sup> After the Second World War, debates lessened and the CIE published new functional colour standards in *The Science of Colour* (1953); these standards united the two sides by restricting colorimetry to a mathematical model and defining colour as a shared property of mind and matter. The only way colour could be less contentious was by

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<sup>15</sup> Crary, p. 96. For Crary, modernization was fundamentally the separation and quantification of the senses, which allowed for new configurations of the body in society. Only within this paradigm could vision be considered liberated from signification and therefore open the possibility for abstraction.

<sup>16</sup> Johnston, pp. 159–82. The Commission Internationale de L'Éclairage (CIE) was formed in 1913 to address practical standards regarding measuring lighting. The organization met every three years and the official languages were French, English, and German. Its objective was to 'study all questions relating to the industry of illumination and to the sciences which are connected with it, and to establish, by all appropriate means, international agreements on questions of illumination'.

<sup>17</sup> Most aspects of colorimetry or colour science have physical bases, like the definition of 'white' and coloured illuminants.

<sup>18</sup> Johnston, p. 171.

<sup>19</sup> Ibid., p. 173.

connecting it to its application, not by its foundations as a perceptual, physical, and psychological interaction.<sup>20</sup> This construction of colour as objective rendered it 'useful' but it also concealed the ambiguities, instabilities, and contingencies that so characterize the history and technologies of colour.

The subjectivity of vision also contributed to a parallel uncertainty about the capacity for an objective human experience of the world. That is, scientists could no longer ascertain results simply through experiential observation. Instead, tools and apparatuses were developed for controlling, measuring, and proving visual phenomena.<sup>21</sup> At issue for the first half of the century was how human vision operated; determining the functioning of colour vision, however, would prove somewhat more elusive.

Physiological studies on vision further isolated and measured aspects of the eye (such as attention, stimuli, response, fatigue, and colour). The experiments of Fechner and Hermann von Helmholtz, among others, formalized perception and rendered the specific subject or content of sight irrelevant. Psychophysical testing eliminated language (and, by its own logic, the human) in order to figure out the non-conscious mechanisms that form the psychophysical reality.<sup>22</sup> Vision became describable in terms of abstract and exchangeable magnitudes expressed arithmetically. This psychophysical quantification of the human sensorium allowed for media technologies to imitate and manipulate human perception. The abstraction and quantification of vision as well as the mechanistic understanding of the eye (as responsive to stimuli without conscious cognition) laid the groundwork for photo-filmic colour technologies that modelled their functioning after the human eye.<sup>23</sup> Colour vision was conceived as responsive; colour technologies would seek to elicit this response.

### Colour vision to natural colour

Using Goethe's conception of subjective vision as a foundation (that colour operated on the human senses) along with work by Thomas Young, who later theorized that the eye was sensitive to three primary colours or visible wavelengths, James Clerk Maxwell proposed

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<sup>20</sup> Ibid., p. 182.

<sup>21</sup> Jordi Cat, *Maxwell, Sutton, and the Birth of Color Photography: A Binocular Study* (Palgrave Macmillan, 2013), p. 112, doi:[10.1057/9781137338310](https://doi.org/10.1057/9781137338310). Sir Charles Wheatstone made some of the first major strides in vision science with his research on binocular vision in the 1830s. In 1838 he developed the stereoscope to demonstrate how binocular vision worked. See also, Lorraine Daston and Peter Galison, *Objectivity* (Zone Books, 2010).

<sup>22</sup> Friedrich Kittler, 'Thinking Colours and/or Machines', *Theory, Culture, & Society*, 23.7–8 (2006), pp. 39–50 (p. 42), doi.org/[10.1177/0263276406069881](https://doi.org/10.1177/0263276406069881).

