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The Other End of the Wire: Uncertainties of Organic and Telegraphic Communication

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In a popular lecture in 1851, German physiologist Emil Du Bois-Reymond proposed that

> the wonder of our time, electrical telegraphy, was long ago modeled in the animal machine. But the similarity between the two apparatuses, the nervous system and the electric telegraph, has a much deeper foundation. It is more than similarity; it is a kinship between the two, an agreement not merely of the functions, but also perhaps of the causes.[1]

In 1851, the telegraph and the nervous system appeared to be doing the same things, and for the same reasons. Their common purpose was the transmission of information, and they both conveyed this information as alterations in electrical signals. By calling the nervous system a "model" for the telegraph, Du Bois-Reymond presented organic communications systems as nature's own means of transmitting information—a "technology" that offered the same exhilarating contact and frustrating limitations.[2]

1. Emil Du Bois-Reymond, "Uber thierische Bewegung," in *Reden*, 2 vols. (Leipzig: Veit, 1887), vol. 2, pp. 50–51. The original German reads: "Das Wunder unserer Zeit, die elektrische Telegraphie, war daher längst in der thierischen Maschine vorgebildet. Aber die Aehnlichkeit zwischen beiden Apparaten, dem Nervensystem und dem elektrischen Telegraphen, ist noch tiefer begründet. Es ist mehr als Aehnlichkeit, es ist Verwandtschaft zwischen beiden da, Uebereinstimmung nicht allein der Wirkungen, sondern vielleicht auch der Ursachen"; my translation.

2. Timothy Lenoir has demonstrated that German physiologists Hermann von Helmholtz and Emil Du Bois-Reymond, the nineteenth-century scientists who made some of the greatest contributions to neurophysiology, were in close contact with com-

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If mid-nineteenth-century physiologists saw nerves as telegraphs, the engineers who designed early communications networks viewed their growing webs as organic structures. A decade before Du Bois-Reymond performed his electrophysiological studies, Samuel Morse wrote: "it [will] not be long ere the whole surface of this country [is] channeled for those *nerves* which are to diffuse, with the speed of thought, a knowledge of all that is occurring throughout the land."[3] Years later, describing the first attempt to lay a transatlantic cable, Morse's son and biographer echoed his father's metaphor: "thus ended the first attempt to unite the Old World with the New by means of an electric nerve."[4] In reading the proposals of nineteenth-century engineers, one begins to suspect that communication in the body and in society can be understood only in terms of each other. As Norbert Wiener writes,"it is certainly true that the social system is an organization like the individual, that it is bound together by a system of communication."[5]

Throughout the nineteenth century, scientists studying organic and technological communications systems inspired one another. Friedrich Kittler has argued in *Discourse Networks* that nineteenth-century media for writing and communication—the telegraph, the typewriter, and later the phonograph and telephone—affected not just the way people wrote and communicated but the way they perceived their own minds and bodies. As organic receiving devices, the body's sensory organs suggested ways to detect, translate, and record a great variety of signals. During the second—and successful—attempt to lay a transatlantic cable in the mid-1860s, physicist William Thomson applied the telegraph wires to his own tongue and found that he could "taste" the differences between signals.[6] Like a human tongue, a telegraph key could both taste and speak. Recounting William Cooke's first anxious demonstration of the

munications engineers like Werner Siemens. By developing models that reflected the apparatus they had adapted from physics and media technology, Helmholtz and Du Bois-Reymond changed people's understanding of the way that nerves transmitted impulses. See Timothy Lenoir, "Helmholtz and the Materialities of Communication," *Osiris* 9 (1994): 185–188, 206–207.

3. This passage is from Morse's letter of February 15, 1838, to his collaborator F. O. J. Smith: Samuel F. B. Morse, *Samuel F. B. Morse: His Letters and Journals*, ed. Edward Lind Morse, 2 vols. (Boston: Houghton and Muffin, 1914), vol. 2, p. 85 (original emphasis).

4. Ibid., vol. 2, p. 382.

5. Norbert Wiener, *Cybernetics, or Control and Communication in the Animal and the Machine*, 2d ed. (Cambridge, Mass.: MIT Press, 1961), p. 24.

6. Hermann von Helmholtz, *Science and Culture: Popular and Philosophical Essays*, ed. David Cahan (Chicago: University of Chicago Press, 1995), p. 150.

British needle telegraph to railway engineer George Stephenson, Latimer Clark described Cooke's receiver as a "trembling tongue of steel."[7] On a Morse instrument, an experienced operator could understand incoming messages just by listening to the sounder and constructing meaning from the clicks as one would from a human voice.[8] Reflecting that "the clattering tongue of brass seems alive as I listen and hear the signals pass," an unknown telegrapher-poet recognized as fully as Thomson or Helmholtz the affinity between the tongue, the ears, and the telegraph key.[9]

People's understanding of the human nervous system shaped the communications devices they built, and many communications engineers made practical use of the body's own wiring. Frustrated in their attempts to develop technological receivers as sensitive as the body's, some scientists incorporated organic "receivers" directly into their systems. Werner Siemens, who designed Germany's telegraph network, had workmen stick their hands into chambers of water, relying on the mild shocks they got to detect faults in his cables' insulation.[10] In the first decade of the nineteenth century, Vorselmann de Heer proposed an "electro-physiological telegraph" in which the ten fingers of a willing subject served as the receiving device. The problem with his apparatus, the scientist complained, was that one had to keep altering the voltage according to the receiver's sensibility.[11]

In the nineteenth century, these comparisons between living and artificial communications systems were not restricted to scientists and engineers. In the 1860s and 1870s, as the "wires" became part of many people's daily experience, a great variety of fiction writers began dealing with the Tantalus torture of telegraphy, which promised vast new knowledge and acquaintanceship but never quite replaced the reassuring certainty of physical presence.[12] As people who

7. Latimer Clark, "Memoir of Sir William Fothergill Cooke," in William Cooke, *Extracts from the Private Letters of the Late Sir William Fothergill Cooke, 1836–39, Relating to the Invention and Development of the Electric Telegraph*, ed. F. H. Webb (London: Spon, 1895), p. 88.

8. Tom Standage, *The Victorian Internet: The Remarkable Story of the Telegraph and the Nineteenth Century's Online Engineers* (New York: Walker, 1998), p. 65.

9. William John Johnston, ed., *Lightning Flashes and Electric Dashes: A Volume of Choice Telegraphic Literature, Humor, Fun, Wit, and Wisdom*, (New York: Johnston, 1877), p. 111.

10. Werner von Siemens, *Werner von Siemens, Inventor and Entrepreneur: Recollections of Werner von Siemens* (London: Lund, 1966), p. 73.

11. George B. Prescott, *History, Theory, and Practice of the Electric Telegraph* (Boston: Ticknor and Fields, 1860), p. 56.

12. In a superb study of Henry James's "In the Cage," Richard Menke analyzes the common assumptions of telegraphy and nineteenth-century realism. As he illustrates, the

worked intimately with artificial tongues and nerves, telegraph operators had a special understanding of the knowledge that long-distance communications provided. In their own stories, one detects the same concerns voiced by neurophysiologists and engineers: an awareness of bodies and machines as closely related communications devices, and of the shortcomings of each. Like physiologists, these creative technicians suspected that knowledge constructed from coded messages could never be certain, and that one could never really know what was happening at the other end of the wire.

