Entrepreneurship in the Early Development of the Telephone: How Did William Orton and Gardiner Hubbard Conceptualize this New Technology?

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Both historians and the public often assume that the "end use" of a new technology is embedded in the technology itself. It is assumed that once a device is invented, it is clear how it will be used and by whom. For instance, in the case of the telephone invented by Alexander Graham Bell in 1876, it was obvious that the device would be used by individuals to talk with each other and that businessmen easily understood the need for setting up local telephone exchanges.[1]

In this paper, I wish to challenge this common assumption. Instead, along with other historians and sociologists of technology, I will argue that the "end use" of technology is created or constructed by a variety of participants in a technological enterprise [Bijker et al., 1987; Bijker and Law, 1992; and Bijker, 1993]. These participants may include the original inventor, the skilled technicians who built the invention, and the first consumers, but here I wish to focus attention on businessmen or nontechnical leaders. Businessmen often play a crucial

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[1]1The research reported here was undertaken while I was a Dibner Library Resident Scholar at the Smithsonian Institution during the summer of 1993, and I am grateful to the staff of the Dibner Library for their assistance. Over the past seven years I have been investigating the invention of the telephone jointly with Michael E. Gorman, and we have been supported by the National Science Foundation and the Spencer Foundation. I wish to thank my undergraduate research associates (the Repo Team) for permitting me to test various ideas out on them. And finally, I am grateful to David F. Weiman for his valuable comments when I presented this paper at the Business History Conference in March 1994.

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role in creating an "end use" for a technology for they possess both perceptions of potential markets as well as the skills needed to bring a new invention to market.[2] In my reading of recent historical studies of invention, I have noticed that backers and patrons are frequently mentioned but their contributions are not necessarily seen as being as important or as creative as the work of the inventor.[3]

To highlight the role of the businessman in the innovation process, I will examine the roles of Gardiner Hubbard and William Orton in the development of the telephone from 1876 to 1879. Although neither man is well known today, both contributed to how the telephone came to be used in the United States. Hubbard was Alexander Graham Bell's father-in-law, and it was Hubbard who played a significant role in identifying and exploiting the commercial potential of the telephone. Orton was president of the Western Union Telegraph Company and encouraged Thomas Edison to develop a telephone for eliminating Bell as a competitive threat. Although publicly opposed to Western Union, Hubbard privately offered to sell Bell's telephone patent to Orton. Curiously, Orton turned down the chance to buy what is sometimes regarded as the most valuable patent of the nineteenth century. To explain their peculiar interaction, this paper will discuss how Orton and Hubbard formulated distinct business-technological mindsets about the telegraph industry and how they used these mindsets in making decisions about the telephone.[4]

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[2]In another study [Carlson, 1991], I argued that Charles A. Coffin played the crucial role in recognizing the central station strategy for the development of electric light and power systems.

[3]In the last decade, a number of new biographies of inventors have appeared based on in-depth archival research. As examples see Leslie, 1983; Friedel and Israel, 1985; Philip, 1985; Crouch, 1989; Hughes, 1989; Jakab, 1990; Cooper, 1991; Brittain, 1992; and Kline, 1992.

[4]Jenkins [1975] introduced the concept of business-technological mindset to explain how businessmen in the photographic industry made decisions about new technological innovations. For a similar concept, frames of meaning, see Carlson, 1992.

In narrating the story of these two men, I wish to suggest that there is a need and opportunity to study once again the entrepreneur. Studies of entrepreneurship flourished in business history forty years ago, and these studies revealed much about the motivation of individuals in taking risks and pioneering new practices [Sass, 1986; Leslie, 1986]. These studies petered out for a variety of reasons, but a key factor was that there was a limit to how much one can say about motivation. In contrast, I will propose that focusing on the entrepreneur in the introduction of new technology is vital because it is the entrepreneur as much as the technologist who shapes the deployment of a new technology. If we want to understand how the material and technological world is constituted, then we need to examine entrepreneurs such as Orton and Hubbard.

William Orton and Western Union

Let us look first at William Orton and his experiences at Western Union. I will argue that the mindset he used to shape Western Union strongly influenced his response to the telephone.