<sup>23</sup> Zeynep Çelik Alexander, *Kinaesthetic Knowing: Aesthetics, Epistemology, Modern Design* (University of Chicago Press, 2017). Similarities can be seen in the aesthetic theories and pedagogies of Imperial and Weimar Germany. Alexander describes 'aesthetics from below' with the term *Kinaesthetic knowing*. It is a form of non-conceptual knowledge obtained by the body itself; aesthetic forms and relations are essentially precognitive and can be experimentally discovered and scientifically measured.

a theory of human colour vision based on three-colour additive primaries: red, blue, and green from which all colours were perceived. Along with Thomas Sutton, he demonstrated this theory in a famous experiment of a tartan ribbon in 1861; they photographed the ribbon through the three colour filters (red, blue, green) and then projected the image through these filters for a full-colour projection image. The experiment essentially modelled the mechanistic operation of the eye itself as a camera and its colour receptors like the colour filters on the projector. French amateur physicist and photographer Louis Arthur Ducos du Hauron would also explore colour separation and recombination in an 1868 patent for three-colour carbon prints and in his *Les couleurs en photographie: solution du problème* (1869). It did not take a great conceptual leap for American inventor Frederic Ives to adapt Maxwell's theory of human colour vision and du Hauron's application of colour separation into his own method of practical colour photography. In 1891 Ives patented and marketed a photography method called the Krömskōp Photochromoscope, based on Maxwell's primaries and the subjective production of colour. From the later 1898 Krömskōp manual, Ives stated explicitly this theory of colour vision:

The impression of color is wholly subjective or dependent upon the formation of the eye by which it is viewed. As far as the light itself is concerned, the waves of different colors are infinitely varied as regards their length, but as the eye has only three tests for them by its three sets of nerves, our judgment is formed by the relative excitation of these three sets.<sup>24</sup>

What seems so strange about Ives's colour process was that it produced images in black and white, or achromatically. It was only upon viewing the achromatic image in a special viewer that simulated human colour vision that a colourful image could be seen. The Krömskōp camera photographed a triple negative with one exposure. These achromatic images hold a unique record of the primary colour and are developed and printed as positives on glass plates, with two images per colour. In other words, they are black-and-white photographic records that are not colourful until seen through a corresponding colour filter. Each of the three pairs of images are held together in an accordion fold by ribbon. The observer positioned the device near a strong natural light source and peered through the two eyeholes as with a stereoscope viewer (*Fig. 2*). When placed on the Krömskōp viewer, the six black-and-white images (three for each eye) were filtered through coloured glass and combined by mirrors and then by the user's own eyes into a merged full-colour image (*Fig. 3*). The Krömskōp therefore manipulated the science of binocular and colour vision for perceived mimetic colour and an object in three dimensions.

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<sup>24</sup> Frederic Ives, *Krömskōp: Color Photography* (Photochromoscope Syndicate, 1898), p. 70.



Fig. 2: Frederic E. Ives, Krömskōp (Stereoscopic Photochromoscope) (1898). Image courtesy of Science Museum Group, United Kingdom.



Fig. 3: Frederic E. Ives, Vase of Flowers (c. 1895), Kromogram. Image courtesy Source Museums Victoria, Australia. The Kromogram is used with a stereoscopic Krömskōp viewer.

Colour images as seen in the Krömskōp viewer existed only at the moment of viewing; it was a temporary mixing of light. Colour printing, in contrast, generally used subtractive colour mixing and its colours exist more independently of the eye of the spectator. The conceit of so-called natural colour was that it worked ‘just like the human eye’; not only with perfect verisimilitude, but also because it recreated the dynamic exchange between the viewer and world, now within the contained display of the device. From the late nineteenth and into the first decades of the twentieth century, such methods of natural colour became the most promising and practical avenue for mimetic colour photographic and filmic reproduction. According to Ives,

[the] search for a direct method of pigmentary colour photography, such as was dreamed of by the fathers of photography and the world at large, appears to have been wholly abandoned, every seeming clue to such an achievement having proved a delusion.<sup>25</sup>

Colour that emerged from scientific knowledge of human vision proved more successful.

