

## The Politics of Innovation

**T**HIS ESSAY PROVIDES A HISTORICAL PERSPECTIVE on the process of innovation in American communications. It is drawn from a larger, ongoing study of communications policy in the post-office department, Western Union, and the Bell System in the formative era that stretched from the adoption of the Constitution to World War I. This period holds special interest for students of innovation, since it witnessed the establishment of a modern postal system as well as the commercialization of the electric telegraph and telephone—three of the most notable improvements in communications technology during the past two hundred years.

It is my hope that this brief account can provide some insight into the innovative process in other complex social institutions, such as primary education. To facilitate comparison, innovation is defined broadly to include conceptual advances as well as technical breakthroughs, and the innovative process is understood to embrace the diffusion as well as the origination of novel methods and ideas.

Communications and education, of course, differ in many ways. Communications has long been one of the most dynamic sectors of American society, while education, with a few notable exceptions, is among the most stable. Nonetheless, several themes in the history of communications would seem to be relevant for educational reformers. These include the inescapability of politics; the indispensability of a broad, uni-

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versalistic mandate; and the instrumentality of competition as a catalyst for change. The history of communications also introduces a note of caution for educational reformers frustrated with the status quo. Even in communications—a realm far *less* hemmed in by societal constraints—the innovative process has never been smooth or straightforward. At the very least, the dynamism of American communications may provide something of a template against which educational reform can be gauged. If a particular innovative strategy failed in communications, it is not likely to succeed in education.

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The earliest—and, very possibly, the most fundamental—innovation in American communications took place in mail delivery. Beginning in the 1790s, the government undertook for the first time to provide a geographically far-flung population with regular, time-sensitive information about commerce and public affairs. Prior to the 1790s, news had been confined to the Atlantic seaboard; by 1828, it had become ubiquitous throughout much of the vast trans-Appalachian hinterland. Almost two decades *before* the commercialization of the electric telegraph, the United States experienced a communications revolution that would exert a far-reaching influence on the pattern of everyday life. In 1832, the respected political theorist Francis Lieber made this point in a compelling way. The modern postal system, Lieber declared in an encyclopedia entry, deserved to be ranked, alongside the printing press and the mariner's compass, as "one of the most effective elements of civilization."<sup>1</sup>

While the American postal system in the early republic almost never receives more than incidental notice from historians, it was in fact the keystone of an elaborate communications infrastructure that included the stagecoach industry and the newspaper press. Indeed, its social effects were so wide-ranging that it can be usefully characterized as a *technological system*, giving it priority—ahead of the railroad and the electric telegraph—as one of the earliest of the great technological systems of the modern age.<sup>2</sup>

Among the outstanding postal administrators in the early republic was John McLean, postmaster general between 1823 and 1829. McLean expanded service, regularized administrative procedures, and instituted a meritocratic personnel policy that, had it not been repudiated by the Jacksonians, might well have become a prototype for the modern civil service. In tribute to McLean's achievement, and to the growing role of mail delivery in American life, President Andrew Jackson officially designated the postal system a government department in 1829. By this time, it was by far the largest organization in the United States.

The single best measure of the growing role of the postal system in the early republic is the rapid expansion in the number of post offices during the first few decades of the new nation's existence. When the Constitution was ratified in 1788, the postal system embraced a mere sixty-nine offices, almost all of which were strung along the Atlantic seaboard in a single North-South chain known today as the Old Post Road. By 1800, the chain had become a network of nine hundred offices; by 1828, over seventy-six hundred. Not until the 1880s would Western Union operate on a comparable scale.<sup>3</sup>

The magnitude of the American achievement is particularly evident if one adopts an international comparative perspective. In the 1830s, there were twice as many post offices in the United States as in Great Britain and over five times as many as in France. In an age in which France had four post offices for every one hundred thousand inhabitants, and Great Britain seventeen, the United States boasted no fewer than seventy-four. European observers were understandably impressed. The American postal system, exclaimed Alexis de Tocqueville following his 1831 trip to the United States, was a "great link between minds" that penetrated into the "heart of the wilderness," bringing enlightenment to all.<sup>4</sup>

The innovativeness of American postal policy owed little to technical breakthroughs in engineering or science. Well into the 1830s, the horse remained the principal motive power. The key postal innovation, rather, was conceptual. Prior to the break with the British crown, American postal policy remained constrained by its fiscal rationale. No achievement garnered colo-

nial postal administrators greater official renown than the amount of revenue that they returned to the treasury. In Great Britain, this fiscal rationale would continue to shape postal policy well into the twentieth century. (Indeed, the British post office would not run its first annual deficit until the 1950s.)<sup>5</sup> In the United States, in contrast, this fiscal rationale was soon supplanted by a capacious commitment to civic education. In a country that claimed to derive its authority from the sovereignty of the people, it seemed self-evident that the citizenry had a right to be well informed.<sup>6</sup> Postal policy in the early republic became a means to this end. As the political theorist Benjamin Rush explained in 1787, the postal system was the “true non-electric wire of government” and the “only means” of “conveying light and heat to every individual in the federal commonwealth.”<sup>7</sup>

The educational rationale for postal policy had major fiscal implications. Now that postal administrators were no longer obliged to maximize the revenue they returned to the state, they redirected the postal surplus to various developmental projects. For a time, postal administrators found it possible to fund these projects out of postal revenue. Beginning in the 1840s, however, they began to run up large annual deficits, obliging Congress to make annual appropriations to cover their costs.

It is sometimes assumed that the adoption of an educational rationale for postal policy was an evolutionary development rooted in social circumstances that could be traced back to the colonial era. While plausible, this assumption is mistaken. Like so many events in the history of American communications, this conceptual advance was, rather, unplanned and unforeseen. No one in 1788, let alone 1776, could have anticipated the full magnitude of the changes that were about to occur.

Consider the celebrated *Federalist* essays that James Madison prepared during the ratification debates to help persuade undecided voters to ratify the Constitution in the pivotal state of New York. Though Madison firmly supported a stronger central government, he did not envision an enlarged role for communications. Citizens would learn about the affairs of state not from the press but, rather, from personal meetings with their representative when he returned home to meet his constituents face-to-face.<sup>8</sup> For example, in *Federalist* number 10—

the most important single piece of political theory to emerge from the constitutional debates—Madison treated *poor* communications as a guarantee of political stability. Given the enormous territory that the new republic embraced, Madison explained, it was logistically impossible for tyrannical factions to conspire against the public good. From such a standpoint, communications improvements were not without their potential perils and, as Madison mused at the time in a private memorandum, might eventually drive the republic apart.<sup>9</sup>

Even Benjamin Franklin failed to anticipate the conceptual advance that would undergird American postal policy in the early republic. This was true even though Franklin was an unusually astute student of public affairs, as well as a former royal postal officer who, in the 1760s, had himself introduced various postal innovations. Indeed, Franklin’s very familiarity with royal postal policy may well have predisposed him to assume that postal policy in the independent United States would remain broadly similar to postal policy under the Crown. It is perhaps not entirely surprising then that Franklin highlighted the administrative continuities with the colonial era during his brief stint in 1775 as the first postmaster general of the United States.