William Orton (1826-1878) was born in upstate New York and studied to be a teacher at the State Normal School at Oswego. As a student, he built a model of an electromagnetic telegraph and wrote his thesis on the subject. After teaching for a few years, Orton ran several book publishing firms, studied law on his own, and became involved in Republican Party politics in New York City. In 1861, he was elected to the city's common council and then appointed a Federal Collector of Internal Revenue for New York. Orton successfully administered the new income tax law, and in 1865 he was promoted to Commissioner of Internal Revenue in Washington.

After six months in Washington, Orton accepted the presidency of the United States Telegraph Company. This firm was a poorly organized amalgamation of three smaller telegraph companies, and it was losing money and unable to raise capital. Within a year, Orton reformed U.S. Telegraph and his effectiveness brought him to the attention of the leaders of Western Union. In 1866, Western Union and U.S. Telegraph merged and Orton was named vice president [Reid, 1879, pp. 520-3].

Western Union had been founded by Hiram Sibley in 1851 as the New York and Mississippi Valley Printing Telegraph Company. During the 1850s, Sibley built up the firm by taking over smaller telegraph lines until he had gained control of the telegraph business in the Midwest (hence the name Western Union). In 1861, Sibley built the first transcontinental line to California and established Western Union as one of the major firms in the industry. In 1866, Western Union absorbed its two remaining rivals, U.S. Telegraph and American Telegraph, achieving, for all intents and purposes, monopoly control of the telegraph industry.[5]

Because of his success in reorganizing U.S. Telegraph, Orton was named president of Western Union in 1867. At once, Orton began to convert Western Union from a confederation of independent companies and lines to a single organization and network. Orton established standard operating procedures and disseminated them throughout the new nationwide organization by creating the in-house *Journal of the Telegraph*. Orton improved the efficiency and reliability of the network by rebuilding poor lines and installing better insulators, wire, and relays. To implement these engineering improvements, Orton established the Office of the Chief Electrician and hired George Prescott to fill this post [Reid, 1879, pp. 529-38].

As Orton perfected the structure of Western Union, he formulated a market strategy. Orton noticed that a significant number of the telegrams transmitted by the company were short business messages--market quotes, buy and sell orders to brokers, and brief instructions to salesmen in the field. For these messages, business customers chose the telegraph because it was quick and reliable, and they were not especially concerned about price [Israel, 1992, p. 129]. Assuming that businessmen would send more and more of these messages as they pursued the new national market made available by

[5]For the early history of Western Union see Thompson, 1947. One has to be somewhat careful in claiming Western Union had complete monopoly control of the telegraph industry. First, like dominant firms in other industries, Western Union found it useful to permit a few small firms to exist (for example the Franklin Telegraph Company). Second, as we shall see, it was possible for new rivals to spring up by building new lines along major railroads.

the railroad, Orton decided to have Western Union concentrate on sending business messages between cities. In doing so, Orton made a distinct choice since he could have pursued several other markets. In several European countries, for example, the bulk of the telegraph messages were either social messages or long government reports. Likewise, Western Union could have also placed newspaper reports at the center of its strategy; although he forged an alliance with the Associated Press, Orton never considered press despatches as important as short business messages.

To control and expand this business market, Orton took two important steps. First, to secure information from capital and commodity markets for Western Union's business customers, Orton bought control of the Gold and Stock Telegraph Company. Gold and Stock had established itself by erecting local telegraph networks for transmitting prices from stock and commodity markets to the offices of brokers and investors. To make its service attractive, Gold and Stock encouraged Thomas Edison and Elisha Gray to develop printing telegraphs or stock tickers which brokers could easily read [Israel, 1992, pp. 125-7]. Because Orton saw Western Union in the long-distance, inter-city business and Gold and Stock operating in the local, intra-city business, he left Gold and Stock as separate firm. Nevertheless, control of Gold and Stock was valuable to Western Union because it gave Western Union access to the market information that business customers wanted.

