Recasting the Information Infrastructure for the Industrial Age

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In the century and a quarter between the framing of the federal Constitution in 1787 and the outbreak of World War I in 1914, the United States evolved from a struggling commercial republic on the margins of Europe into one of the most powerful industrial nations in the world. Accompanying the rise of the United States to world power was a comparable transformation in the informational environment. The period witnessed an unprecedented expansion in printing and publishing, the emergence of information-intensive industries such as credit reporting and life insurance, and the elaboration of major innovations in science, technology, and education. Each of these developments could furnish the theme for an essay on the role of information during the "long nineteenth century" that stretched from 1787 to 1914.

Yet there was one development that may well have been the most fundamental. This was the recasting of the facilities for transmitting information cheaply, reliably, and on a regular basis throughout the country and around the world. Challenged by the size of the territory to be spanned, emboldened by a highly competitive institutional setting, and inspired by an irrepressible popular demand for more and better information, government administrators, business leaders, and ordinary Americans joined together in a grand collaborative project that would have been unimaginable in any prior age. The central institutions in the information infrastructure during this period—the Post Office Department, the Railway Mail Service, Western Union, and the Bell System—may seem rudimentary today. Yet, at the time, they played a major role in U.S. business and public life.

The first communications revolution of the long nineteenth century began in the 1760s, with the emergence of an organized opposition to the Crown, and culminated in the 1820s with the establishment of a
national postal network. The second began in the 1840s, with the expansion of the railroad and the commercialization of the telegraph, and culminated in the 1910s with the completion of a national telephone grid.

It is one of the themes of this chapter that the speed with which it was theoretically possible to convey information from place to place—by, say, stagecoach, railroad, telegraph, or telephone—was merely one dimension of a complex social process. In part, this is because the transmission of information involved then—as it does now—not only its conveyance but also its routing. Indeed, for many information users, the speed with which information was transmitted might well have been less valued than its cost and accessibility, and the regularity and reliability with which it was conveyed. It is also worth remembering that speed is a relative concept. From the standpoint of a merchant in the 1830s, a mounted horse express that traveled at ten miles an hour was moving extremely fast. After all, with a few minor exceptions, at no prior time had information ever been conveyed at a more rapid pace.

The concept of an information infrastructure is somewhat novel, and for this reason it deserves a few words of explanation. The phrase highlights the fact that the transmission of information has long been coordinated by a constellation of institutions, rather than by a single government agency or business firm. Often these institutions were complementary rather than mutually exclusive. Telegraphy supplemented mail delivery, and telephony supplemented telegraphy, without rendering either mail delivery or telegraphy obsolete. When Andrew Jackson won the presidency in 1828, the principal elements in the information infrastructure were the postal system, the stagecoach industry, and the newspaper press. On the eve of the Civil War, in 1861, the infrastructure had expanded to embrace the railroad, the telegraph, the wire service, and the commodity exchange. By World War I, it had expanded once again to include the railway mail service and the telephone grid.

The concept of an informational environment is also worth a brief comment. Although this phrase may seem at bit abstract, it draws attention to a familiar enough phenomenon: namely, the far-reaching yet often subtle ways in which the information infrastructure has shaped, and continues to shape, institutional patterns and cultural norms. In this way, it reminds us of the legacy of decisions made long in the past. Like the French countryside, the present-day informational environment is the product of an ongoing partnership between purposeful human agents and an institutional setting that is so pervasive that it is easily mistaken for a natural world. Just as the farming techniques of medieval agriculturists left their mark on the physical environment of early modern Europe, so, too, have the actions of government administrators, business leaders, and information users of all kinds shaped the informational environment of the early twentieth-century United States.

Reorienting the Information Infrastructure
of the Commercial Republic

Ever since the 1760s, Americans have hailed an informed citizenry as a civic ideal. Yet it was not until after the framing of the federal Constitution in 1787 that this ideal was finally translated into law. From an institutional standpoint, the world of the framers of the Constitution remained an informational ancien régime. The early history of the American postal system is a case in point. Established in 1775 by the Continental Congress shortly after the start of the War of Independence, the system remained a small and uninfluential institution for the next seventeen years. As late as 1788, the American postal system had a mere sixty-nine offices, virtually the same number that its colonial counterpart had in 1765.

The first postmaster general was Benjamin Franklin, a logical choice since, in addition to being a prominent supporter of the colonial cause, he had previously spent more than two decades as an administrator in the royal postal system. Franklin shared the faith of the Revolutionary generation in an informed citizenry. Yet, as postmaster general, he merely sought to replicate, under American control, the institution that he had helped administer when the postal system had been under the Crown.

Franklin held the postmaster generalship for only a few months before giving it over to his son-in-law, Richard Bache. Bache ran the institution—with indifferent success—for the duration of the war. Bache's successor, Ebenezer Hazard, compiled a decidedly better administrative record. It was Hazard, for example, who in 1785 enlisted stagecoach contractors for the first time to convey the mail on a regular schedule—a practice that, in later decades, would prove influential. Yet Hazard lacked the authority—and the Continental Congress lacked the will—to institute any permanent changes in policy.

When the founders of the American republic met in Philadelphia in 1787 to establish a stronger national government, they had little reason to anticipate the full magnitude of the changes in communications...
policy that were about to occur. Communications policy had figured little on the debates over the drafting of the new constitution and received scant attention in the Federalist essays that James Madison, Alexander Hamilton, and John Jay wrote to help build support for its ratification in the pivotal state of New York.

Only in the years after the framing of the federal Constitution would it become evident that the government had an obligation to keep the citizenry informed on a regular basis about the affairs of state. With the adoption in 1788 of the Constitution by popular consent, this ideal acquired the force of a categorical imperative. Now that popular assemblies had demonstrated their sovereignty in the most unequivocal way by deliberating upon, and approving, a fundamental charter of law, it seemed incontrovertible that the citizenry had, at the very least, a right to remain well informed.3 Since the postal system was the only long-distance communications technology, this put its expansion high on the political agenda.

Key figures in the subsequent restructuring of the information infrastructure included Benjamin Rush and James Madison. As Rush explained as early as 1787, to adapt the "principles, morals, and manners of our citizens to our republican forms of government," it was "absolutely necessary" that the government circulate "knowledge of every kind" through every part of the United States. To fulfill this ambitious mandate, Rush looked to the postal system, the "true non-electric wire of government," and the "only means" of "conveying light and heat to every individual in the federal commonwealth."4 Madison editorialized in 1791 that Congress had an obligation to improve the facilities of communication by encouraging commerce, national improvements, an opposition press, and, most important of all, the "circulation of newspapers through the entire body of the people" in the mail.5

The policy innovations that Rush and Madison championed helped inspire the passage of the Post Office Act of 1792. This law included no ringing preamble to invite detailed historical scrutiny—and thus is often overlooked even by specialists in the field. Yet it deserves to be remembered as a key event in the history of information in the United States. No single legal enactment—not the free press guarantee in the First Amendment, not even the provisions for public education that Congress mandated in the Northwest Ordinance—did more to institutionalize the communications revolution that traced its beginnings back to the struggle against the Crown.6

The Post Office Act of 1792 had three main provisions. First, it barred government officials from opening personal letters to monitor domestic subversion; second, it admitted newspapers into the mail at extremely low rates; and third, it transferred control over the designation of new post routes from the executive branch to Congress. While these might seem like arcane procedural matters, in practice they established institutional mechanisms that had broad-ranging practical import. The first provision safeguarded civil liberties by establishing a precedent for a right to privacy, while the second and third provisions guaranteed that, as the area of settlement expanded from the Atlantic seaboard to the Trans-Appalachian hinterland, the government would provide a far-flung citizenry with subsidized, time-specific information on business and public affairs.

For a time, the expansion of the postal network was constrained by the international tensions that culminated in the War of 1812. With the ascendency following the Treaty of Ghent in 1815 of a younger generation of nationally minded public figures that included Henry Clay, John Quincy Adams, and John McLean, these constraints receded. Together, these national republicans, as they were commonly called, promoted an "American System" that fostered the interregional movement of agricultural staples, manufactured goods, and information of all kinds. As postmaster general between 1823 and 1829, McLean played a particularly conspicuous role in this ambitious government-sponsored project. Fittingly, it was during his tenure in office that the postmaster generalship was elevated to cabinet rank. After all, in the 1820s the postal system first became widely known as one of the largest, most politically powerful, and most administratively complex organizations in the country. The rapid rise of the postal system to national prominence in this decade was symbolized by President Andrew Jackson's decision, shortly after his inauguration in 1829, to elevate the institution to the status of a government department, a distinction it would retain for the next century and a half.

The expansion of the postal network in the early Republic was a remarkable achievement that could not have been anticipated by any of the statesmen who had drafted the Constitution in 1787. While in 1788, the postal system had fewer than 100 offices, by 1800 the total had increased to 903, and by 1820 the number was 4,500 (see table 3.1). The speed at which this network grew struck some contemporaries as nothing short of astonishing; one Washington editor remarked in 1826 that the expansion was so rapid as "almost to stagger belief," and "did we not know its history to be true, it might pass and be received as a romantic tale, having no foundation but in the regions of fancy, in the wanderings of imagination."7
By 1828, the postal network was complete. At that time, the United States, with its 7,500 post offices, had by far the largest postal system in the world. From an international perspective, this fact highlighted the distinctiveness of the American case. At a time when the United States boasted seventy-four post offices per 100,000 inhabitants, Great Britain had seventeen, and France four.8

Perhaps the most revealing measure of the magnitude of the government’s achievement was the extent to which the postal network had kept pace with the westward expansion in the area of settlement. Between 1790 and 1840, the settled territory over which the federal government presided increased by a remarkable 300 percent; even so, the postal network expanded at an even more rapid rate. In 1790 there had been one post office for every 3,500 square miles of settled territory; by 1840, there was one post office for every 61 square miles, an increase of almost 600 percent (see table 3.1).9

As the postal network expanded, so too did the volume of information that it conveyed. In 1800, the postal system transmitted 1.9 million newspapers and 2 million letters. By 1840, it was transmitting almost 39 million newspapers and more than 40 million letters (see table 3.2). The newspaper totals, postal authorities agreed, were significantly understated, since accounting procedures were notoriously lax. It is also worth remembering that, in this period, newspapers were almost invariably read in groups—almost never by solitary individuals, as is the custom today. Although it is impossible to say for certain, there is a good deal of anecdotal evidence to suggest that, on average, an individual copy might well be read—or listened to, as the case might be—by as many as a dozen different people.10

The expansion in newspaper conveyance was particularly impressive, since newspapers accounted for the great bulk of the mail. Throughout this period, newspapers made up as much as 95 percent of the weight of the mail, while accounting for no more than about 15 percent of the revenue. In the absence of the newspaper subsidy, it is inconceivable that newspapers could have circulated in such numbers or on such a geographically extensive scale.11

Just as the government subsidized the transmission of newspapers, it also subsidized the cost of gathering news. Throughout the early republic, the government permitted every newspaper editor to receive, free of charge, one copy of every other newspaper in the country. Newspaper editors came to depend on this privilege for much of the material they used to fill their columns. In conjunction with the low postal rates, this policy made newspapers editors—including the editors of the burgeoning country press—one of the most privileged occupational groups in the United States.