The new, sweeping rationale for communications policy was institutionalized in the Post Office Act of 1792. Though this law has occasioned little sustained discussion from specialists in the period, and is almost invariably omitted from textbook accounts, it deserves to be remembered as a landmark in American communications policy and one of the most significant pieces of legislation to have been enacted in the early republic. The text of this act includes no ringing phrases to invite historical scrutiny. Yet it established two principles that would soon restructure American communications in a fundamental way.

The most important of these principles invested Congress, rather than the executive, with the authority to establish new postal routes. Since Congress could be expected to be more responsive to local pressure than postal administrators, this principle virtually guaranteed that the postal network would rapidly expand from the Atlantic seaboard into the trans-Appalachian West. To this day, in the National Archives there are

thousands of petitions to Congress that testify to the determination of ordinary Americans to improve their access to news from afar. "We recommend that a post be established to our district and county towns," declared one group of South Carolinian petitioners in 1793, since such communications were the "soul of commerce!" Lacking such a "direct, regular, and immediate communication by posts," the petitioners explained, they were "kept in ignorance," and "know not anything which concerns us, either as men or planters."<sup>10</sup> Before long, ordinary Americans came to assume they had a *right* to be linked to the communications network, regardless of the cost. In some instances, as critics did not fail to point out, this led to the establishment of routes that could not bear one-hundredth of the expense.<sup>11</sup>

The second principle provided a series of targeted subsidies for the press. Not only did Congress admit newspapers into the mail—a major departure in its own right from colonial and revolutionary practice—but it also permitted them to be transmitted at highly favorable rates. In addition, Congress formalized a long-standing convention that enabled newspaper editors to gather news at a minimal cost. The results were predictable. During the early republic, newspapers typically made up as much as 95 percent of the weight of the mail, while generating a mere 15 percent of the revenue. Interestingly, this subsidy troubled few contemporaries, in part because, in this period, newspapers were the *only* item that the vast majority of postal patrons received.<sup>12</sup>

Taken together, these various principles enshrined *universal access* as a defining feature of American communications policy. Public figures in the early republic may not have termed this mandate "universal service," yet it anticipated in several regards the corporate philosophy that would later be championed in the Bell System by Theodore N. Vail.

To accommodate the expansion in mail volume that had been set in motion with the Post Office Act of 1792, postal administrators established a stagecoach-based, hub-and-spoke sorting scheme that involved the creation of a network of distribution centers overseen by a team of middle managers. This organizational innovation proved surprisingly enduring and lasted until

the Civil War, when it was supplanted by the train-based, continuous-sorting scheme that came to be known as railway mail. For a time, Congress even underwrote the establishment of a rudimentary national stagecoach network by awarding highly advantageous mail contracts to stagecoach proprietors. According to one estimate, the stagecoach industry soon came to rely on postal contracts for as much as 33 percent of its total revenue.<sup>13</sup> "Having obtained the mail contract from Milledgeville to Montgomery, Alabama," announced one typical broadside in 1826, the proprietors would soon establish a stagecoach line to transport passengers between these two towns.<sup>14</sup>

So long as the postal system remained self-sustaining, the cost of the various cross-subsidies was borne by letter writers—and, specifically, by merchants and the well-to-do. Prior to the passage of the Post Office Acts of 1845 and 1851, which significantly reduced the basic letter rate—ushering in what reformers hailed as the age of "cheap postage"—it could cost as much as 50 cents to mail a single letter, a substantial sum in an age when many Americans made \$1 a day. Not surprisingly, as late as the 1830s, congressmen could matter-of-factly proclaim high letter postage to be *popular*—since, by subsidizing newspaper carriage and rural mail routes, it benefited the many at the expense of the few.<sup>15</sup>

One of the unanticipated consequences of these cross-subsidies was the incentive they offered entrepreneurs to underbid the government on selected routes. In the period between 1839 and 1851, a number of enterprising individuals—including William Harnden, Henry Wells, and James W. Hale—established independent mail-delivery firms that competed head-on with the post-office department, providing postal patrons with a comparable, and, in many instances, superior level of service for a significantly lower fee. The independents also introduced a number of innovations that were subsequently adopted by postal administrators, including mandatory prepayment, mail boxes, and postage stamps.

Why these firms emerged at this time, and not earlier, is an open question. Yet the competitive challenge that they posed was unmistakable. At the height of the independent mail-delivery boom in 1845, as many as two-thirds of all the letter mail in the

country was being conveyed by nongovernmental carriers—or, as the phrase went, “outside of the mail.”<sup>16</sup> In the entire history of the U.S. Postal Service, postal administrators have never faced a more formidable threat. In response, Congress passed the Post Office Acts of 1845 and 1851, which mollified postal patrons by significantly lowering the basic letter rate and fortified the postal monopoly by plugging the legal loopholes that the independents had so successfully exploited.

It is something of a puzzle why so many subsequent postal innovations—including city delivery, railway mail, rural free delivery, and parcel post—lagged behind their counterparts in Europe. Equally perplexing is the repeated failure of reformers to expand the jurisdiction of the post-office department to embrace telegraphy and telephony, as was common in much of the rest of the world. After all, in the early republic the American postal system had been innovative in a number of realms. Why did this trend not persist throughout the rest of the century?

At least part of the answer can be traced to the extraordinary sensitivity of American political leaders to the specter of political corruption. Public figures of all political persuasions deplored the partisan manipulation of public office, stymieing reformers intent on expanding the government work force. Jacksonian party leaders galvanized this concern by lavishing an unprecedented number of postmasterships on political supporters, institutionalizing the notorious “spoils system” that would undergird federal hiring practices until well after the Civil War. Indeed, to an extent that is often overlooked even by specialists in the period, the creation in the 1830s of the mass party—and, with it, the modern two-party system—owed a major debt to the *prior* expansion of the postal system in the period before 1828.<sup>17</sup>

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The specter of corruption played an equally conspicuous role in the early history of electric telegraphy. In particular, it helps to explain why this major technical breakthrough—the first communications technology to be based on electricity—came to be

administered as a private enterprise. In the deregulatory climate of the late twentieth century, this outcome may seem unsurprising. A century ago, however, it set the United States apart. In this period, the United States was the *only* major industrialized country in which telegraphy was administered by a private corporation rather than a public agency. Yet if the inventor of the telegraph, Samuel F. B. Morse, had had his way, the United States would have diverged less markedly from the European norm.