Second, in pursuing the short business message market, Orton invested selectively in new technology. Although several inventors (including Edison) had developed automatic telegraph systems which used punched tapes to send and receive messages more quickly, Orton refused to invest in them. From Orton's view, it was a waste of time and money to prepare a punched tape for a short message when an operator could just send it.[6] Instead, Orton encouraged the development of devices which could send multiple messages over a single wire. By

[6]Edison's efforts to develop an automatic telegraphic are documented in Edison Papers, vol. 1. For Orton's opposition to automatic telegraphy, see Israel, 1992, pp. 132-4.

being able to send two, four, or even more messages over a single wire, Western Union could increase the volume and speed of messages without having to make heavy investments in stringing new lines or hiring more operators. Consequently, Orton purchased Joseph Stearns' duplex (two message) patent in 1872 and he supported Edison and Prescott's work on a quadruplex (four message) system in 1874 [Israel, 1992, pp. 135-40].

Thanks in part to the duplex and quadruplex, Orton was able to maintain a steady annual profit while increasing the number of messages and decreasing the cost per message (Table 1). By 1873, Western Union was conducting ninety percent of the telegraph business in the United States [Wolff, 1976, p. 41]. However, this does not mean that it was all smooth sailing for Western Union in the early 1870s. Simultaneous with his efforts to establish Western Union's strategy and structure, Orton had to fight off the dangers of a rival network and a hostile takeover.

Table 1. Growth, Profits and Average Tolls of the Western Union Telegraph Company, in 1866-77

Year	Miles of Line	No. of Offices	No. of Messages Sent (mil)	Profits ($mil)	Annual Decrease in the Average Tolls per message(¢)
1866	37,380	2,250	---	---	---
1867	46,270	2,565	5.9	2.6	---
1868	50,183	3,219	6.4	2.6	.5
1869	52,099	3,607	7.9	2.7	15.3
1870	54,109	3,972	9.2	2.2	13.8
1871	56,032	4,606	10.6	2.5	6.0
1872	62,033	5,237	12.4	2.8	3.3
1873	65,757	5,740	14.5	2.8	3.7
1874	71,585	6,188	16.3	2.5	7.7
1875	72,833	6,565	17.1	3.2	.9
1876	73,532	7,072	18.7	3.4	3.1
1877	76,955	7,500	21.2	3.1	7.3

One threat came from Wall Street. Sibley and Orton had rapidly built up Western Union by erecting lines along railroads and placing telegraph offices in railway stations. However, this meant that as new transcontinental railroads were built, railroad financiers could create their own telegraph networks and not ally themselves with Western Union. Jay Gould pursued this strategy twice, first in 1874-8 and again in 1879-81. In the first episode, Gould used his control of several railroads to help the Atlantic and Pacific Telegraph Company quickly build a rival telegraph system.[7] To steal business away from Western Union, the Atlantic and Pacific cut prices in January 1877 and forced Western Union to follow suit. Unfortunately, while the reduction in prices generated a large volume of business for Atlantic and Pacific, the firm lacked a sufficient number of lines to transmit the messages quickly and reliably. To cope with the message volume, Atlantic and Pacific tried using Georges D'Infreville's crude duplex and Edison's automatic system, and Gould convinced Edison to join the firm briefly as its Chief Electrician. Despite these steps, Atlantic and Pacific performed poorly (it never paid a dividend), and Orton was able to force a merger in the spring of 1878 [Reid, 1879, pp. 586-7; Israel, 1992, pp. 146-7].

The other major challenge for Western Union came from Washington. No sooner had Western Union achieved national dominance in 1867 than individuals such as Gardiner Hubbard began attacking it as a threat to American democracy. For Hubbard and others, Western Union was the first national monopoly, and they did not believe that this corporate giant would exercise any restraint in raising prices or that it would serve the public interest. For these critics, the fact that Western Union was reluctant to cut prices and indifferent to some inventions (such as automatic telegraphy) suggested that the firm was pursuing private gain at public expense. Critics were especially concerned that Western Union had access to both market information as well as private business messages, and that the firm could use this

[7]Gould was apparently especially motivated in attacking Western Union because it was controlled by his rival William H. Vanderbilt; see Josephson, 1934, pp. 205-6.

information to manipulate markets in its favor and ruin individual businessmen. Finally, critics were worried that by transmitting news for the Associated Press, Western Union could also interfere with freedom of the press [Sumner, 1879].

In response to these real and perceived problems, critics of Western Union attempted to persuade Congress to take action. Some thought that the Post Office should be permitted to erect its own telegraph lines and they cited the nationalization of telegraph lines in England, France, and Belgium as positive examples. Others, particularly Hubbard, thought the Federal government should guarantee competition in the industry by underwriting the creation of a second telegraph network [Lindley, 1975]. (I will say more about this proposed federally-subsidized network in a moment when I discuss Hubbard's mindset).