Other favored classes of information included magazines and government documents. Magazines enjoyed preferential postal rates beginning in 1794, while government documents passed through the mail free of charge, provided only that they bore the signature, or frank, of an authorized agent, such as a postmaster or congressman.

The rapid expansion of the postal network in the early Republic owed much to the determination of ordinary Americans to maintain close ties with the wider world. Better mail delivery was one of the few tangible benefits that Congress had the authority to bestow, and

Table 3.1 The Expansion and Geographical Penetration of the Postal Network, 1790-1840

<table>
<thead>
<tr>
<th>Year</th>
<th>Post Offices</th>
<th>Population per Post Office</th>
<th>Settled Area per Post Office</th>
</tr>
</thead>
<tbody>
<tr>
<td>1790</td>
<td>75</td>
<td>43,084</td>
<td>3492.7</td>
</tr>
<tr>
<td>1800</td>
<td>903</td>
<td>4,876</td>
<td>339.3</td>
</tr>
<tr>
<td>1810</td>
<td>2,300</td>
<td>2,263</td>
<td>180.2</td>
</tr>
<tr>
<td>1820</td>
<td>4,500</td>
<td>1,796</td>
<td>116.3</td>
</tr>
<tr>
<td>1830</td>
<td>8,450</td>
<td>1,289</td>
<td>75.5</td>
</tr>
<tr>
<td>1840</td>
<td>13,468</td>
<td>1,087</td>
<td>61.4</td>
</tr>
</tbody>
</table>


Note: Population excludes Indians and slaves.

Table 3.2 Letters and Newspapers Transmitted by the Postal System, 1790-1840

<table>
<thead>
<tr>
<th>Year</th>
<th>Letters (millions)</th>
<th>Letters Per Capita</th>
<th>Newspapers (millions)</th>
<th>Newspapers Per Capita</th>
</tr>
</thead>
<tbody>
<tr>
<td>1790</td>
<td>0.3</td>
<td>0.1</td>
<td>0.5</td>
<td>0.2</td>
</tr>
<tr>
<td>1800</td>
<td>2.0</td>
<td>0.5</td>
<td>1.9</td>
<td>0.4</td>
</tr>
<tr>
<td>1810</td>
<td>3.9</td>
<td>0.7</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>1820</td>
<td>8.9</td>
<td>1.1</td>
<td>6.0</td>
<td>0.7</td>
</tr>
<tr>
<td>1830</td>
<td>13.8</td>
<td>1.3</td>
<td>16.0</td>
<td>1.5</td>
</tr>
<tr>
<td>1840</td>
<td>40.9</td>
<td>2.9</td>
<td>39.0</td>
<td>2.7</td>
</tr>
</tbody>
</table>

Source: John, Spreading the News, 4.

Note: Population excludes Indians and slaves; the newspaper total for 1790 is based on data for 1791; the newspaper total for 1800 is based on data for 1799.
individuals quickly grew expert at lobbying their representative for new routes and more frequent service.

The principal constraint upon postal expansion was the reluctance of fiscally prudent congressmen to authorize any improvements in service that might run the institution into debt. Indeed, for a time postal administrators actually returned to the treasury a modest annual surplus. Congress achieved its dual mandate of service and self-sufficiency by keeping rates on letter postage artificially high. In effect, Congress imposed a hidden tax on merchants, the great majority of whom lived in New England and the Mid-Atlantic states, in order to subsidize the transmission of newspapers and the maintenance of the postal network in those parts of the country that could not cover the cost—in particular, in the South and West. In some instances, as critics did not fail to point out, Congress authorized the establishment of routes that could not bear one-hundredth of the expense.12

The information infrastructure in the early Republic owed little to steam power, and nothing to the railroad, which was still in its infancy in 1828. As late as 1840, several years after the railroad had begun to carry the mail, the horse remained the primary motive power. Though postal administrators occasionally arranged to transport the mail by steamboat, the stagecoach remained the principal means of conveyance. This fact provides a revealing glimpse of how far a sophisticated information infrastructure can operate without any dependence on fossil fuel.

Among the most important organizational innovations in the information infrastructure of the early Republic was the establishment in 1800 of a network of distribution centers to facilitate the routing of the mail. For the next sixty years, this "hub-and-spoke" sorting scheme, overseen by a team of middle managers, was a cornerstone of postal administration. No longer was it necessary for postmasters to open every mail sack at each office, as they had prior to 1800. Surprisingly, resilient, this hub-and-spoke sorting scheme was little altered by the coming of the railroad; it remained a pillar of the information infrastructure from 1800 until after the Civil War, when it was gradually supplanted by the continuous sorting scheme known as railway mail.

Equally innovative was the willingness of postal administrators to subsidize stagecoach service in order to establish a rudimentary system of public transportation. By the 1820s, postal administrators had grown accustomed to awarding stagecoach firms sums that significantly exceeded the cost that they would have had to pay post riders to carry the mail. With the possible exception of the newspaper press, few enterprises were more dependent on federal largesse. According to one estimate, fully 33 percent of all stagecoach industry revenue came from this single source.13

Since the government provided no comparable bonus for road-building, the stagecoach subsidy helps to explain why travelers like the English writer Charles Dickens complained so frequently about the bumpiness of the ride. In effect, the public investment in the means of passenger conveyance had outstripped the capacity of the transportation infrastructure over which the passengers were conveyed.

The Informational Environment of the Commercial Republic

The completion of the national postal network reoriented the informational environment of the early American Republic from the Atlantic seaboard to the Trans-Appalachian hinterland. In conjunction with a rudimentary national banking system, a burgeoning trade in agricultural staples, and a competitive and dynamic commercial sector, the postal network hastened the emergence of a national market for information. In its absence, it is hard to imagine the rise of geographically extended, information-intensive industries such as credit reporting and life insurance, or nationally oriented organizations such as the voluntary association and the mass party.

The rapid, regular, and reliable transmission of information was of particular importance to merchants engaged in long-distance trade. Postmaster General McLean declared in 1828 that "no inconsiderable amount of the active capital of the country" was transmitted through the postal system every year.14 Each year, one knowledgeable insider estimated in 1855, some $100 million was transmitted in this way.15

Much of this money took the form of bank notes and other forms of negotiable currency, all of which went uninsured. Surprising as it might seem to us today, it was by no means uncommon for merchants to send through the mail as much as $10,000 in cash. While some of this money was stolen or lost, the vast majority reached its intended destination. Had theft been endemic, after all, merchants would not have continued to rely on the postal system to this extent to settle their accounts. Indeed, there can be few better measures of the effectiveness of the institution in this period, or of the high regard in which it was held.

In cities, towns, and villages throughout the United States, the arrival of the mail was a major event. Post offices were almost always located in the heart of the business district and were often thronged with merchants anxious to hear the latest news. In Rochester, New York,
merchants continued to congregate daily at the post office until well after the Civil War. This was true, interestingly enough, even on Sunday, the one day when virtually every other commercial establishment was obliged by law to shut down. Though convention proscribed women from visiting the post office on this day, the lobby was almost invariably thronged with men who had stopped by to chat, discuss the week’s events, and pick up their mail (see figure 3.1). Only in 1912 did the Post Office Department close its offices to the public on this day, ending a practice that dated back to 1810.

If an individual received anything in the mail, it was far more likely to be a newspaper than a letter. Prior to the major letter-rate reductions in 1845 and 1851, letter writing remained confined mostly to merchants, the well-to-do, and public figures who enjoyed the franking privilege, which permitted them to send or receive an unlimited number of letters free of charge. Postage was customarily borne by the recipient, rather than the sender, and could sometimes total 50 cents, a substantial sum in an age when many laborers made $1 a day. Newspapers, in contrast, were relatively cheap to transmit, and could be sent anywhere within the United States for less than 2 cents a copy. The vast majority circulated within an area of, at most, a few hundred miles. Only a few—including Niles’s Register, the National Intelligencer, and, in a slightly later period, the New York Tribune—reached an audience that aspired to be genuinely national in scope.

Like so many features of American society in the early Republic, the newspaper market was polycentric. Though Washington was the political capital—and therefore a major publisher of government documents—it hosted few influential organs of public opinion, a situation that would have been inconceivable in Great Britain or France.

The novelty of the informational environment sparked a good deal of contemporary comment. When the mail arrived, observed one English visitor in 1814, the townspeople hurried to the post office, where they “formed a variety of groups round those who were fortunate enough to possess themselves of a paper.” This was true, the visitor added, not just in the cities, but throughout the countryside. “I am of the opinion,” he elaborated, “that this general circulation of newspapers throughout America, tends very much to the instruction of the country people, and divests them of that air of ignorance and rusticity which characterizes the greater part of the peasantry in Europe.” The information that newspapers conveyed might be “superficial,” but it gave men a “general acquaintance with the world”:

It sets before them the actions of their countrymen, and the government under which they live; it renders them familiar with the transactions of foreign nations; and though confined to a small spot themselves, yet at one view they become acquainted with every section of the globe. Without a knowledge of what is passing in the world, man may be said to be an isolated being; but with a newspaper before him, he mixes with society, hears the opinions of others, and may communicate his sentiments upon men and things to all parts of the world.”

The democratization of the informational environment struck a special chord with painters, who documented its social implications in a series of memorable genre scenes. One of the earliest painters to dram-
atize this theme was John Lewis Krimmel. In “The Village Tavern,” completed in 1814, Krimmel demonstrated how the arrival of the mail during the War of 1812 provided artisans and gentry alike with up-to-date news from the front, challenging the gentry’s monopoly over public affairs. The popular appetite for information had simply overwhelmed the constraints on its widespread circulation. Never again, Krimmel seemed to imply, could the gentry presume to monopolize access to news from afar (see figure 3.2).

Among the most evocative renderings of the voracious public demand for information was Richard Caton Woodville’s “War News from Mexico” (see figure 3.3). Woodville set his political parable in a post office during wartime—in this case, the Mexican War. At the center of Woodville’s canvas is a group of men eagerly scanning a newspaper for the latest military dispatches. Hovering on the periphery is

Figure 3.2 “Village Tavern.” John Lewis Krimmel completed this painting of the interior of a village post office in 1814, toward the end of the War of 1812. The view depicts the arrival of newspapers with up-to-date reports about the course of the war. Information is freely available to everyone—including women, children, and artisans. Note the obvious discomfort the gentleman in the middle of the room; no longer will the gentry be able to block the flow of the news. Note also the newspaper-filled portmanteau that is draped over the shoulder of the mail carrier in the doorway. Courtesy of the Toledo Museum of Art.

Figure 3.3 “War News from Mexico.” Painted in 1848 by Baltimore artist Richard Caton Woodville, this scene illustrates the importance of newspapers as a source of information about the wider world. The setting is a hotel that also houses the post office, a common arrangement in the 1800s. Note that the news is being read aloud, a customary practice at the time. On the margins are a woman (partially visible in a window) and several African-Americans. They, too, are curious about the latest news. Yet they are plainly overshadowed by the white men who, in this period, dominated American public life. Courtesy of the American Antiquarian Society, Worcester, Mass.
a woman and a free black; Woodville seems to imply that as the public sphere expanded beyond the gentry, it has rendered increasingly marginal the participation of anyone who could not claim to be white and male.