Lightning Flashes and Electric Dashes, a collection of stories by British and American telegraphers, provides fascinating ground on which to study these concerns of a culture struggling to communicate. Published in 1877, the collection affirms Kittler's hypothesis that new media technologies give rise to new fictions, literature that is structurally and thematically transformed. In the preface to *Lightning Flashes*, the volume's editor wrote: "the art seems to demand a literature of its own."[13] By comparing three telegraphers' stories with the popular lectures of Hermann von Helmholtz (1821–1894), one of the century's foremost physiologists, I will explore the scientist's and the technician-authors' common interests in bodies, machines, and epistemology.[14] When they represented the thrills and frustrations of communication, I will argue, scientific and creative writers articulated problems characteristic of an entire culture. To follow the exchange of images among nineteenth-century writers describing communication in the body and in society is to enter a complex circuit of thought—a system of coils, cross-links, and loops in which a fluctuation at any point instantly becomes a property of the entire system.

The Uncertainties of the Nerves

No one illustrates the kinship of nineteenth-century physics and physiology better than Hermann von Helmholtz, who made signifi-

development of British fiction in the latter half of the nineteenth century shows how "the imaginative possibilities of a medium may change as newer technologies emerge" (Richard Menke, "Telegraphic Realism: Henry James's *In the Cage*," *PMLA* 115 [2000]: 975–990, on p. 979).

13. Johnston, *Lightning Flashes* (above, n. 9).

14. It might be objected that Helmholtz's popular lectures are not representative of his real scientific thinking, that they are mere "translations" of his theories for lay audiences, but an examination of his writings shows that this is not the case. As Timothy Lenoir has revealed, metaphor underlies Helmholtz's understanding of sensory systems. I agree strongly with Lenoir that such comparisons between organic and technological systems were not mere devices for popularization, but were incorporated into the scientist's vision and understanding of the nervous system. See Lenoir, "Helmholtz" (above, n. 2), pp. 185–188.

cant contributions to both. A rigorous empiricist, Helmholtz did his best to explain human sensory systems in terms of physical laws, overcoming experimental or theoretical obstacles through his ability to reason from analogy. By his own account, he particularly excelled at applying the techniques of one field to the problems of another.[15] Some of the instruments he designed for scanning the eye, for example, were based on devices for astronomical observation. As a physicist, Helmholtz advanced people's understanding of thermodynamics, proposing the law of the conservation of energy in 1847. He is just as well known, however, for his achievements in physiology and medicine: the measurement of the velocity of the nerve impulse (1850), the invention of the ophthalmoscope for exploring the retinal surface (1850), and his still-accepted theory of color vision. An outstanding writer and speaker as well as experimentalist and theoretician, Helmholtz loved to explain scientific discoveries to the public. In his widely read popular essays on energy, optics, and acoustics, he followed the same strategy he did in the laboratory, configuring the problems of perception in terms of physics; and those of physics, in terms of the body.

Helmholtz's lifelong interest in perception derived not just from his genuine interest in the way the body worked, but from his philosophical roots in Kantian epistemology. In the 1830s his mentor, Johannes Müller, had developed a physiological hypothesis related to Immanuel Kant's ideas about how much one could know: the theory of specific sense energies. Like Kant's philosophy, Müller's hypothesis claimed that the mind relied on fixed, inborn perceptive structures to make sense of the world.[16] Rather than serving as "passive conductors," Müller argued, sensory nerves and organs had a "special sensibility to certain impressions."[17] For any given sensation, the qualities perceived resulted not from any inherent property of the external object exciting them, but from the inherent properties of the sensory apparatus responding to them. Müller believed that

15. Helmholtz, *Popular Essays* (above, n. 6), p. 387; hereafter cited parenthetically (*PE*).

16. See Hans Günther Dosch, "The Concept of Sign and Symbol in the Work of Hermann Helmholtz and Heinrich Hertz," *Études des lettres* 1–2 (1997): 49; S. P. Fullinwider, "Hermann von Helmholtz: The Problem of Kantian Influence," *Studies in the History and Philosophy of Science* 21 (1990): 44; Timothy Lenoir, "The Eye as Mathematician: Clinical Practice, Instrumentation, and Helmholtz's Construction of an Empiricist Theory of Vision," in *Hermann von Helmholtz and the Foundations of Nineteenth-Century Science*, ed. David Cahan (Berkeley: University of California Press, 1993), pp. 110–118.

17. Johannes Müller, *Elements of Physiology*, trans. William Baly, 2d ed., 2 vols. (London: Taylor and Walton, 1839), vol. 1, p. 819.

> sensation . . . consists in the communication to the sensorium, not of the quality or the state of the external body, but of the condition of the nerves themselves, excited by the external cause. We do not feel the knife which gives us pain, but the painful state of our nerves produced by it. . . . We communicate . . . with the external world merely by virtue of the states which external influences excite in our nerves."[18]

According to Müller, our sensations and our knowledge reflect not the world but our limited capacity to perceive it.

For the most part, Helmholtz agreed with his teacher about the limits of human perception, arguing that we must never confuse actual phenomena with our experiences of them. "The way in which [the colors] appear," he asserted in an 1868 lecture on vision, "depends chiefly upon the constitution of our nervous system" (*PE* 167). While he concurred with Müller that the human sensory apparatus could deliver only very restricted information, he moved further and further away from his teacher's nativist ideas about perception. In the late 1850s, new discoveries in optics convinced Helmholtz that vision, like hearing, was a learned process in which the brain used the eye as a "measuring device."[19] Although he insisted that all knowledge was learned and could be traced to sensations, he warned his audience in 1878 that the "fundamental distinction [we make between sensations belonging to the different senses] does not completely depend on the type of external impression by which the sensation is stimulated; rather, it is determined completely, solely, exclusively by the sensory nerve that has been affected by the impression"(*PE* 345). In the body, as in the laboratory, people were limited by the sensitivity of their instruments.

In his autobiographical sketch, Helmholtz described the brain as the experimenter's most valuable tool and asserted that one must understand "the capabilities of our power of thought" exactly as one must understand the sensitivity of the telescope or galvanometer

18. Ibid., pp. 819–820.

19. See Lenoir, "Eye as Mathematician" (above, n. 16), p. 111. Helmholtz's relationship with Kantian epistemology is more complex than it might first appear. While Lenoir argues for a "final break" with Kant (and Müller) by 1867 (ibid., p. 153), S. P. Fullinwider believes that Helmholtz "consider[ed] himself a true Kantian up through the end of his life" ("Kantian Influence" [above, n. 16], p. 41), and P. M. Heimann finds that even the third volume of Helmholtz's *Optics* (1867) contains "characteristically Kantian phraseology" (P. M. Heimann, "Helmholtz and Kant: The Metaphysical Foundations of *Über die Erhaltung der Kraft*," *Studies in the History and Philosophy of Science* 5 [1974]: 205–238, on p. 221). Fullinwider agrees with Lenoir, however, that Helmholtz "transformed Kantian epistemology" by proving that much of what Kant considered to be intuition was actually learned empirically (Fullinwider, "Kantian Influence," pp. 41, 45).

that one worked with (*PE* 389). Everywhere in the body he witnessed interactions that suggested well-known mechanized processes, and he pointed out these parallels to his readers to enhance their appreciation of both. His famous essay "The Conservation of Force [*Kraft*]" (1847), accepted today as the first articulation of the law of the conservation of energy, actually grew out of his studies of muscle action and animal heat.[20] In this early study of thermodynamics, Helmholtz told readers that "the moving force of the muscle must be at work in [the arm], and [the muscles] must obey the nerves, which bring to them orders from the brain. . . . Just so is it with machines" (*PE* 98). Not surprisingly, he singled out the weaving machines that were driving the Northern European economy, "the work of which rivals that of the spider": just as the human arm resembled parts of the weaving machine, the mechanical weaver resembled the natural spinner (*PE* 99).