Morse’s approach to telegraphy was shaped by his familiarity with the optical telegraph that had been invented by Claude Chappe in the 1790s in revolutionary France. Chappe’s telegraph consisted of a chain of towers—located, on average, ten miles apart—fitted with a pair of wooden shutters that could be arranged in a variety of positions. By manipulating the shutters, operators could transmit in just under three minutes a rudimentary message from Paris to Lille, a distance of 100 miles. Most early messages were government dispatches; during most of its history, the French government prohibited ordinary individuals from using Chappe’s telegraph at all. Chappe coined the term “telegraphy”—which meant, literally, “writing at a distance”—to describe his invention, even though it was not, strictly speaking, a *recording* medium. The optical telegraph proved invaluable to Napoleon, who used it to coordinate military campaigns, and it remained a mainstay of French communications for almost fifty years. Along with the guillotine, it deserves to be remembered as one of the principal technological innovations to have been spawned by the French Revolution.<sup>18</sup>

Morse’s telegraph resembled Chappe’s in several ways. Like Chappe’s, it relied on relays to transmit signals over long distances. Chappe’s relays were human; Morse’s, automatic. French telegraph administrators referred to their human relays as “mutes”—which they were, quite literally, since the government employed deaf people to staff the intermediate towers that were located in between the stations at which messages were sent and received.

Chappe’s example also influenced Morse to prepare a dictionary code to translate words and phrases into a numeric form. Like Chappe, Morse assumed that it would take far too long to

transmit messages letter by letter. Only hesitantly—and at the prodding of his assistant, Alfred Vail—would Morse switch to the dot-and-dash alphabetic code that to this day bears his name and that has been used by telegraphers ever since.

While Morse was well aware of his indebtedness to Chappe, he took pains to highlight the distinctiveness of *his* invention. First, Morse contended, it facilitated continuous, twenty-four-hour transmission, in contrast to the optical telegraph, which was restricted to the daytime and good weather. Second, it made it possible to record messages in a permanent form—making the electric telegraph, as it were, the first *true* telegraph. Morse believed this feature of his invention to be a compelling advantage, and went so far as to suggest that operators could record incoming messages in bound books, if this were desired.<sup>19</sup>

Perhaps the most startling difference between Morse's telegraph and Chappe's stemmed from Morse's ideas regarding public policy. Like Chappe, Morse assumed that the government would play a prominent role in telegraph regulation, and lobbied hard to persuade Congress to purchase his patent outright. Wary of unregulated competition, Morse hoped in this way to ensure that his invention would be commercialized in a socially responsible manner. Should the electric telegraph be left in the hands of "speculators" who might "monopolize it for themselves," Morse warned, it could easily become the means of "enriching the corporation at the expense of the bankruptcy of thousands."<sup>20</sup> Unlike Chappe, however, Morse rejected the notion that his invention would be used primarily for government dispatches. The electric telegraph, Morse posited, was but "another mode" of accomplishing the "principal object" for which the postal system had been established, "to wit: the rapid and regular transmission of intelligence."<sup>21</sup> Accordingly, he intended it to be open to the public at large, a policy he regarded as "more in consonance" with the "political institutions under which we live."<sup>22</sup>

Morse's faith in government control was widely shared. In an age in which no individual business enterprise could match the administrative capacity of the central government, it made sense for reformers to look to the state to oversee such a

potentially vast undertaking. In the 1830s, for example, New York harbor master Samuel Reid urged Congress to establish a 1,200-mile line of optical telegraphs between New York and New Orleans. Reid proposed that this enterprise be overseen by the post-office department, which, he believed, would help to guarantee the sanctity of the messages it transmitted. Though Congress never built Reid's line, his project had the support of many prominent public figures, including Postmaster General Amos Kendall, who hailed it as "just the thing" to supplant a horse express that he had established on the same route to carry the mail.<sup>23</sup>

Morse's commitment to government control led him in 1843 to secure a federal grant to build a forty-mile telegraph line between Washington and Baltimore. Morse completed his line in 1844; in the following year, he secured its transfer to the post-office department, where it would remain until Congress abandoned the idea of a government telegraph in 1847.

While Morse favored government ownership of his telegraph patent, he opposed the establishment of an exclusive government monopoly. Fearful of the "vast mischief" that such a powerful institution might come to exert, Morse recommended, as an alternative, that Congress lease the rights to various routes for a specified sum, promoting in this way a "general competition." Such an arrangement, Morse hoped, would combine the advantages of private initiative and public oversight. It also promised to raise a good deal of money. Should the government take the new technology "solely under its own control," Morse predicted, the income derived from the leases alone would be of "vast amount."<sup>24</sup>

Had circumstances been different, Congress might have established a practical leasing arrangement, or conceivably even a government-administered system. Whig presidential contender Henry Clay publicly supported government control of Morse's invention, as did Democratic postmaster general Cave Johnson, albeit with the reservation that he did not see how a government telegraph could ever cover its costs.<sup>25</sup>

Notwithstanding a solid base of bipartisan support, Morse failed to prevail upon Congress; much to his chagrin, he presided over the privatization of the new technology. The reasons

for Morse's failure are complex, and included bad luck, technical setbacks, personality conflicts, and a tacit refusal on the part of Congress to increase the patronage that would be at the disposal of the party in power.

Once it became evident that Congress had no intention of purchasing Morse's patent a swarm of entrepreneurs entered the field, and the American telegraph industry was born. Just as Morse had feared, he had inadvertently unloosed a competitive maelstrom, or what one telegraph historian has termed an era of "methodless enthusiasm."<sup>26</sup> Industry leaders like Hiram Sibley did their best to bring some order to the confusion: first by instituting a series of pooling arrangements in the 1850s; then by cooperating with the Union army during the Civil War; and, finally, by merging several regional firms into Western Union, which emerged in 1866 as the first nongovernmental institution to operate on a truly national scale.

