BRIGHT SIGNALS

A HISTORY *of* COLOR TELEVISION

SUSAN MURRAY

B R I G H T S I G N A L S

SIGN | STORAGE | TRANSMISSION

A series edited by Jonathan Sterne and Lisa Gitelman

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A HISTORY *of* COLOR TELEVISION

SUSAN MURRAY

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FOR MUNRO & QUINN

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FIGURE I.1 Image from a 1954 Inco Nickel TV Shadow Mask ad.

Introduction

> The prevailing U.S. apathy to tinted TV was echoed last week by an idle viewer at Rich's department store in Atlanta. "I know the grass is green at Ebbets Field," he said. "It isn't worth $400 more to find out *how* green."
>
> —*Time*, 1956

Color television was a hard sell. Although the public, regulators, and industry insiders were impressed by the relatively crude images they saw at even the very first demonstrations of the technology in the late 1920s, and while color was generally thought to be the inevitable technological addition that would ultimately complete the sensory experience of television, it was deemed impractical from the start. At times, color television was considered too expensive, technologically cumbersome, and challenging to stabilize and manage; it required too much bandwidth and would set a higher bar for "true fidelity." As a result of this demanding complexity, the technology for color television existed for over twenty years primarily either as a novelty or as a challenge to what the industry came to quickly accept as the speediest route to standardization and commercialization—black and white television. Even after the color standard was adopted by the Federal Communications Commission (FCC) in 1953, it would be more than a decade before color television became widely available in the United States. Consequently, the historical narrative of color television is full of false starts, failure, negotiation, and contention. Yet it is also a narrative that reveals the

complex interconnections between the development of color television and the study of subjectivity and perception, the presumed role of video aesthetics, the psychological power of color use, the play between the spectacular and the real, the assumptions that structure the production and reception of specific genres, and the power of television's narrational and commercial agency, especially when compared to film and photography. The unique qualities of color television are both historically located in the larger context of nineteenth- and twentieth-century color media and tied to the specific discourses framing the capacities and affordances of television as a seeing device.

Surprisingly, there has been little scholarly attention paid to this fertile history. While there have been countless books and articles written about postwar U.S. television, few mention color as more than an aside, a footnote, or a singular moment in the history of broadcast regulation. These histories have ignored the many ways in which the quest for and production of color became central to the operations, finances, branding, and marketing of RCA (which owned NBC) and CBS at different moments in their maturation. Or how color was widely considered the ultimate victory in innovation for the industry and a defining factor in the modernization of the look of television and its relationship to other forms of visual media post-1960. Moreover, unlike in some recent color film scholarship, television scholars have not yet read industrial discourses around, and studies of, electronic color in relation to broader philosophical and cultural conversations about the nature of color. And even though the study of color in design and media has become a key area of research as of late in other fields, surprisingly this interest, with a few exceptions, has not extended to research on television color specifically. In the last five years or so, a number of notable books have been published on the topic of film and color (primarily in the United States and United Kingdom) that have explored production techniques, color management, technical and artistic processes and practices, and the meanings generated by color use.[1] Additional works on color and consumerism, design, and digital color released in recent years have also altered our understanding of color use and production.[2] For these authors, color represents a fresh vantage point through which to reconsider well-trodden histories, analyses, and approaches to various forms of media and consumer culture. Color also invites meditations on sub-

jectivity and perception, which opens up new pathways for discussions of aesthetics and spectatorship.

The explanation for the oversight of color in the study of television likely involves the placement of the battle for FCC approval as the sole focus of all color television history, as well as the reluctance of many contemporary U.S. television studies scholars to engage with questions of technology, vision, and aesthetics. Television is most commonly thought about in terms of the cultural narratives and ideologies it creates and engages with, rather than as a highly complex technology of visual culture. Consequently, thinking through how technology and the processes of development and regulation shape the look of the television image is not something that has been considered until recently.

In the past, technical histories of television have primarily been left to the engineers, most notably George Shiers, Raymond Fielding, and Albert Abramson, who have written books and articles in technical journals, and Ed Reitan, who slavishly chronicled the history of color television technology and production in mostly nonnarrative form on his website before his death in 2015.[3] These technical histories are highly detailed chronicles of the processes and results of innovation in television; however, they often lack the cultural, industrial, and/or political context needed to provide a more complete picture of the various forces at work in the formulation of the idea and material object of television. This marginalization of the technical in relation to the rest of television studies scholarship has been showing signs of change in the last few years, in large part due to the growing influence of media archeology and the history of science and technology on the methods and focus of media historiography. A handful of scholars have even recently begun to engage with color television history specifically.[4] For example, Andreas Fickers has chronicled the history of color television standards in Europe, while Jonathan Sterne and Dylan Mulvin have written two articles that explore rich and intricate "perceptual histories" of the American standards period.[5]