Perhaps because of his experience as a laboratory scientist, Helmholtz most frequently compared human organs to manmade instruments when he assessed their abilities to detect the phenomena around them. He described the eye as a camera obscura and commented that despite its remarkable powers, one would be very annoyed at an optician who sold one an optical instrument with the same defects. In one of his most intriguing analogies, he compared the inner ear to a piano, writing that in this exquisitely sensitive instrument, the hairs of the organ of Corti wait, like piano strings, to be "set into sympathetic vibration" (*PE* 60). Together, he proposed, these tiny hairs were accomplishing what a Fourier analysis could accomplish in mathematics: as each hair responded to its own natural resonance frequency, the organ resolved a complicated wave pattern into a number of simple, individual waves (*PE* 62–66). Like musical instruments, the human sensory organs and the nerves attached to them could respond only to vibrations of a particular type, and only in a limited way. The signals they transmitted to the brain did not in the least resemble the stimuli that had excited them.

What, then, was the relationship between a nerve impulse and the external event that it represented? Like Müller before him, Helmholtz called activity in a nerve a *Zeichen* ("sign" or "symbol") of its exciting cause.[21] "The sensations of our nerves of sense are mere

20. Kathryn M. Olesko and Frederic L. Holmes, "Experiment, Quantification, and Discovery: Helmholtz's Early Physiological Researches, 1843–50," in Cahan, *Helmholtz* (above, n. 16), pp. 66–67.

21. For a systematic study of Helmholtz's use of the term "Zeichen," see Dosch, "Concept of Sign and Symbol" (above, n. 16).

symbols indicating certain external objects," he explained in an 1857 lecture on harmony, and it took a good deal of practice to learn how to interpret them (*PE* 66). In the eye, he pointed out, "the sensations of the optic nerve are for us the ordinary sensible sign of the presence of light," but other types of stimulation—pressure on the eyeball, or an electrical shock applied to the optic nerve—could produce the same sign (*PE* 152). It was up to the mind to interpret patterns of signs and to infer what they actually represented.

There was a significant difference, however, between Helmholtz's and his teacher Johannes Müller's uses of the term "sign." Both scientists relied on the word to describe the complex relationships among the external stimulus, the nerve impulse that transmitted it, the sensation registered by the sensory organ, and the mind's representation of that sensation. To Müller, the representation was to the sensation simply as "the sign for a thing."[22] Helmholtz, on the other hand, argued that people learned to associate signs with objects in the real world by studying how their eye and hand movements affected their positions relative to those objects.[23] In Müller's view, one could learn to read the nerves' signs but could never know the world in itself. Helmholtz, however, believed that one could use the relationships between signs to experiment on the world and gain meaningful knowledge of it.

A central weakness of previous studies of perception, Helmholtz argued, was their failure to distinguish between the concepts of "sign" and "image." In his 1878 lecture on perception, he told his audience that "insofar as the quality of our sensation gives us information about the peculiarity of the external influence stimulating it, it can pass for a sign—but not for an image. For one requires from an image some sort of similarity with the object imaged. . . . A sign, however, need not have any type of similarity with what it is a sign for."[24] A picture, Helmholtz explained, was an "image or representation of the original" because it looked like what it was; it was "of the same kind as that which [was] represented" (*PE* 166). A nerve impulse, on the other hand, looked pretty much the same in every

22. Lenoir, "Eye as Mathematician" (above n. 16), p. 117.

23. Ibid., p. 122.

24. Helmholtz, *Popular Essays*, p. 347. The original German reads: "Insofern die Qualität unserer Empfindungen uns von der Eigenthümlichkeit der äusseren Einwirkung, durch welche sie erregt ist, eine Nachricht giebt, kann sie als ein Zeichen derselben gelten, aber nicht als ein Abbild. Denn von einem Bilde verlangt man irgend eine Art der Gleichheit mit dem abgebildeten Gegenstande. . . . Ein Zeichen aber braucht gar keine Art der Aehnlichkeit mit dem zu haben, dessen Zeichen es ist" (quoted in Dosch, "Concept of Sign and Symbol" [above, n. 16], p. 49).

nerve, for every type of stimulus, and bore no mimetic relationship to the event that had inspired it. Citing Thomson's ability to "taste" signals transmitted along the transatlantic cable in the 1860s, Helmholtz declared that "nerve fibers and telegraphic wires are equally striking examples to illustrate the doctrine that the same causes may, under different conditions, produce different results" (*PE* 150). What was language to the telegraph key was taste to the tongue. Like electrical fluctuations, nerve impulses produced the results they did not because of what had excited them or even because of what they were, but because of the device that was receiving them.

As signs arbitrarily attached to the things they represented, Helmholtz proposed, nerve impulses most closely resembled words in a language. It was no accident, he submitted, that Thomas Young, who devised the first workable model for color vision, had also excelled at interpreting Egyptian hieroglyphics.[25] "There is a most striking analogy," declared Helmholtz in his 1868 lecture on vision, "between the entire range of processes which we have been discussing, and another System of Signs, which is not given by nature but arbitrarily chosen, and which must undoubtedly be learned before it is understood. I mean the words of our mother tongue"(*PE* 201). Justifying his comparison, he pointed out that one had to learn the relationships between names and objects just as one had to learn the relationships between sensations and objects: "The words are arbitrarily or accidentally chosen signs. Each different language has different signs. Its understanding is not inherited" (*PE* 354–355). Once links have been established between sensations and objects, he argued, these quickly become "just as firm and indestructible" as the associations between words and objects (*PE* 201). Not just nerve impulses but the sensations they made possible could be taken as "signs" of external reality.

Looking back on his studies of perception, Helmholtz reflected that "the impressions of the senses are only signs for the constitution of the external world, the interpretation of which must be learned by experience" (*PE* 390). Color, for instance, was a creation of the mind, a "sign" of physical properties that had nothing to do with the subjective sensation (*PE* 168). Just as eighteenth-century writers had compared language to clothes in which the truth might be "dressed up," Helmholtz envisioned sensations as the clothing of reality. In "The Facts in Perception" (1878), he wrote that objects in

25. See Mary A. B. Brazier, *A History of Neurophysiology in the Nineteenth Century* (New York: Raven Press, 1988), p. 7; Helmholtz, *Popular Essays*, p. 161.

space "seem to us 'clothed' with the qualities of our sensations . . . although these qualities of sensation belong to our nervous system alone and do not at all reach beyond into external space" (*PE* 352). If all knowledge could be traced to sensations, and if these sensations were mere signs of external reality, then one could "know" only in a relative, never in an absolute, sense. One could function only by assuming that under the same conditions, for the same object, sensations would appear the same. What was so extraordinary was that given "so inconstant a system of signs," one could recognize objects and function in the world at all (*PE* 173).