The nineteenth-century viewing public’s interest and fascination with camera-recorded colour was in its double valence as both of external reality and as a colour attraction that staged colour vision.<sup>26</sup> Ives’s colleague, William Jennings, recalled his first experience viewing ‘down the brass tube’ of an early model of the Krömskōp in which he saw ‘not a colour photograph — but a blue vase full of real flowers!!!’.<sup>27</sup> Colour’s relationship to photographic realism was grounded in its indexicality; that the image, including colour, was a chemical record of external reality made by light. Attractions, deriving from Tom Gunning’s cinema of attractions, cultivated a particular mode of spectatorship that called attention to itself through overt display. In the case of cinema, attractions exist largely outside of narrative formulations.<sup>28</sup> Even as natural colour technologies emphasized new capacities for photographic realism, they also capitalized on the transience of colour as a sensorial phenomenon

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<sup>25</sup> Frederic E. Ives, ‘The Optics of Trichromatic Photography’, *Photographic Journal*, 25.3 (1900), pp. 99–120 (p. 99) <<https://archive.rps.org/archive/volume-41/722277>> [accessed 19 July 2025].

<sup>26</sup> Rachel Lee Hutcheson, ‘Coming Attraction: The Event of Color, Techniques of Screening and Filtering in Early “Natural” Color Film and Photography’, *Grey Room*, 96 (2024) <<https://www.greyroom.org/issues/96/247/coming-attraction-the-event-of-color-techniques-of-screening-and-filtering-in-early-natural-color-film-and-photography/>> [accessed 17 July 2025]. ‘Attraction’ directly references Tom Gunning’s theorization of the cinema of attractions. See Tom Gunning, ‘Attractions: How They Came into the World’, in *The Cinema of Attractions Reloaded*, ed. by Wanda Strauven (Amsterdam University Press, 2006), pp. 31–39 (pp. 36–37) <<https://www.jstor.org/stable/j.ctt46n09s.5>> [accessed 17 July 2025].

<sup>27</sup> Letter from W. N. Jennings to F. E. Ives, 18 December 1930, Library of Congress, Washington DC, Frederic Eugene Ives and Herbert Eugene Ives Papers, 1869–1957, MSS27508, Box 1: General Correspondence, Folder ‘1930’.

<sup>28</sup> Gunning, p. 36.

by creating a concentrated colour viewing experience, one in which the image could only be experienced with the viewing device.

### Colour sensibility and natural colours

Natural colour technologies emerged alongside efforts to measure, manage, and control colour. The chemical revolution, inaugurated by William Perkins's accidental creation of mauve in 1851, profoundly transformed the production and conception of colour. Aniline dyes synthesized all the colours of the rainbow from the black stuff of coal tar — modern chemistry made real a dream of ancient alchemy.<sup>29</sup> As colour production became industrialized as a chemical process, colour as such became abstracted from its material referent and wholly new colours like mauve, as well as heliotrope, fuchsine, magenta, and many more came to exist. New words were also created to name these and further disassociated particular colours from long-standing metaphorical and semantic connections as well as material value structures. Colour achieved a new perceptual immediacy in the absence or detachment from representation with associative meanings that evoked physical sensations and mental processes.<sup>30</sup> This 'colour revolution' reveals the ambivalence of colour, as simultaneously an enticing attraction and true to life. As visual culture in the nineteenth century became increasingly permeated by chemically produced colours, the boundaries between natural and artificial, verisimilitude and spectacle seemed particularly uncertain even as everyday life became brighter, more colourful and 'artificial' through consumer products and popular culture.<sup>31</sup>

Natural colour photography and film entered this complex field late in the nineteenth century, further confounding terms of nature and artifice, mechanical objectivity and perceptual subjectivity. Natural colour introduced a competing term in photography between hand-applied colours, monochrome tones, and what would become 'black-and-white' photography of the interwar period.<sup>32</sup> Natural colour photographs indeed made chemical-mechanical records of the world, but their photographic images were far less malleable by the hand of the artist in the dark room. Just as pictorialist

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<sup>29</sup> Michael Taussig, *What Color is the Sacred?* (University of Chicago Press, 2009), p. 26.

