Visions of Electric Media

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3. Human-Seeing Machines
From Annihilating Space to Mediated Vision

Abstract
Chapter Three investigates the emergence of systems thinking in the historical development of television around the turn of the 20th century. This chapter elucidates the continuities and discontinuities linking the Victorian conception of 'seeing by electricity' and the Machine-Age construction of electronic screens. The scientific developments that facilitated electronic technology and the sociopolitical philosophy of efficiency contributed to a new conception of television. The rhetoric of the annihilation of space that had propelled nineteenth-century progress was displaced by a belief that human beings should adapt to these new, artificial environments. Comparing and contrasting extension theory and systems thinking shows how this new philosophy of technology contributed to a new way of thinking about 'distant electric vision'.

Keywords: Annihilation of space; progress; philosophy of technology; systems thinking; efficiency

Predictions of a future in which people would see by electricity did not die out despite fundamental technical barriers. These fantasies persisted into the first decade of the 20th century. While seeing by electricity continued to be a persistent concept during television's speculative era, it also contributed to expectations for television when it re-emerged in American popular culture in the early 20th century. Television as we know it, the electronic transmission of moving images, came about in the 20th century. A. A. Campbell Swinton coined the term ‘distant electric vision’ in a 1908 letter published in Nature, which introduced electronics and applied physics.
into the practices of seeing by electricity. Swinton’s letter indicates a major shift in the scientific community’s approach to engineering and designing television. It encouraged engineers to adopt electronics in their designs. As a result, the forms of television changed to incorporate human physiology and the role of the human observer in these new systems.

Examining the similarities and differences between seeing by electricity in nineteenth-century visual culture and television in the early 20th century reveals the ways in which technology was thought to mediate communication and visual perception. Similar arguments have been made about the transformation of vision in visual culture. Jonathan Crary and Stephen Kern, for example, have examined the intellectual history, science, and literature demonstrative of a shift in ways of seeing between the nineteenth and 20th centuries. Studies in the visual culture of science, such as Nicolas Rasmussen’s and Oliver Gaycken’s histories of the microscope, also challenge the apparently self-evident definition of media and practices of image-making. Martin Willis also examined Victorian literature and science to demonstrate a similar kind of shift. In film history scholarship, William Uricchio and Tom Gunning have also made claims about the role of modernity in shaping a new kind of vision and thus contributing to the culture and practice of the cinema.

Seeing by electricity encompasses a history of literature and culture without actual material invention. For this reason, historians most often relegate this period to the ‘pre-history’ or speculative era populated with

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'ego-documents' and science fiction. Even though the culture of seeing by electricity produced no functional media artefacts, its visual culture and popular science offer glimpses into the formation of expectations for both cinema and television. Including the cultural and imaginative dimensions of technology with the technical and scientific offers a broader, more inclusive, and more robust view of the processes through which cultures and technologies co-emerge.

By focussing closely on the historical period 1878-1911, this chapter examines the visual culture and discourse of television. The visual culture of seeing by electricity bears resemblance to the ‘television’ that emerged in the first decade of the 20th century. By examining the similarities and differences between these two types of television, I will show how a way of seeing thought to be unmediated transformed into a new construction of vision dominated by realistic illusions and screen-mediated communication.

The cultural construction of mediated vision in both cases closely aligns with two distinct philosophies of technology. The nineteenth-century culture of seeing by electricity promoted a vision of technology as facilitating the user’s ability to extend the body through space. The popular rhetoric was summed up in the familiar phrase ‘the annihilation of space’, and supports a philosophy of technology associated with machines as extensions of the body. Seeing by electricity visualized the extension of the eye through space, able to see over the physical horizon and access distant points instantaneously. With the emergence of large technical systems and electronic practices, the mode of engineering changed to one of systems. Whereas nineteenth-century designs emphasized devices analogous to parts of the body, 20th-century systems incorporated the process of human vision into the technical methods for seeing by electricity. Along with the burgeoning sciences of psychology and physiology and the progressive efficiency movement, ‘distant electric vision’ reworked television as a kind of seeing and the observer as a human seeing-machine. Television works because scientists engineered a new way of seeing that relied as much on human visual and cognitive perception as on the mechanics of electricity and light.


This chapter examines the transition from the nineteenth-century visual culture of seeing by electricity to the emergence of systems thinking in the early 20th century. After identifying the philosophy of technology associated with the nineteenth-century rhetoric of space-annihilation, this chapter examines the early 20th-century developments in engineering. The theory that technology extends innate human capacities evolved from a basic one-to-one relationship between eye and device to a more sophisticated understanding of visual and technological systems. Electronic engineering contributed to new directions in television development. Thinking about television as a large technical system enabled electronic engineering to reconfigure the shape and meaning of this new technology. A renewed faith in engineering made way for a vision of the human and the machine working together as parts of an efficient system.

Seeing by Electricity, Annihilating Space

Of the dozens of engineers who worked on the problem of seeing by electricity, only a handful were recognized in both technical and popular communities: Constantin Senlecq, George Carey, Shelford Bidwell, and Jan Szczepanik. Senlecq and Szczepanik called their inventions ‘telectroscopes’, while Carey used the term ‘selenium camera’, and Bidwell coined the phrase ‘telegraphic photography’. These engineers stand out because their names show up most frequently in the literature in both major daily newspapers like the *London Times* and the *New York Sun* as well as scientific periodicals such as *Nature* and *Scientific American*. These four inventors also published visual depictions of their schematics, an extra element that gave their work a more recognizable component. The seeing-by-electricity craze reached its height in the 1880s. All sorts of frauds and tricksters crawled out of the woodwork with claims that they had constructed a working mechanism. Several were revealed to be hoaxes and those that were not surely were just empty promises and grandstanding. Scientists were taken more seriously when their claims were accompanied by a visual design, schematic, or other demonstrative component.

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Designs offered by Senlecq, Carey, and Szczepanik most accurately characterize the general concept of seeing by electricity as it was known in nineteenth-century scientific and popular culture. French scientist Constantin Senlecq was the first to present a 'telectroscope' to a popular audience in 1879, just weeks after Punch published the spread attacking Edison for his talk of electric light (Figure 21).9 Modelled after the camera obscura and powered by electricity, Senlecq’s device took advantage of state-of-the-art knowledge about the electrical conductivity of the mineral selenium. News of Senlecq’s telectroscope spread fast and wide, making appearances in London Times, New York Sun, and Scientific American. His name resurfaces two years later when, in 1881, he published a revised and updated design.10 Senlecq was nothing if not persistent.

American amateur inventor George Carey also published sketches for a ‘selenium camera’ in *Scientific American* in 1880 (Figure 22). 11 Despite the name, his designs resemble Senlecq’s closely. Selenium cells turn the light...
into electrical voltage, which is then transmitted along 100 wires to individual cells assembled in a mosaic in the distant screen. Both sketches show the screen in profile in order to provide the optimal view of the electrical circuitry. On one end, the camera obscura captures the light reflecting off of a scene. Picturing the screen from its side seems counter-intuitive to anyone familiar with television as a visual medium. But, in 1879, there were no moving images. Instead, these depictions drew attention to the electrical wiring. Emphasizing the similarities between the mosaic of cells and the retina, inventors and journalists appealed to readers’ knowledge about the eye to describe how television would work.