While my analysis of the FCC color standards helps frame this book, my overall focus is more expansive. The question of color and the nature of its attendant affordances, conventions, limitations, and complications were unremitting and influenced not only the priorities and direction of the television industry but also the way that viewers understood them-

selves in relation to that industry and its technology. In conceptualizing the project, my aim was to locate the core period from the moment of the technology's invention to the time in which it was no longer considered novel in U.S. broadcasting. What I discovered through archival research was an extended and rigorous discussion, over more than forty years, about electronic color, occurring across commercial, regulatory, consumer, and scientific communities, that not only was one of the primary forces determining television's future but also configured the broader understanding and use of a distinctly modern form of vision.

One of the primary lines of argument threaded through all the chapters of this book is that color television, distinct from both monochrome television and other forms of color media, was imagined and sold as a new way of seeing. Color not only represented a new aesthetic for television (largely determined by FCC standards for color technology and the color management and production techniques established by networks) but also promised a peculiar viewing experience for audiences. Even though color television was not broadcast in 3D or even high-definition during the years before 1970, there was a consistent assertion made about its dimensionality and the way that it invited viewers to completely immerse themselves in the image, which is similar to the way that IMAX or 3D technologies are discussed today. Fabric textures were said to pop, the reflection on bodies of water shimmered, and dancers and their costumes revealed a new level of subtlety and expressiveness in movement—the viewer felt transported, her senses stimulated on a multitude of levels. The sense of immersion arose from the way that the electronic color images were said to overwhelm the senses, refine and enhance vision, and expand horizons. Jack Gould, television critic for the *New York Times*, made this very argument in a 1964 review of two color documentaries, stating, "The addition of color imparted a vibrancy and dimension to the superb photography that left no doubt there is virtually a new medium of TV at hand. The delicacy of the shading and greater pictorial depth stemming from the contrast offered by various hues were integral parts of a more exciting process of communication." He added that in the documentary on Rome he was reviewing, "one could almost feel the texture of the historic streets and buildings."[6] The 1952 manual for the CBS Remington Rand Vericolor TV camera chain asserted this idea even more vigorously:

> Much of the significance of color in television is striking, even to the casual observer. Aside from the most obvious effect, namely, that color introduces a sense of reality and a lifelike quality into the picture, comparison of a color television picture with the corresponding black-and-white image makes it apparent that not only are small objects more perceptible, but outlines in general seem to be more clearly defined. . . . Color television also seems to introduce a certain perception of depth. This is due, in part, to the increased ability of color to reproduce the contrasts and shadows as well as highlights and reflections in different hues, while the degree of color saturation, which is a function of distance, strongly enhances the three dimensional quality.[7]

Color television's promise of an immersive and intimate level of visual proximity fostered its development in a field outside of entertainment too: medical education. Largely promoted in the late 1940s and early 1950s by investor Smith, Kline and French (SKF), a Philadelphia-based pharmaceutical company, along with I. S. Ravdin, chief of surgery at University of Pennsylvania Hospital, and Peter Goldmark, head of CBS Laboratories, color television technology modified for medical use was adopted by teaching hospitals across the nation and was demonstrated regularly at medical conventions.[8] Praised for offering the ability to virtually transport viewers to an ideal viewing position of a live surgery or other medical event, for being able to transmit live and large-scale microscopic images from one location to another for diagnostic purposes, and for enabling medical practitioners to see what they otherwise could not on a microscopic image through the manipulation of color and light, color television promised to improve upon medical vision and the traditional surgical amphitheater experience. Although there were attempts to use monochrome television for medical purposes, the technology proved insufficient. Dr. Ravdin argued that one of the unique properties of color television that made it so ideal for medical use was "a sense of depth which is necessary for the adequate teaching of surgery," noting that with color television, "the deep recesses of body cavities which ordinarily are difficult to discern can now be readily observed because of the various color gradations."[9]

Coupled with the claims about its distinctive form of vision, color television was said to have a unique psychological and emotional hold

over viewers that made them more attentive, engaged, and open to the images and claims made before them. These beliefs about the power of color television were, of course, sold to advertisers and audiences by the networks and manufacturers in an effort to get them on board with the color project. Yet they also informed what genres and production techniques would be used to illuminate the purported unique qualities of the technology. Color television was positioned as the ideal form of modern American consumer vision, a discursive construct that by the 1960s had begun to intersect with Cold War rhetoric regarding surveillance and truth-telling devices and technologies. At that point, color television came to also represent American scientific prowess and the ability to withstand seeing and being seen via a technology of revelation and veracity.