Undoubtedly drawing on his experience in Washington as Commissioner of Internal Revenue and his ties to the Republican Party, Orton successfully beat back these threats. To do so, Orton cultivated congressmen and regularly testified on Capitol Hill. In his testimony, Orton defended Western Union using a variety of arguments, but he frequently returned to two themes. First, he argued that the need to earn a return on the huge capital investment made by stockholders drove Western Union to build and operate an efficient telegraph network. Second, Orton claimed that only a private organization could fully discipline its workforce and prevent the violation of private messages or the misuse of market information. In contrast, he suggested that a government telegraph system would have operators who were politically appointed and this would leave inevitably to mischief [Wells, 1873; Orton, 1874]. Using arguments such as these, Orton was able to stymie attempts to either nationalize the telegraph or create a rival. In doing so, Orton helped establish the general pattern of telecommunications as a private industry which responds to Federal regulation.

The Potential for Innovation in the Telegraph Industry

In facing down challenges from Gould and Hubbard, Orton employed various tactics--price competition, political lobbying, and hostile takeovers. In this turbulent environment, though, technological

innovation came to play a new and important role. To maintain its dominant position, Western Union needed to adopt new inventions such as duplex and quadruplex. At the same time, the challengers--Gould and Hubbard--also realized that innovations might be used to gain a foothold in the industry. As an editor of the *Telegrapher* observed in 1875,

> improved apparatus has become of vital importance, and, consequently, telegraphic inventors who, for some years past, have been regarded as bores and nuisances, suddenly find themselves in favor, and their claims to notice, recognition and acceptance, listened to with respectful attention. All parties are now desirous of securing the advantages which may be derived from a development of the greater capacity of telegraph lines and apparatus. The fact has become recognized that the party which shall avail itself to these most fully will possess a decided advantage over its competitor or competitors.
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> That this state of telegraphic affairs affords the opportunity for the inventive talent and genius of the country which has hitherto been wanting, is unquestionable.[8]

By the mid-1870s, the combination of Western Union's dominance and the possibility of creating a rival network created a unique and novel market for telegraph inventions. In fact, one could argue there was a demand for "blockbuster" inventions or patents which could be used by Western Union or its challengers. Thus, as Bell, Gray, and Edison were investigating devices that would become the telephone, they were not working in "normal" business environment but rather a "hothouse" environment that favored a breakthrough.

The breakthrough sought by Orton, Hubbard, and others in the telegraph industry was the "next generation" of multiple message systems. In the mid-1870s, several inventors in Europe and America began designing acoustic or harmonic telegraphs. Inspired partly by the

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[8]"The Progress of the Telegraphic Contest," *The Telegrapher*, 11 (30 Jan. 1875), p. 28.

work of the German physicist Hermann von Helmholtz, investigators thought it might be possible to send and receive several messages by assigning a separate acoustic tone to each message. Elisha Gray experimented with an acoustic system beginning in the winter of 1866-7 and he publicly demonstrated a version in July 1874 in New York.[9] Because Gray was chief electrician for the Western Electric Manufacturing Company and Western Electric was one of Western Union's major suppliers, Orton quickly became aware of Gray's work.

In March 1875, Orton learned that another obscure inventor, Alexander Graham Bell, was working on a similar harmonic scheme. At that moment, Orton was quite interested in new multiple message systems since Edison had gone over to work for Atlantic and Pacific, and it was unclear who actually owned the quadruplex.[10] Orton had Bell demonstrate his apparatus, only to find Bell's arrangement inferior to Gray's design.[11] Nevertheless, Bell's work helped convince Orton that harmonic telegraphy might well be the next breakthrough. Consequently, when Edison sheepishly returned to work for Western Union in July 1875, Orton asked him to develop an acoustic telegraph.[12]

Although there were technical reasons for why Orton turned down Bell in March 1875, strong personalities also played a part. Bell was promptly (but politely) escorted out of Orton's office the moment Orton learned that Bell was associated with his nemesis, Hubbard. To understand why the mere mention of Hubbard led Orton to refuse to work with Bell, let us examine Hubbard and his opposition to Western Union.