<sup>30</sup> Cubitt, p. 114. See also, John Gage, *Colour and Meaning: Art, Science, and Symbolism* (Thames & Hudson, 1999).

<sup>31</sup> Esther Leslie, *Synthetic Worlds: Nature, Art and the Chemical Industry* (Reaktion, 2005); *Bright Modernity: Color, Commerce, and Consumer Culture*, ed. by Regina Lee Blaszczyk and Uwe Spiekermann (Palgrave Macmillan, 2017); Regina Lee Blaszczyk, *The Color Revolution* (MIT Press, 2012); and Laura Anne Kalba, *Color in the Age of Impressionism: Commerce, Technology, and Art* (Pennsylvania State University Press, 2017).

<sup>32</sup> Kim Timby, 'The Colors of Black-and-White Photography', in *The Colors of Photography*, ed. by Gockel with Jirka and Jungmann, pp. 201–30, doi:[10.1515/9783110661484-008](https://doi.org/10.1515/9783110661484-008); Nathalie Boulouch, 'Couleur versus noir et blanc', *Études photographiques*, 16 (2005), pp. 140–51 (p. 140) <<http://journals.openedition.org/etudesphotographiques/726>> [accessed 17 July 2025]; and Sally Stein, 'Autochromes without Apologies: Henrich Kühn's Experiments with the Mechanical Palette', *History of Photography*, 18.2 (1994), pp. 129–33, doi:[10.1080/03087298.1994.10442338](https://doi.org/10.1080/03087298.1994.10442338).

photographers had established photography as a fine art, colour threatened to drive it back into the realm of mere technical feats of mechanical replication.

Autochromes were a form of colour transparency first patented by Auguste and Louis Lumière in 1903. They were the most widely used form of natural colour photography from its commercialization in 1907 until the 1930s.<sup>33</sup> Autochromes and similar 'screen'-plate processes were 'self-colouring', chemically recording and reproducing colour rather than hand-colouring or altering using tonal printing techniques.<sup>34</sup> The transparency greatly simplified Ives's colour separation process. Instead of three separate colour records, the glass plate was covered with a single layer of **aniline-dyed starch grains** in the three additive or light primaries: red, blue, and green. The finished transparency then required a strong light source from the back for illumination, otherwise the plate appeared to be entirely black.<sup>35</sup> Screen colour transparencies were initially met with enthusiasm and adopted by amateurs, professionals, as well as many artists. Colour photography was popular among camera clubs in Europe and the United States and no less central a figure than Alfred Stieglitz held multiple exhibitions with autochrome colour photographs at his 291 Gallery in New York in the years 1907 to 1910.<sup>36</sup> One of the most consistent criticisms of this form of natural colour photography, however, was that the process allowed the photographer little direct control over the resulting colours of the plate.<sup>37</sup> Unlike monochrome darkroom developing, there was no stage at which the photographer could intervene in developing the image to alter or correct the colours. One reviewer from the *British Journal of Photography* noted: 'When one thinks of the inexorable laws that govern the simple processes in the working of Autochromes, the idea of controlling them seems as impossible as the controlling of the colours of the rainbow.'<sup>38</sup> The autochrome was governed by the inflexible laws of the machine and its faithful commitment to external reality. But the colours reproduced on the plate were often considered too bright and therefore lurid, the fault of the

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<sup>33</sup> Eastman Kodak's Kodachrome colour-reversal film took over the commercial market. Significantly, Kodachrome had to be processed entirely by Kodak facilities and further distanced the photographer from the darkroom or the ability to alter the image in development.

<sup>34</sup> Similar screen-plate processes that used a glass transparency coated with light-sensitive dyes in microscopic mosaics or grids include Omnicolour, Paget plate, Thames plate, Agfa plate, Dufay, Finlay, Dioptrichrome, and many more.