The democratization of the public sphere was, as these paintings suggest, not without its ironies and unintended consequences. The morally ambiguous character of this process was pointedly revealed in 1835 when, to appease the South, Postmaster General Amos Kendall blocked the transmission into the slaveholding states of information dealing with the slavery issue. The resulting information embargo had the full approval of President Jackson, and it remained in place until the Civil War, significantly exacerbating the growing sectional rift between the North and the South. Kendall's conduct struck many as of questionable legality, and raised howls of protest in the North. "I denounce it," declared Massachusetts Congressman John Quincy Adams seven years after the event, "as a violation of the freedom of the press, as a violation of the sacred character of the post office, and of the rights and liberties of all the free people of the United States." The embargo remains to this day as one of the most thoroughgoing peacetime assaults on the freedom of the press in U.S. history. The willingness of the Jacksonians—long praised as apostles of political democracy—to embrace this action underscores one of the paradoxes that accompanied the institutionalization of the civic rationale for communications policy that the founders of the republic had so earnestly espoused.

The Railroad and Telegraph Recast the Information Infrastructure for the Industrial Age

The second communications revolution of the long nineteenth century was set in motion in the 1840s with the rapid expansion of the railroad and the commercialization of the telegraph. The advent of the telegraph is often hailed as a decisive turning point in the history of communications; in certain respects, however, the telegraph was less significant than the railroad, which emerged, during this decade, as an important means of conveyance for the mail.

The potential of the railroad for mail delivery had first been glimpsed in the 1830s by Postmaster General Kendall. Just as Kendall found himself unable to mediate the growing conflict between North and South, he also found it impossible to resolve the thorny conflict between the government and the railroad over the appropriate contracting terms. Kendall readily conceded the railroad's superiority as a mode of conveyance. Yet he warned that existing legislation made it extremely difficult for postal administrators to secure satisfactory arrangements, and he even hinted that Congress might be obliged to raise postal rates to cover the cost. "Certain it is," Kendall declared, "that if the demands of railroad companies are to be satisfied, most of whom are not willing to serve the public as they serve individuals, and seem to think that the Government is bound to make their investments profitable, there will be little left of the means of this department to pay for the conveyance of the mails on other lines, much of the interior of the country must be deprived of them altogether, and the rates of postage, instead of being reduced, must be increased." The crux of the problem was the unsuitability of the existing contracting methods. In the stagecoach era, it made sense for postal administrators to advertise for bids to transport the mail, since it was relatively easy to start up a new line. In the railroad era, however, this assumption no longer made sense, since competition between two railroads on a single route was unknown. As a consequence, railroads were free to charge what they wished, and to run their trains in accordance with their best interests, even if their scheduling significantly slowed the carriage of the mail.

To help resolve this dilemma, Kendall urged Congress to establish a maximum rate for railway mail pay. Though Congress obliged, railroads quickly found various ways to evade this restriction. Kendall also briefly experimented with a special horse-express—which he justified, in large measure, as an attempt to outpace the railroads. In addition, he tried, without success, to secure for the government its own special mail train.

Kendall's failure to contain contracting costs led his successor, Charles Wickliffe, to propose a different approach. To gain control of the right-of-way and to help limit expenses, Wickliffe urged Congress to award the leading railroad lines a long-term mail contract, in the form of a substantial lump sum payment. Had Congress supported Wickliffe's proposal, the government would have committed itself to making a substantial investment in the completion of the railway network. Yet Congress refused to take Wickliffe's advice, leaving him (and his successors) with little recourse but to pay the railroads whatever amount they might deem to be fair.

The failure of Kendall and Wickliffe to work out satisfactory contracting terms had major implications for mail delivery. Unlike their counterparts in Great Britain, France, and most of the other European countries, U.S. postal administrators never secured control over the
scheduling of the railroads that carried the mail. This failure significantly complicated the establishment of advantageous routing arrangements and marked a sharp departure from the stagecoach era, when postal administrators had routinely coordinated stagecoach schedules to minimize unnecessary delays.

The failure of the government to adapt to the railroad created a market niche for the private expresses, a new kind of business enterprise that sprang up between 1839 and 1845 in New England and the Mid-Atlantic states on the most heavily patronized routes. These firms took advantage of the means of conveyance that the railroad provided to transport small parcels, including money and letters, in competition with the Post Office Department, and in violation of the laws undergirding the postal monopoly. The first private express was established in 1839 by William Harnden, a young man of modest means who had previously worked as a conductor on the Boston and Worcester Railroad. By 1845, at the height of the boom, dozens of entrepreneurs had joined Harnden in transmitting information of all kinds. Though it is difficult to know just how much mail these firms conveyed, one congressman calculated that—in conjunction with other, more informal means of conveyance—they were probably transmitting as much as two-thirds of all the correspondence in the United States.21

The private expresses proved popular with merchants and received a generally favorable reception in the press. In large measure, this was because they charged significantly lower rates than the Post Office Department. This proved to be relatively easy, since they operated exclusively on routes where Congress had for half a century kept the rates on letter postage artificially high.

The rise of the private expresses confronted the Post Office Department with the greatest administrative challenge in its history. Determined to destroy the competition, Wickliffe vigorously prosecuted violations of what he firmly believed to be the government’s legally guaranteed letter-mail monopoly. Government attorneys instituted dozens of suits against individual expressmen, such as James W. Hale, who quipped at one point that he was the “most arrested man in the world.”22 Within Congress, Wickliffe’s tactics met with broad bipartisan support. During the extensive debates over postal policy between 1839 and 1845, no congressman proposed the abolition of the postal monopoly, and few praised the private expresses as a laudable example of private enterprise. Indeed, the very notion that mail delivery might be privatized still remained somewhat exotic, since the concept of private enterprise had yet to acquire the positive moral connotation that we now take for granted.

Outside of Congress, the private expresses enjoyed a broad base of popular support. Newspaper editors in Boston, New York, Philadelphia, and Baltimore championed their cause, as did merchants in New England and the Mid-Atlantic states. In 1845, Congress bowed to the inevitable and significantly lowered the basic letter rate to 5 and 10 cents, depending on the distance that the item was conveyed. Subsequent legislation in 1851 reduced the basic letter rate even further for most domestic destinations to a flat 3 cents—where it remained with minor modifications for the next hundred years.

The independent mail delivery boom hastened the recasting of the information infrastructure to accommodate the railroad as a means of conveyance. In 1845, Congress eliminated most of the subsidies that stagecoach firms had traditionally enjoyed. In 1851, it abandoned the presumption that the postal system should remain self-supporting, making it possible to draw on general revenue to cover the cost of railroad transportation. By this time, the railroad had emerged as the principal means of conveyance on the most heavily patronized routes. Yet it was not until the Civil War that postal administrators would finally begin to scrap the long-outmoded, stagecoach-based, hub-and-spoke sorting scheme and replace it with the train-based, continuous sorting scheme that would come to be known as railway mail.

To take full advantage of the routing possibilities that the railroad afforded, Postmaster General John Creswell established the Railway Mail Service in 1869 as a distinct and largely autonomous branch of the Post Office Department. Under the leadership of a succession of able superintendents—George A. Armstrong, George N. Bangs, and Theodore N. Vail—railway mail quickly established itself as a central information infrastructure of the industrial age.

The Railway Mail Service was one of the first enterprises to coordinate the routing of information throughout the length and breadth of the United States. Its mission was deceptively simple: to transmit the mail from sender to recipient as rapidly as a passenger could travel between these two points. To achieve this goal, railway mail managers promulgated an entirely new set of administrative protocols and entered into complex and ongoing negotiations with the postal distribution centers and the railroads. No other administrative entity transmitted such an enormous number of items, and only Western Union operated on a comparable geographical scale.

At the core of railway mail was an elaborate administrative apparatus that was overseen by a superintendent and a staff of geographically based division heads with the assistance of a team of roving inspectors.
The sorting itself was performed by a cadre of highly trained clerks who were much admired for their reliability, accuracy, and esprit de corps. These men routed the mail for the entire country as they traveled about in specially equipped railroad cars fitted with custom-built wooden sorting cases subdivided into pigeonholes. To help insulate the railway mail clerks from the debilitating effects of patronage politics, Congress decreed early on that none were to be subject to partisan dismissal—a striking departure from the norms that prevailed in the rest of the department.

The most ambitious project that railway mail administrators sponsored during the early years of the service was the “Fast Mail.” The Fast Mail was a special high-speed train, staffed by railway mail clerks, that ran day and night between New York and Chicago on a fixed schedule at the then extraordinary speed of forty miles per hour. Far more than merely an experiment in high-speed transportation, the Fast Mail was a showcase for advanced routing techniques, and a goad to all the mail contractors whose lines bisected the New York–Chicago route. Inaugurated during the tenure of Superintendent Bangs, the Fast Mail was supervised by Bangs’s assistant, and soon-to-be successor, Theodore N. Vail (see figure 3.4). Vail relished the challenge that the Fast Mail provided, and he used it to better coordinate not only the government’s own operations, but also the railroads that the government relied on to carry the mail. Indeed, at one point Vail went so far as to propose, unsuccessfully, that Congress grant the Post Office Department “absolute power” to determine which trains should carry the mail, and how much room they should provide to facilitate its sorting.

The Fast Mail proved to be expensive, making it a perennial target for congressional critics. Yet during its brief heyday in the 1870s, it provided its managers with an invaluable lesson in the possibilities of administrative coordination. Indeed, to an extent that no one could possibly have imagined at the time, it may well have provided Vail—who would later go on to a distinguished career in telephony—with a foretaste (and, perhaps even a template) for the kind of managerial innovations he would later implement at American Telephone & Telegraph (AT&T).

While the Railway Mail Service marked a new major departure in the routing of information, it remained dependent on the existing transportation-based means of conveyance. For this reason, it has rarely been accorded the respectful attention that is routinely lavished on the telegraph, the first electrically based communications technology.
The telegraph industry in the United States began in 1844 with the establishment by Samuel F. B. Morse of a forty-mile line between Washington and Baltimore. Morse's project, like most technological breakthroughs, had been subtly shaped by preexisting assumptions and norms. In particular, it owed a good deal to the well-known system of optical telegraphy that Claude Chappe had devised in the 1790s in revolutionary France.

Chappe's telegraph consisted of a chain of towers that had been fitted up with a pair of wooden shutters that could be arranged in a variety of positions. Under normal conditions, it could transmit a detailed message in less than three minutes over a distance of 100 miles. The French government invested heavily in the new technology and soon established an optical telegraph network that linked all the country's major cities. It remained a mainstay of French communications for fifty years.25

Chappe's telegraph popularized the idea that information could be transmitted at long distances at an almost instantaneous speed. Indeed, Chappe coined the term "telegraphy"—which meant, literally, "writing at a distance"—to characterize his invention, even though, strictly speaking, it was not a recording medium, since it left no written record and relied entirely on sight. Though no comparable system was ever established in the United States, merchants in Boston and New York soon established telegraphs on similar principles to hasten the transmission of information from sea to shore.26 By 1820, more than forty newspapers had incorporated some variant on the word "telegraph" into their title. A few years later, it would even find its way onto the masthead of Andrew Jackson's leading campaign newspaper in the election of 1828. Popular interest in the new technology was widespread. "It must...be evident to the most common observer," declared one optical telegraph enthusiast, "that no means of conveying intelligence can ever be devised, that shall exceed or even equal [its] rapidity...for, with the exception of the scarcely perceptible delay at each station...its rapidity may be compared to that of light itself."27

Optical telegraphy held a special fascination for postal administrators, since it offered the possibility of beating out any potential competitor in the transmission of information. Ever since the 1820s, when John McLean had proclaimed his determination to outpace any private express, a generation of postmasters' general had preached the gospel of speed. McLean briefly debated the merits of a government-sponsored optical telegraphy, as did Amos Kendall, who at one point was reputed to have hailed it as "just the thing" to supersede a high-speed horse express that he had established between Washington and New Orleans.28

Morse echoed these sentiments, and took it for granted that his telegraph should be regulated by the federal government, preferably under the control of the Post Office Department. The electric telegraph, Morse explained, was but "another mode" of accomplishing the "principal object" for which the Post Department had been established, "to wit: the rapid and regular transmission of intelligence."29 To help bring this about, Morse lobbied Congress to purchase his patent. Only when it became obvious that Congress had no intention of buying him out did he proceed to develop the new technology as a private enterprise.