Despite the nervous system's reliance on signs, Helmholtz felt that this representational system permitted a consistent relative, if not absolute, knowledge. By learning to read the signs of perceived events *relative to each other*, one could use the language of the nerves to construct a reasonably faithful representation of the world outside. One had only to look at the telegraph, Helmholtz argued, to see the plausibility of this model. In the telegraph, as in the nervous system, what produced meaning was not the signals themselves, but the receiving apparatus: "In the net-work of telegraphs, we find everywhere the same copper or iron wires carrying the same kind of movement, a stream of electricity, but producing the most different results in the various stations according to the auxiliary apparatus with which they are connected" (*PE* 150). For Helmholtz, the principles of telegraphy revealed the way that the body processed information: in both systems, indistinguishable impulses created by very different causes became meaningful only when received and interpreted.

The Uncertainties of the Wires

Throughout the 1850s and 1860s, the American and European public—including physiologists like Helmholtz—witnessed the explosive growth of telegraph networks.[26] In 1849, the United States had 11,000 miles of telegraph lines; in 1850, Great Britain had a mere 2,200. By 1854, the United States had 42,000 miles; Great Britain, 40,000; France, 18,000; and Prussia, about 4,800. By 1867, the United States had 90,000; Great Britain, 80,000; France, 70,000; and Prussia, 45,000.[27] In 1860, George Prescott reported that American telegraph lines were "creeping over the Rocky Mountains," and by 1861 the first transcontinental line was complete.[28] A trans-

26. Standage, *Victorian Internet* (above, n. 8), pp. 57–59.

27. George Sauer, *The Telegraph in Europe* (Paris: n. p., 1869), pp. 9–11.

28. Prescott, *History* (above, n. 11), pp. v–vi.

atlantic cable connected Europe and America fleetingly in 1858, and then permanently in 1866. As one writer had predicted in 1848, the world was becoming "covered with net-work like a spider's web."[29]

Like a vast nervous system, this worldwide network promised to unite societies just as organic communications systems unified bodies, and early responses to the telegraph, especially to the transatlantic cable, reveal a widespread cultural tendency to think of the new "lines" as organic links. Henry Field called the transatlantic cable "a living, fleshy bond between severed portions of the human family," and a writer in 1878 declared that "the electric wires which web the world in a net-work of throbbing life utter their voices in all their varied tongues."[30] In his *Story of the Telegraph*, published just after the completion of the first transatlantic cable, Charles Briggs asked his readers to imagine a world "belted with the electric current, palpitating with human thoughts and emotions."[31]

Those who used the telegraph, however, quickly discovered the shortcomings of these new "nerves," and in fiction by and about telegraphers we encounter the same doubts about the artificial communications system that are found in Helmholtz's descriptions of the nervous system. On the one hand, operators found it exhilarating to receive coded messages from distant cities, messages that only they could decode and understand. Intimately connected to the keys and wires that provided their raison d'être, they viewed these electronic "tongues" and "nerves" as extensions of their own bodies.[32] As devices that linked living to technological communications systems, telegraph keys realized the romantic vision of a nervous system continuous with the natural environment and helped to develop what Susan Buck-Morss calls the "synaesthetic" view of human perception. According to this new, modern understanding of nerves, she proposes,

29. Standage, *Victorian Internet,* p. 58.

30. Ibid., pp. 104, 170.

31. Charles F. Briggs and Augustus Maverick, *The Story of the Telegraph and a History of the Great Atlantic Cable* (New York: Rudd and Carleton, 1858), p. 12.

32. In *Bodies and Machines*, Mark Seltzer points out insightfully: "The turn-of-the-century fascination with technologies of writing and representation inheres not simply in the notion that machines *replace* bodies and persons . . . nor is it accounted for primarily in the notion that persons are *already* machines . . . nor even is it 'covered' in the notion that technologies *make* bodies and persons. . . . What makes it possible for these powerfully insistent, but not entirely compatible, notions to communicate on another level is the radical and intimate *coupling* of bodies and machines" (Mark Seltzer, *Bodies and Machines* [New York: Routledge, 1992], pp.12–13).

> the nervous system is not contained within the body's limits. The circuit from sense-perception to motor response begins and ends in the world. The brain is thus not an isolable anatomical body, but part of a system that passes through the person and her or his . . . environment. As the source of stimuli and the arena for motor response, the external world must be included to complete the sensory circuit.[33]

Viewed synaesthetically, nerves became part of an open system, and, as the stories of telegraph operators show, telegraphy played an important role in developing this new concept of extended nerves.

The contact provided by these prosthetic nerves and sensory organs, however, proved as tenuous as that of late-twentieth-century e-mail relationships.[34] While it was thrilling to be "in touch" with unknown hands at distant keys, one could never truly know the numerous people with whom the new nerve network connected one. Worse, it was never quite clear just how many mechanical tongues were transmitting the messages to unknown ears. While the telegraph offered new contacts, it provided little privacy.[35] In stories by telegraph operators, we read not just the concerns of communications engineers, but the concerns of scientists investigating the nervous system. Like Helmholtz, telegraph operators suspected that their "nerves" were conveying pitifully little information about the real world. The organic and technological communications systems performed the same functions but also shared the same weaknesses: one could never be sure what was happening beyond the receiving apparatus.

Reflecting on the advantages of Morse's telegraph in 1847, Werner Siemens praised "the simplicity of Morse's apparatus, the relative facility of acquiring the alphabet, and the pride which fills everyone who has learnt how to use it, and which causes him to become an apostle of the system."[36] A gifted technician who would go on to design Prussia's telegraph network, Siemens could see that the Morse

33. Susan Buck-Morss, "Aesthetics and Anaesthetics: Walter Benjamin's Artwork Essay Reconsidered," *October* 62 (1992): 3–41, on p. 12.

34. Standage, *Victorian Internet* (above, n. 8), p. 209.

35. In a study of Henry James's story of telegraphy, "In the Cage," Andrew J. Moody explores social fears about telegraphic "leaks." Telegraphic confidentiality depended entirely upon the trustworthiness of employees, so that public fears became particularly acute when workers were discontented and threatened to strike. Even as it made possible the rapid transmission of information, the telegraph offered "new potential for . . . loss of control of information" (Andrew J. Moody, "'The Harmless Pleasure of Knowing': Privacy in the Telegraph Office and Henry James's 'In the Cage,'" *Henry James Review* 16 [1995]: 53–65, on p. 59).

36. Siemens, *Recollections* (above, n. 10), p. 82.

apparatus's superiority rested on the operator's manual dexterity. The genius of the new communications device was that it incorporated the hands, ears, nerves, and brain of its operator, who merged with it to form a doubly empowered device for transmitting and receiving information.

In the fiction by these "apostles" of Morse code, however, the human elements of the hybrid communications devices express mixed feelings about the new technology. *Lightning Flashes and Electric Dashes* offers readers exciting dramas built around tenuous telegraphic connections, relationships that are entirely dependent on electronic communication. Socially isolated, expressing themselves in an argot unique to their own set, these fictional telecommunications workers bear a striking resemblance to twentieth-century hackers.[37] The stories of *Lightning Flashes* expose the conflicting feelings of alienation, power, eroticism, and paranoia bubbling in those who spend their lives communicating over the wires. Like Helmholtz's brain, these operators can never be sure about the physical reality that corresponds to the signals they are receiving.