If anyone had any luck at all, it was Shelford Bidwell. He recognized early on that the mechanisms involved would only be able to transmit still pictures, which is why he patented his process as ‘telegraphic photography’ (Figure 23). The dream of television persisted despite the physical odds. And people continued to draw pictures of what a mechanical eye would look like. But the history of how scientists figured out ways to transmit still pictures (facsimile) diverges from the history of moving-image technology when these distinct technologies began producing positive results in the early 20th-century.12

After a decade of failed experiments, hoaxes, and hype, a sense of disillusionment set in among the scientific community about the possibility of seeing by electricity. By the 1890s, Bidwell became recognized as the authority on the science of seeing by electricity. A discussion in *English Mechanic*, for example, referred to his work as the most promising accomplishment in the history of attempts to reproduce images at a distance.13 One correspondent made a distinction between Bidwell’s transmission of still pictures and the possibility of transmitting moving images. But, because

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of the technical nature of Bidwell's work, he did not receive much notoriety outside of the specialized British community of technicians devoted to the practical science of telegraphy. Any discussion of ‘seeing by electricity’ tended to attract characters more prone to flights of fancy.

Nearly two decades after the telectroscope had first been introduced, Polish inventor Jan Szczepanik made his claim to fame with the new tellectroscope, a favourite in the European as well as American press leading up to the 1900 Paris Exposition Universelle. Szczepanik's grandiose claims and his intriguing biography made him an attractive rags-to-riches tale, a

Figure 23. Shelford Bidwell, 'Telegraphic Photography,' Journal for the Society of Telegraph Engineers and Electricians 10, September 1881, 357.
story that the press flocked to when taking advantage of the hype over the upcoming Exposition (Figure 24). As a result, Szczepanik drew far more attention in the popular press than in technical publications. In contrast to Senlecq and Carey, Szczepanik's designs took a different form. Szczepanik's telectroscope utilized mirrors, and descriptions of the device appealed to the reproduction of images, not to selenium cells. Comparing these two generations of telectrosopes shows how the invention of the cinema had already started to have an effect on the field of electrical engineering. Other inventors of this time were known to have replaced the familiar selenium with mirrors and projection screens, perhaps to resemble the new invention of cinema more closely or else simply to downplay selenium as yesterday's news.

The vigour with which the press promoted Szczepanik's telectroscope resembles the attention generated by Edison's inventions.14 One journalist remarked how Szczepanik would 'out-Edison Edison'.15 Along with the enthusiasm for the young Polish inventor came a similar rhetoric. While Edison's journalists recycled themes of wizardry and go-aheadism, Szczepanik became associated with the power to extend one's grasp across the vastness of space by means of technology.

Linking Szczepanik with Edison's recognizable 'Far-Sight machine', a Boston journalist hailed his telectroscope as the 'latest step toward space-annihilation'.16 The phrase 'the annihilation of space', though already popularized decades earlier by telegraphic journalists, came back with full force in stories about Szczepanik. As Stephen Kern explains it:


The ‘annihilation of distance’ was not a science-fiction fantasy or some theoretical leap of physicists; it was the actual experience of the masses who quickly became accustomed to an instrument that enabled them to raise money, sell wheat, make speeches, signal storms, prevent log jams, report fires, buy groceries, or just communicate across ever increasing distances.\(^{17}\)

Conventionally used to hail the extraordinary advances in science, technology, and industry, ‘the annihilation of space’ associated the new sense of domination over physical and natural limitations made possible by railroads, telegraphic networks, and the telephone.

Historian of technology Leo Marx identified the trope in his important 1964 book *The Machine in the Garden*, which linked the American tradition of the pastoral with the ironic fascination with machines. Marx wrote:

No stock phrase in the entire lexicon of progress appears more often than the “annihilation of space and time,” borrowed from one of [Alexander] Pope’s relatively obscure poems [...] The extravagance of this statement apparently is felt to match the sublimity of technological progress.\(^{18}\)


In this passage, Marx identifies several tropes in the rhetoric of American technological progress, including associations between the machine, nature, and history relevant to nineteenth-century American literature. Marx explains how the machine and nature seemed to fuse together into a ‘technological sublime’. His analysis helps explain the exaggerated rhetoric that fuelled the culture of seeing by electricity. The many claims about the invention of seeing by electricity implicitly connected the power of new technology with a sense that humankind had gained mastery over nature. The telectroscope would make it possible to extend a person’s vision beyond the physical limitations established by nature.

Along with the rhetoric of technological progress associating Szczepanik with the annihilation of space, his popularity also brought the German philosophy of technology to the awareness of the English-speaking world. The papers made Szczepanik out to be a sort of follower of the work of R. E. Liesegang, and, by extension, fashioned Liesegang into a kind of guru. Several articles noted how Szczepanik’s interest in electrical engineering grew from the inspiration he found in the writings of Liesegang.19 Liesegang’s philosophy of technology, which promoted the power of technology to make humans stronger, was even more extreme and progressive than that of his American counterparts. The introduction reads like a manifesto: ‘When the first automaton, that is better constructed than man, is brought to life, the purpose of the world will have been achieved: Man will be God.’20 In a sense, Liesegang’s treatise fuses the philosophy of technology with the popular science of television.

By the time Szczepanik rose to fame, Liesegang had already published several books, including Die Organologie (Organology) (1892) and Beiträge zum Problem des elektrischen Fernsehen (Contributions to the problem of electric television) (1891; 1899).21 Organology laid the foundation for his philosophy of technology, an ‘attempt to eliminate the dualism between organic and inorganic’.22 In Contributions, Liesegang outlined not only the technical requirements for the functioning of television, but also a philosophical way of thinking about the meaning of technology. Along with noted German

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19 ‘Der Elektrische Ferneher, besuch bei Herrn Ein Jan Szczepanik,’ Neue Weiner Tageblatt (Vienna, Austria), 17 March 1898; ‘Das Telelectroscop’ Lanterna Magica 14.54 (Leipsig), May 1898.
20 R. E. Liesegang, Beiträge zum Problem des elektrischen Fernsehen (Dusseldorf, 1891; 1899); Siegfried Zielinski, Audiovisions: Cinema and Television as Entr’actes in History (Amsterdam: Amsterdam University Press, 1999), 133.
philosopher Ernst Kapp, Liesegang promoted a philosophy of technology rooted in the idea that machines extend humankind’s natural abilities.\textsuperscript{23} Liesegang’s ‘organology’ drew on Kapp’s theory of ‘organ projection’, following Kapp’s ‘extended argument that all technical artifacts are projections of human organs, in that “humans unconsciously transfer form, function and the normal proportions of their body to the works of their hands.”’\textsuperscript{24} Kapp had coined the new term the ‘philosophy of technology’, and the idea that machines were extensions of the human body in both concept and design became the basis for extension theory. In the 20th century, prominent American communications scholar Marshall McLuhan popularized the media as ‘extensions of man’.\textsuperscript{25} These theories encourage a way of thinking about technology as prosthetics. This approach posits that people model tools after embodied faculties, as the hammer extends the arm. In this way, technology extends, supplements, or replaces parts of the body.