Even critics of federal largesse favored governmental control. "In the hands of individuals or associations," warned the notorious fiscal conservative Cave Johnson, the electric telegraph might become the "most potent instrument the world ever knew to effect sudden and large speculations—to rob the many of their just advantages, and concentrate them upon the few...The use of an instrument so powerful for good or for evil cannot with safety to the people be left in the hands of private individuals uncontrolled by law."30

To Morse's chagrin, Congress refused to purchase his patent, obliging him and his partners to seek private funding. Jumping at the chance, a swarm of promoters began to string telegraph lines between the leading commercial centers, inaugurating what one nineteenth-century telegraph historian called an era of "methodless enthusiasm."31

By 1848, telegraph lines linked New York to both New Orleans and Chicago. By 1850, 12,000 miles of wire had been strung; by 1853 the total had almost doubled, to 23,000 miles.32

Wartime is often a catalyst for innovations in communications technology, and the Civil War was no exception. Shortly after the fighting began in 1861, telegraph promoter Hiram Sibley completed the first transcontinental telegraph line between Omaha and San Francisco. Sibley's line rendered obsolete the Pony Express, a transcontinental horse express that had been established the previous year. The transcontinental telegraph owed its impetus less to commercial considerations than to political fiat, and, in particular, to a construction subsidy that Congress wrote into the Pacific Telegraph Act of 1860. For a time, it seemed as if Sibley might well extend the telegraph to Europe by way of the Bering Strait and Siberia. The construction of a trans-Siberian line actually began, only to be abandoned in 1866, when the news came of the successful completion of a cable under the Atlantic between the United States and Great Britain.

74  A Nation Transformed by Information
During the Civil War, the military leaders of both the Union and the Confederacy found the telegraph to be an indispensable logistical aid. While the telegraph had already been used in various European conflicts—most notably, in the Crimean War—it had never before been deployed in wartime on such a geographically extensive scale. Union military officers proved particularly skilled in putting it to good use. By the end of the war, they had authorized the construction of some 15,000 miles of line. President Abraham Lincoln relied on a steady stream of telegraph dispatches to keep open the lines of communication with his commanders in the field. According to military telegrapher David Homer Bates, the president spent more hours during these years in the telegraph office at the Department of War than in any other place, with the exception of the White House itself.

Military mobilization proved particularly advantageous for telegraph firms, such as Western Union, that maintained an extensive telegraph network inside the Union lines. Western Union officials worked closely with the Union army during the war, and, following a brief flurry of mergers, emerged in 1866 as the first industrial combine to operate on a scale that was at all comparable to the Post Office Department. By 1880, Western Union transmitted 29.2 million messages over a network of 244,000 miles of wire and boasted a network of more than 9,000 offices (see table 3.3.). Three-quarters of Western Union's offices were of244,000 miles of wire and boasted a network of more than 9,000 offices (see table 3.3.). Three-quarters of Western Union's offices were located in railroad stations, a testament to the pivotal importance of offices. Three-quarters of Western Union's offices were located in railroad stations, a testament to the pivotal importance of offices. Three-quarters of Western Union's offices were located in railroad stations, a testament to the pivotal importance of offices. Three-quarters of Western Union's offices were located in railroad stations, a testament to the pivotal importance of offices.

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Western Union officials gained valuable administrative experience from the unprecedented mobilization of men and material that had taken place during the war. Many Western Union telegraphers had served in the military telegraph corps, an experience that instilled in them a preoccupation with speed and accuracy and a vivid appreciation of the power of the state. These habits of mind proved surprisingly enduring and would shape Western Union's business strategy for the next thirty years.

Of the many Western Union officials to have been shaped by the wartime mobilization, perhaps the most enterprising was William Orton, the first president of Western Union following its consolidation in 1866. Though Orton had no formal background in telegraphy, he had earned high marks from telegraph investors for his energetic stint late in the war as commissioner of inland revenue in the Department of Treasury. At Western Union, Orton put to good use the legal, administrative, and political skills that he had deployed so effectively as a public administrator. In addition to promoting the vigorous expansion of the firm's core business, the long-distance market, Orton dedicated Western Union to providing its customers with information in a reliable and impartial way. In this way, as one longtime colleague would later recall, Orton strove to elevate the horizons of the enterprise to embrace "considerations of citizenship" rather than mere "questions of simple profit and loss."

Western Union dominated long-distance telegraphy during the Gilded Age. To be sure, at various points company officials faced serious challenges from the Baltimore & Ohio Railroad, the Postal Telegraph Company, and the financier Jay Gould. In each of these contests, Western Union emerged victorious—although, in the case of Gould, at the cost of according him a dominant voice on the board of directors, which Gould retained from 1881 until his death in 1892.

Western Union's position in the intraurban market was considerably more precarious. Here it competed with a multitude of firms that employed different types of electrical signaling devices, such as fire alarms, stock tickers, and call boxes of various kinds. By 1870, thirty-eight municipalities had fire alarm systems; by 1880, this total had increased to 103; by 1902, to 764. Western Union intraurbans included the Gold & Stock Company and the American District Telegraph Company. In 1885, American District had fifty-two offices and 12,000 subscribers, and it responded to 6,000 calls a day.

To strengthen Western Union's market position, Orton expanded its manufacturing capabilities and briefly sponsored a program of research. In 1871, he helped acquire for Western Union a controlling interest in Western Electric, a major supplier of telegraphic equipment. At roughly the same time, Orton hired a number of inventors—i-
cluding Thomas Edison and Elisha Gray—to increase the capacity of Western Union's wire network. Orton's research program culminated with Edison's quadruplex telegraph, a device that could transmit four messages simultaneously over a single wire.  

The greatest threat that Western Union confronted was not economic but political. With its consolidation in 1866, the firm became the first industrial combine to transcend decisively the boundaries of the individual states. Predictably enough, Congress found this situation unsettling, and in response it passed the Telegraph Act of 1866. This legislation granted those telegraph firms that consented to its provisions the right to string wires along every post route in the country. In return, it obligated these firms to permit Congress to purchase all their telegraphic assets at a mutually agreed upon price, should Congress so decide. 

The Telegraph Act marked a compromise between Western Union, telegraph entrepreneurs who sought a national charter, and reformers who favored the outright nationalization of the industry. These Western Union critics were soon joined by several congressmen and Boston reformer Gardiner Greene Hubbard who would quickly emerge as Western Union's most determined foe. 

Hubbard was a lawyer with extensive experience in public utilities and a tireless promoter of projects intended to promote the public good. Beginning in 1868, he lobbied Congress for several years to charter a "postal telegraph" that would compete with Western Union by reducing rates and expanding public access. Hubbard's ideas are of interest, since, in the following decade, he would become a key backer of the Bell Company, the progenitor of the Bell System and AT&T. 

Hubbard lost few opportunities to chastise Western Union for its failure to realize the democratic potential that he believed to inhere in the new technology. From his standpoint, Western Union's rates were too high, its service too limited, its technology too primitive, and its offices too few. In articulating a position he had held for fifteen years, Hubbard declared in 1883: "As a telegraph for business, where dispatch is essential and price is of little account, the Western Union system is unrivaled; but as a telegraph for the people it is a signal failure."  

Hubbard was a keen student of communications policy, and his views were strongly reminiscent of the arguments that postal reformers such Joshua Leavitt had deployed in the 1840s in urging a reduction in the basic letter rate. Like Leavitt, Hubbard firmly believed that the American people had a God-given right to communicate with each other, and that existing institutions were impeding the free flow of informa- 

The Informational Environment during the Transition from Commercial Republic to Industrial Nation 

Few events in the nineteenth century raised greater expectations than the advent of telegraphy. The new technology was an agency of "almost
superhuman facilities," or so declared one of Morse's business partners in 1845: "Every interest, political, social, commercial, and industrial, will find the use of the telegraphic facilities sine qua non. . . . It is destined to effect a revolution in the business, the social, political, commercial and industrial relations of men, such as neither the more potential physical power of steam, nor the noiseless influence of the compass, has developed, gigantic and sublime, to the contemplative mind, as the results of each have been, and are, and are to be. . . ."

The actual development of the new technology was decidedly more prosaic. Early telegraphy was often irregular and could be surprisingly slow. Storms often interrupted service, and even in good weather operators were bedeviled by technical difficulties that stemmed from poor insulation. To make matters worse, telegraphy had to compete with mail delivery, which by 1844 had attained a high level of service. It was hard to convince Americans to patronize the new technology; in the words of one telegraph promoter, looking back on the early days of the industry, the Post Office Department already "served every purpose of ordinary intercourse." Long after the telegraph had become an established institution, a postal clerk could still report that the arrival of a single letter could still could "convulse the market" and create a "commotion" at the commercial exchange." It was not until the 1880s that the number of telegrams Western Union transmitted would equal the number of letters that the Post Office Department had delivered in 1840—which was prior to the passage of the Post Office Act of 1845.

Mail delivery remained particularly important in the sparsely settled and newly developed regions of the West. Here, as one postal administrator noted in 1880, the "comparative scarcity and expensiveness" of the telegraph rendered merchants entirely dependent upon the Post Office Department. Even journalists were slow to make the transition. In the period between 1844 and 1860, for example, only 8 percent of news stories in American newspapers originated as telegraphic dispatches, while 46 percent still came by mail. The advantages of mail delivery were especially evident following the passage of the Post Office Acts of 1845 and 1851, which it made possible, for the first time in U.S. history, to send a letter without worrying about the cost. Telegrams, in contrast, remained relatively expensive throughout the century. Though rates varied widely, depending on a number of factors, including the competitive situation, a ten-word telegraph message almost never cost less than 50 cents. In 1876, it cost $2.00 to send a ten-word telegram between New York and San Francisco. In contrast, it cost a mere 3 cents to send a letter this distance—and the letter might contain hundreds, or, conceivably, even thousands of words.

The limited facilities that Western Union provided further constrained its utility. As late as 1880, for example, Western Union had a mere 9,000 offices, far fewer than the 43,000 offices in the postal network. And, as critics like Hubbard were quick to point out, three-quarters of these offices were in railroad stations—which, unlike post offices, were often inconveniently located far from the center of town.