"A Perilous Christmas Courtship"

J. M. Maclachlan's "A Perilous Christmas Courtship; or, Dangerous Telegraphy" dramatizes this uncertainty in a simple, direct way, playing the hacker's power to communicate against his or her inability to act at a distance. As the story opens, the Scottish narrator depicts himself as an anonymous figure in a London crowd. Sensing his isolation, he reflects: "There was I, a telegraphic idler whose train had rushed him too soon officeward, among that ever changing crowd."[38] Physically surrounded by strangers, he feels much less in touch with other people in the London throngs than he does exchanging thoughts with distant bodies over the wire.

With half an hour to kill, the narrator encounters his old coworker, Frank, "the quondam crack telegraph operator . . . my Colossus of Wires" (PCC 65). Over a drink, Frank begins explaining how he came to leave telegraphy, and consequently to prosper. Proud of his newly acquired wealth and social position, the narrator's friend refers contemptuously to the eighteen shillings a week he once earned for his "dot and dashing labors" (PCC 65). Although he has abandoned his career as a telegrapher, Frank has incorporated the operator's mentality to the point that it is reflected in his narration. Interrupting his lengthy description, he tells his friend: "But let us abbreviate,

37. Standage, *Victorian Internet*, pp. 64–65.

38. J. M. Maclachlan, "A Perilous Christmas Courtship," in Johnston, *Lightning Flashes* (above, n. 9), p. 65; hereafter cited parenthetically (PCC).

as we used to say on the wire" (PCC 66). Face to face with his former friend, he still associates intimate communication with telegraphy.

Frank opens his rags-to-riches tale with an erotic image that runs through all of the *Lightning Flashes* stories: that of the beautiful, highly skilled, and highly sexualized female operator who loves to play with words over the wire. The first time he visited the London office, Frank recalls:

> I was led, nervous and bashful, through rows of tittering and whispering young lady telegraphers, who seemed to have no object on earth second to that of rendering a provincial youth awkward and shy. Arriving at "Gb" wire, my *gaucherie* forsook me as if by magic. The lady seated at the key burst upon my dazed senses like a vision of transcendent glory and heavenly beauty. (PCC 66)

The rows of beautiful women, arranged like cells in the cortex, simultaneously excite and intimidate him, their function as operators heightening their attractiveness as Frank thinks about everything their skillful hands and minds can do.

Hired for their lower pay requirements as well as their purportedly superior "manual dexterity," female telegraphers were common in the 1870s.[39] Managers of telecommunications networks preferred hiring women because they cost so much less than male employees. When female workers married, they were forced to retire, so that they never rose very high in the pay scale and never drew pensions.[40] Frequently, too, female candidates came from a higher-class background than young males and were better readers and writers.[41] Women, furthermore, were thought to have "a good system of involuntary muscles" and to be "faster than men in light rhythmical activities."[42] This belief in women's superior manual skills and lack of agency in their movements encouraged employers to view them as natural workers, even as machines, while regarding men as women's natural managers.[43] By

39. Standage, *Victorian Internet* (above n. 8), p. 134.

40. Moody, "Privacy" (above, n. 35), on p. 56.

41. William B. Stone, "On the Background of James's 'In the Cage,'" *American Literary Realism* 6 (1973): 243–247 on p. 244.

42. Katherine Marie Stubbs, "Mechanizing the Female: Discourse and Control in the Industrial Economy," in *The Image of Technology in Literature, the Media, and Society*, ed. Will Wright and Steve Kaplan (Pueblo: University of Southern Colorado Press, 1994), p. 266.

43. Intertwined with late-nineteenth- and early-twentieth-century Taylorist discourse that "model[ed] human movements after machines," Katherine Stubbs has detected "a somewhat different discourse . . . which articulated a correspondence between machines and certain types of human bodies" (ibid., p. 264). This "rhetorical construc-

1897, women constituted 33 percent of London's telegraphers and 55 percent of its counter clerks.[44]

In 1877, part of the excitement of receiving signals from an unknown hand was that one could not be sure whether its owner was male or female—a fact that led to many flirtatious exchanges. But even Frank, who knows the gender of his new acquaintance in London, is excited at the prospect of communicating with her, for he does not know anything about her beyond her appearance. Enraptured by Violet, his communications goddess, he begins cabling her from his office back in Scotland. At first Violet arouses him with her inaccessibility, for "unlike most other telegraphic ladies, she d[oes] not seem to care to 'do a flirt' on the wire" (PCC 66). The freedom of anonymity inspired many telegraphers to play erotic games when the lines were not otherwise occupied, but Violet proves properly, frustratingly, reserved. With persistence, however, Frank "so far improve[s] [the] slight 'wire' acquaintance as to get an introduction to her family," and the two become lovers (PCC 66).

Because of the four hundred miles of real space separating them, however, Frank soon finds that his relationship must be restricted to a series of electronic dispatches. His reflections on their dot-and-dash love-making convey another feeling expressed throughout the *Lightning Flashes* collection: a deep frustration with the limits of electronic communication, which only stimulates the desire for physical presence by offering fleeting, tantalizing contact:

> When I returned, sedate, but not unhappy, to the Glasburg end of Violet's wire, such a burning stream of affection, solicitude, and sentiment flowed over that senseless iron thread . . . that I often thought, when our words grew warmer than usual, that the wire might positively *melt,* and so cut the only link that bound us in love together! That link was over four hundred miles long, . . . and yet we seemed as near to each other as if 'twere only a clothes line! (PCC 66)

The more Frank communicates with Violet, the more aware he becomes of all that he cannot communicate. By depicting this maddening play of presence and absence, Frank's story explores exactly how much—and how little—a telegraphic wire can influence actions four hundred miles away.

To distinguish their parasitic communications from the official dispatches for which the line was built, the lovers develop a code

tion" presented women as more machine-like than men, more adept at involuntary movements and hence better suited for working with machines. I am grateful to N. Katherine Hayles for bringing Stubbs's work to my attention.

44. Moody, "Privacy" (above, n. 35), p. 56.

within a code. Depending entirely upon these private signals, their on-line relationship progresses fitfully as they crave expressions of love that their system cannot convey. On Christmas day, a very glum Frank is on duty in his Scotland office when "the London instrument, which had laid inert and silent nearly all that quiet day, to my intense wonderment and surprised delight suddenly chirruped forth 'F.'" Recognizing their private signal, Frank asks himself, "Could it be my darling at the other end of the wire?" (PCC 66–67). Sure enough, Violet has bribed a porter to enter the colossal, empty London office and send her lover a private Christmas message. Though the system is down, their private, forbidden communications continue.

While dots and dashes can never transmit the touches Frank craves so desperately, they do convey a good deal about his partner's mood and emotions through the nuances of her personal touch on the key. Technological communications, like those sent directly by the body, have a distinct personal rhythm, and from the duration and spacing of Morse's dots and dashes, an experienced operator could detect not just the sender's sex and identity but his or her personality and mood.[45] As is the case physiologically, the interpreting brain makes sense of incoming signs by reading them relative to one another. While Violet is in the abandoned office, robbers break into the building, and Frank "hears" a sudden change in her style. He perceives "a tremulous line, ending in a series of unconnected dashes and dots that seemed to shiver on the armature, just as if the hand that held the key wavered and shook with some strong emotion, and endeavored vainly to form characters almost mechanically" (PCC 67). The author makes it clear that the nerve between London and Scotland can transmit not just information, but emotion as well. Keeping her head, the beleaguered Violet cables Frank for help. Restricted by problems of real space—and real economics—he runs across the street to a competing telegraph company and sends a frantic message to their London office which, unlike that of his own company, is open on Christmas and is located just two blocks from Violet's.