While relatively obscure in American media history, German literature scholar Stefan Andriopoulos noted Kapp and Liesegang’s important contributions to the German history of television in his study on early television philosophy:

Liesegang opens his Contributions on the Problem of Electrical Television with a reference to Kapp’s Outlines of a Philosophy of Technology, according to which ‘almost all tools, machines, etc. are unconscious copies that imitate parts of the human being’ (P, p. iii). Liesegang, for whom the Morse telegraph corresponded to the human sense of touch and the telephone to the ear, thus understood his ‘instrument for the telegraphing of lens-produced images’ as ‘imitating the sense of sight’ (P, pp. 1, iv).\textsuperscript{26}


\textsuperscript{24} Brey, 3 (quoting Kapp 1877, p. v-vi, Brey’s translation); Ernst Kapp, Grundlinien einer Philosophie der Technik (Braunschweig, Germany: Druck und Verlag von George Westermann, 1877). On the German ‘Machine-Age culture’ and the philosophy of technology, see Heidi Voskuhl, ‘Engineering Philosophy: Theories of Technology, German Idealism, and Social Order in High-Industrial Germany,’ Technology and Culture 57, no. 3 (2016).


\textsuperscript{26} Andriopoulos, 632.
According to Andriopoulos, a direct line can be traced from the emergence of the philosophy of technology in Germany in the late nineteenth century and the technical development of television occurring at the same time. If Liesegang drew on Kapp, and Szczepanik found inspiration in Liesegang, their philosophy of technology found its way into the English-speaking world by association. Andriopoulos encourages an inclusive view of the history of television culture:

The slow accumulation of technical and physical knowledge, beginning around 1890, accelerating in the 1920s, and enabling the first wireless transmissions of moving pictures in the last years of that decade did not take place in a vacuum that could be separated from its contingent cultural contexts. 27

While Andriopoulos focusses on the connections between occultism and television history, a similar point should be made about the way historical modes of thinking about technology represented in the philosophy of technology provide models for both the cultural reception of new technology and the technological development of new inventions. In this way, the late nineteenth-century popularity of extension theory links to the rhetoric of technological progress found in the ‘annihilation of space’ as well as the shape and meaning of ‘seeing by electricity’ in American popular culture.

The analogy supporting the philosophy of extension theory came across in both the verbal descriptions and the visual depictions of seeing by electricity. The particular approach taken by these engineers emphasizes the electrical function of the device. Technical descriptions detail the mechanism by which selenium converts light into electricity. Special care is taken to describe the process by which the devices would transmit light in the form of electricity. One strategy resurfaces in technical explanations linking the technical design with the eye’s retina. Engineers would liken their diagram to the arrangement of rods and cones in the retina, for example. Irish inventor Denis Redmond described his electric telescope functioning like a human eye in his 1878 letter published in *English Mechanic*:

By using a number of circuits, each containing selenium and platinum arranged at each end, just as the rods and cones are in the retina, the
selenium end being exposed in a camera, I have succeeded in transmitting built-up images of very simple luminous objects. 28

Describing their devices for seeing by electricity with reference to the faculty of vision proved a common way of explaining not only how the technology was meant to work, but also how it would change the way we see. Drawing the connection between the electric seeing device and the human eye carried with it an implicit assumption about the relationship between man and machine. An electric telescope was more than a tool: it would help move the human observer towards the goal of annihilating space.

Similarly, a letter published in the London Times that year corroborated the association between eye and electric telescope. Middleton of St. John’s College outlined a lecture recently given before the Cambridge Philosophical society:

[I] pointed out a striking analogy between the camera of the instrument and that of the human eye; the thermoelectric elements of the instrument and the rods and cones of the eye; the conducting system of insulated wires emanating from the plate of the instrument and the optic nerve (or bundle of conducting fibres of the eye) – supposing that as the electric currents in the instruments effected a registration on the sensitive paper, so in the eye the nerve currents to the optic nerve probably leave some brain trace on the mind. 29

Drawing on physiological metaphors to explain the process of seeing by electricity had the double advantage of humanizing a technical craft and bringing a recognizable function to the proposed technology. Journalists and inventors alike persisted in explaining the meaning of seeing by electricity by reference to the way the devices resembled and, to an extent, were modelled after the human eye.

Represented in both verbal descriptions and visual diagrams, these designs emphasize the eye-camera analogy, a method quite distinct from the emphasis on visible images and screens that emerged following the popularity of the cinema. The visual culture of seeing by electricity emphasizes process over picture for the very reason that these devices only existed on paper. Reproducing moving images was simply not possible

29 H. Middleton, ‘Seeing by telegraph,’ Times (London), 24 April 1880. See also ‘Seeing by Electricity,’ The Electrician, 7 March 1890, 448-450.
using nineteenth-century methods for manufacturing selenium, referred to as ‘sluggish’. These designs were radically impractical in both cost and operation. Were someone to have built a working prototype, it would have cost an estimated 1.25 million pounds, and even then the synchronization and speed of transmission would have been insufficient to process a true moving picture. The telectroscope was never actually built, and, as a result, no one ever had the pleasure of looking through an electric telescope to see the world beyond the horizon.

Engineers tended to depict their designs for seeing by electricity with emphasis on the stand-alone devices. This strategy supports the method of descriptions used, which focused on the processes of electrical transmission and mechanical synchronization. In the schematics accompanying the technical descriptions and in artist visualizations that appeared in the illustrated news, telectroscopes, electric telescopes, and selenium cameras also bear a physical resemblance to the design of the human eye. In contrast to the fantastic literature and satires depicting the culture of telephonoscope, which emphasize magnificent screens and magic mirrors, the technical literature represents seeing by electricity as a mechanical endeavor built on the principles of electrical engineering. Little attention is paid to the screens or to the images that were expected to appear in them. Instead, descriptions and schematics focus on the placement of electrical wiring and mechanical construction of the equipment.

Two particular designs stand out that illustrate the analogy between the human eye and the electric telescope. The first, a ‘selenium eye’ invented by Werner von Siemens, offers a literal translation of the eye into a scientific device meant to simulate vision. The other, a mosaic of selenium cells, represents a common approach to the design of the receiver: a nineteenth-century version of a television screen. Schematics in patent applications and diagrams in technical periodicals alike portray the devices, whether a selenium camera or a mosaic screen, like an ‘artificial retina’ or an ‘electrical eye’, with selenium (light-responsive) cells assembled like the rods and cones.


in the retina.\footnote{Werner Von Siemens, ‘Action of Light on Selenium,’ \textit{Nature} 13, no. 334 (March 1876); ‘Siemens’ Sensitive Electric Eye,’ \textit{Scientific American}, 8 December 1876: 374.} These writers concentrated less on the role of the actual observer or user of the device and more on the resemblance between the technology and the body. Sometimes the devices resembled eyes in their design as well as in their discursive explanation, as in the case of Werner von Siemens’s literal approach to the artificial eye (Figure 25). \textit{Scientific American} described the illustration of Siemens’s ‘electric eye’: ‘the whole is comparable to an eye, in which the screens represent the lids, and the selenium plate the retina.’\footnote{‘Siemens’ Sensitive Electric Eye,’ \textit{Scientific American}, 8 December 1876: 374.} A quote from the inventor follows, giving the analogy more concrete form:

‘Here,’ says Dr. Siemens, ‘is an artificial eye, sensible to light and to differences in colour, which gives signs of fatigue when it is submitted to the prolonged action of light, which regains its strength after resting with closed lids,’ and which, by an electro-magnet attachment, may be made to close itself, as does the human eye involuntarily, on the occurrence of a vivid flash.