The other argument underpinning this book is that color, as a concept and a phenomenon, came with a significant amount of cultural and industrial complexity and baggage and therefore brought with it tension, instability, and anxiety as it shaped the discussion about what television was ultimately supposed to do and be. In placing electronic color in relation to the aims and ideologies of American consumer culture and alongside the history of color theory and of other forms of color media (film and photography), we see how both the subjectivity and the volatility of color in general informed the way that color television was produced and received. We also come to understand how the processes and practices around electronic color and its management were simultaneously extensions of and distinct from those developed for other forms of color media.

These arguments give shape and direction to this book, which is organized chronologically, starting at the moment of invention (1928) and ending at the point at which the U.S. networks completed their conversion to color and a significant portion of the audience owned color sets (1970). This bracketing allows me to explore color television technology as a point of difference in the production and experience of television and to investigate the various ways color was, over time, integrated into the system of production and process of reception through cultural, industrial, regulatory, commercial, technological, and aesthetic negotiation. Each chapter is organized around a particular issue or stage—for example, innovation, standardization, calibration, conversion, and global expansion—that defined the industry's relationship to color at a specific

moment. The first half of the book focuses more overtly on the technology of color television, while the second half brings that history and conceptual framing to bear on moments in more traditional cultural and industrial histories.

Chapter 1 examines the early experimentation in and demonstration of color television technology, focusing primarily on the mechanical systems of John Logie Baird in the United Kingdom and Herbert E. Ives at Bell Labs in the United States. In this chapter, I am decidedly not interested in any sort of "inventor as hero" narrative or making claims about who should be considered the *true* inventor or patent holder of color television. Instead, I investigate the ways the technology was conceived of in terms of its relation to vision and veracity, as well as to other image-based mediums, while also considering the specifics of the demonstrations of this new technology and how they were described and received. Because this was a period in which the various possible applications for the technology were being imagined and debated, it is a rich moment to explore in terms of what were considered to be the unique qualities of electronic color and how it was expected to alter communication, pleasure, knowledge, and access to cultural and educational experiences. I end with a brief discussion of Baird's part-electronic high-definition and stereoscopic color systems (demonstrated in the late 1930s and early 1940s) and CBS's 1940–1941 demonstrations and public relations push for Goldmark's mostly electronic field-sequential system. With these demonstrations, which were primarily to the press, retailers, and regulators, CBS was attempting to disrupt the National Television Systems Committee (NTSC)—a group formed by the Federal Communications Commission to study systems and recommend standards—and the FCC process that appeared at that time to be leading toward a 525–scan line black and white standard, which the network and others felt was too limiting for future technological advancements, such as the broadcasting of color, which, as CBS argued, required a larger bandwidth. The protracted process of setting a separate color standard for U.S. television almost a decade after the black and white standard was established is a discussion that is saved for the following chapter.

My objective in chapter 2 is to place the process of color television standardization within a larger history of color theory, measurement, and management across various disciplines and industries. In framing the chapter this way, my intention is to intervene in the typical television

history narrative of the "color wars" between RCA/NBC and CBS, wherein standards are primarily a result of the moves and machinations of various governmental and broadcast industry players. This approach to the history creates the impression that the debates and discussion and ultimate outcome of this process (from 1948 to 1953) occurred in isolation and without the influence of complicated scientific, organizational, and historical precedents and entanglements. Like a number of recent books on the histories of color film, I begin the chapter outlining the philosophical and theoretical engagements with the question of color and subjectivity and then go on to explore the nineteenth-century development of color measurement systems (by scientists, artists, and philologists) that relied on studies of the nature of human vision and empirical research into the makeup of and interaction between colors. However, I then track how these systems of colorimetry made possible the standardization of color in industry and governmental institutions in the twentieth century and the role that those institutions and systems of measurement had in the formation of standards for film and then, eventually, television. The chapter concludes with an extended discussion of the approval process of the FCC and the work of the NTSC panels, detailing their psychophysical and technical tests of various color systems and the theories and cultural assumptions about color, television, and perception that structure them.

Even after the NTSC color system became the standard in 1953 and commercial broadcasting had been approved, color television remained technologically unstable and required much refinement and management at the levels of production, transmission, and reception. The first half of the decade, therefore, primarily served as an experimental and promotional period. In chapter 3, I analyze the discourses that framed the responses of critics, advertisers, network executives, and the public to the arrival of color to television in the context of both the specific value of and concerns over electronic color and the larger cultural anxieties around the potentialities and failures of color. I trace the development of color training for ad agencies, sponsors, and network employees, along with systems of calibration and color adjustment at the points of production and reception. The chapter wraps up with an examination of the earliest color programs and NBC's strategy behind its "introductory year" of color programming in 1954.