Perhaps the best index of the relative importance of the Post Office Department and Western Union was the size of their operating budgets. At no time did Western Union's annual revenue exceed that of the Post Office Department. Between 1870 and 1890, the operating budget of the Post Office Department was, on average, three times as large as that of Western Union. In 1880, for example, the Post Office Department had $33.3 million in operating revenue; Western Union, $10.6 million. In 1900, the gap had widened, with the Post Office Department bringing in more than $100 million, and Western Union, a mere $23 million (see table 3.4).

Through data on telegraphic usage are hard to come by, several generalizations can be ventured. Few Americans ever had occasion to send a telegraph—far fewer than wrote letters or received a newspaper in the mail. A mere 2 percent of the American people, estimated Western Union President Norvin Green in 1887, ever had had occasion to send a message by wire. Fully 87 percent of all the messages that Western Union did transmit, Green added, were business-related. Of

Table 3.4 Relative Expenditures on Mail Delivery, Telegraphy, and Telephony, 1866-1920

<table>
<thead>
<tr>
<th>Year</th>
<th>Post Office Department operating revenue (millions of dollars)</th>
<th>Western Union operating revenue (millions of dollars)</th>
<th>Bell System operating revenue (millions of dollars)</th>
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<tr>
<td>1866</td>
<td>14.4</td>
<td>4.6</td>
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<td>1870</td>
<td>18.9</td>
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<td>1880</td>
<td>33.3</td>
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<td>1890</td>
<td>60.9</td>
<td>20.1</td>
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<tr>
<td>1900</td>
<td>102.4</td>
<td>22.8</td>
<td>46.1</td>
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<tr>
<td>1910</td>
<td>224.1</td>
<td>30.7</td>
<td>164.3</td>
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<tr>
<td>1914</td>
<td>287.9</td>
<td>45.9</td>
<td>224.5</td>
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<td>1920</td>
<td>437.2</td>
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<td>448.2</td>
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the remainder, 8 percent were news-related, and the remaining 5 percent personal. Many of the business-related telegrams were frankly speculative—or, as Green put it, had been occasioned by the buying and selling of goods where “no transportation and often no delivery is ever made.”

A substantial fraction of this speculation took place outside of the regular commercial exchanges, in the so-called “bucket shops.” These controversial, often precarious, and sometimes clandestine businesses permitted small operators to speculate in agricultural commodities and corporate securities without having to work through a mercantile exchange. Bucket shops, Green observed, generated a “considerable percentage” of Western Union’s total revenue, by “selling and buying, forfeiting margins when they expired, settling, when the customers shall demand, at the quoted price at the instant, and no delivery is ever pretended to be made.”

Among the heaviest telegraph users were merchants trading in agricultural staples such as cotton and wheat. Since these staples had a ready market in Europe, price information was a valuable asset, particularly in commercial entrepots located far from the Atlantic seaboard, such as the cotton ports of New Orleans and Mobile and the wheat-processing marts of Buffalo, St. Louis, Minneapolis, and Chicago. A business editor remarked in 1854 that before the coming of the telegraph, traders had taken advantage of advance information to speculate in agricultural staples on an enormous scale. Each year, the editor estimated, planters had lost some forty million dollars in this way—a sum that, since the telegraph, had been reduced to probably one-twentieth its former magnitude.

While the telegraph hardly eliminated speculation, it did change its character. Now that price data were transmitted telegraphically, traders lost the ability to capitalize on advance knowledge of price differentials in distant locations. Instead, they began to speculate about the likely price of staples at specific future dates. Time, as it were, supplanted space as the great unknown. Before long, this practice led to the establishment of the futures market. Odd as it might seem, traders began to purchase crops that had yet to be harvested—and even that had yet to be planted. Planters and farmers found this arrangement advantageous, since it enabled them to sell their crop at a predictable price, protecting themselves against an unexpected market downturn. Traders hoped to profit from unanticipated increases in market demand, and sometimes they tried to drive up the price by purchasing a large fraction of the available contracts and refusing to sell.

To coordinate these complex transactions better, merchants established the modern mercantile exchange. The Chicago Board of Trade dated from 1848, the same year the telegraph reached the city. In the next few years merchants set up similar institutions in several other leading commercial centers, including St. Louis, Minneapolis, and Buffalo. Often these exchanges were located at quite a distance from the site of production. The principal cotton exchange, for example, was located in New York City rather than Mobile or New Orleans.

Mercantile exchanges transformed agricultural staples into easily quantified abstractions that could be bought or sold. For the first time, it became possible to purchase a given quantity of a specific agricultural staple in a distant market without having to rely on middlemen with first-hand information about local conditions. In the process, agricultural staples became commodities, something they had never been in nature.

Telegraphy had analogous consequences for the transmission of news. To regularize news transmission, several New York editors joined together in the 1840s to form the New York Associated Press. Before long, the Associated Press became a newsbroker, and information a commodity. Telegraph officials granted newsbrokers various privileges, including special rates and—most important of all—preferential access to the telegraph wires. The ability of newsbrokers like the Associated Press to coordinate the distribution of time-sensitive information gave them an influence that many regarded as politically dangerous, and which embroiled the industry in a number of public controversies in the Gilded Age.

Few firms used the telegraph more intensively than the railroad. Indeed, there is more than a little truth to the nineteenth-century commonplace that the railroad and the telegraph marched together across the continent as the “Siamese twins of commerce” (see figure 3.5). Telegraphic train-dispatching helped managers prevent accidents, coordinate operations, and generate the data necessary to monitor traffic flows. Financier Jay Gould declared that without the active cooperation of the railroads, the telegraph system, “in its broadest and most popular features” had no financial basis “by which it could exist, as a valuable enterprise, for an hour.”

During the early years of telegraphy, the relationship of the telegraph and the railroad was hardly self-evident. Had the railroad never been invented, the first decade of commercial telegraphy would have been substantially unchanged. After all, the primary users of the new technology were merchants dealing in agricultural staples, and the primary
Figure 3.5 American Progress. This lithograph was based on an 1872 painting by John Gast. According to its caption, it represents the "grand drama of Progress in the civilization, settlement, and history of this country." Emblematic of this progress was the "Star of Empire," the robed woman who hovers over the westward movement. Among her gifts is information. In her right hand she carries a book (the testimonial of our national enlightenment), in her left, a telegraph line ("to flash intelligence throughout the land"). Source: Crockett's New Overland Tourist and Pacific Coast Guide (Chicago: Overland Publishing, 1879-1880), 2:12-13. Courtesy of Robert Dalton Harris.

axis linked New York and New Orleans—a route that the railroad had yet to traverse.

The slow adoption of telegraphic train dispatching was particularly surprising since, in the United States—in contrast, for example, to Great Britain—most railroads were single-tracked. Single-tracking cut down on capital costs, yet it greatly increased the risk of collision and enormously complicated the administrative challenge of coordinating routine operations. "The telegraph is rarely seen in America running beside the railway," remarked one English editorialist in 1854, "for what reason we do not know; the consequence, however, is that locomotion in the United States is vastly more dangerous."55

The first American railroad to experiment extensively with telegraphic train-dispatching was the New York & Erie. Station managers relied on telegraphy to regulate train movements as early as 1851, though the procedure does not seem to have been systematized for a number of years.46

The Erie's general superintendent, Daniel McCallum, wrote a report that in 1856 describing the new uses for the telegraph. McCallum was one of the first managers to clearly delineate the lines of authority on a major railroad and he regarded the telegraph as an indispensable managerial tool. "It would occupy too much space," McCallum declared, "to allude to all the practical purposes to which the telegraph is applied in working the road; and it may suffice to say, that without it, the business could not be conducted with anything like the same degree of economy, safety, regularity, or dispatch...."57 McCallum required station managers to transmit by telegraph hourly reports stating the precise position on the line of every passenger train and every important freight train. Should a train run significantly behind schedule—ten minutes for a passenger train, thirty minutes for a freight train—McCallum required the conductor to report the cause of the delay to the telegraph operator when he reached the next station. The operator, in turn, was responsible for transmitting regular reports to the general superintendent. At this point, it was transcribed, as fast as it was received, on a "convenient tabular form," that showed, "at a glance" the "position and progress of trains, in both directions, on every division of the road."58

McCallum used the data generated by the telegraph to hasten what business historian Alfred D. Chandler Jr., has called "control through statistics." McCallum's goal was not simply to improve safety, but also to coordinate more effectively the deployment of resources. Indeed, McCallum went so far as to contend that a single-tracked railroad that relied on telegraphy to coordinate the movement of its rolling stock was actually superior to a double-tracked railroad that continued to rely on more rudimentary methods.

Within a few years, McCallum's example was emulated by most of the other leading eastern railroads—including the Baltimore & Ohio, the New York Central, and the Pennsylvania. During the 1860s, telegraphic train-dispatching became commonplace throughout the United States. In the West, the Chicago, Burlington, & Quincy led the way, followed by the Illinois Central.59 The first telegraph superintendent on the Illinois Central was hired in 1862; a few years later managers issued a printed rule book that included an extensive section on "Movement of Trains by Telegraph."60 Other lines soon followed their lead, often at the instigation of Western Union officials.61
Telegraphic train-dispatching benefited both the railroad and the telegraph. Railroads received an unlimited amount of free telegraphing on the road and a certain amount of free telegraphing throughout the rest of the network. Since railroad managers could telegraph free of charge, it is difficult to know just how much information they transmitted; in all probability, the volume was enormous. Telegraph firms secured free office space and telegraph operators, as well as the free transportation of poles, wires, and other materials. Most important of all, they received an exclusive right to transmit messages over the railroad’s right-of-way, forestalling competition and ensuring themselves a reliable conduit for their own long-distance traffic.62

Just as the telegraph facilitated the administrative coordination of the railroad, it also became a key managerial tool in manufacturing. Beginning in the 1850s, a number of industrial firms began to place unprecedented demands on the information infrastructure. These enterprises were typically much larger and more complex than any institution in the period prior to 1840, with the exception of the Post Office Department. Had these firms’ managers not been able to rely on the fast and reliable means of communication that the telegraph provided, it would have been more difficult, if not impossible, for them to have attained the administrative coordination of production and distribution that was such a key feature of the business enterprise in the industrial age.

Firms adopted telegraphy selectively. In credit reporting agencies, the telegraph proved to be a less important technological innovation than the typewriter—since, unlike the typewriter, it was used primarily in unusual circumstances, and never for the routine transmission of information.63 Telegraphy played an equally modest role in iron and steel, presumably because managers did not find it necessary to maintain tight control over their stock.64

In businesses that specialized in perishable products, such as meatpacking, telegraphy quickly became indispensable. By the 1880s, two leading Chicago meat packers, Armour and Swift, required daily telegraphic reports from their East Coast agents on the state of the market. In an average year, the total cost of these dispatches came to $200,000, a substantial sum.65 Meat spoiled rapidly, and the packers regarded it as extremely vital to know how much they could safely ship. “The head offices are in constant telegraphic communication with the branch houses and commission agents during the progress of the sale of each carload of beef, obtaining information and giving advice,” declared one government observer.66
invention at a "very low cost." 69

The successful commercialization of telephony in the United States owed a good deal to the creative leadership of its early champions. Particularly influential were promoter Gardiner Greene Hubbard, inventor Alexander Graham Bell, and manager Theodore N. Vail.