Siemens’s electric eye provided an early model for thinking about the analogy between the eye and the seeing-machine in a very literal way. While it may not have been a device for seeing like the other telectroscope schemes, it illustrates the design philosophy connecting the limitations of human physiology with the powers of technology to defy nature.

While the cathode ray tube provides the recognizable model for the television screen, its nineteenth-century counterpart was designed using the eye as a model. Engineers described the construction of mosaic screens of selenium cells that resembled the arrangement of rods and cones in the retina. Among the many proposals, Fritz Lux’s 1902 patent application provides an exemplary model (Figure 26). While Lux wrote of the inspiration he drew from nature, he also notes the limits to the metaphor.

To construct an apparatus that works in practice, it is best to take as the role model nature, that produces such wonderful and perfect faculties. Suppose taking nature’s eye as a model for the construction of a television. Even so, the model does not inform on the actual process of seeing, but one can assume that it determines that the image projected on the retina is
transmitted instantaneously to the brain. And so it is also the imperative with television to transmit the image instantaneously.\textsuperscript{34}

Siegfried Zielinski refers to Lux’s mosaic as an ‘archaic pixel structure’.\textsuperscript{35}

For a contemporary reader, the resemblance between the electrical and organic mosaics would have been clearly apparent. The analogy maintained a strong presence in both the design of technical artefacts and the engineer’s methods of description.

Reference to the body and the eye in particular continued to support explanations of television after the turn of the century. These analogies persisted into the 1920s, and, to some degree, have never entirely left the discourse. During the height of the seeing-by-electricity craze in the 1880s,

\textsuperscript{34} Fritz Lux, \textit{Der Elektrische Fernseher} (Ludwigshafen, 1903), 7.

\textsuperscript{35} Zielinski, \textit{Audiovisions}, 71.
less attention was paid to the screen and to the image. That changed after the invention of the cinema, as the emergence of moving-image discourse made the persistence of vision and the role of the viewer increasingly important in the functioning of the visual illusion. Instead of the 1:1 correlation between eye and camera, the analogy persisted as a common explanation to which was added a host of scientific explanations and user experiences. As the popular science of television developed into the first decades of the 20th century, the discussion continued to draw on the body-machine analogy, while ocular physiology and the process of human vision became more and more important in explaining how and why television worked.
Extension theory has become an enduring aspect of the philosophy of technology because of the simplistic way it connects the human and the machine. The approach supports the enduring metaphor that technological design resembles organically evolving organisms. One could not hope for a more commonsensical explanation of the meaning of technology than extension theory’s underlying principle: the hammer is designed as an extension of the arm. The appeal of extension theory is seen in the popularity of Marshall McLuhan’s work. His version of extension theory promotes a vision of the body as incomplete without a technological supplement, a prosthetic.

To interpret extension theory merely as a theory of prosthetics strips the philosophy of its underlying basis in the duality of man and machine. Doron Galili, for example, in his study of extension theory in early 20th-century film and television, notes how the theory of prosthetics works as a model for television as easily in its nineteenth-century speculative era as in its early 20th-century technological development. Insofar as the theory of the prosthetic functions as an analogy of vision that links the eye to the mechanical camera, it draws from the simple body-machine metaphor. Film scholar Pasi Valaiho, on the other hand, provides a denser interpretation of extension theory that recognizes its roots in the duality of man and machine. Valaiho’s reading of Kapp’s theory of organ projection comes to resemble the theory of the cyborg, which recognizes the human as a hybrid entity. A theory of prosthetics based on the body-machine metaphor treats the human as if the body was an incomplete organism without some kind of technological supplement. The extension theory of Kapp, on the other hand, developed out of the belief that man and machine were more alike than different.

Identifying correlations in the cultural history of television with the development of a popular science and a philosophy of television provides a more robust strategy. Restricting extension theory to a culturally specific late nineteenth-century construction of power, progress, and space annihilation allows for a distinction to be drawn between the late nineteenth-century philosophy of technology and the enduring metaphors linking the human body to mechanical designs. Extension theory arose in full force in the cultural climate of the late nineteenth century, associated with the power of technology to annihilate space. Kapp’s philosophy of technology, for example, grew up from a foundational understanding of the body and the

36 Galili, 109.
37 Valaiho, 80–82.
machine as dual mechanisms. Without the underlying belief in human-machine hybridity, 20th-century extension theory came to rely too heavily on a simplistic body-machine metaphor. Beyond the metaphor linking the human body to the design of technical artefacts, however, the theory falls short of explaining the complexities of television.

Extension theory has its limits, however, as a means for explaining the cultural aspects of technological change. Cultural history provides an alternative way of understanding technological change, distinct from a focus on the history of technology. From this view, technological developments can be understood as reflecting cultural attitudes about the limits of the human.

Extension theory reflects the late nineteenth-century conception of technological change. Since extension theory became popular in the late nineteenth-century, the technologies that grew up during this time could also be understood as reflecting these same attitudes towards the limits of the human body’s natural capacities – to hear and see at a distance, to record pictures automatically.

From this perspective, the technological ability to hear and see at a distance, and even to capture pictures automatically either by photographic or cinematic means, could be understood as signifying the cultural desire to compensate for a lack of such capacities in the human body itself. For example, the telephone compensates for the body’s incapacity to extend indefinitely across space; while the telephone allows its users to hear over vast distances, it also reveals their innate limitation fixed as we are in space and time. Extension theory also suggests that there is something artificial or unnatural about technology. If people make tools to compensate for a lack, then technology provides the means to make people more than human. Its proponents have been accused of technological determinism, a single-minded view that relegates ‘progress’ to the force of technological change. Extension theory in general and the notion of technology as prosthetics more specifically suggests that tools lend power to the humans who wield them, eventually allowing for the few to rule over the many. This view encapsulates an outdated Victorian conception of technology. It suggests an imbalanced relationship between technology and the self that is powered by the ambition to rule the world, or otherwise to annihilate space. When science imposes the sense of deficiencies in vision, in the form of faulty eyes

and slow senses, technology comes to save the day. It considers the human, at worst, flawed and incomplete, and, at best, a hybrid organic machine.39

As historian of technology Carl Mitcham has shown, Kapp's philosophy of technology grew out of a particular cultural and historical moment. As such, it conveys a German historical-materialist approach to technology: ‘Along with Marx, Kapp was a left wing Hegelian[...]. Kapp’s adaptation of Hegelian dialectic called for the ‘colonization’ and transformation of this environment, both internally and externally.40 To adopt a conception of technology that views technics as a form of life entails a consideration of the ways such theories reflect on cultural and historical constructions of human identity. The transhistorical conception of human identity (homo faber: man the tool maker), situated at the core of extension theory, neglects the ways in which technology is both culturally constructed and intricately tied to what it means to be human. Extension theory ties to a cultural conception of the human that can exist intact without the aid of technology. In this view, technology is an ‘other’ to life.