Chapter 4 moves beyond NBC's first year of color broadcasts and ex-

amines the use of color and video technology as a central component of modern design on network specials during the mid-1950s. However, before I get to the topic of network programming in this chapter, I first recount RCA/NBC's investment in local station conversion, their road-showing of color television across the nation, NBC's branding in relation to symbols of color, the building of color studios, the placement of color sets in public places, and the network's initial attempts at studying and then selling the "quality" color audience to advertisers. In covering this ground, we witness the processes of both conversion and expansion, and also the way that color had to be marketed and promoted through specific means and referring to specific rhetorical tropes and visual symbols. At a time in which color set ownership was still limited to relatively well-off early adopters, executives had to devise strategies for consumers to envision color television, whether through network identifications that announced color programs as they came on their black and white sets or through local promotional events that not only provided opportunities for people to view color television but in some instances lit up buildings and the sky in RGB color as the company worked to place electronic color into the public imagination. This was also a time in which both specific emotional and perceptual engagements with color were analyzed and then used to promote color viewing. Color use in television was said to engender a more intensive psychological and visual attentiveness in relation to the image, and that belief framed the assumed relationship between a viewer/consumer and color commercials and color programming. It also buttressed the idea that color viewing as an experience is more immersive, expansive, and both more realistic and more sensational than viewing monochrome.

I continue to delineate color media's relationship to the indexical and fantastical in chapter 5 by examining the use of color in, and marketing of, certain genres in the early to mid-1960s that were considered to be better at highlighting the features of color television viewing than others. Specifically, I spend the majority of the chapter discussing color cultural documentaries. Documentaries of this period are typically thought of as sober, highly political black and white endeavors intended as a cultural corrective to late-1950s network scandals and FCC chair Newton Minow's 1961 "vast wasteland" speech to the National Association of Broadcasters (NAB). Yet color cultural documentaries, which combined educational imperatives with visual exploration and entertainment,

were also popular at this time and were considered to be an excellent form through which to sell the need for and attributes of color on television. These documentaries tended to focus on art, travel and tourism, and nature, and promised to transport or immerse viewers in another world—one that could only be fully experienced through color. Whether the topic was diving deep with Jacques Cousteau, traveling through Rome with Sophia Loren, or receiving a guided tour of the Louvre, these colorcasts encouraged viewers to linger on the spectacular and realistic image before them in order to increase their sense of "being there" and temporarily submerge themselves in another world.

This purported ability of color television to expose the spectacular "real" or "natural" as it extends human sight continues to be explored in chapter 6, but is placed in the context of color television's 1960s global expansion through international displays, satellite technology, the adoption of color systems by other nations, and eventually, the inclusion of a color TV system on Apollo missions to the moon. In this chapter, I also look at the way color television's heightened relationship to veracity was picked up by and fused with forms of Cold War rhetoric that worked to claim color television as a potential tool of surveillance and detection.

I end the book by looking ahead from the 1960s to the normalization and full dissemination of analog color television and point toward the questions that need to be raised in terms of contemporary screen color in an effort to link them up to the history explored here.

The governing idea of this book is that color television was an incredibly complex technology of visual culture that disrupted and reframed the very idea of television while also revealing deep tensions and aspirations about technology's relationship to and perspective on the "natural" world and, relatedly, our potential to extend human sight and experience. As the following pages will demonstrate, color television was considered both an assumed next step in the advancement of the technological extension and replication of human sight as well as a radical departure from the norms, procedures, and priorities set by the black and white standard.

CHAPTER ONE

"And Now—Color"