The rise of Western Union did not go uncontested. Troubled by its high rates and limited geographical scope, industry critics lobbied to bring it under federal control. Though these efforts proved almost entirely unsuccessful, they did hasten the passage of the Telegraph Act of 1866, which granted Congress the authority to purchase, at a mutually agreeable price, the assets of every telegraph company in the United States that agreed to be bound by its terms. In return, the law gave consenting firms the right to erect telegraphic lines on any postal route in the country, a valuable privilege in an age in which the individual states continued to exercise a broad range of powers over their internal affairs. This agreement proved acceptable to most of the leading firms in the industry, including Western Union, whose officials came to hail it as a contractual guarantee that its shareholders' rights would be duly respected.

Interestingly, Western Union's critics generated little support among the merchants and manufacturers who were the principal users of the new technology. From their standpoint, speed and accuracy—and not cost and access—were the overriding concerns. So long as Western Union transmitted time-sensitive commercial information quickly and accurately between the leading commercial centers, which Western Union did reasonably well, its business customers had little cause for complaint.

For industry critics, this was precisely the problem. "As a telegraph for business, where dispatch is essential and price is of little account," declared Massachusetts lawyer Gardiner Greene Hubbard in 1883, "the Western Union system is unrivaled; but as a telegraph for the people it is signal failure."<sup>27</sup>

Industry critics often contrasted Western Union's narrow, business-oriented focus with the much broader mandate of the post-office department. In urging a government takeover of the industry, Wisconsin Congressman Cadwallader C. Washburn in 1869 posited that the cost of a telegram should be low enough that telegraphy, like letter writing, could be accessible to the poor. Why, he asked rhetorically, should it cost an immigrant servant girl in Illinois a week's hard labor to telegraph a ten-word greeting to her friends back in New York?<sup>28</sup> "The telegraph office holds the same relation to the educational interests of the people that the post office does," postulated Iowa Congressman Frank W. Palmer in 1872. "Yet the telegraph office is established only where it seems to be the pecuniary interest of its shareholders that it should be established. This policy, in a country of unexampled enterprise and progress in other respects, is a mockery of the whole genius of our people."<sup>29</sup>

Western Union officials rebutted these arguments in various ways. Almost invariably, they conceded Congress the right to buy them out under the terms of the Telegraph Act of 1866—provided, of course, that their shareholders were properly reimbursed. Yet they consistently opposed the establishment of a government-subsidized "postal telegraph" that would compete with them head-on. Competition, even more than government ownership, was their *bête noire*. This was true even though, as Western Union officials occasionally acknowledged, competition *had* not only forced major rate reductions but also significantly expanded the industry's geographical scope.

Should Congress nationalize the industry, Western Union officials warned, the consequences would be unfortunate. Every European government ran its electric telegraph at a loss, as Western Union president Norvin Green observed in 1883. Should Congress require the industry to lower its rates and expand its facilities, it would have no choice but to subsidize its opera-

tions. Yet since far more Americans paid taxes than sent telegrams, such a policy would be highly regressive. After all, less than half a million Americans ever sent a telegram, far fewer than mailed a letter or received a newspaper that had been sent through the mail.

Green also warned of the potential political dangers of government control. In monarchical regimes, he observed, the government monopolized the telegraph in order to protect it against the "plots and schemes" of "disaffected and opposing elements or parties."<sup>30</sup> Such a repressive policy, however, had no place in the republican United States. Should the government nationalize the industry, Green warned, it might well exert a corrupting influence over the electoral process, particularly if it augmented the insidious influence that postal patronage had already come to exert. The "genius of our government," Green postulated, is that the "people rule." And, at least for the present, public sentiment was "adverse" to the "administrative power" having any such advantage in "directing or controlling the popular will."<sup>31</sup> Elaborating on his position a few years later, Green remarked that, if it could indeed be demonstrated that telegraph rates *were* lower in Europe—a perennial debating point that Green refused to concede—this could be explained by the determination of European governments to "reconcile the public" to the "enormous engine of power and espionage" that the government telegraph had there become.<sup>32</sup>

Far more successful than industry critics in shaping Western Union's business strategy were its many business rivals. Western Union was particularly vulnerable to competition in the intra-urban market, where barriers to entry were low. Even in its long-distance telegraphy, it was repeatedly challenged by upstart rivals, of whom the most formidable was the financier Jay Gould.

Gould's strategy rested not in his superior technology—for he had none—but rather on an artful combination of financial daring and political clout. Twice in the late 1870s, Gould cobbled together a rival telegraph network that Western Union officials found prudent to buy out, at a heavy cost, in order to avoid a full-scale rate war. "No one knows better than Gould," explained an exasperated Norvin Green during the midst of the

first of these struggles, "that an opposition telegraph in this country cannot be made a success as a business enterprise."<sup>33</sup> Still, Gould's challenge *did* force Western Union to drop rates and expand and improve service for its clientele.

In certain circumstances, Western Union officials took the lead in encouraging innovation. In the 1870s, for example, Green's predecessor William Orton aggressively sponsored inventors who promised to increase the carrying capacity of its telegraph lines. At the time, no wire could transmit more than one message in a single direction at a specific moment. To overcome this obstacle, Orton purchased the rights to a novel telegraphic apparatus that had been patented by Joseph B. Stearns. Stearns's invention made it possible to transmit two messages simultaneously over a single wire, doubling its capacity. Orton hailed Stearns' duplex as the most important innovation in electric telegraphy since Morse's original invention; by 1872, an improved version was widely used on Western Union's lines throughout the United States.<sup>34</sup>

Orton regarded ownership of Stearns' patent as a valuable competitive weapon. To protect his investment, he patented as many similar inventions as he could. Toward this end, Orton hired Thomas A. Edison, then a still-youthful tinkerer best known as the inventor of a stock ticker. By putting Edison on his payroll, as Orton explained to Stearns, Western Union would be able to "anticipate other inventors" and also to patent "as many combinations as possible."<sup>35</sup> Edison was rather more candid. Orton had hired him to work on the duplex, as he later testified, "as an insurance against other parties using them—other lines."<sup>36</sup>

Orton's decision to hire Edison led, unexpectedly, to the invention of an acoustic or quadruplex telegraph, a device that could transmit *four* messages on one line simultaneously, two in each direction. Though Orton had subsidized Edison's quadruplex research, he somehow failed to acquire for Western Union the necessary patent, and, for a time, Edison dangled his invention before Western Union's competitors, including Jay Gould.