It follows, then, that the new directions in early 20th-century television depend on a different philosophy of technology. The popular science of television that emerged with full force in the 1920s conveys an inadequacy in the simplistic body-machine metaphor. A popular account of television from 1931 points out the limits to the body-technology analogy. In noting the similarities and differences between telephony and television, the author declares ‘it is significant that nature has evolved only a receiving system for visual impressions, and that there is no organism capable of originating visual impressions at will, as we can set up to imitate sound impressions’.41 The human body’s lack of a screen pushes the limits of the metaphor. In cases such as this, the body-machine metaphor reaches the end of its capacity to explain the meaning of technology.

Another writer of popular science begins his explanation of the transmission process by describing the electric eye, a photoelectric cell which constitutes the electronic version of the selenium cell. Instead of simply offering the analogy as shorthand for describing the technical aspects, the author continues by noting the limits to the metaphor. ‘Figuratively speaking, this circuit acts as an extensible optic nerve. Unlike an actual nerve channel, it cannot terminate directly in the brain of the observer. Therefore, it terminates in certain electrical equipment—the viewing

39 Brey 7-8.
40 Mitcham, 21–23; Väliaho, 80–82.
apparatus.42 Explanations such as these show how popular science began to incorporate a more sophisticated understanding of the role and meaning of technology in general and television specifically as it affected the process of human visual perception.

Early 20th-century popular science encouraged a new way of thinking about television as a perceptual process, a partnership between humans and technology. This new strategy was represented in a shift in the visual representations of television designs, in the scientific explanation of television systems, as well as in the technical methods adopted to solve the problem of television according to new discoveries in physics.

Metaphors

In the history of technology, metaphors have always provided a strong expression of the meaning of technology. In the nineteenth century, analogies with the telegraph and nervous system established a link between technology and the body. As Nicholas Wade explains, these metaphors have always provided a basis for understanding the meaning and function of technology. The strategy can be found in many different cultures across time.

Our understanding of perceptual processes[...] has very often been shaped by concepts and models drawn from other fields of scientific enquiry and applied as analogies of the working brain[...]. Such analogies may be widely accepted, to the point of being thought self-evident, but their inadequacy has become [sic] apparent before long[...]. No doubt all such analogies were useful at the time they were proposed, but it is important to be aware that they are speculations rather than explanations, and that this applies as much to the computer as it does to clockwork. It is simply a measure of our ignorance that we do not know how to characterize the operation of the brain in terms that are independent of analogy with other sorts of mechanisms.43

Clockwork, automata, hydraulics, telephones, and computers: the correspondence of technology to the body has a long history that extends back long before the Industrial Revolution. Along with the historical analogies of

clockwork to cognition, automata to the mechanical body, and telegraphy to the nervous system, television came to fill a role at first analogous to the eye and was eventually understood as a mode of perception-at-a-distance. Tracing the long history of these correspondences helps us to recognize the ways in which cultural and intellectual history and the history of technology are imbricated. Culture and technology evolve so intimately that it makes little sense to study them in isolation.

Iwan Rhys Morus argues that technological systems establish body-machine analogies that extend across time.\(^{44}\) Morus’s study of the British telegraph explains how a technological network can become analogous to the human nervous system. He writes: ‘The metaphor worked both ways.’\(^{45}\) If the telegraph network could be understood as operating at the speed of human thought, then the brain could also be understood as a mechanical system. If there is any doubt as to how the metaphor transcended mere visual resemblance, look at how ‘telegraph’ came to function in informal language to reflect the way the body can unconsciously reveal one’s thoughts. The Oxford English Dictionary offers an example: ‘a tiny movement of her arm telegraphed her intention to strike’. In a similar way that the telegraph resembled the nervous system, television grew out of the age-old correspondence between camera and eye. Electrical networks revealed a sophisticated metaphor that bound technology with human visual perception.

When Alexander Graham Bell filed his first patent for the telephone, he chose to call it a ‘talking telegraph’. Before his success with the telephone, the telegraph had provided the model on which new inventions were based. It encouraged a way of thinking about communicating over a distance that was mediated by a public service, the telegraph office. The telephone broke that mould; it introduced a direct relationship between the user and the machine.

The suggestion that human users had direct access to their distant correspondents established a new way of thinking about communication at a distance. The machine became, in a sense, an extension of the user’s natural senses. Hearing at a distance quickly opened up the possibility of seeing


\(^{45}\) Morus, 457.
at a distance. Journalists often remarked how the possibility of seeing by electricity had become an inevitable follow-up to the telephone. The gist of these arguments followed the form: ‘Since it has become possible to hear at a distance, why should we not also be able to see?’

The period Stephen Kern refers to as the ‘culture of time and space’ witnessed a shift in modes of mediated perception, from one based on face-to-face mediation, such as in the telegraph office, to one of machine-mediated communication, as in the user’s direct contact with the telephone. With this context in mind, seeing by electricity can be understood as a new way of thinking about time and space. The culture of seeing by electricity drew its expression from the late nineteenth-century conceptions of technological progress and the annihilation of space.

Electronic Television: The Emergence of Systems Thinking

While extension theory characterizes the way seeing by electricity seemed to convey a sense that technology offered users a new ability to ‘extend’ their reach beyond physical boundaries, a different approach to the design and conceptualization of television arose in the early 20th century. From the direct metaphor of eye-to-camera emerged an extended metaphor of the human visual system, a new relationship between eye-brain cognitive process and electronic television system. I term this transition the emergence of systems thinking. Peter Checkland defines systems thinking as ‘a particular way of thinking about the world’, a model that has existed in varying degrees of popularity since the birth of Western civilization.

46 ‘Seeing by Electricity,’ The Electrician, 7 March, 1890, 448-450. Statements like this litter the nineteenth-century literature on ‘seeing by electricity’. Interestingly enough, once television became a functional technology in the 1920s, this phrase switched to the ability to smell at a distance along with telepathy. See, for example, Moseley’s extravagant claims in the introduction to his book, Television: Today and Tomorrow (London: Sir Isaac Pitman & Sons, 1934).

particular emphasis on the way systems thinking draws inspiration from organic (living) models. However, as becomes apparent in his survey of systems thinking across the centuries, each cultural historical moment carries with it a particular social agenda.

According to the applications of systems thinking to the problem of television in the early 20th century, the process of human seeing provided the model for how television systems should function. The metaphors persisted, though emphasis shifted from organs to systems. The nineteenth-century notion of extending the range of vision gave way to a bio-technical construction of the human visual system analogous to the electronic television apparatus. Television evolved as a system analogous to the telephone and electric power. Just as the telegraph crossed the nation like a nervous system, television grew into a functional metaphor for the human visual system. The shift can be seen represented both in the scientific and popular discourses as well as in their associated methods of illustration and design.