<sup>35</sup> Caroline Fuchs, 'Anticipation and Reality: A Re-Evaluation of Autochrome Projection', *PhotoResearcher*, 19 (2013), pp. 32–42 (p. 33) <<http://www.eshph.org/journal/photoreseracher-no-192013/#more-68>> [accessed 17 July 2025]. According to Fuchs, autochrome plates only allowed 7.5 per cent of the incoming light to pass through.

<sup>36</sup> Between 1907 and 1909 Stieglitz exhibited autochromes at least five times at his gallery but by 1910 completely excluded them from the International Exhibition of Pictorial Photography at the Albright Gallery in Buffalo, New York (Stein, p. 132).

<sup>37</sup> Fuchs, pp. 35–37.

<sup>38</sup> F. C. Tilney, 'Review: The Studio Portfolio of Colour Autochromes', *Colour Photography Supplement, British Journal of Photography*, September 1908, unpaginated.

technology, but also of the poor taste of the photographer. Everyday life was too full of unharmonious colour combinations which needed to be carefully composed to be considered aesthetic or an art. Rather than exhibiting 'all the colours of the rainbow', a successful colour photograph had to demonstrate the 'colour sense' of the practitioner. To create an aesthetic of colour photography and to display acceptable colour sense photographers embraced pastels and subtle colour combinations while avoiding too vibrant or contrasting colour subjects.<sup>39</sup> The only way the photographer could truly completely 'control' the device and the unruly colours of the world, however, was to become a 'stage manager'. Eschewing disharmony of everyday colour combinations in the spontaneity of the snapshot, colour photography could only become an art through arrangement or staging: 'the picture has been prepared as one prepares a stage-picture; the Camera has merely been used to perpetuate it.'<sup>40</sup>

Portraiture was a key genre of staging widely practised by colour photographers but few as successful as Olive Edis. She opened her first studio in 1905 and began working with autochromes around 1912. Edis exhibited her colour work frequently from the 1910s until the 1930s, primarily in the Royal Photographic Society's annual exhibitions. Edis's portraits were noteworthy for her emphasis on the lifelike quality of the sitter, in natural subtle colouration and poses that she achieved through the exclusive use of natural light indoors. These portraits feature incredibly saturated yet subtly varied colour, tight framing of the sitter in half-length or three-quarter views that focus on the face and bust. Edis posed her subjects wearing sumptuous fabrics with a variety of textures against a dark background that accentuated the effects of light captured by the autochrome.<sup>41</sup> In this portrait of her sisters the pastel blues they wear are contrasted with the rose-coloured silk fabric draped over the green velvet (*Fig. 4*). Rather than emphasizing the colour technology through bold contrasts, Edis constructed a subtle play of colour and texture that demonstrated her sophisticated colour sense.

Unlike many autochrome photographers who made smaller scale colour images for lantern projection, Edis specialized in larger format images (full plate 18 × 30 cm or half plate approx. 9 × 12 cm) with dense surfaces that could not be projected. Stating 'I work for quality and reflexion', she almost exclusively displayed her colour images using reflected daylight. For this, she patented her own viewing device, generally termed

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<sup>39</sup> Stein, p. 131.

<sup>40</sup> [Dixon Scott], *Colour Photography and Other Recent Developments of the Art of the Camera*, ed. by Charles Holme (Offices of 'The Studio', 1908), p. 9.

<sup>41</sup> According to Edis, 'For colour photography, I like a simple gown of sumptuous material and colour', quoted in Marguerite Mooers Marshall, 'Why Women are Hard to Photograph', *Evening World* (New York), 1 November 1920, p. 33.