The quadruplex debacle was the final chapter in Western Union's brief experiment in the active sponsorship of new technology. Under the leadership of Green, who became president



shortly after Orton's death in 1878, the firm returned to its prior strategy of purchasing promising inventions on the open market. Lacking a firsthand knowledge of electrical technology and convinced that the telegraph industry had become technologically mature, Green assumed that Western Union's control of key duplex and quadruplex patents guaranteed it a dominant position in the field.<sup>37</sup>

Green's conservative business strategy shaped his decision in November 1879 to cede the nascent telephone industry to William H. Forbes, the president of a small and struggling start-up firm that was then known as National Bell. Had Western Union remained in telephony—then an infant industry but a mere three years old—it might well have emerged as a leading player. Western Union controlled several key telephone patents, had a major ownership stake in one of the country's leading manufacturers of electrical equipment, and owned the American Speaking Telephone Company, which ran successful telephone exchanges in several cities, including New York and Chicago. Yet Green preferred to compromise, and, after extensive negotiations with Forbes, turned Western Union's telephone patents over to National Bell in return for a seventeen-year royalty on every telephone that National Bell leased and a monopoly over interurban telegraph messages originating in National Bell's local telephone exchanges. Since at this time telephony was confined to a geographical range of approximately 30 miles, Green believed that he had struck an excellent bargain. Henceforth, Western Union would focus on the long-distance communications market, and Bell on the local loop.<sup>38</sup>

To this day, it is by no means certain why Green gave up on the telephone. Green's official correspondence makes it plain that he fully recognized its commercial potential and, especially in his earliest negotiations, had much confidence in Western Union's patent position. Though Green's negotiations with Forbes *did* occur during the same months that Green was immersed in a fierce competitive struggle with Gould, there are few hints in Green's correspondence that Gould's threat influenced Green's decision to sell out. Far more important was Green's revulsion at the prospect of a competitive struggle. "I have had much difficulty" in winning the consent of my associates, Green

confessed to Forbes, shortly before they closed the deal, since, among other things, Green's associates had been legally advised that "we shall have less difficulty in continuing the use of our telephones than you will in yours." Yet, Green added, in the end Western Union and its allies were willing to concede a portion of what they "firmly believe they are entitled to" for the "sake of peace and harmony" and to "avoid the trouble, loss, and expense of a wasteful competition."<sup>39</sup>

Equally shortsighted was Green's decision three years later to sell to Forbes Western Union's controlling interest in Western Electric, the principal manufacturer of Western Union telegraph equipment. Once again, Green defended the spin-off as simple common sense, since, as he explained to an associate, "everything in our line that we manufacture costs us more than we could buy it for."<sup>40</sup> Yet from the standpoint of hindsight, it was another major missed opportunity. Within a few decades, Western Electric would evolve into Bell Labs—one of the leading research facilities in the modern world—while Western Union would suffer the indignity of being taken over in 1910 by AT&T, the successor firm to Forbes's National Bell.

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The early history of telephony demonstrates how a different, more expansive business strategy could, under the right circumstances, hasten the rise of what would become, by World War I, one of the largest and most innovative institutions in the country. The origins of AT&T date back to February 1876, when Western Union scourge Gardiner Greene Hubbard secured a patent for a novel communications device that had been recently invented by Alexander Graham Bell.

Hubbard initially had little interest in Bell's experiments in telephony. As a keen student of telegraphy, however, he recognized that Bell's research in voice transmission had great relevance to the quest for an acoustic telegraph—which, like a quadruplex, could transmit multiple messages over a single wire. When, in 1874, Hubbard learned that no patent for an acoustic telegraph had yet been issued, he urged Bell to turn his energies in this direction.<sup>41</sup>

To Hubbard's chagrin, Bell had little interest in acoustic telegraphy and continued to experiment with voice transmission. A teacher of the deaf, he hoped to devise a means to improve their ability to communicate. Among his pupils was Hubbard's deaf daughter, Mabel, with whom he had fallen in love and who he hoped to marry. Hubbard begrudgingly conceded the merits of Bell's invention, and when Bell devised a workable telephone, Hubbard secured him two key patents. In July 1877, Hubbard organized the Bell Telephone Company to exploit the telephone commercially. Two days later, Bell married Mabel in Hubbard's front parlor. According to a well-known and very likely apocryphal story, the previous fall Hubbard had offered to sell Bell's first telephone patent to Western Union president William Orton for \$100,000. Only when Orton refused—or so the story goes—did Hubbard turn his attention to transforming the Bell Telephone Company into a viable business enterprise.<sup>42</sup>

The telephone industry, like the telegraph industry before it, crystallized around the control of key patents. None were more important than the two patents Hubbard secured for Bell. In the period between 1876 and 1894, when the Bell Company enjoyed a patent monopoly, Bell lawyers won over six hundred infringement suits, giving the fledgling firm a major competitive boost.

Hubbard's business strategy combined a vigorous defense of patent rights with the energetic recruitment of agents to set up operating companies in various localities. To retain a modicum of control over these firms, Hubbard decided to lease, rather than sell, its patented telephone apparatus and to acquire an ownership stake in the operating companies. Typically, Bell licensees solicited subscribers in a relatively small geographical area, such as a city or town, who they then connected to a central switchboard or exchange. Few of the operating companies interconnected, since technical constraints kept telephony's range to about thirty miles.

Hubbard's strategy helped to insure that the Bell operating companies maintained consistent technical standards and a high level of service. Eventually, it would facilitate the creation of the interconnected telephone network that would come to be

known as the Bell System. Early on, however, interconnection remained little more than a visionary dream. Though Bell established AT&T as a long-distance subsidiary in 1885, the vast majority of telephone calls would continue to take place within local exchanges until well after World War I.