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[9]For a detailed discussion of Gray's work on the harmonic telegraph, see Gorman et. al., 1993. See also Hounshell, 1975; 1976; 1981.

[10]Edison's work on the quadruplex and his complex relationships with Western Union and Atlantic and Pacific are documented in Edison Papers, vol. 2.

[11]Bell to Papa and Mama, 5 March and 22 March 1875, Box 5, Bell Family Papers.

[12]Edison, "Reis Telephone Drawings," [July 1875] in Edison Papers, vol. 2, pp. 524-6.

Hubbard and the Postal Telegraph

Gardiner Greene Hubbard (1822-97) was born in Cambridge, Massachusetts to a distinguished New England family. He attended Phillips Academy (Andover), Dartmouth College, and Harvard Law School. Hubbard built up a substantial legal practice in Boston. His practice included some patent work, and he helped Gordon McKay secure patent coverage for his shoemaking machinery. In the 1850s, Hubbard took a keen interest in using technology to improve Cambridge, and he was instrumental in establishing gas and water systems as well as a horsecar railway between Boston and Cambridge.[13]

In 1868, Hubbard turned his attention to the telegraph industry and questioning Western Union's dominance. It is not clear why Hubbard took up this topic, but he did share with Charles Francis Adams and other Bostonians a suspicion of large-scale organizations, especially those controlled by New York financiers.[14] As he did with other causes, Hubbard undertook a massive study of the telegraph business in Europe and America. Through this research, Hubbard concluded that Western Union was not serving the public interest: the company was pursuing only a business market, it was not using the most up-to-date technology (such as automatic systems), and it was not reducing its prices [Hubbard, 1868].

For Hubbard, the solution lay in rethinking the market for the telegraph. In Europe, telegraph networks handled a substantial volume of social messages and government reports; why not build a system to serve these markets as well as businessmen? To reach these additional groups, Hubbard proposed that telegraph offices be located not just in railway stations (Western Union's common practice) but in post offices which were much more convenient to the average citizen. Partly

[13][Biographical Sketch of Gardiner Hubbard], n.d., Box 16, Hubbard Family Papers.

[14]Hubbard linked his concerns about Western Union with Adams' efforts to reform the railroad industry in Hubbard, 1873, p. 84. On Charles Francis Adams' concerns about railroads and large-scale organizations, see McCraw, 1984, p. 1-56. For a discussion of the concerns of other Bostonians in the post-Civil War era, see Hall, 1984, pp. 261-70.

because the telegraph offices would be placed in post offices, Hubbard called his scheme the postal telegraph plan. Hubbard was confident that there was an enormous potential market for social and governmental messages and that this demand could be used to lower prices and expand telegraph service to every town and village in America. In doing so, Hubbard believed he was creating a telegraph system which would better serve the needs of the American public and advance democracy [Hubbard, 1890].

To create his alternative telegraph system, Hubbard did not hesitate to seek government support, for he had done so with other causes. In the mid-1860s, concerned that deaf students such as his daughter Mabel were not receiving adequate public education, he convinced the Massachusetts legislature to support a school for the deaf. Hence, it is not surprising that Hubbard took his idea for a postal telegraph system to Washington and sought funds from Congress in 1868.

What is surprising, though, is that Hubbard asked Congress to provide the capital for a private corporation which would build the new network and in turn enter into a contract with the Post Office.[15] This private corporation would be run by Hubbard and his associates. In proposing that the Federal government provide the capital for his company, Hubbard comes across as a genuinely puzzling character, as both a grasping entrepreneur and high-minded reformer. Somehow he was perfectly comfortable combining a crusade for the public good (fighting the Western Union monopoly) with pursuing private gain.[16] It is as if one combined Ralph Nader with Lee Iaccoca.

With great energy, Hubbard lobbied and persuaded Congressmen to introduce bills for a postal telegraph scheme in sessions from 1868 to 1876 [Lindley, 1975]. Orton vigorously fought back, and the annual

[15]Just as the Post Office contracted with private railroads, reasoned Hubbard, so the Post Office could contract with his new company to transmit telegrams.