Fig. 4: Olive Edis, Katharine Legat (née Edis); Emmeline McKendrick (née Edis) (1910s), autochrome. National Portrait Gallery, London © National Portrait Gallery.

a diascope.<sup>42</sup> These and other similar devices formed one of the primary methods of displaying colour transparencies using daylight.<sup>43</sup>

**Diascopes** were somewhat like stereoscopes in that they created a mode of viewing removed from their surroundings and one in which the object-like photograph was experienced as a three-dimensional image. The diascope regulated the viewing experience in two important ways: first, by framing the image with a semi-enclosed viewing reservoir; second, by modulating the transfer of light. It also modified the viewing of a two-dimensional transparency into a three-dimensional, reflected image. For display in the diascope, the colour plate was inserted upside down and reversed into the top panel of the lid. When opened about sixty degrees on a hinge, daylight streamed

<sup>42</sup> Olive Edis, 'The Lure of Colour: A Review of the Pictorial Colour Transparencies and Prints', in 'The Year's Photography', *Photographic Journal*, 66 (October 1926), pp. 57–60 (p. 59); and Mary Olive Edis, 'Colour Photography — No. 17,132. Method of Viewing Autochrome Transparencies (Colour Photographs on Glass)', *British Journal of Photography*, 7 August 1914, p. 615.

<sup>43</sup> There were, however, a variety of display methods like simply holding the transparency up to light or mounting the transparency in a frame against the window or more complex lampshade and cabinet displays. See H. F. Perkins, 'Methods of Exhibiting Colour Transparencies', *British Journal of Photography*, 7 April 1916, pp. 13–15 (p. 13).



Fig. 5: Olive Edis, Diascope viewer and autochrome (c. 1910–30). Victoria and Albert Museum, London. Image by author.

through the diffusion sheet and through the back of the autochrome. The colour image then reflected onto the horizontal mirror forming the bottom panel. The angle of the image in the reflection prevented interference by the viewing observer in the image. Moreover, the use of the mirror gave the image a distinct three-dimensionality (Fig. 5). Edis described this as ‘an effect of stereoscopic brilliance which is difficult to explain’.<sup>44</sup> An article in the *Evening World* elaborated this effect:

Miss Edis’s colour photographs are almost uncannily lifelike [...]. The photograph is never transferred from the glass plate on which it is taken, but the plate is placed in a dainty leather case and so arranged that it can be hung in a window or set in front of a lighted lamp. Then, the light falling through, shows every tint of the subject’s hair, eyes and complexion.<sup>45</sup>

Instead of the pictorial space approaching the viewer, space *recedes* into the mirror image and into the diascope. In the case of portraits this display method enhanced the spatiality and even lifelike quality of the subject. Edis and other colour photographers explicitly framed their subjects for display in the diascope and to enhance the creation of illusionistic depth. The effect of this illuminated display and realistic quality of the colour portrait conflated light and colour with animation. In Edis’s description of working with colour photography, she advised walking around the subject to find ‘a point at which all

<sup>44</sup> Edis, ‘Lure of Colour’, p. 59.

<sup>45</sup> Marshall, p. 33.

the colours leap to life, and light touches with brilliance the most dead-alive subject'.<sup>46</sup> Subjects are 'dead-alive'; initially dead and waiting to be animated by the photographer's colour pulse. While photography in monochrome seemed to cast its subjects into purgatory — a likeness always tied to the past — illuminated colour portraits viewed in the diascope returned the photograph to the present and to the living.<sup>47</sup>

Only at the beginning of the nineteenth century does a screen come to mean a site for images, a meaning that stemmed from phantasmagoria and dioramas.<sup>48</sup> For most of its history, *screen* in English had more architectural connotations as a structural partition and facade, or environmental meanings as concealment, protection, or filtering.<sup>49</sup> What is emphasized by these definitions is that screens are not passive, static surfaces that receive dynamic images, but are themselves constitutive forces and help condition viewing.<sup>50</sup> Olive Edis's autochrome portraits exploited diascope viewing as a kind of screen that activated a dynamic relationship between the autochrome, the diascope image, and the observer. As Francesco Casetti notes, a screen marks the site of becoming, rather than a static ontology.<sup>51</sup> The portrait image viewed in a diascope was not just a photograph and not just in colour, but a likeness that became 'present' or enlivened. The diascope created the conditions of possibility for a screened image: in this case, a still photographic image enlivened by colour and light and rendered dimensional rather than flat as with projected images on a cinema screen. Within the diascope viewer, the photographic object as such was suppressed for its reflected, screened image — one that emerged illuminated in full colour and exceedingly lifelike.