Hubbard's involvement in telephony grew directly out of his own prior experience with telegraphic reform. Though Hubbard was no inventor, he was well aware of the commercial value of an acoustic telegraph that, like the quadruplex, could transmit multiple messages over a single wire. He was thus understandably intrigued when he learned that Bell was experimenting with just such a device.

Hubbard bankrolled Bell's experiments in the expectation that Bell would invent an improved telegraphic instrument that Hubbard could sell to Western Union. Bell had other ideas. Far less interested in multiple telegraphy than in voice transmission, Bell hoped to invent a machine that could transmit human speech. Hubbard initially regarded Bell's research on telephony as a distraction, and did all he could to keep Bell focused on the multiplex. Bell refused to give up his work on the telephone, even though he had good reason not to alienate his patron (among other things, he had fallen in love with Hubbard's daughter, Mabel, whom he hoped to marry).

Hubbard was initially reluctant to commercialize the new technology himself. Just as Morse had hoped to sell his telegraph patent to the government, so Hubbard tried at first to unload the telephone on Western Union. Toward this end, at some point in the fall of 1876 Hubbard arranged an interview with William Orton. Precisely what the two men said to each other during their conference remains a matter of speculation, since no first-hand account has survived. Many years later, one of Bell's closest associates, Thomas A. Watson, recounted that Hubbard had offered Western Union Bell's telephone patent for $100,000, and that Orton had declined. 70

Orton's refusal to purchase Bell's patent is often cited as one of the worst decisions in the annals of U.S. business. Yet it is not hard to understand why he acted as he did. Hubbard had long been one of Western Union's most outspoken critics, and Orton was, quite naturally, reluctant to reward his longtime adversary with what was, at the time, a quite substantial sum. It was Orton's "repugnance" toward Hubbard, one telegraph official later reminisced, that prevented him from acquiring for Western Union a "controlling interest" in Bell's invention at a "very low cost." 71

Once Hubbard discovered that there was no easy way to cash in on Bell's patents, he set about to commercialize the telephone himself. On July 9, 1877, Hubbard formally drew up papers to establish the Bell Telephone Company as a patent association. Two days later, Bell married Mabel Hubbard in Hubbard's front parlor.

Hubbard had long criticized Western Union for its narrow focus on the business market and aspired to establish the telephone industry on a broader, more inclusive foundation. Middle-class Americans such as himself (Hubbard frequently presented himself as such in his numerous essays on telegraphic reform) constituted a potentially enormous market for communications that Western Union had conspicuously neglected. 72

Bell shared Hubbard's idealism, and in 1878 prophesied that the telephone would one day become an everyday medium of social communication on a nationwide scale. At a time when telephony remained limited for technical reasons to a distance of twenty miles, and a host of related issues had yet to be resolved, this was an extraordinary claim. Explaining his beliefs to one group of investors, Bell said that in the future telephone wires would unite the "head offices" of the telephone company in different cities, making it possible for individuals to communicate over vast distances by "word of mouth."

Bell conceded that such ideas might appear "Utopian and out of place." Yet he remained confident that "such a scheme" would be the ultimate result of the commercialization of the new technology, and urged investors to at all times keep this "end in view," so that "all present arrangements of the telephone may be eventually realised in this grand system." 73

Bell focused, like Hubbard, on the middle-class market, broadly conceived. In particular, he envisioned the telephone replacing the speaking tubes, bell pulls, and other devices that the well-to-do relied conceived. In particular, he envisioned the telephone replacing the speaking tubes, bell pulls, and other devices that the well-to-do relied on to maintain contact with their household staff. Once householders became accustomed to the new technology, he reasoned, they would urge its extension to stores and offices and push for the establishment of a central exchange. In an age when even modest middle-class households employed one or more servants, this was an ingenious strategy, and one that was well calculated to help insure that the arbiters of taste and fashion would soon come to regard the new industry in a favorable light.

This expansive vision of the potential of the new technology shaped its commercialization in several ways. To encourage homes as well as offices to install telephones, Hubbard offered unlimited monthly service for a single fee. This rate structure had the
advantage of being relatively simple to administer. Other pricing schemes, based on message units, could have been devised—and some were, particularly in Europe.

Equally innovative was Hubbard’s development strategy. Fearful that poor-quality service would raise doubts about the soundness of the new technology (and also intent on securing a steady return), Hubbard refused to sell telephones outright. As an alternative, he licensed promoters to establish operating companies in specific localities. Typically, Bell licensees solicited subscribers in a relatively small geographical area, such as a city or town, whom they then connected to a central switchboard or exchange. Few of these exchanges interconnected, at least at first, since technological constraints limited a telephone conversation to a range of no more than about twenty miles. Notwithstanding these limitations, Hubbard’s development strategy furnished a key precedent for two key tenets of the Bell System: namely, that the parent firm would maintain technical standards among the operating companies and that it would control the manufacturing of the necessary equipment, including the switchboards and telephones.

Hubbard’s greatest administrative achievement was his recruitment of Theodore N. Vail as Bell’s first general manager. Hubbard first met Vail in 1876 during a trip that Hubbard took across the country as the chairman of a special government commission on railway mail pay. Hubbard was much impressed by the vigor, breadth of vision, and organizational acumen that Vail brought to the superintendence of the Railway Mail Service, and he urged Vail to cast his lot with the fledgling telephone industry. Vail, for his part, found Hubbard’s enthusiasm for telephony infectious, and, frustrated by congressional opposition to his ambitious plans for the Fast Mail, jumped at the chance to make a fresh start.

Vail’s greatest administrative challenge at Bell came during the very first year of his appointment. The antagonist, predictably enough, was Western Union. Now convinced of the merits of the new technology, President Orton decided in late 1877 to enter the telephone business. Since Western Union had already established a subsidiary in intraurban telegraphy, it proved relatively easy to set up the American Speaking Telephone Company as a rival to Bell.

For a brief moment in the late 1870s, Western Union seemed poised to dominate the telephone industry and relegate Alexander Graham Bell to a footnote in the annals of invention. In addition to its own telephone patents, Western Union had at its disposal a formidable array of administrative and legal talent, an almost unlimited supply of capital, and an ownership stake in Western Electric, the largest manufacturer of electrical equipment in the country. American Speaking Telephone established operating companies faster than Bell and secured a beachhead in several major cities, including New York and Chicago. (The firm even had, in its secretary, James D. Reid, its own corporate historian. When, for example, Reid described in 1879 the newly emerging telephone industry in the first edition of his history of telegraphy, he treated the American Speaking Telephone Company in some detail, while omitting from his discussion any mention whatsoever of Hubbard or Bell.)

Though Bell’s defenders could not hope to match Western Union’s resources, they were not without some key assets of their own. In addition to Bell’s patents and Hubbard’s zeal, they had in Vail a skillful tactician with a keen grasp of the relevant issues. As his first official act as general manager, Vail sent every Bell licensee a copy of Bell’s first patent, with a note enjoining them to keep up the fight against Western Union. In the ensuing months, Vail worked diligently to secure the licensees the funding necessary to stave off the competition, and to force Western Union onto the defensive by suing it for infringing on Bell’s patent rights.

Most important, Vail helped convince Boston financier William H. Forbes to invest in the firm. Forbes quickly became the leader of a group of Boston investors who provided the Bell Company with a much-needed infusion of cash. In the absence of the financial resources that the Boston group provided, it is hard to imagine how the fledgling Bell Company could have met the challenge that Western Union posed. In recognition of this contribution, in early 1879 Hubbard renamed the firm the National Bell Telephone Company, and persuaded the Massachusetts legislature to increase the amount of capital that it was legally entitled to raise.

Hubbard and Bell had assumed that the National Bell stockholders would choose Hubbard as the first president of the reorganized firm. To their surprise, the investors settled on Forbes. Forbes’s appointment curtailed Hubbard’s authority, and deeply worried Bell, who feared that Forbes might cut a deal with Western Union that would tarnish his scientific reputation. Yet as it turned out, neither had much cause for concern, since Forbes fully shared their determination to battle Western Union.

In November 1879, following extended negotiations, Forbes emerged triumphant, having persuaded Orton’s successor, Norvin Green (Orton had died in 1878), to cede the telephone market to National Bell. This agreement, Vail later observed, was “the most important single event
in the history of the telephone business. For its part, Western Union promised to stay out of telephony, and to transfer to Bell its telephone assets—including its operating companies and every one of Edison’s and Gray’s patents. In return, Bell agreed to turn over to Western Union all of the interurban telegraph messages originating in Bell telephone exchanges, and to pay Western Union a generous royalty for the next seventeen years on every telephone it leased.

In retrospect, Green’s abandonment of the telephone industry seems no less shortsighted than Orton’s refusal to purchase Bell’s patent. Yet, at the time, it too made a certain amount of sense. Preoccupied with the long-distance business market—and resigned, as Orton had been before him, to the eventual government takeover of Western Union’s assets—Green concluded it was simply not worth the effort to embark on a new venture that might not realize its full commercial potential for another twenty-five years. Green’s lawyers had advised him that Bell’s patents would prove hard to contest, and Green lacked the stomach for a fight. Though Green’s negotiations with Forbes did occur during the same months Green was immersed in a fierce competitive struggle with the financier Jay 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 long, drawn-out competitive struggle. In the end—as Green explained to Forbes, after the final settlement had been reached—Western Union had been willing to compromise for the sake of “peace and harmony” and to avoid the “trouble, loss, and expense of a wasteful competition.”

The acquisition of Western Union’s telephone business significantly augmented Bell’s burgeoning network of operating companies. By 1881, as Forbes took care to point out in Bell’s first published stockholder’s report, Bell and its licensees had established telephone service not only in urban centers, where Bell was already well established, but in all but nine of the nation’s cities with a population of more than 10,000. Since telephony was a mere five years old, this statistic demonstrated an impressive record of growth.

Following the Western Union settlement, Forbes and Vail moved swiftly to consolidate their rapidly expanding telephone empire. In 1881, they once again increased the firm’s legal capitalization, and changed the firm’s name, this time to the American Bell Telephone Company, a moniker it would retain for the next twenty years. In addition, Bell lawyers redoubled their efforts to protect Bell’s patent position, which from the outset they had defended with great skill. Between the granting of Bell’s first patent in 1876 and the expiration of Bell’s last major patent in 1894, Bell lawyers found themselves embroiled in 600 separate legal disputes; they never lost a case.

Of particular importance for the future was Vail’s 1881 acquisition of a controlling interest in Western Electric—a leading manufacturer of electrical equipment that, for the past ten years, had been affiliated with Western Union. The following year, Western Electric became an exclusive supplier of Bell telephone equipment, a position it would long retain. Interestingly, Western Electric’s owners fully supported the takeover; they reasoned that, if the company remained independent, Bell might well enter into an exclusive manufacturing agreement with some other firm.

The acquisition of Western Electric helped make American Bell one of the first business enterprises to promote continuing research in the production and development of electrical equipment. In this way, Bell executives established a tradition that would culminate in 1925 with the establishment of Bell Labs, a key element in the information infrastructure of the Information Age.