Once he has wired for help, however, Frank realizes his actual powerlessness. Well aware of what a four-hundred-mile barrier really means, he can only wait as he envisions his beloved violated or murdered by the thieves. In despair, Frank curses the tantalizing instrument that never offers quite enough contact: "forgetful of the four hundred miles which separated me from the cruel wretches who

45. Standage, *Victorian Internet* (above, n. 8), p. 130.

threatened all I held dear, I desperately shook the fatal instrument in a paroxysm of impotent rage" (PCC 68). Though the telegraph promises intimate contact, it tortures its operator by failing to provide the physical presence it suggests.

Thanks to the communications power that the wires *do* provide, help arrives in time, but Frank is unimpressed with these extensions of his nerves and resolves to free himself from the Tantalus torture forever. Interestingly, the story upholds his rejection of telegraphy by rewarding him with a wife (Violet), a child, and a lucrative new career, possibly because Maclachlan shares his frustrations. Through Violet's family, Frank obtains a position on the Stock Exchange, where he subsequently "prosper[s] amazingly" (PCC 68). But by 1877, of course, the British Stock Exchange owed its burgeoning life to the same tantalizing telegraphy abandoned by Frank.[46] While this one Scottish telegrapher escapes the tenuous relations offered by the net, his entire society is coming to depend upon these relations for its socioeconomic survival. By 1870, William Orton, the president of Western Union, could boast that the telegraph was "the nervous system of the commercial system."[47]

"Kate: An Electro-Mechanical Romance"

Like "A Perilous Christmas Courtship," Charles Barnard's American tale, "Kate: An Electro-Mechanical Romance," depicts people's desperate need for intimate contact and private communication. In particular, it suggests the pleasures and dangers of communicating privately in a public web. In this case, the problems of personal contact in the telegraphic network merge with the closely related ones offered by the railroads, for the ingenious, frustrated lovers are a telegrapher and an engineer.

Kate and John, the main characters, are introduced through their intimate relationships with machines, and the author conveys the mechanical grounding of their courtship through highly eroticized descriptions of their technological counterparts. The opening line of the story, "She was a beauty," delivers an ironic jolt when the reader discovers that this "beauty" is not a woman, but John's locomotive:

> From head-light to buffer-casting, from spark-arrester to airbrake coupling, she shone resplendent. A thing of grace and power, she seemed instinct with life as she paused upon her breathless flight. Even while resting quietly upon the track, she trembled with the pulsations of her mighty heart. . . . She seemed

46. Standage, *Victorian Internet*, p. 170.

47. Ibid.

> long and slender like a greyhound, and her glistening sides, delicate forefeet, and uplifted head were suggestive of speed and power.[48]

Before he ever meets Kate, John is intimately joined to his engine, which the author presents not just as an eroticized mate but as an extension of his own body. Once he discovers the young telegrapher, a reference to the engine's "forefoot so daintily thrust out in front" (K 53) aligns the engine with his prospective human mate, who takes a brief ride with "one little foot steadied against the boiler" (K 55). When John shows Kate his mighty engine, the narrator tells us, "the little electrician was charmed. . . . what a magnificent machine he had beneath him!" (K 55). John loves his engine, and the author conveys his excitement over Kate by expressing each passion in terms of the other.

Like the operators in "A Perilous Christmas Courtship," Kate feels socially isolated and finds intimacy only through electronic exchanges. In her rural station office,

> there was a sunny window that looked far up the line, and a little opening where she received the messages. She viewed life through this scant outlook, and thought it very queer. . . . Sometimes between the trains the station was quite deserted, and were it not for the ticking of the clock and the incessant rattle of the fretful machine on her desk, it would be as still as a church on Monday. At first she amused herself by listening to the strange language of the wires, and she even made the acquaintance of the other operators. (K 54)

When Kate listens in on the communications of others, their "tongues of brass" strike her as mechanical and uninteresting until she hears a sophisticated female "voice" that charms her ear. Like Frank, Kate has a sensitive ear for the "language of the wires," and she recognizes one woman (Mary) in a distant city as a "lady." Gradually, as Kate's and Mary's personal messages slip through between the official ones, the complex circuit connecting the two telegraphers lets them become intimate friends.

Sadly, in their attempts to communicate face-to-face, Kate and John are nowhere near as successful as are the two women over the wire. As luck would have it, the two lovers are continually thwarted by dispatches that reach Kate's station just as John arrives, chaining her to her key. Unable to exchange thoughts in person, they are left with only the vaguest, most unsatisfying signals: "Ah!" exclaims the narrator, "a dress fluttering in the doorway. . . . With both hands on the throttle-valve, the engineer leans out the window. A handker-

48. Charles Barnard, "Kate: An Electro-Mechanical Romance," in Johnston, *Lightning Flashes* (above, n. 9), p. 53; hereafter cited parenthetically (K).

chief is quickly flirted in the air" (K 54). Restrained not just by physical and economic circumstances, but by their fear of discovery, Kate and John find themselves unable to communicate. Despite their obvious attraction, the engineer and the telegrapher do not want their mating signals to be read by others, and they long for a system in which they can talk more privately. Simply to communicate is not enough; like the other characters in the telegraphers' stories, they long to exchange thoughts via signals and circuits known to them alone.

When the frustrated lovers finally do have a private conversation, it is about how to communicate. At first, Kate suggests that John whistle to signal her when he passes. Re-creating Helmholtz's argument about the possibility of human knowledge, she persuades him that a single sounding of the whistle has no meaning in itself, but a series of toots becomes informative because of the time intervals between them. When he gives her only a single blast, she explains, "I cannot tell your whistle from any other, and so, I sometimes miss seeing you." Seeing her point but unwilling to make his communication public, John replies, "if I gave two whistles or three, they would think it meant some signal, and it would make trouble" (K 55). The urge for intimate contact proves too great, however, and when Kate teaches John how to blast out her name in Morse code, he learns the signal eagerly. For a time, the lovers are content as John blares out this mechanized mating call twice a day.

Kate still fears discovery, however, for their code is shared by an entire community of hackers.[49] Late one evening, she signals Mary and confesses her worries to her friend. Here again, the author makes it clear that even when one communicates through a series of electronic "breaks," it is possible to have a personal style: "At once the two girl friends were in close conversation with one hundred miles of land and water between them. The conversation was by sound in a series of long and short notes—nervous and staccato for the bright one in the little station; smooth, legato and placid for the city girl" (K 56). By comparing the flow of signals to music, the author shows quite aptly how patterns of sound can suggest moods and personality traits. To help her country friend, the clever Mary suggests a more daring but more secure way of communicating: Kate and John must rig their own private, parasitic circuit. At first Kate hesitates, for such tampering is against company rules, but eventually she decides to build the circuit when two itinerant operators hear John's "Titanic love-signal" and ask each other "Kate? Who's

49. Standage, *Victorian Internet*, pp. 129–131.

Kate?" (K 57). There can be no private messages when everywhere there are trained receiving ears.