Hubbard's influence upon Bell's business strategy declined around 1880, when his leadership was successfully contested by shareholders determined to steer a more fiscally prudent course. Notable successors included E. J. Hall, a key figure in Bell's expansion in the South. Hall did much to institutionalize Bell's distinctive business mindset, which disparaged competition and venerated stability, consensus, operational efficiency, and technical expertise. Hall also cultivated support for Bell technical standards among sympathetic government officials, particularly in state legislatures and state regulatory commissions. Just as the judiciary had shielded Bell from competition between 1876 and 1894, so the state governments helped it to fend off potential challengers between 1894 and World War I. The political entrepreneurship of Bell executives like Hall significantly raised barriers to entry in the industry, since it obliged Bell's competitors to match its high performance standards. In addition, it eliminated the looming threat to Bell's administrative autonomy that was posed by municipal regulation.<sup>43</sup>

Bell executives adopted a selective approach to innovation. The most pressing technical challenge in late-nineteenth-century telephony was what one historian has called the "switchboard problem." As the number of subscribers in a given telephone exchange multiplied, it became progressively *more* expensive to provide customers with a basic level of service—reversing the typical pattern in mass-production industries like steel and automobiles. The larger the number of subscribers, the greater the problem. Several Bell rivals met this challenge by automating the switching process. Bell executives, in contrast, stuck by manual switching. Prior to World War I, virtually every telephone call that a Bell subscriber made required the personal intervention of a highly trained, female telephone operator.<sup>44</sup>

Why Bell proved so reluctant to adopt automatic switching is an intriguing question. Part of the answer is technical: prior to

World War I, no satisfactory method of automatic switching had yet been devised. Yet if Bell executives had made automatic switching a high priority, it seems likely that this technical hurdle could have been more speedily surmounted, as it eventually would be in the 1920s. More fundamental were the social and cultural assumptions that automatic switching undermined. In particular, automatic switching violated the principle of “user transparency”—that is, the notion that telephony should be kept as simple as possible, requiring of subscribers nothing so demanding as the need to dial a number. This assumption reflected the sensitivity of Bell executives to the fact that most telephone subscribers hailed from the middle or upper classes and had come to regard telephone operators as a logical extension of their household staff. The decision to use the telephone—or so these executives assumed—should be akin to ringing a servant to hand-deliver a personal note. “The telephone operator,” declared AT&T president Theodore N. Vail in 1915, was the “servant of every subscriber, as though she was in his office or in his direct employ. . . . There never can be, in my opinion, any way devised to get rid of the ‘intelligence’ which at some point in making up the connection is apt to be required.”<sup>45</sup> Not until the 1920s, with the widespread introduction of the dial telephone, would Bell democratize telephony by permitting subscribers to hold a telephone conversation without having to rely on the assistance of operators to make the connection.<sup>46</sup>

Bell executives proved far more committed to solving the problem of long-distance telephony. Here, too, social and cultural assumptions loomed large. Though the market for long-distance telephony remained decidedly limited, Bell executives were driven to secure it by what one historian has aptly termed their “almost irrational commitment” to interconnection.<sup>47</sup> The invention by Bell engineers in the 1880s of the loading coil and in the 1900s of audion, the first vacuum tube, were major steps toward the realization of this goal. So, too, was the advent, in 1915, of telephone service between New York and San Francisco, which demonstrated for the first time the feasibility of telephony on a truly continental scale.<sup>48</sup>

The promise of long-distance telephony may have captivated Bell executives; yet it proved to be extremely expensive and, in large part for this reason, had little appeal for the vast majority of telephone subscribers. What they demanded, rather, was cheap and reliable service within a limited geographical range. The obliviousness by Bell executives to this commercial reality encouraged the rise, following the expiration of Bell’s patents in 1894, of a legion of independent telephone firms that offered rudimentary, inexpensive telephone service not only in urban centers, where Bell was already well established, but also in many rural regions that Bell had yet to tap. Independent strongholds included St. Louis, Rochester, New York, and countless smaller cities and towns in the South and Midwest.<sup>49</sup>

It would be a mistake to contend, as some historians have, that the independents alone hastened the creation of the ubiquitous national telephone network that we take for granted today. This goal would not be attained until after World War II and was much facilitated by generous federal subsidies for the establishment of telephone service in rural regions. Yet the independents did greatly expand the market for telephony, even as they confronted Bell executives with a competitive challenge that they had no choice but to meet.<sup>50</sup>

Bell’s strategic response to the independents was coordinated by Theodore N. Vail, president of AT&T between 1907 and 1919. Vail’s long career with Bell began in 1878, when Hubbard appointed him the first general manager of the Bell Telephone Company. Vail left the firm in 1887 and, after a twenty-year hiatus, returned in 1907 at the behest of a banking consortium led by J. P. Morgan. The Morgan interests had large holdings in Bell securities and looked to Vail to end the threat that the independents posed to their investments. They were not to be disappointed.

The cornerstone of Vail’s business strategy was his commitment to universal service. Universal service for Vail meant nothing more, and nothing less, than the connection of all existing telephones; it did not necessarily entail either rate reductions or the extension of telephony into poorly served areas. To popularize interconnection, Vail launched one of the earliest public-relations campaigns in the history of American

business. Its theme was “one system, one policy, universal service,” which succinctly expressed Vail’s vision of an integrated national telephone network under the supervision of AT&T—which, since 1900, had been the parent company of the various Bell interests.

Like many Bell executives, Vail admired technical efficiency, disliked competition, and placed great faith in systems engineering. Driven by what historians have come to call the “network mystique,” he made the continuous pursuit of technological innovation a key corporate goal.<sup>51</sup> To translate these values into practice, Vail promoted various improvements in technical standards, sponsored basic research in telephone technology (including long-distance telephony), and systematized the relationship between AT&T and the various operating companies. To build political support, Vail articulated a novel theory of corporate governance in a remarkable series of public addresses. No longer, Vail declared, would AT&T be administered as a private enterprise for the benefit of its shareholders; henceforth, it was to be a public utility dedicated to the public good.

Vail’s strategy proved highly effective. By World War I, it had minimized the challenge posed by the independents and stabilized the value of AT&T’s stock. Universal service was the key. Emboldened by Vail’s vision of a unified telephone network, AT&T encouraged the interconnection of Bell and non-Bell telephone exchanges, ending the challenge that the independents posed. Moreover, Vail carved out for AT&T an enviable political niche. Under his leadership, the attorney general joined with Bell executives in 1913 to establish ground rules for the industry. This agreement legitimated Bell’s dominant market position, forestalled (at least for a time) the threat of anti-trust proceedings, and promulgated a set of principles that would structure relations between Bell, the operating companies, and the independents for over seventy years—until the court-mandated breakup of the Bell System in 1984.

How Vail came to his faith in universal service is an intriguing question. One likely source was his firsthand familiarity with the universalistic mandate of the post-office department, where he had worked for a time in the 1870s as superintendent

of the railway mail service. Another possible influence was Vail’s uncle, Alfred Vail, one of the key figures in the early history of electric telegraphy and a staunch advocate of government telegraphy. Vail’s views were also doubtless shaped by his long friendship with Gardiner Greene Hubbard, who had hired Vail away from the post-office department in 1878. Whatever its origins, Vail’s ambitious vision was by no means unprecedented. Indeed, it reinvigorated a long-standing civic tradition in American communications policy that included Hubbard’s critique of Western Union, Samuel F. B. Morse’s call for government control of electric telegraphy, and Benjamin Rush’s vision of a national postal network. By rejecting the narrowly commercial business strategy that had so constrained Western Union, Vail reinterpreted for the twentieth century the expansive rationale for long-distance communications that had first found expression in the Post Office Act of 1792.