Vail left AT&T in 1887 following a quarrel with the Boston investors over financial policy, but by this time he had established the firm on a foundation that it would maintain for the next 100 years. One early milestone came in 1884, when, under Vail’s leadership, American Bell established the first commercial telephone service between Boston and New York, a distance of several hundred miles. Slowly but steadily, Bell-funded engineers were making advances in transmission technology that made it possible to link the various operating companies in a single interconnected network. No longer would telephony remain restricted to a mere twenty miles. Vail’s preoccupation with transmission technology occasioned his appointment, in 1885, as the first president of American Telephone and Telegraph (AT&T), a wholly owned subsidiary with a mandate to focus on long-distance transmission. Eight years later, following Vail’s departure, AT&T achieved another technical breakthrough when, for the first time, it extended service from New York to Chicago.

With the expiration of Bell’s last major patent in 1894, Bell executives suddenly confronted a host of newly chartered telephone firms. In the following decade, some 6,000 independents sprang up throughout the United States. These firms 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 in the South and Midwest. By 1907, non-Bell
firms operated half of the telephones in the United States (see table 3.5).

The independents greatly expanded the market for telephony and forced Bell to extend its network at an unprecedented rate. In 1891, several years prior to the expiration of the Bell patents, fewer than four of every 1,000 Americans had a telephone. By 1910, fifteen years after the rise of the independents, the number of telephones had increased to 82 per 1,000 Americans (see table 3.6). In the period between 1894 and 1914—the first two decades of competition—Bell installed ten times as many telephones as it had in the period between 1876 and 1893.

Though the independents provided little long-distance service, few customers cared. Far more important, at least initially, was their ability to offer low rates and a reasonable level of service. In large measure, the ability of these firms to underbid Bell can be explained by the simple fact that, on account of their relatively small subscriber base (compared to Bell), they had little need to make a comparable investment in switching technology. This was because in telephony, in contrast to mass-production industries such as steel or automobiles, expanding the scale of operations led to an increase, rather than a decrease, in unit cost. The larger the number of subscribers, the greater the problem. Or, to put it somewhat less abstractly, as the network expanded, it became relatively more expensive to provide the necessary facilities to enable a user to make a call.64

The rise of the independents forced Bell Telephone executives to rethink their business strategy. Following the lead of E. J. Hall, a key figure in Bell's expansion in the South, they entered into a variety of sublicensing agreements with firms that remained outside of their direct control. Sublicensing proved particularly advantageous in peripheral regions like the South, because it enabled Bell to expand its network at a minimum cost.65 Unlike the Bell operating companies, the sublicensees lacked direct financial ties to the parent company, yet they could interconnect with the Bell network, provided that they maintained certain technical standards.

Hall also cultivated support for high technical standards among sympathetic government officials, particularly in state legislatures and state regulatory commissions. Hall's skillful political entrepreneurship significantly raised barriers to entry in the industry, since it obliged Bell's competitors to meet its exacting operating requirements. Just as the judiciary had shielded Bell from competition between 1876 and 1894, so the state governments helped it fend off potential challengers between 1894 and World War I.66

Bell strategy assumed a heightened coherence in 1907, when a New York banking consortium headed up by J. P. Morgan gained control of AT&T and appointed Vail to the presidency. Back in power, Vail picked up where he had left off two decades before.

The cornerstone of Vail's business strategy was his commitment to universal service. Universal service for Vail was soaring ideal that, at times, assumed an almost utopian cast. Like Bell and Hubbard, Vail had a visionary streak, and he was firmly convinced that, at some future

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Table 3.5 Telephone Usage Patterns, 1876-1920

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Telephones* (millions)</th>
<th>Telephones Per 1,000 Population</th>
<th>Local Telephone Calls (millions)</th>
<th>Toll Telephone Calls (millions)</th>
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<tbody>
<tr>
<td>1876</td>
<td>3</td>
<td>0.1</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>1880</td>
<td>54</td>
<td>1.1</td>
<td>0.2</td>
<td>2</td>
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<tr>
<td>1890</td>
<td>234</td>
<td>3.7</td>
<td>1.4P</td>
<td>10P</td>
</tr>
<tr>
<td>1893</td>
<td>266</td>
<td>3.9</td>
<td>1.9</td>
<td>34</td>
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<td>1900</td>
<td>1,356</td>
<td>17.6</td>
<td>7.7</td>
<td>193</td>
</tr>
<tr>
<td>1910</td>
<td>7,635</td>
<td>82.0</td>
<td>35.3</td>
<td>862</td>
</tr>
<tr>
<td>1920</td>
<td>13,273</td>
<td>123.4</td>
<td>50.2</td>
<td>1,607</td>
</tr>
</tbody>
</table>


*Bell System and independent companies.

*Totals for 1889.

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Table 3.6 Competition in Telephony, 1893-1920

<table>
<thead>
<tr>
<th>Year</th>
<th>Bell System (millions)</th>
<th>Independent (connecting) (millions)</th>
<th>Independent (nonconnecting) (millions)</th>
<th>Percentage Connecting</th>
<th>Percentage Nonconnecting</th>
</tr>
</thead>
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<tr>
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<td>0.3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>1900</td>
<td>0.8</td>
<td>0.02</td>
<td>0.5</td>
<td>63</td>
<td>37</td>
</tr>
<tr>
<td>1905</td>
<td>2.3</td>
<td>0.3</td>
<td>1.6</td>
<td>61</td>
<td>39</td>
</tr>
<tr>
<td>1907</td>
<td>3.0</td>
<td>0.8</td>
<td>2.3</td>
<td>63</td>
<td>37</td>
</tr>
<tr>
<td>1910</td>
<td>3.9</td>
<td>2.0</td>
<td>1.8</td>
<td>77</td>
<td>23</td>
</tr>
<tr>
<td>1912</td>
<td>4.8</td>
<td>2.5</td>
<td>1.4</td>
<td>84</td>
<td>16</td>
</tr>
<tr>
<td>1920</td>
<td>8.7</td>
<td>3.8</td>
<td>0.7</td>
<td>95</td>
<td>5</td>
</tr>
</tbody>
</table>

time, AT&T would provide a basic level of telephone service to every household in the country. This was, however, a highly unrealistic objective at a time when telephones could be found in fewer than 10 percent of American households. In the interim, he aspired to the less ambitious, yet still quite challenging, goal of interconnecting every existing telephone controlled by Bell. To popularize interconnection, Vail launched a public relations campaign that was by far the largest effort of its kind to have ever been mounted by a U.S. corporation. Its theme was “one system, one policy, universal service,” which succinctly expressed Vail’s vision of an integrated telephone network under the supervision of AT&T.

Vail’s strategy was predicated upon a close working relationship with the New York investors under J. P. Morgan. In addition to providing AT&T with the capital it needed to buy out selected independents, the Morgan group was determined to block the creation of an independent long-distance network. Confident that AT&T could always outspend the competition, Vail followed Hall’s lead and encouraged state legislatures and state regulatory commissions to mandate high technical standards for telephone firms operating within their jurisdictions—establishing, by no means inadvertently, barriers that the more poorly capitalized independents found difficult to meet.

One area in which Vail proved unwilling to innovate was in switching. Though AT&T’s competitors had begun in the 1890s to introduce automatic switching, before 1920 virtually every telephone call made with Bell equipment had been connected manually by a telephone operator—almost always a young woman known as a “hello girl.” Vail was reluctant to move ahead in this area for several reasons. AT&T had a huge investment in mechanical switching equipment and Vail was understandably hesitant to write it off as obsolete. Technical challenges also loomed large. Automatic switching raised a host of perplexing operational problems, especially in a network as large as the Bell System. Still, had Vail made automatic switching a priority, it seems likely that AT&T could have moved a good deal faster in this area than it did (see figure 3.6).

Vail’s business outlook posed a further constraint. Automatic switching violated the principle of “user transparency”—that is, the notion that telephony should be kept so simple that subscribers would not even have to dial a number. Like Hubbard and Bell, Vail remained sensitive 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 Vail assumed—should be analogous to ringing a maid to hand-deliver a personal note. “The telephone operator,” Vail declared, was the “servant of every subscriber, as though she was in his office or in his direct employ. . . . There can never 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.” 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 a Bell System operator to complete the connection.

Vail proved far more committed to solving the problem of long-distance telephony. Though the market for long-distance service remained quite limited, Vail was driven by what one historian has aptly
The invention by Bell engineers in the 1880s of the loading coil and in the 1900s of the audion (an early vacuum tube) were major steps toward the realization of this goal. So 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.

The New York–San Francisco connection was a major technical triumph, since it had required the use of the audion, one of the key innovations of the Information Age. In the following years, AT&T built on this breakthrough by experimenting with the audion in wireless telegraphy, or what would soon come to be known as radio.

AT&T’s foray into the new technology was short-lived. Fearful of possible legal action under the Sherman Anti-Trust Act, Bell pulled out of radio as a precaution. This decision drew on a certain fund of experience—in the years preceding World War I, AT&T had found itself embroiled in a related lawsuit aimed at contesting its control over the telephone business. This legal action was abandoned in 1913, when, to the surprise of many observers, AT&T Vice President Nathan Kingsbury and U.S. Attorney General James C. McReynolds devised an out-of-court settlement that made major concessions to the independents. Had McReynolds and Kingsbury failed to work out the compromise that became known as the Kingsbury Commitment, the Bell System might well have been broken up or even nationalized. The Kingsbury Commitment required Bell to provide access to its long-distance lines to independents that sought such a connection; the settlement also promulgated a set of principles that would structure relations between AT&T, the operating companies, and the independents for more than seventy years—until the court-mandated breakup of the Bell System in 1984.

Given the present-day deregulatory climate, one might assume that the Kingsbury Commitment was a clear victory for monopoly over competition. After all, it weakened the independents, and left the Bell System intact. Yet this was not how it was commonly understood at the time. Far more important to contemporaries was the role of this agreement in defusing pressure for the nationalization of the entire telephone industry—which was, as one popular magazinist aptly observed, one of the “big, smoldering issues” of the day. Government ownership of telephony was an established fact in Great Britain, France, and every other major industrial country; in the 1910s, such ownership had the support of many U.S. public figures, including Postmaster General Albert Burleson. In such a political setting, the independents quite understandably supported the Kingsbury Commitment as the lesser of two evils. Indeed, one historian of the independents has gone so far as to credit the endorsement of the agreement by these firms as a major reason the industry escaped the evil of government ownership. “It is fair to say,” this historian observed, that if the Kingsbury Commitment had not “broken the ice” and convinced both the independents and AT&T that they had an equal stake in the status quo, the “public ownership zealots” in Washington might have been able to “put over” on a “disunited and internally bickering industry” a much more intrusive regulatory scheme.

During World War I, the federal government did, in fact, briefly assume control of the telephone industry. Yet Congress proved disinclined to perpetuate this experiment once the hostilities ceased, and in 1919 it swiftly returned the industry to its investors. It may well be that this outcome owed more than a little to the collective ability of AT&T, the government, and the independents to devise a politically acceptable regulatory regime.

Vail’s business strategy proved so successful and enduring, that it is tempting to speculate a bit about the organizational models upon which he drew. One possible source of inspiration was, of course, the telegraph industry. Vail had briefly worked for Western Union as a telegraph operator in his youth, and was familiar with the prominent role that his cousin, Alfred Vail, had played in the 1840s in helping Samuel F. B. Morse’s to set up the Washington–Baltimore line.

Yet the influence of telegraphy on Vail’s managerial style is easily exaggerated. In several key respects, Vail’s leadership of the Bell System differed from Orton’s and Green’s administration of Western Union. Unlike Vail, Orton and Green lacked a commitment to systems integration, opposed all forms of government control, and, with the exception of a brief moment in the 1860s and 1870s, displayed scant interest in technological innovation.