As the determined lovers set out to build their private circuit, the author describes the construction in such detail that the story can only be read as a how-to manual for hackers. Using an abandoned wire, a pickle-jar battery, and eleven dollars' worth of electronic gear, Kate and John build a circuit that will ring a bell in her office whenever his engine passes a pair of trees several miles away. Because of a special rod he has attached to his engine, the bell sounds for his train alone. Thanks to modern communications technology, Kate and John are on the brink of achieving the intimate contact for which they have so sorely longed.

As Kate waits anxiously to see whether their new apparatus will succeed, her own overloaded neural circuits create chaos in the technological ones. Describing the infatuated operator's distraction, the author of "An Electromechanical Romance" conveys the interdependence of the physiological and mechanized circuits that have their interface in the beleaguered heroine: "It was very singular how absent-minded and inattentive the operator was that day. She sent that order for flowers to the butcher, and Mrs. Robinson's message about the baby's croup went to old Mr. Stimmins, the bachelor lodger at the gambrel-roofed house" (K 59). Like the apparatus to which she is continually attached, Kate is a communications device of sorts, and both the technological and physiological systems are susceptible to breakdown and overload.[50] When either system is overtaxed, messages can be misdirected, and communications can go awry. As it turns out, the illegal circuit works beautifully, and, informed of her lover's arrival, Kate is able to put on a "dainty hat" before John appears (K 60).

As Kate's poor performance makes clear, the human portions of telegraphic circuitry were often its weakest links, and because the railways depended upon telegraphy for their signals, they were open to error in any way that their human machinery was vulnerable. As the author puts it, "life [is] an iron road with dangers everywhere"

50. In a study of Henry James's "In the Cage," Jennifer Wicke argues that in the late nineteenth century, "women come to mediate exchange." Increasingly recognized as office workers, telegraphers, telephone operators, and consumers of commercial goods, female workers used their minds and bodies to move an entire society's information: "Communication flows through them," writes Wicke, "telegraphically or otherwise enhanced; information traveling along class lines collocates in them; the mechanisms of mass cultural transfer of libidinal, commodity desire are set up with 'woman' at the switch point" (Jennifer Wicke, "Henry James's Second Wave," *Henry James Review* 10 [1989]: 146–151, on p. 148). Kate, whose mind and hands must juggle messages about the town's business, provides an interesting illustration of Wicke's hypothesis.

(K 54). One evening a group of hungry railroad company directors stop at the station for dinner, leaving their train on the main track. Unexpectedly, Kate's signal sounds, warning her that John's engine is approaching, and she cries to the directors to move their train to a siding and rushes out into the night to signal her lover. Thanks to her warning, the deadly collision never occurs, but the grateful directors demand to know how she knew the express was coming. When she confesses, they call a meeting on the spot and declare that "whereas, John Mills, engineer of engine Number 59, of this railway line, erected a private telegraph; and, whereas he, with the assistance of the telegraph operator of this station . . . , used the said line without the consent of this Company, and for other than railway business: it is resolved that he be suspended permanently from his position as engineer, and that the said operator be requested to resign" (K 61–62). If the company is to maintain control over the communications system on which it depends, it can permit no private use of its circuits, no unauthorized local power centers in its information net. While the directors remove Kate and John from their web, they reward John for his initiative and technical skill, appointing him chief engineer in a new repair shop. There is no mention of a job for Kate.

Like "A Perilous Christmas Courtship," Kate and John's "electromechanical romance" ends with the substitution of presence for absence, of physical for electronic contact, as the operator and engineer bond with each other instead of with their mechanical prostheses. With desire fulfilled, there is no further need for telecommunications, technical ingenuity, or narration itself. "Handiness," the tale implies, is best devoted to the public good, not to the construction of private circuits, and private communications conducted over public networks will always be discovered in the end. In its closure, the American tale echoes the Scottish one in privileging physical presence over long-distance communication. That is not the case for all the stories in the collection.

"Playing with Fire"

A third tale, L. A. Churchill's "Playing with Fire," represents the pleasures and risks of nineteenth-century telecommunications with much deeper irony. Like the stories of Frank and Kate, it explores the frustrating limitations of telegraphy, but it far exceeds them in suggesting how these restrictions can be used to creative advantage. In this story, the heroine, Rena, is a skilled, eroticized dispatcher who in the opening paragraph "thr[ows] back her curls in an energetic manner with her left hand while she open[s] her key with the

right."[51] Rena, however, lacks Kate's and Violet's mating instincts. She may be "the best looking operator on the line," but for her, the wires come first (PF 69). Rena draws her identity from her profession as a telegrapher, and she loves to play games with her key.

In "Playing with Fire," the problem of knowing to whom one is writing merges with much broader cultural anxieties about people's ability to know one another on any level. As suggested in the other stories, physical presence does not necessarily facilitate communications. The inability to know to whom one is speaking, these operators imply, is not a problem unique to telegraphy. Instead, complaining about the shortcomings of telegraphic communication becomes a way of articulating the difficulties of communication in general. We can never know the real thoughts of our neighbors, despite widely held assumptions about class and gender. In this operator's tale, it is Americans' assumptions about male and female behavior that come under attack. Woven into what might have been a traditional story of love and marriage are subversive avowals of online flirtation for its own sake.

"A merry body, and fond of fun," Rena resolves to trick a female dispatcher in a nearby office by wooing her over the wire as a man. "I must do something to keep from stagnating in this dull office," she vows. "Yes, I will sign a man's name and fool her in grand shape" (PF 69). Like Kate and Frank, Rena is a seasoned operator, and she communicates with the puns and abbreviations of nineteenth-century hackers.[52] She tells the other telegrapher, whom she knows only as "Bn," that her name is Isaac:

> "My name is Isaac, but I sign 'Ic.'"
>
> "U are joking, I fear. Is your name really Isaac?"
>
> "I am not, truly. If you ever want me call 'Ic.' . . . I saw u sitting near ur window the other day while I was passing there on the train, and . . . I compared u to a white rose I held in my hand." (PF 69)

While their ears detect only clicks and pauses, the two operators' abbreviations rely upon the sound of the spoken language—itself a system of signs—that their signals supposedly represent. Although the telegraphers work with dots and dashes, their delight in language's confluences drives the game. The woman seems pleased by this compliment, and Rena thinks, "If I can make her think I am really and truly a man, I will have some fun of the first water. . . . I fancy she

51. L. A. Churchill, "Playing with Fire," in Johnston, *Lightning Flashes* (above, n. 9), p. 69; hereafter cited parenthetically (PF).

52. Standage, *Victorian Internet*, p. 130.

liked being told she looked like a rose" (PF 69). Happy with the thought that she is desired by this unknown woman, Rena continues her suit, and the female telegrapher responds eagerly.