## Conclusion

The disappearance of the qualifier 'natural' from colour photography and film was brought about by its standardization and ubiquity in subsequent technical devices, the

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<sup>46</sup> Edis, 'Lure of Colour', p. 60.

<sup>47</sup> Roland Barthes, *Camera Lucida: Reflections on Photography*, trans. by Richard Howard (Hill and Wang, 1981), p. 77. With the phrase 'that-has-been', Barthes characterizes the two temporalities of a photograph, what has been in front of the camera is present (in the photographic image) and simultaneously absent (not actually there).

<sup>48</sup> John Plunkett, 'Transparencies, Optical Recreations, and the Invention of the Screen', in *Visual Delights – Two: Exhibition and Reception*, ed. by Vanessa Toulmin and Simon Popple (Indiana University Press, 2005), pp. 175–93 (p. 175).

<sup>49</sup> Craig Buckley, Rüdiger Campe, and Francesco Casetti, 'Introduction', in *Screen Genealogies: From Optical Device to Environmental Medium*, ed. by Buckley, Campe, and Casetti (Amsterdam University Press, 2019), pp. 7–26 (p. 8), doi:[10.5117/9789463729000](https://doi.org/10.5117/9789463729000).

<sup>50</sup> Christian Metz, *The Imaginary Signifier: Psychoanalysis and the Cinema*, trans. by Celia Britton and others (Indiana University Press, 1982); and Kaja Silverman, *The Threshold of the Visible World* (Routledge, 1996), pp. 195–96. *Screen* is an essential concept for media theory, and has been theorized extensively by Christian Metz, Kaja Silverman, and others through Lacanian psychoanalysis. For these theorists too, the screen is not simply an image surface but plays a constitutive role through which the subject is apprehended.

<sup>51</sup> Francesco Casetti, 'Primal Screens', in *Screen Genealogies*, ed. by Buckley, Campe, and Casetti, pp. 27–50 (pp. 29–30).

industries of colour reproduction, and their operations by the mid-twentieth century.<sup>52</sup> This subsequent epistemological paradigm seemingly resolved the contingency and ambiguities of colour as an effect of the body and its environment. Colour became more situated as a practical physical element and — more recently — as a digital, numerical one. It became certain and fixed as well as distanced from the modern subject. Colour has consequently largely receded from everyday attention only to re-emerge in privileged contexts, like that of Eliasson's *Room for one colour* which magnifies the subjective quality of colour seen in so many earlier natural colour technologies.

Natural colour technologies return us to a period of indeterminacy, when colour was as subjective as objective, as experiential as representational, and when its viewing circumstances elicited the perceptual responsiveness of the viewer. Natural colour emerged within a complex realignment of the sensorium in modernity from the nineteenth and early twentieth centuries. Yet just as much as photographic realism, natural colour technologies drew upon a wider range of scientific discourses, popular visual culture, and attractions to create new relationships of representation and viewing. Contemporary digital photographs and immersive installations occlude the in-between quality of colour by overemphasizing its mechanical and digital standardization, and its bodily immediacy, respectively. Early twentieth-century natural colour technology, on the other hand, recognized the inherently unstable and intermediary nature of colour as neither wholly subjective nor objective.

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<sup>52</sup> Cubitt, pp. 138–51. These standardizations of colour span from cathode ray tube televisions to LED screens, pixels, and projectors, as well as digital colour spaces and CMYK printing.

**Competing Interests**

The author has no competing interests to declare.