One early 20th-century work of popular science, Modern Inventions (1915), describes ‘The Human Eye as a Model’:

Optically speaking, the eye is a camera obscura containing a lens by means of which the image of what is looked at is cast upon the retina, as on the focusing screen of an ordinary camera. The surface of the retina is connected through the optic nerve with the brain by means of a very large number of little threads or nerve fibers, each of which is joined to a certain definite point on the retina, and which when stimulated by the action of the electro-magnet waves which we term little communicates to
the brain, in a mosaic form, an idea or conception of the various portions of the image.\textsuperscript{50}

This writer’s description suggests that the simple 1:1 analogy between eye and camera no longer provided an adequate model for television. As television developed into a system, it became necessary to extend the analogy to include the process of human vision. While the description still begins with noting the foundation of the technology in the eye as a model, it develops into a more sophisticated analogy with the human visual system.

As electronics and the systems approach became a general model, engineers moved away from the design of individual components, which

\textsuperscript{50} V. E. Johnson, \textit{Modern Inventions} (New York: FA Stokes, 1915), 241.
supported a way of thinking about the media as adjunct, to the senses, to a more sophisticated model of the technology-systems approach, which supports a way of thinking about humans and technology as symbiotic. Illustrating this concept, television inventor John Logie Baird used the term ‘human television system’ in one New York Times interview, describing it as ‘an apparatus in imitation of the human optical system. The human eye consists essentially of a lens which casts an image of the object viewed upon the retina’. A new concept of vision and tele-vision emerged along with the notion of television as a system. It integrated the process of human vision, and, in the literature, it became more common to refer to vision as a system. The ‘Human visual system’ incorporated the eyes, retina, and brain while placing a new emphasis on the process by which the brain made sense of the image.

The emergence of systems thinking can be discerned as early as 1899, with Cleveland Moffett’s illustration of Szczepanik’s telectroscope that

was published in the American periodical *Pearson’s magazine* (Figure 27). It pictures a generic human observer, a man in profile, whose eye is placed in immediate contact with a metallic viewer. The figure offers the suggestion of ‘the subject’ at the other end of the line. This ‘cross-section of the receiving and transmitting boxes’ suggests a system altogether different from the machines that existed before it. Szczepanik’s telectroscope shows a system, no longer just a stand-alone camera or screen, which takes into account the human observer and his television ‘subject’.

This case offers a unique overlap of what seems like two different worlds. Compare Moffett’s systems illustration, for example, with two other approaches to the representation of the telectroscope. One, from the patent, emphasizes the process by which the system was designed according to the principles of electrical engineering (Figure 28). Another, from the *Illustrated London News*, emphasizes the telectroscope in a way that would be recognizable to a popular reader (Figure 24). It shows how the system uses mirrors to transmit an image from one place to another. Looking at these images side by side reveals three different communities of thought. The technical diagram establishes the legitimate scientific nature of the invention by communicating the function of the device according to the conventions of electrical engineering. The *Illustrated London News* follows a traditional Victorian approach according to the culture of seeing by electricity, which emphasized the heroic character of the inventor, but with the slight difference of appealing to an audience versed in theatrical stage illusions. Moffett’s systems diagram would have appealed to general readers of the periodical, while also representing a new scientific bent in the development of television technology. Representing the telectroscope as a system rather than a singular camera or screen marks a departure from the established culture of seeing by electricity. It suggests that the way of thinking about television as a system linking two places together had begun to take hold in the technical community as well as in the popular culture.

It wasn’t until 1908, when physicist A. A. Campbell Swinton proposed applying scientific methodology to the ‘problem of television’, with the use of cathode rays, that a change in the culture of seeing by electricity became apparent. As a physicist, Swinton looked on the problem from an altogether

53 Cleveland Moffett, ‘Seeing by Electricity,’ *Pearson’s Magazine*, October 1899, 493.
different direction than those who had tackled it in the past. Harnessing the power of the electron opened up new possibilities. Swinton and his colleague Silvanus Thompson described television as at once a simple concept and a complex technical problem.55 The central idea of seeing by electricity seems simple enough. But to achieve a practical result, they explained, required a sophisticated knowledge of and mastery over the physical world. Swinton was not the first to suggest using electronics, but his respected position in the American scientific community and the confidence with which he spoke gave his message the force needed to generate interest in a new direction for television, which he referred to as ‘distant electric vision’.56 Vacuum tubes and electron beams transformed television into a technology so scientifically complex that amateurs no longer played a role.

His contribution reached the scientific community in the form of a letter published in Nature in response to a statement made by Shelford Bidwell. Bidwell had written, in frustration, about the barriers halting progress in telegraphic photography, principally the ‘sluggishness’ of the selenium element. Swinton responded: ‘it is wildly impracticable to effect even 160,000 synchronized operations per second by ordinary mechanical means’.57 Coming at the ‘problem of television’ from the world of physics and applied science made Swinton’s contribution new and noteworthy. His approach differed from the established methods for ‘seeing by electricity’ and encouraged a new way of thinking about television as a scientific endeavour. He gave voice to a new generation of electronic engineers, and to a new approach to television.

Swinton’s expression of television, encapsulated in ‘distant electric vision’, offers insight into the way the scientific community drew on the expectations established by ‘seeing by electricity’. The culture of telectroscopes had been translated through the language of science, only to make its way back into the popular culture of the teens. Swinton opened his 1912 presidential address to the Röntgen society, for example, with a familiar exclamation about man’s mastery over nature and scientific power.58 But, to this general concept, he adds several new features. First, he privileges science over

58 Swinton, ‘Presidential Address,’ 1.
Figure 29. A. A. Campbell Swinton, schematic for distant electric vision, 'Presidential Address,' *Journal of the Röntgen Society* 8.30, 1912, 10.

Figure 30. Hugo Gernsback, 'Television and the Telephot,' *Electrical Experimenter,* May 1918.
technology, and scientific practice over practical invention. Approaching an old concept from a new perspective, Swinton describes seeing by electricity as a problem to be solved by science: ‘It supposes an entirely new application of Crookes tubes and the phenomena of Cathode Rays.’ Beginning with the science, Swinton then introduces the problem to be solved with this new knowledge and practice: ‘distant electric vision, or the power to see objects a great way off by electrical means[...] [an] extension of our sense of vision’.

Second, he extends the body-machine metaphor into a systems analogy. Though introduced through the simple metaphor, his description emphasizes visual processes and the perception of images in the brain analogous to the function of a television system. In addition to recognizing the human eye as a model for distant vision, just as the ear modelled the telephone, Swinton develops an extended analogy that draws on knowledge of the visual processes involved in perceiving images in the brain.59 Far from the simple 1:1 eye-camera analogy, ‘distant electric vision’ articulates a more complex interpretation of the human visual system applied to the problem of seeing by electricity.