One day, Rena receives a letter requesting an encounter in real space. The railway timetables have permitted her friend an hour-and-twenty-minute layover at Rena's station, and the on-line lovers can finally meet in the flesh. Regretting the end of her intimacy with the unknown woman, Rena thinks: "I am so deeply interested in her that I more than half wish this Isaac business was a reality" (PF 70). When the train arrives, however, no female passenger disembarks. Instead a "tall, fine-looking fellow" approaches her, asking for Isaac. Realizing that the game is up, Rena confesses that she is Isaac but tells him that she is waiting to meet a friend. As an experienced operator, the attractive man asks, "What does your friend sign?" To one who spends her life reading electronic signals, one's personal "sign" is a mark of identity as telling as her own face, and Rena responds, "her office call is 'Bn,' but I believe she signs 'D'" (PF 70–71). The fine-looking young man, of course, is "Bn." The trickster has been tricked by the same strategy with which she hoped to fool the female operator: she has made false assumptions about the origin of the signs she is reading.

Like a Shakespearean comedy, this operator's tale offers a socially sanctioned narrative closure after experimenting with traditional gender roles. "Bn"—who half-believed he was intimate with another *male* operator and thoroughly enjoyed it—confesses: "often I have wished I *was* Miss Dwinnell, if Isaac would care for me as he seemed to care for her. But things are now just as they should be, and if you do not consider the action too abrupt, I would like to ask you to be my wife" (PF 71). Rena, however, refuses his offer, and the author rejects the restorative ending the reader expects. "Home love is not for me," declares Rena. "I have duties you know nothing of—a purpose in life which I must work out alone" (PF 71). More devoted to her key than to family values, she dedicates her life to telegraphy.

In an epilogue, the author kills off the stubborn heroine, perhaps in consternation for her denial of traditional gender roles. "A few years later Rena died," we read. "Her work was done" (PF 71). Apparently, even Rena's invocation of the Calvinist work ethic cannot overcome her rejection of domesticity. This harsh conclusion, however, is as unconvincing as that of LaClos's *Les liaisons dangereuses*, the classic tale of deceitful communications. In the telegrapher's story and the French novel, the real life of the tale is in the perverse courtship, not in the severe dénouement. The story of Rena suggests that if one uses the new communications system to create an optical

illusion of sorts, establishing a new, false identity, the physical world will eventually overwhelm the scheme, but what fun one will have while it lasts! Not knowing who is at the other end of the wire can be disturbing, even frightening, but it can also be liberating and exhilarating. With the anxiety about not knowing comes the pleasure of not being known, so that telegraphy's tenuous relation with the real world simultaneously empowers and disempowers the lonely operator.

Conclusion

Niklas Luhmann has proposed that "the system of society consists of communications. There are no other elements, no further substance than communications."[53] If Luhmann is correct—and nineteenth- as well as twentieth-century cultural developments suggest that he is—then it is not surprising that communications should arise as a central issue in scientific as well as literary texts. Certainly the physiologist Helmholtz and the telegraphers whose stories compose *Lightning Flashes* were equally worried about people's limited capacities to communicate with each other and to know and understand distant events. Both the scientist and the creative technicians express concerns about the severe restrictions of organic and technological communications systems, and both actively compare the two in weighing their shortcomings. While many German telegraph operators knew Helmholtz's popular essays, it is unlikely that these Scottish and American telegraphers ever read the physiologist's writings directly. Their similar treatment of epistemological problems is not evidence of influence, but of a deep-set cultural anxiety about knowing.

While these writers' treatments are comparable, they are by no means identical, and an examination of their differences can be as informative as a study of their similarities. The authors of *Lightning Flashes* depict people hungry for human contact, intelligent conversation, and physical and emotional bonds, and their characters seek not just reliable but private systems of communication. As operators, these writers worry about all aspects of telegraphic circuits: primarily about the ability to send and receive information clearly, but also about the many unwanted ears that may be receiving the signals they send.

Because of his different interests, Helmholtz focuses on the body's function as a *receiver* of information. As a physicist and physiologist, Helmholtz wants to understand how the eye and ear convert physi-

53. As quoted in Seltzer, *Bodies and Machines* (above n. 32), p. 159.

cal aspects of our environment into the images and sounds we perceive. Unlike the creative writers studied here, he hopes that everyone *does* receive the same signals, since only by comparing the perceptions of individual observers will it be possible to know anything at all.[54] While he uses the telegraph as a metaphor and believes strongly in the parallels between natural and artificial communications systems, he uses it in a very specific way: to show that the meaning of signals depends entirely upon the apparatus receiving them. This fact in itself places severe restrictions on human knowledge, and the possibility of codes and wires specific to individual receiving minds threatens to destabilize our knowledge even further. Because of their different experiences and goals, physiologists like Helmholtz had no desire for the private communications so coveted by telegraphers.

The English language suffers from its heavy concentration of meaning on the verb "to know," and the distinction made in Romance languages between knowing information (*saber*, for instance, in Spanish) and being acquainted (*conocer*) sheds light on the distinctive desires of those working with organic and technological communications systems. Helmholtz is probing the mind's ability to construct factual knowledge and refers to the telegraph to point out the uncertainty of that knowledge. Because of the consistent relationships between the signs one reads, he believes, it is still possible to learn how to read properly and to gain a realistic, although limited, understanding of the world. Human knowledge, however, will always be restricted because, like a telegraphic apparatus, the human nervous system can only read incoming information in certain ways.

The telegraphers, in contrast, are exploring the ways that one can know *people*. When nineteenth-century writers compare telegraph wires to nerves, and keys to tongues and ears, they are noticing the body's resemblance to technological receiving devices just as Helmholtz does, but they are also expressing their desire for meaningful relationships with other human beings. As the stories of Frank, Kate, and Rena show, the long hours and monotonous work required of telegraphers created frustration and loneliness.[55] Ironi-

54. Olesko and Holmes, "Experiment" (above, n. 20), p. 94.

55. William B. Stone reports that British telegraphers worked an average of 48 hours per week, alternating between weeks of 60 and 36 hours. See Stone, "On the Background" (above, n. 41), p. 245. Female operators in London found that it was not possible to live on what they earned, and both male and female telegraphers were often discontented and threatened to strike. Between 1895 and 1897, in Great Britian, a grievance committee looked into telegraphers' complaints—and decided to lower their pay. See Moody, "Privacy" (above, n. 35), pp. 55–56.

cally, those entrusted with nineteenth-century society's communications were among its most isolated members. In the United States, particularly, with the vast spaces encompassed by its new communications net, workers in rural offices spent far more time listening to their machines than to the voices of other human beings. When they wrote about their machines, these operators interwove their intimate relationships to their technological communications devices with their hunger for intimacy with other human communicators like themselves. While there was an undeniable overlap between physiologists' interests and their own, it was people, not facts, that they wanted to know.

The common interests of Helmholtz and these creative writers, however, remain highly significant. Both recognize the weak links between remote events and the mind's understanding of them, and both, like Luhmann, point to communications as a problem equally essential to culture and to biology. Both the scientist and the creative writers recognize the body's affinity to society's communications machines, and both explore the limits of what one can know through either organic or technological communications systems as well as through combinations of the two. In neither case are their comparisons simple ones, presenting the artificial as a weak substitute for the natural, or long-distance communication as a weak substitute for presence. Helmholtz occasionally uses technological devices to point out the weaknesses of sensory organs, and the telegraphers, especially the author of "Playing with Fire," show some of the advantages of telegraphy over face-to-face communication. Both the scientist and the creative writers use a specific type of communication—the vaunted mid-century telegraph networks—to raise questions about people's abilities to know or communicate anything, under any circumstances. By exploring the uncertainties of telegraphy, they voice doubts about their culture's communications—about its essential structure.