Early Color Systems

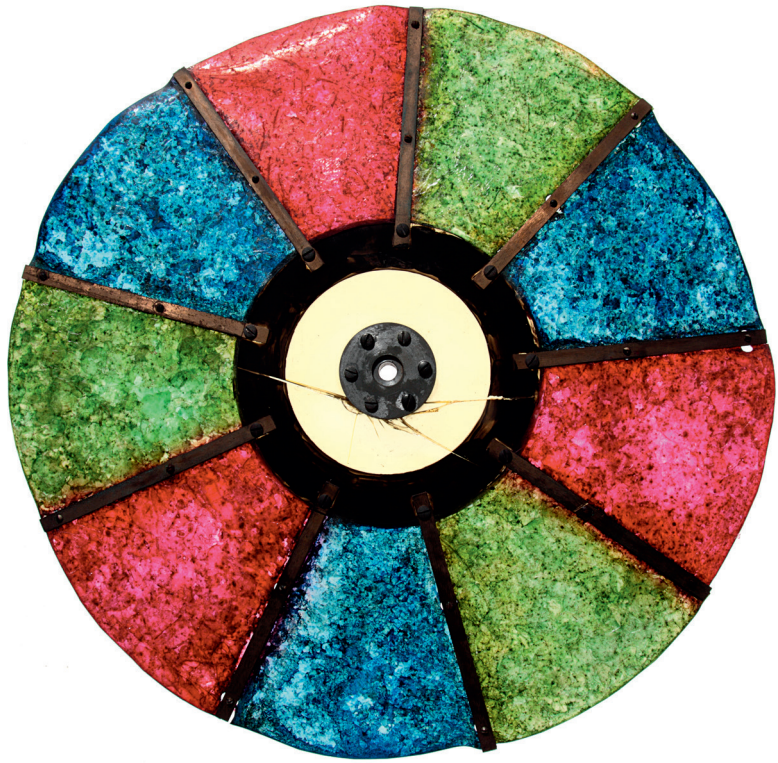

FIGURE 1.1 A color wheel from a 1946 GE 950.
COURTESY OF THE PICTURE LIBRARY, NATIONAL MUSEUMS SCOTLAND.

As others have long argued, television is distinguished from other visual media, especially film, by its claims to *liveness*, *immediacy*, and *extension of vision*. The notion of "seeing at a distance"—seeing through walls, through space and time, witnessing things as they happen *elsewhere*—has been the primary promise of television since the late nineteenth century and is the frame through which early research into television is discussed. The notion of television entered the public imaginary as a possible, or even probable, form of seeing device that would add pictures to the already existing sound-based communication media of the telegraph and telephone, often retaining the point-to-point function of those parent media. Conceptualizations of technologies similar to what would come to be known as television were often represented as an improvement on or completion of the sensory experience of the telephone (in the form of what came to be called two-way television), enabling geographically distant individuals to share time and space in a state of simultaneous virtual presence. Television imagined in this manner would provide a complete replication (through sound and image) of another place or person to be experienced by a viewer. In fact, in drawings and descriptions of early models of technologies prefiguring television, it is as though the person before the camera is being transported, appearing before the viewer not within the confines of a receiving set, but existing in real space as a kind of apparition (see figure 1.2).

Even though "natural" color processes (as opposed to tinting or hand coloring) were not yet available in color photography or motion pictures, it was assumed color would eventually be a feature of a device such as television, since it would surely be essential for the realistic experience of virtual presence. While there had been conceptual proposals for color television systems as early as 1880, the first patent application describing a rudimentary system, which included the use of color filters, tubes, selenium cells, and a mirror drum, was put forth in 1902 by Otto von Bronk for Telefunken in Germany.[1] Six years later, Armenian engineer Hovannes Adamian patented his own mechanical system in Germany, Britain, and France, and then in Russia in 1910. In 1925, Vladimir Zworykin filed a patent for a television system that included a color screen; Adamian demonstrated a three-color system (an advancement on his earlier two-color model) in the United States; and Harold McCreary, an engineer for Associated Electric Laboratories in Chicago, used cathode ray tubes to design a system of simultaneous color transmission, which

FIGURE 1.2 "The reproducing apparatus at work." From "The Teleectroscope: Herr Szczepanik's Wonderful Invention Explained," *Los Angeles Times*, April 3, 1898, 3.

meant that it would transmit three colors—red, blue, and green—at the same time. Yet a working color system that was able to reproduce images with a decent level of fidelity was proving to be far more difficult to develop than a black and white system, so the race to be first in television was one that focused primarily on monochrome.

As do many discussions about the process of invention, histories of television technologies often become bogged down in descriptions of "firsts." These histories can be helpful in the construction of chronologies and in tracing the complicated path of innovation; however, they also bear the marks of what Wiebe E. Bijker refers to as "implicit assumptions of linear development" of the technology over time.[2] This type of narrative can also obscure the labor of particular individuals and the economic, political, and social structures that enable one inventor or lab to come out on top in the race to claim ownership over a particular technology. The early history of color television has been traditionally framed as such a history, and various nations have laid claim to being the site of the invention of color television, including Scotland (inventor John Logie Baird) and Mexico (inventor Guillermo González Camarena). In truth, there is in this history no singular narrative resulting in an

ultimate moment of innovation. We can best understand the history of color television as an invention that came about through research into a number of various technologies, including monochrome television, color photography, telephony, radio, and telephotography (the transmission of still images via telephone wire).