\* \* \*

In the period between the adoption of the federal Constitution and World War I, the innovative process in American communications followed no consistent pattern. The most fundamental technical breakthroughs—electric signaling in the 1840s, voice transmission in the 1870s—emerged in highly unusual contexts that provide few obvious lessons for students of innovation today. Equally idiosyncratic was the conceptual advance that hastened the creation of the modern postal system in the years immediately following the adoption of the federal Constitution.

Yet certain themes do stand out that may provide some guidelines for the future. Most major innovations originated *outside* of existing institutions. In telegraphy and telephony, technical breakthroughs spawned entirely new industries. In mail delivery, a conceptual advance invested an existing institution with a sweeping new rationale. The principal exception was long-distance telephony, which, though important later on, had yet in this period to be widely diffused.

Equally instructive is the relevance to the innovative process of what might best be termed the organizational culture. Institutions like the Bell System that defined their mission in broad,

universalistic terms proved to be not only more enduring but also more innovative than institutions like Western Union, which did not. Even the post-office department enjoyed, for a time, a reputation for innovation, even though in the end this proved impossible to sustain. It is hardly surprising that key decision makers at the post-office department and Western Union distrusted innovation. Institutions, after all, tend to resist change. Yet it may prove of some value to recall that, at least in communications, competition could prove a major stimulus for the diffusion of new methods and ideas. This was true even in the Bell System, where executives like Vail had championed innovation as a business strategy. At no point, however, was competition synonymous with an absence of government regulation. Indeed, the history of American communications provides compelling evidence that stability and change need not be necessarily opposed and that highly regulated institutions *can* foster innovation, particularly if their leadership articulates a compelling vision and commands not only the necessary technical and financial resources but also the levers of power.

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## ENDNOTES

- <sup>1</sup>Francis Lieber, *Encyclopedia Americana*, vol. 10 (Philadelphia: Carey and Lea, 1832), 289.
- <sup>2</sup>Richard R. John, *Spreading the News: The American Postal System from Franklin to Morse* (Cambridge, Mass.: Harvard University Press, 1995), chaps. 2, 3. To avoid potential misunderstanding, I refrained in this book from calling the postal system a "technology," since this term is sometimes restricted to mechanical contrivances such as a steam engine or telegraph key. If, however, one follows the example of Thomas P. Hughes and expands the definition of technology to embrace large-scale networks—such as an electrical power grid—then it is entirely appropriate to characterize the postal system in this way. For the more conventional view, see Ruth Schwartz Cowan, *A Social History of American Technology* (New York: Oxford University Press, 1997), 151–152.

- <sup>3</sup>David Paul Hochfelder, "Taming the Lightning: American Telegraphy as a Revolutionary Technology," Ph.D. dissertation, Case Western Reserve University, forthcoming.
- <sup>4</sup>Alexis de Tocqueville, *Democracy in America*, ed. J. P. Mayer, trans. George Lawrence (1835; 1840; reprint, Garden City, N.Y.: Doubleday & Co., 1969), 384–385, 11.
- <sup>5</sup>M. J. Daunt, *Royal Mail: The Post Office since 1840* (London: Athlone Press, 1985), 339.
- <sup>6</sup>Richard D. Brown, *The Strength of a People: The Idea of an Informed Citizenry in America, 1650–1870* (Chapel Hill: University of North Carolina Press, 1996), chap. 4. See also J. R. Pole, *The Gift of Government: Political Responsibility from the English Restoration to American Independence* (Athens, Ga.: University of Georgia Press, 1983).
- <sup>7</sup>Benjamin Rush, "Address to the People of the United States," *American Museum* 1 (1787): 10.
- <sup>8</sup>The constitutional provision granting Congress the authority to establish post roads, Madison observed at one point—to the surprise of later commentators, such as jurist Joseph Story—was a "harmless" power unlikely to figure prominently in public life. That Madison could have dismissed the postal system in this way, Story wrote in 1833, was "one of the most striking proofs of how much the growth and prosperity of the country have outstripped the most sanguine anticipations of our most enlightened patriots." Alexander Hamilton, James Madison, and John Jay, *The Federalist*, ed. Jacob E. Cooke (1787–1788; reprint, Middletown, Conn.: Wesleyan University Press, 1961), 287; Joseph Story, *Commentaries on the Constitution of the United States*, vol. 3 (Boston: Hilliard, Gray, and Company, 1833), 22.
- <sup>9</sup>James Madison, "Notes for the *National Gazette* Essays," c. 1791–1792, in *Papers of James Madison*, ed. Robert A. Rutland et al. (Charlottesville: University Press of Virginia, 1983), 14: 159.
- <sup>10</sup>Petition of the inhabitants of Washington District, South Carolina, *State Gazette of South-Carolina* (Charleston), 1 July 1793, in *South Carolina Postal History*, ed. Harvey S. Teal and Robert J. Stets (Lake Oswego, Ore.: Raven Press, 1989), 23–24.
- <sup>11</sup>*Annals of Congress*, 4th Cong., 2d sess., 1 February 1797, 2057–2058.
- <sup>12</sup>For a different view, see James W. Carey, *Communication as Culture: Essays on Media and Society* (Boston: Unwin Hyman, 1989), 1.
- <sup>13</sup>John F. Stover, "Canals and Turnpikes: America's Early Nineteenth-Century Transportation Network," in *An Emerging Independent American Economy, 1815–1875*, ed. Joseph R. Frese and Jacob Judd (Tarrytown, N.Y.: Sleepy Hollow Restorations, 1980), 75.
- <sup>14</sup>Cited in Henry DeLeon Southerland, Jr., and Jerry Elijah Brown, *The Federal Road through Georgia, the Creek Nation, and Alabama, 1806–1836* (Tuscaloosa, Ala.: University of Alabama Press, 1989), 61.
- <sup>15</sup>*Register of Debates*, 22d Cong., 2d sess., 2 January 1833, 939.