A look at the visual representations of ‘distant electric vision’ illustrates how the new approach to television made its way into American popular culture and popular science. While Swinton presented the scientific community with a technical schematic (Figure 29), the popular press experimented with new ways of illustrating the concept to the public. These illustrations gave the image of television a heightened appeal and introduced a new way of representing television. A notable example can be found in Hugo Gernsback’s popular-science periodical Electrical Experimenter. The magazine was marketed to and targeted practical-minded hobbyists, like Gernsback’s earlier publishing venture Modern Electrics. Both mingled radio news and ‘wider aspects of scientific experimentation’ with a Q&A section and how-to articles.60 But unlike its predecessor, Electrical Experimenter included more illustrations, a larger format, and short fiction in its colourful pages. The magazine combined the attractiveness of pulp with a practical approach

Figure 31. ‘How Television Equipment Works at One End of the Two-Way Line,’ illustrated by H. G. Seidstad for *Popular Science*. ‘Talk, Hear, SEE on This Phone: Two-Way Television Is Demonstrated in Laboratory As an Engineering Stunt,’ *Popular Science*, July 1930, 22.

Figure 32. Alden Armagnac, ‘A Telescopelike Window,’ *Popular Science*, 1929.
Figure 33. Illustration by Will B. Johnstone, ‘Face with the Smile,’ *New York Morning World*, 10 April 1930.

Figure 34. H. W. Secor, ‘Television, of the projection of pictures over a wire,’ *Electrical Experimenter* 3, August 1915, 131-132.
to science and technology, fostering the emergence of mainstream science fiction and popular science.

While the culture of seeing by electricity pictured screens like mirrors or looking glasses, Machine-Age television developed according to a similar aesthetic model. Hugo Gernsback imagined his Telephot as a handheld mirror (Figure 30). The Bell Labs Two-Way television seemed to offer a ‘window for viewing [an] image of [a] distant person’ (Figure 31). One writer of popular science referred to electronic television as a ‘telescope-like window’ (Figure 32).

Fears of technological change also persisted along similar lines. Journalists echoed the nineteenth-century anxieties of surveillance and privacy articulated in the press response to the far-sight machine in the form of sarcastic commentary. When Bell Labs unveiled their Ikonophone in 1930, it gave concrete form to those fears, inspiring one cartoonist to picture the potential for telephone users to spy on women while they were in the shower (Figure 33). In fact, fears of the invasion of privacy never completely went away and, in some respects, were heightened when the prospect of video telephony re-emerged later in the 20th century. One journalist offered a similar critique of the Picturephone when Bell brought the idea back in the 1950s. The illustrator’s depiction of the astonished telephone user assaulted by the bill collector bears such close resemblance to ‘Professor Goaheadison’s Latest’ and the criticisms against Edison’s ‘far-sight machine’ from 1889 that it supports, somewhat deceptively, a sense that the idea of television has remained relatively stable over time.61

Electrical Experimenter’s article on Swinton’s ‘distant electric vision’ (1915) features two distinct approaches to the representation of television (Figure 34).62 While the discussion and representation of ‘seeing by electricity’ had tended to be directed towards either scientific or popular readership, Electrical Experimenter departs from that convention by combining both approaches. The first consists of two figures that make up a banner across the head of the article. Illustrating the television user’s perspective, it identifies the ‘man at right being transmitted and reproduced on screen in front of lady. Her face is transmitted and reproduced […] before man’. Between the two distant correspondents stretch electrical lines that extend across a

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Figure 35. H. W. Secor, ‘Television Perfected at Last,’ *Science and Invention*, 1927.
pastoral landscape. While the illustration resembles a cinematic montage, it also draws on the reader’s appreciation of the actual distance separating the correspondents. The article also reproduces a version of Swinton’s technical schematic on the reverse page. Including both a landscape and an electronic-systems diagram in the same article suggests that the concept of seeing by electricity was in a state of transition. Engineers and the reading public alike were witness to the merging of two perspectives: that of the cultural expectations of distance and communication established by seeing by electricity and the new frontier of scientific possibility offered by electronics.

The figures published in Secor’s article provide an early example of the trend towards picturing television as a system with a human user.

Continuing the tendency to intermingle popular and technical illustrations, Figures 35-38 document a new mode of picturing television as such a system. In popular science periodicals like *Science and Invention, Modern Mechanics,* and *Popular Science,* artists adopted an approach that fused the technical appearance of schematics with the visual rhetoric of nineteenth-century television. Whereas Figure 34 represents two different strategies in representing television, those strategies appeared to merge into one another as popular-science magazines placed more importance on illustrations in
the 1920s. These diagrams illustrate how the technological system provides a means to mediate the relationship between the human and the screen.

One example comes from a 1927 article of Secor's: ‘A general lay-out of the wire transmission scheme for transmitting television images’ (Figure 35).64 This early attempt to illustrate Bell Labs’s two-way television system shows care taken in characterizing the user. Identified in Figures 31, 39-41 as observers, subjects, or simply pictured as an eye, these pictures show how the user became a part of the system. These illustrations consistently depict the user’s eye connected to the apparatus using a dashed line. Travelling from the user to the lamp, screen, or disc, it emphasizes the way the user sees into or through the machine. Connecting the eye to the apparatus in this way can be understood as a strategy for engineering as well as a recognizable reference to the viewer’s line of sight.

‘A general lay-out’ connects two people across an abstract length of space: ‘200-mile wire line’. Suggesting an expanse of space, it represents the connection between two distant correspondents over a virtual divide. Compared to the representation of a natural landscape from the 1915 depiction, for example, it marks a shift from representing television as the latest in space annihilation to the process of technologically mediated vision. As it was no longer possible to depict the immensity of the television system as it extended across space, representations shifted towards an emphasis on the user’s process of vision and the mode of electrical mediation. A single electrical wire would no longer suffice. Space became an abstract concept, as did the perceived distance separating the users.

A similar illustration appeared in Television News (1931), along with the description: ‘Approximate representations (in graphic form) of what goes on in a complete television system’ (Figure 40).65 Like ‘a general lay-out’, Nason’s ‘approximate representations’ picture two users looking through an apparatus. It follows the strategy seen in Secor’s representation of the line of sight. The users appear in strict profile, emphasizing the way they seem to be looking at each other. In contrast, Secor’s subject ‘being transmitted’ at left appears at a slight angle making it seem like his gaze is directed at the ‘lens’ rather than at the viewer. At the other end of the line, Secor depicts the viewer at right gazing at a miniaturized reproduction with an attentive look on his face. Simplified from the detail offered in Secor, Nason’s ‘image current’,

Figure 39. ‘How the Light Waves from the Subject are Transmitted by Radio and Converted back into a Picture at the Receiver,’ in ‘What Television Offers You,’ Popular Mechanics, November 1928, 820-824.

Figure 40. Sanabria Television System, Television News, September-October 1931.

Figure 41. ‘The Transmitter for Radio Pictures,’ in ‘Television for the Home,’ Popular Mechanics, April 1928, 531.
depicted as an electrical cable, draws a direct connection between the eyes. The arrows travelling along Nason’s electrical cable, more recognizable in the simplified composition than in Secor’s depiction of both image and voice channels, emphasizes the directionality of the signal moving from the onscreen subject at left to the television observer at right across an abstract distance by means of an electronic signal. Replacing the enumeration of the many components that make up the apparatus depicted in Secor’s ‘general lay-out’, with an abstract representation of electrical signals allows Nason’s ‘approximate representations’ to show how the electrical signal mediates the vision between two users. It departs from the depiction of an actual or virtual landscape in order to emphasize the electronic mediation of vision.