During the mid-1920s, inventors such as John Logie Baird, Charles Francis Jenkins, Ernst Alexanderson, Herbert E. Ives, Ulises Armand Sanabria, Vladimir Zworykin, and Philo T. Farnsworth were experimenting with, demonstrating, and filing patents related to television. Their systems and devices were first conceptualized and then realized as both monochrome and mechanical (meaning they operated through moving parts rather than cathode ray tubes), although two of those individuals, Baird and Ives, demonstrated *color* systems at decade's close. In a 1954 presentation, Elmer Engstrom, head of research at RCA labs, claimed that "it has always been the objective of those engaged in television research to achieve television in color. . . . Color was considered as a natural step to follow black-and-white television."[3] Putting it another way, Frank Stanton, who served as president of CBS from 1946 until 1971 and was an early champion of color television, asserted in 1946 that "any discussion of television's future must be based on one incontrovertible and well-documented fact: that, at best, black and white television on the lower frequencies can constitute a temporary service."[4] This is certainly how color television is described in retrospect: an inevitable and predetermined move toward the perfection of the technology. This familiar refrain is both a result of the narrative of linear progress that underscores so much of technological innovation and a discourse specific to television that has to do with veracity and vision.

The framing of "seeing at a distance" through television acts as an analogy as well as indicating television's role as a kind of prosthesis. Those working on early models of television would describe the apparatus both in relationship to how it engages with the human eye (persistence of vision, for example) and how it mimics the eye's basic functions, including color reception. Doron Galili's research reveals that this relationship between the electronic eye and the human eye was assumed from the very earliest moments in which television entered into the "technological imaginary."[5] These nineteenth-century conceptual models for a technology that would later become television represented a unique form of electrical sight. Early experiments with selenium cells, a photoconductive

chemical element that was a component of a number of early proposals for television, were especially resonant with the idea of a technological replication of the eye, as the way in which the cells responded to light and color closely aligned with contemporary beliefs about how the retina functioned. As Galili notes, this metaphorical connection was also a consequence of the way that synapses and neural pathways were already being conflated with the functions of electricity in the 1860s and '70s.[6]

An experiment by Baird—a Scottish engineer and inventor who early in his career worked on prototypes of thermal socks, rustless razors, and pneumatic shoes but who would be written into history as one of the primary inventor-founders of television (both color and monochrome)—provides an example of television as prosthetic eye that takes the analogy a step further. Working with an actual human eyeball acquired through somewhat questionable means from the chief surgeon at Charing Cross Ophthalmic Hospital, Baird later told the *New York Times* that the "eye of a London boy helped him to see across the Atlantic," as the organ was part of an experimental machine for testing television's "long-distance vision." He went on to describe his acquisition and use of the eye in detail:

> I had persuaded a surgeon to give me a human eye which he had just removed, in order that I might try by artifice to rival nature. . . . As soon as I was given the eye I hurried in a taxicab to the laboratory. Within a few minutes I had the eye in the machine. Then I turned on the current and the waves carrying television were broadcast from my aerial. The essential image for television passed through the eye within half an hour of the operation. On the following day the sensitiveness of its visual nerve was gone. The eye was dead, but it had enabled me to prove an important theory on which I had been working on for some time. I had been dissatisfied with the old-fashioned optical dodge of a selenium cell and lens, and felt that television demanded something more refined. The most sensitive optical substance known is the nerve of the eye, called the visual purple. It was essential to get some of this visual purple in the natural setting of the human eyeball in order to use it as a standard of perfection in completing the visual parts of my apparatus.[7]

Despite the probability, as many have claimed, that the "visual purple" (rhodopsin, a light-sensitive receptor protein) of the boy's eye may

not have actually revealed much of anything about Baird's "Televisor," the story is a fascinating example of the way that the contemporary understanding of the human eye was built into television's very technology. Baird's tale is vivid and gruesome, but it also leaves the reader with the image of technology's ability to beat out, to extend the life of, to replicate indefinitely the fragile and ultimately mortal human sensory system. That poor eye of the London boy of Baird's retelling gave up its last bit of life for the larger project of seeing at a distance. However it's not just the way that the eye functions that helps model television, but also how its seeing is a complicated and subjective process. As Anne-Katrin Weber argues, television's reliance on persistence of vision and other forms of "trickery" of the eye, such as enabling the eye to construct a cohesive image from a collection of dots or lines, "highlighted the difficulty of conceiving vision as unmediated or direct, as an 'exterior image of the true or the right,' and revealed the subjectivity of seeing, produced not outside but within the perceiving subject."[8]