A far more plausible, though often overlooked, organizational seedbed for Vail’s ideas was the Post Office Department. Ever since the passage of the Post Office Act of 1792, postal administrators had striven, in one way or another, to provide the citizenry with universal access to up-to-date information about commerce and public affairs. Though this goal differed in several ways from Vail’s commitment to universal service, it did share with it an unambiguously civic cast. Even more direct were the lessons that Vail may have drawn from the Railway Mail Service, over which he had presided in the 1870s. Particularly suggestive was Vail’s involvement in the Fast Mail. This project, after all, was a major experiment not only in high-speed long-
distance transmission, but also in interconnection, technical standard-setting, and the administrative coordination of a highly decentralized federation of operating units. Without wishing to push the analogy too far, it may well be that it furnished Vail with at least some of the ideas that he would later deploy with such effectiveness at AT&T.

The Informational Environment of the Industrial Nation

"What strikes and frightens the backward European almost as much as anything in the United States," declared one English visitor in 1912, is the "efficiency and fearful universality" of its telephone service:

Just as I think of the big cities as agglomerations pierced everywhere by elevator-shafts full of movement, so I think of them as being threaded under pavements and over roofs and between floors and ceilings and between walls, by millions upon millions of live filaments. . . . the European telephone is a toy, and a somewhat clumsy one, compared with the inexorable seriousness of the American telephone.99

The Englishman's observation was borne out by comparative data. At the turn of the twentieth century, there was one telephone for every sixty individuals in the United States; one for every 115 individual in Sweden; and one for every 1,216 individuals in France.96 In 1909, there were more telephones in the hotels of New York City than in all of Spain.97

Telephony shaped U.S. business in a variety of ways. By facilitating interpersonal communication within localities and inside buildings, it reduced the demand for messenger boys. And by providing senior-level administrators with a tool for overseeing foremen, middle managers, and other subordinates, it encouraged the physical separation of the factory floor from the executive suite, a necessary precondition for the emergence of the central office district. Bell engineer John J. Carty observed: "It may sound ridiculous" to hail Alexander Graham Bell and his successors as the "fathers of modern commercial architecture—of the skyscraper." Yet, Carty added, the relationship between telephony and the multistory office building was impossible to ignore. "Suppose there was no telephone and every message had to be carried by a personal messenger. How much room do you think the necessary elevators would leave for offices? Such structures would be an economic impossibility.98

The emergence of the skyscraper significantly augmented the authority of the central office. So did the novel requirement that sales representatives report back to headquarters every day when they were on the road. To meet this demand, hotel owners installed telephones in the guest rooms of establishments that catered to business travelers, an innovation that at this time distinguished U.S. hotels from their counterparts in the rest of the world.

The speed with which the telephone transformed social relations within the firm is easily exaggerated. At no point did telephony entirely displace written communication, or render obsolete any of the other information-related technologies that were beginning to come into widespread use. In certain large firms—such as the Metropolitan Life Insurance Company, in New York—the telephone faced stiff competition from pneumatic tubes, an ingenious mechanical delivery system that had the advantage of leaving a written record. In the late nineteenth century, Metropolitan employees within the firm's New York headquarters were transmitting pneumatically some 5,000 messages a day.99

Executives sometimes tried to compensate for the absence of a written record by mounting two phones on their desks—one for their own use, and one for their stenographer (see figure 3.7). Yet this expedient was awkward and expensive, and it rarely caught on. Outright resistance to the new technology was by no means unknown, particularly when its introduction was unaccompanied by any related changes in organizational design. A manager of a medium-sized manufacturing firm in Connecticut in 1917 complained, "Time is lost, confusion results and money is spent in endeavoring to locate executives [for telephone calls] when they are out in the plant."100

For many Americans—in particular, those in the middle and upper classes—the telephone provided a useful substitute for a face-to-face exchange, just as Bell and Hubbard had hoped. Storekeepers large and small quickly came to recognize it as an indispensable business asset. Telephony proved especially valuable for individuals whose cultural authority rested on technical expertise or verbal skill. This was particularly true of the lawyers, bankers, doctors, ministers, and civic leaders who made up such a vital part of the professional middle class.

By World War I, many middle- and upper-class households had come to regard the telephone as a necessity. But it was hardly inexpensive. The
average residential rate for a Bell telephone in 1895 was $4.66 a month, or $66 a year—which put it well out of the reach of the working poor. It is hard to come up with comparable totals for later decades, since Bell began to give households the option of choosing between metered service and a flat monthly rate. In addition, households could sometimes secure more inexpensive service from the independents, or by sharing a party line that enabled several families to share a single circuit. Long-distance telephony was especially expensive. In 1919, for example, it cost $16.50 to make a three-minute call between New York and San Francisco, and $4.65 to make a three-minute call between New York and Chicago. Not until well after World War II would it become at all common to make long-distance calls from one's home, and, as late as the 1930s, less than 2 percent of all telephone traffic crossed state lines. Prior to the expiration of the Bell patent monopoly in 1894, few farms had telephones. With the rise of the independents, rural tele-

Recasting the Information Infrastructure for the Industrial Age

This chapter reminds us that the prehistory of the present-day Information Age antedates the invention of the computer by a century and a half, and, in fact, is older than the United States. Beginning in the 1760s with the emergence of an organized opposition to the Crown, and accelerating in the 1790s with the expansion of the postal network, information has always figured prominently in American life. In conjunction with the seemingly insatiable demand of Americans for more and better information, the transformation of the information infrastructure during the long nineteenth century goes far toward explaining why a faith in the emancipatory potential of communications has long been one of the most distinctive, and enduring, of American cultural traits.

Between the adoption of the Constitution and World War I, two distinct yet partly overlapping communications revolutions recast the informational environment in the United States. The first of these
revolutions received its initial impetus in the 1760s, when large numbers of Americans came for the first time to regard the creation of an informed citizenry as a valued ideal. This cultural imperative found an institutional embodiment in the postal system, which, after an uncertain beginning in the 1770s and 1780s, acquired a discernibly modern form with the passage of the Post Office Act of 1792.

The first communications revolution reoriented the informational environment of the commercial republic from the seaboard to the hinterland. No longer would the primary information flows be transatlantic, as they had been in the informational ancien régime that existed prior to 1787. By 1828, a Trans-Appalachian, land-based informational environment had come to supplement—though never altogether to supersede—the Atlantic, maritime informational environment that had once yoked the United States to Great Britain.

The second communications revolution recast the informational environment for the Industrial Age. This revolution began in the 1840s with the expansion of the railroad and the advent of the telegraph, and accelerated in the 1870s with the elaboration of the Railway Mail Service and the coming of the telephone. By World War I, this information infrastructure was complete. In many ways, it would become the foundation of the information infrastructure of the present-day Information Age.

This second communications revolution shaped the informational environment in a variety of ways. In its first, transitional phase, it fostered major institutional innovations in commodity trading and news reporting and improved internal communications within business enterprises that operated on a geographically extended scale. In its second (and final) phase, it eased rural isolation and hastened the rise of the modern central office district and the professional middle class.

The history of the information infrastructure in the United States cannot be fully understood by focusing exclusively on the interplay of technology and markets. No less important have been the cultural norms that decision-makers relied on to shape the course of events. The ideal of an informed citizenry inspired postal administrators such as John McLean; the ideology of private enterprise constrained telegraph officials such as William Orton and Norvin Green; and the ethos of universal service guided telephone executives such as Theodore N. Vail. Political considerations have also proved significant. Congressional opposition stymied competition in mail delivery; the specter of government control narrowed time horizons at Western Union; and various kinds of government regulation have shaped the contours of the telephone grid.

While competition has often been a catalyst for change, it remains undeniable that the communications sector has been dominated for long periods by a relatively small number of large institutions—the Post Office Department, the Railway Mail Service, Western Union, and the Bell System. To a remarkable extent, it was these institutions—each a first mover in its respective realm—that, in conjunction with the constant demand of countless Americans for more and better information, best explains the transformation of the American informational environment in the long nineteenth century that began in 1787 with the framing of the Constitution and closed in 1914 with the start of World War I.
Chapter 3

For suggestions and advice, I am grateful to David Hochfelder, Alfred D. Chandler Jr., and James W. Cortada. None of these individuals should be held accountable for the ideas expressed in this essay, which are mine alone.


6. John, Spreading the News, chap. 2.


8. John, Spreading the News, 5. The United States total excludes Indians and slaves; the British total includes Ireland.


11. John, Spreading the News, 38.


28. Printed memorial from John R. Parker to the Senate and House, January 1837, copy addressed to Amos Kendall, Incoming Correspondence, RG 28, Post Office Department, National Archives, Washington, D.C.
32. Thompson, Wrring a Continent, 241.
39. See, for example, William Orton to Anson Stager, January 24, 1871, and Orton to T. H. Willson, January 2, 1889; both in president's letterbooks, WUR-SI.
46. Green to William F. Vilas, November 17, 1887; president's letterbooks, WUR-SI.
47. Ibid. "Another large class of customers," Green added, "are the patrons of the race course, and the pool rooms connected therein by wires; where chances are bought and sold in all the cities, some of which are a thousand miles from the scene of contest."
53. Cited in Thompson, Wring a Continent, 204.
54. Reid, Telegraph (1886 ed.), 585.
58. Ibid., p. 105.
59. Alvin F. Harlow, Old Wires and New Waves (New York: Appleton, 1936), 212. It was during the 1860s, Harlow added, that the “welding” of the telegraph and the railroad took place (p. 213).
61. Reid, Telegraph, 482, 488.
62. Ibid., 479.
66. Cited in ibid., 396.
71. Charles A. Tinker to Thomas Eckert, April 17, 1890, president’s letterbooks, WUC-SI.
74. Reid, Telegraph, 629-632.
77. Pier, Forbes, 118-120; Bruce, Bell, 281.
79. Norvin Green to William H. Forbes, September 3, 1879, president’s letterbooks, WUR-SI.
83. For a related yet somewhat different assessment of Vail’s contribution, see Galambos, “Vail and the Role of Innovation.” Galambos downplays the centrality of Vail’s efforts prior to 1887, and concentrates on his role in shaping the “expectational horizons” of AT&T in the years following his return to the presidency in 1907.
89. Theodore S. Vail to Arthur Brisbane, June 25, 1915, president’s letterbooks, AT&T Archives, Warren, N.J.

91. Lipartito, Bell System, 225.
94. For a different conclusion, see Claude S. Fischer, America Calling: Social History of the Telephone to 1940 (Berkeley: University of California Press, 1992), esp. p. 83.
100. Cited in Yates, Control through Communication, 185.

Chapter 4

1. One measure of this shift is the percentage distribution of national income or aggregate payments; see U.S. Bureau of the Census, Historical Statistics of the United States, Colonial Times to 1957 (Washington, D.C.: Government Printing Office, 1960). In the 1879–1889 period, the manufacturing sector edged out the previously dominant agricultural sector, 16.6 percent to 16.1 percent, respectively; subsequently, manufacturing accounted for an increasing percentage while agriculture stagnated and then gradually fell in percentage (Series F34 and 43, p. 140).
A Nation Transformed by Information

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from Colonial Times to the Present

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