- <sup>16</sup>William D. Merrick, *Speech of Mr. Merrick, of Maryland, on the Bill to Reduce the Rates of Postage*. . . (Washington, D.C.: Gales and Seaton, 1845), 13.
- <sup>17</sup>Richard R. John, "Governmental Institutions as Agents of Change: Rethinking American Political Development in the Early Republic, 1787–1835," *Studies in American Political Development* 11 (Fall 1997): 371–374.
- <sup>18</sup>Martin Van Creveld, *Technology and War, from 2000 B.C. to the Present* (New York: Free Press, 1989), 155.
- <sup>19</sup>Morse's biographer highlighted this feature of Morse's invention by terming it a "recording telegraph," which distinguished it not only from the French optical telegraph but also from various needle telegraphs then in use in Great Britain. Samuel Irenaeus Prime, *The Life of Samuel F. B. Morse, LL.D., Inventor of the Electro-Magnetic Recording Telegraph* (New York: D. Appleton, 1875).
- <sup>20</sup>Samuel F. B. Morse to Francis O. J. Smith, 15 February 1838, in *House Report* 753, 25th Cong., 2d sess., 335: 8.
- <sup>21</sup>Samuel F. B. Morse to Levi Woodbury, 27 September 1837, in *House Report* 753, 9.
- <sup>22</sup>Samuel F. B. Morse to C. G. Ferris, 6 December 1842, in *House Report* 17, 27th Cong., 3d. sess., 426: 9.
- <sup>23</sup>Printed memorial from John R. Parker to the Senate and House, January 1837, copy addressed to Amos Kendall, Incoming Correspondence, RG 28, Post Office Departments Records, National Archives, Washington, D.C.
- <sup>24</sup>Morse to Smith, in *House Report* 753, 8–9.
- <sup>25</sup>Henry Clay to Alfred Vail, 10 September 1844, Vail Telegraph Collection, Smithsonian Institution Archives, Smithsonian Institution, Washington, D.C.; Cave Johnson, "Report of the Postmaster General," 1845, in *Sen. Doc.* 2, 29th Cong., 1st sess., 470: 861.
- <sup>26</sup>Robert Luther Thompson, *Wiring a Continent: The History of the Telegraph Industry in the United States, 1832–1866* (Princeton: Princeton University Press, 1947), chaps. 6–15.
- <sup>27</sup>Gardiner G. Hubbard, "Government Control of the Telegraph," *North American Review* 137 (December 1883): 522.
- <sup>28</sup>Cadwallader C. Washburn, *Postal Telegraph: Speech . . . Delivered in the House of Representatives, December 22, 1869* (Washington, D.C.: F. & J. Rives & George A. Bailey, 1869), 13.
- <sup>29</sup>Frank W. Palmer, *Postal Telegraph . . . in the House of Representatives, February 17, 1872* (Washington, D.C.: Congressional Globe, 1872), 4.
- <sup>30</sup>Norvin Green, "The Government and the Telegraph," *North American Review* 137 (November 1883): 433.
- <sup>31</sup>*Ibid.*, 433, 434.
- <sup>32</sup>Norvin Green, "Are Telegraph Rates Too High?" *North American Review* 149 (November 1889): 574.

- <sup>33</sup>Norvin Green to Hugh Allan, 27 June 1879, president's letterbooks, Western Union Records, Archives Center, National Museum of American History, Smithsonian Institution, Washington, D.C.
- <sup>34</sup>Paul Israel, *From Machine Shop to Industrial Laboratory: Telegraphy and the Changing Context of American Invention, 1830–1920* (Baltimore: Johns Hopkins University Press, 1992), 135–138.
- <sup>35</sup>*Ibid.*, 138.
- <sup>36</sup>*Ibid.*
- <sup>37</sup>*Ibid.*, 143–144.
- <sup>38</sup>Robert W. Garnet, *The Telephone Enterprise: The Evolution of the Bell System's Horizontal Structure, 1876–1909* (Baltimore: Johns Hopkins University Press, 1985), chap. 4.
- <sup>39</sup>Norvin Green to William H. Forbes, 3 September 1879, president's letterbooks, Western Union Records.
- <sup>40</sup>Norvin Green to R. C. Stone, 1 August 1881, president's letterbooks, Western Union Records.
- <sup>41</sup>The standard account of Bell's invention remains Robert V. Bruce, *Alexander Graham Bell and the Conquest of Solitude* (Ithaca: Cornell University Press, 1973).
- <sup>42</sup>George David Smith, *The Anatomy of a Business Strategy: Bell, Western Electric, and the Origins of the American Telephone Industry* (Baltimore: Johns Hopkins University Press, 1985), 27.
- <sup>43</sup>Kenneth Lipartito, *The Bell System and Regional Business: The Telephone in the South, 1877–1920* (Baltimore: Johns Hopkins University Press, 1989), chap. 8; Milton L. Mueller, Jr., *Universal Service: Competition, Interconnection, and Monopoly in the Making of the American Telephone System* (Cambridge, Mass.: MIT Press, 1997), chap. 9.
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- <sup>45</sup>Theodore N. Vail to Arthur Brisbane, 25 June 1915, president's letterbooks, AT&T Archives, Warren, N.J.
- <sup>46</sup>Venus Green, "Goodbye Central: Automation and the Decline of 'Personal Service' in the Bell System, 1878–1921," *Technology and Culture* 36 (October 1995): 912–949. See also Kenneth Lipartito, "When Women Were Switches: Technology, Work, and Gender in the Telephone Industry, 1890–1920," *American Historical Review* 99 (October 1994): 1075–1111.
- <sup>47</sup>Lipartito, *The Bell System*, 225. "By its very nature," Lipartito explains, innovation is a process that takes place in the absence of perfect foreknowledge and, thus, has an "irrational or nonrational side." It is a mistake, he adds, to assume that every innovation is successful because the innovator "saw further or looked deeper" than did others into the "true nature of a technology." On the contrary, it might be just as true that the successful innovator "proved

skillful at closing off other roads and making his innovation seem like the right choice.”

<sup>48</sup>Neil H. Wasserman, *From Invention to Innovation: Long-Distance Telephone Transmission at the Turn of the Century* (Baltimore: Johns Hopkins University Press, 1985).

<sup>49</sup>Mueller, *Universal Service*, chaps. 6, 7; Claude S. Fischer, *America Calling: A Social History of the Telephone to 1940* (Berkeley: University of California Press, 1992), chaps. 4, 5.

<sup>50</sup>Fischer, *America Calling*, 105–107.

<sup>51</sup>Louis Galambos, “Theodore N. Vail and the Role of Innovation in the Modern Bell System,” *Business History Review* 66 (Spring 1992): 95–126, esp. 108.

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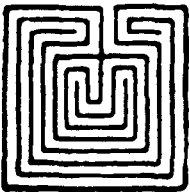
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