While the transmission and reception of black and white moving images was certainly a remarkable achievement, it did fall short of the ideal of replicating what one experiences in the process of seeing. Seeing in "natural color" at a distance in stereoscopic or 3D—advancements that were already in development at the time of Baird's experiment—was considered the closest one could come to replicating the human experience of seeing the world, and therefore was held up as an ideal for television.[9] However, as mentioned briefly in the introduction, even if color was considered to be an essential component of the ultimate end state of television, it was also considered expensive and troublesome. It took up far more bandwidth than monochrome; the technology and lighting required were often cumbersome; there was more potential for problems with the image (flicker rate issues, instability, etc.); and the bar for "true fidelity" (especially when it came to the representation of human flesh) was set significantly higher for color, which meant that the technology had to be at a more advanced state of development to even be considered acceptable by viewers, consumers, and regulators. Consequently, the period of the late 1920s was primarily a time of experimentation with color systems that had little hope of becoming the industry standard and going on the market. In a 1930 paper in the *Journal of the Optical Society of America,* Herbert E. Ives, the head of Bell Labs' special research department (which focused on facsimile and television research), and A. L.

Johnsrud acknowledged the expensive, complex, and often difficult nature of color television compared to monochrome, predicting that these features would mean that the technology would have to "wait much longer for its practical application."[10] They would be proven correct on this point, as the color television project would largely be abandoned for the majority of the 1930s.

In the rest of this chapter, I will briefly detail the little known period of early experimentation with and demonstration of mechanical television in the late 1920s and the work done by CBS's Peter Goldmark in the late 1930s on his mechanical field-sequential color system, which was largely considered a significant advancement on that of Baird's and Bell Labs' apparatuses. I will spend some time discussing the details of the early color demonstrations, how they were described and understood, and whether or not they were deemed capable of highlighting the features of electronic color imaging. Although there were breaks and gaps in this period of innovation, the scientific, industrial, and cultural position of color television during these early years would help shape the reception of the technology as it began to further penetrate the popular imagination in the 1940s and become a viable and standardized consumer good in the 1950s.

"PAINTING TELEPICTURES": EARLY EXPERIMENTS AND DEMONSTRATIONS

The individual credited with being the first to *display* a successful color system was Baird, who held a demonstration in London on July 3, 1928.[11] His 120-line mechanical system employed a rapidly rotating Nipkow disc with three sets of holes cut into spiral patterns that were covered with red, green, and blue filters. When the disc spun, the images were scanned with alternating lines of the three colors—an interlacing scanning system that helped cut down on flicker (a detectable fading on the screen that occurs between scanning cycles). The receiver then picked up the scanned red, green, and blue images one color at a time and projected them onto a very small screen where the colors were blended. After a demonstration of what was then called daytime television (a monochrome screen that could be viewed not only in a dark room but also in natural or bright light) on the roof of Baird's Long Acre lab, Baird led his guests—mostly reporters and scientists—downstairs, where he had set

up a room for the color system. What happened next was meticulously described by the *Manchester Guardian*:

> The receiver in this case gave a somewhat smaller image, about half as large again as an average cigarette card but the detail was perfect. When the sitter opened his mouth his teeth were clearly visible; so were his eyelids and the whites of his eyes and other small details about his face. . . . He picked up a deep red colored cloth and wound it round his head, winked, and put out his tongue. The red of the cloth stood out vividly against the pink of his face, while his tongue showed as a lighter pink. He changed the red cloth for a blue one and then, dropping that, put on a policeman's helmet, the badge in the center standing out clearly against the dark blue background. The color television proved so attractive that the sitter was kept for a long time doing various things at the request of the spectators. A cigarette showed up white with a pink spot on the end when it was lit. The fingernails on a hand held out were just visible and the glitter of a ring showed on one of the fingers.[12]

Baird had begun working on his color television not long after he had successfully developed a black and white system, an experience he touted as "seeing by wireless."[13] He also simultaneously worked on a number of variations and improvements on television between 1926 and 1929, including Phonovision (recorded television signals on a gramophone record), long-distance television, stereoscopic television (an early version of 3D), and "noctovision" (infrared television). Although he would not work to refine color television to any serious degree until the late 1930s and early 1940s, when he combined it with stereoscopic television, Baird's multiple demonstrations of color television in this brief period of his initial interest in color impressed government officials and members of the press. An article published in the *Journal of the Royal Society of Arts* reported on Baird's successful demonstration of color to the British Association meeting in Glasgow in 1928:

> The images transmitted, consisting as they did of only fifteen elemental strips [scanning lines], showed a surprising amount of detail: in the human face, the whites of the eyes, the colour of a protruded tongue, and the teeth were clearly reproduced. Mixtures of strawberries, raspberries and leaves were recognisable: not only the colour