Scientific illustrations continued to depict the line of sight with dashed lines. This also became a common strategy in human engineering (now known as human-factors engineering or ergonomics) as a way of portraying the user’s interface with a machine (human-screen interaction). The use of human-engineering strategies in television design is most apparent in the way Bell Labs depicted their two-way television project. As represented by Bell Labs’s engineers, ‘a pictorial sketch of two-way television system’ features the viewer’s full body and a chair. Like ‘a general lay-out’ and ‘approximate representations’, ‘pictorial sketch’ features an observer with lines emanating from his eyes. Comparing such figured with schematics from ergonomics illustrates how human-screen interaction informed the design of television systems in the 1920s.

There is a marked contrast between the visual rhetoric of seeing by electricity with the depictions of television systems that became popular in the 1920s. While the former provide a visual representation of the annihilation of space, the latter depict television as a system with a human user. These illustrations privilege the user’s interaction with an interface. Similar to the way the jagged and dotted lines in the systems diagrams visualized the abstractness of mediation, these pictures show how the image represented

on the screen will function as the focal point of televisual mediation. The prominence of the observer in these depictions emphasizes how integral human visual perception had become to the operation of television. If distant electric vision would be possible, it would be a matter of learning how the human fit into the machine.

Taking into account the emergence of systems thinking in the development of television in the 1920s requires a media theory that recognizes how the user’s visual perception is mediated by the technological apparatus. A theory of technological extensions focusses primarily on the material, mechanical, and physical properties that link the body to the machine. In its nineteenth-century formulation, extension theory presents a weak conception of the intrinsic hybridity of human and machine.

In order to recognize how deeply entangled the human and the machine are, we should turn to other approaches that define human and machine more broadly. Mark Hansen’s media theory, for example, understands technology as a central factor in the human life environment, along with culture and visual representation. His approach considers a redefinition of media and technology from the perspective of embodied perception. In a work co-authored with visual-studies scholar W. J. T. Mitchell, he seeks to distance ‘media’ from a conception based in representations (sounds and images) to one based on embodied perceptions. In addition, he replaces technology with technics, ‘a practical knowledge emanating from skill, art, or practice’, which allows for an expanded interpretation of the role of technology in culture distanced from a foundation in mechanical artefacts.68 They write: ‘media, in our view, also names a technical form or formal technics, indeed a general mediality that is constitutive of the human as a “biotechnical” form of life.’69 Used as an alternative to the philosophy of technology, media theory breaks down artificial divisions between technics and culture in order to treat them both as aspects of a lived environment.

Elsewhere, Hansen extends this definition into a theory for understanding ‘medium as environment for life’.70 ‘Media theory’ reminds us that there is no such thing as ‘unmediated’ perception, just as culture and nature work together to construct a sense of ‘reality’. From this perspective, media in general and television in particular define a way of seeing as a kind of visual

perception that is a culturally and historically specific learned behaviour. ‘Medium as environment for life’ suggests that moving-image technology and human visual perception co-exist and co-evolve. The emerging complexity suggests that visual media and visual perception are inextricably connected. Our way of seeing the world constructs our way of representing it, and vice versa.

Conclusion

In comparison to television’s nineteenth-century ‘speculative era’, which encompasses the culture of seeing by electricity, a new mode of representation emerged in the early 20th century. Along with scientific developments in electronics, systems thinking came to dominate both the technical and cultural modes of representing what television was and what it would become. Along with the introduction of these scientific discoveries emerged a modern construction of vision that relied on the concept of technological mediation.

Both ‘seeing by electricity’ and ‘distant electric vision’ comprise television’s speculative era. While both appear to resemble television in form and function, there are several important differences that should be recognized. The metaphor of vision no longer drew a direct connection between the eye and the televisual mechanism. While the metaphor of ‘the human eye as a model’ persisted, many writers of popular science were quick to make clear how the metaphor provided merely a figurative correlation. As a sign that the hyperbolic claims of the annihilation of space had finally come true, representations of television in the Machine Age emphasize the picture on the screen as well as the screen itself as a mediating device. The image on the screen perceived by the viewer comes to seem more and more separated from its real-world referent. The representations, underlying science, and discourse of television changed significantly enough between the nineteenth and 20th centuries to constitute a rebirth of the medium.

But, in essence, its form and function remained relatively unchanged. Television continued to be described as a tool to connect people across great distances in real time. Whether a one-way relay of the images and sounds of a theatrical entertainment or a two-way communications medium, the general functions remained consistent. The appearance of television also remained stable.

‘Seeing by electricity’ materialized in both cultural and technological circles. While, as a technology, it clearly resembles the modern concept of
television, its visual rhetoric differs dramatically. The nineteenth-century culture of seeing by electricity conveys a sense of unmediated vision. Discussion of annihilating space, communicating with friends and family at a distance, or witnessing a live theatrical performance makes no mention of the way the technology itself forms a barrier to the feeling of presence-at-a-distance. It established expectations of direct access, lacking a sense of mediation or representation. Telectroscopes and telephonoscopes were magic mirrors infused with the real possibilities facilitated by technological achievements. In many respects, the telectroscope was not a technology through which to see. Rather, it represented a culture expecting to have the world at its fingertips. Seeing by electricity functioned as the visual representation of the annihilation of space.

While the desire to annihilate space and the enthusiasm for technological progress had driven the culture of seeing by electricity, the Machine Age infused television with new possibilities fuelled by scientific and industrial mastery over nature. For all intents and purposes, distant electric vision was a different beast entirely. Distant electric vision carries with it assumptions about the limitations of the body and mind in a physical world, infusing electronic television with a sense of control over nature and manipulation of visual perception. Electronics, systems, and the efficiency movement carry with them new connotations for Machine-Age television. In this period, the visual culture of science and technology rewrote the agenda as one of engineering vision, rather than establishing a sense of closeness to those far away.71

The next chapter picks up the story in the 1920s, when electronic television re-emerged in popular culture after a hiatus in the physical laboratory. Swinton’s promotion of using science to inform technological developments inspired a new generation of engineers. Over the next decade, television was hidden away in the physical laboratory. When it re-emerged in the 1920s, it had transformed into a new kind of seeing-technology. New processes and practices, including illuminating engineering, photometry, colorimetry, psychophysics, and the philosophy of the efficiency movement, facilitated the rebirth of the medium.

71 For example, historian of technology Lewis Mumford describes the Machine Age in his 1933 Technics and Civilization as a culture between two worlds. He borrows a geological metaphor to describe how technologies can change while seeming to stay the same in different cultural moments: the pseudomorph. See Lewis Mumford, Technics and Civilization (Chicago, IL: University of Chicago Press, 2010 [1934]), 265.
A new understanding of electronically mediated communication came to dominate the discourse in the 1920s. In both scientific and popular periodicals, the problem of television became a matter of engineering both the technology and the human visual perception of the image. Technicians became more likely to describe television as a screen interaction distinguishable from face-to-face interaction. When television re-emerged in American popular culture in the 1920s, a host of assumptions, scientific methods, and technical practices came along with it, which proved difficult to explain to the public. A new language of popular science would mediate the technical concepts and terminology for the benefit of the consumer.

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