> but the tones and shades of irises, poppies and marguerites [daisies] could be seen. The chief difficulty occurs, of course, with whites, in which the relative strengths of red, green and blue have to be carefully balanced: fortunately, the visual accommodation is large, however, and it is remarkable to what extent light may differ from white and yet appear but slightly tinted.[14]

For such a small image with so few scan lines, the amount of detail is certainly notable, as is the reported legibility of the color. Baird was displaying what would be understood as the most "natural" of the vivid colors through flowers, fruits, and faces, and he focused especially on variations of red (one of the most challenging colors to reproduce) through the tongue, red cloth, poppies, strawberries, and raspberries. We will see this develop as a common feature and collection of objects in early color demonstrations.

The following summer (1929), mechanical color was demonstrated in the United States at AT&T Bell Labs with a system that used filters and discs like Baird's but that also contained two distinct features: a bank of photocells at the receiving end that picked up the color signals (and was said to catch the depths and subtleties of the red hues even better than Baird's)[15] as well as a set of mirrors that worked to mix the colors and display the image on the screen (see figures 1.3–1.5). In his description of the "beam scanning" method employed in the Bell color system, Ives, whose research into photoelectronic cells led to his groundbreaking work on the transmission and reception of television signals, linked his research on color television to previous achievements in telephony and in the science of color photography.[16] Since his youth, Ives had been involved in the development of color photography, initially through his father, Frederic E. Ives, who was a pioneer in the field, having developed Kromskop, the first commercially available color photography system in England and the United States, in the late 1880s. In reporting on H. E. Ives's work, *Science* claimed that this "new method of color television is essentially a combination of these two achievements of father and son."[17] The younger Ives had also worked on an early color facsimile prototype, which successfully transmitted a color image using color separations in 1924. While recognizing that "principles used in three-color photography" formed the basis of his understanding of how *additive* color (color created by mixing primary colors of light) functioned and that there had

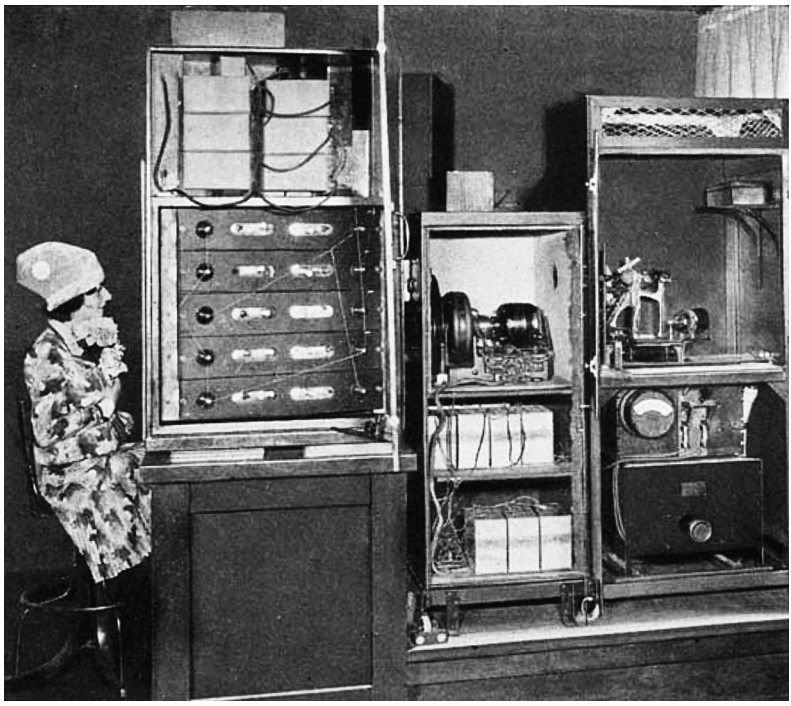

FIGURE 1.3 Bell Labs color television system, 1929. From "Two-way Television and a Pictorial Account of Its Background," developed by Bell Telephone Laboratories (with AT&T), April 1930, 18.

always been an assumed parallel between color photography and color television, Ives's particular method did not have any "close counterpart" in color photography and could not be replicated in that medium.[18] In other words, color television was conceptually related to—and perhaps indebted to—color photography, but television's need for high-speed colored light sources "capable of following the variation of the television signal current" made its demands and processes unique.

Calling television in color (inaccurately) "an American achievement," the *Western Electric News* described Ives's June 1929 demonstration as:

> a score or more of New York newspaper men, gathered recently in the Bell Laboratories, walked past a piece of apparatus enclosed in a heavy curtain and, one by one, peered into an aperture that resem-