[16]Elsewhere, Hubbard has been seen solely as a grasping entrepreneur and his reform efforts as insincere; see Lindley, 1975.

hearings for the postal telegraph bill came to be known as the "Wm. Orton and Gardiner Hubbard Debating Society."[17] Although the postal telegraph bill was never passed, Hubbard never gave up his belief in the need for an alternative telegraph system and he instead looked for other ways to force Western Union to change [Hubbard, 1890].

Hubbard, Bell, and the Telephone

Hubbard found a new way to challenge Western Union in the creative ideas of Alexander Graham Bell. Bell was a young Scotsman who had emigrated with his parents to North America to help promote his father's system of visible speech. Visible speech was a system in which the deaf were taught to associate different sounds with symbols and thus taught to speak. Anxious to secure the best possible teaching techniques for his daughter and other deaf children, Hubbard invited Bell in 1872 to come Massachusetts to teach visible speech. Bell taught first at the state-sponsored school for the deaf and then secured a professorship at Boston University.

Although a dutiful son, Bell did not wish to devote his life to advancing his father's system. In 1872, he turned to invention to make his mark on the world. Bell may have read how Western Union had purchased Stearns' duplex, and this led him to decide to develop his own multiple message telegraph [Bruce, 1973, p. 93]. Drawing on the extensive knowledge of acoustics he had acquired in teaching visible speech, Bell investigated a harmonic telegraph.

In the fall of 1874, after he had begun courting Hubbard's daughter Mabel, Bell told Hubbard of his telegraph experiments. Hubbard took an immediate interest in Bell's efforts and encouraged him to perfect his harmonic scheme as quickly as possible. Hubbard knew that he could use the invention of a better multiple telegraph to bring about change in the telegraph industry [Bruce, 1973, pp. 125-7].

Although Bell tried a dozen different arrangements, he was never able to get his harmonic telegraph to work properly [Gorman et al.,

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"Congress and the Telegraph," *The Telegrapher*, 10 (6 June 1875), p. 135.

1993, pp. 5-14]. Bell realized, in part, that he was not succeeding because he lacked the manual skills to implement his ideas; however, rather than give up, Bell concentrated on being a "theoretical inventor" and perfecting the theory behind his multiple telegraph [Bell, 1876, p. 8]. In the course of his theoretical musings, Bell came to be far more interested in not just sending individual tones electrically but the possibility of sending complex sounds (such as the voice) over a telegraph wire. In February 1876, Bell filed a patent for his harmonic telegraph scheme which included claims for a speaking telegraph.[18] Six weeks later, Bell succeeded in transmitting the voice and thus inventing the telephone.[19]

Although Hubbard was much more interested in getting Bell to complete his multiple telegraph, he followed Bell's telephone experiments and he arranged for Bell to exhibit his inventions at the Philadelphia Centennial Exhibition in the summer of 1876. At the Centennial, scientists, inventors, and other dignitaries were fascinated more by Bell's telephone than his multiple telegraph, and Bell began to focus more attention on perfecting his telephone. Through the remainder of 1876, Bell tested on his telephone on increasingly longer telegraph lines and he began giving lectures demonstrating the telephone [Bruce, 1973, pp. 188-214]. For Bell and other scientifically-minded people, the telephone was a discovery remarkable in illustrating the relationship between sound and electricity.

Groping toward a Strategy for the Telephone, 1876-7

For almost a year (March 1876-February 1877), neither Hubbard nor Bell gave much thought about how to introduce the telephone commercially. In fact, Hubbard at first thought it best to sell the Bell's

[18]Alexander Graham Bell, "Improvement in Telegraphy," U.S. Patent 174,465 (filed 14 Feb. 1876, granted 7 March 1876).

[19]Alexander Graham Bell, Entry for 8 March 1876, "Experiments made by A. Graham Bell. (Vol. I)," Notebook, Box 258, Bell Family Papers.

telegraph, harmonic telegraph and telephone to Western Union. Perhaps Hubbard naively thought that Western Union lacked the technology needed to reform itself, and that if provided with breakthroughs such as the harmonic telegraph and telephone, the company could change. Hubbard may also have wanted to see his future son-in-law established financially, and he could accomplish this by getting a good price for Bell's inventions. Accordingly, in the fall of 1876, Hubbard offered Bell's patents to Orton for $100,000.[20]

Much to the amazement of later historians, Orton apparently turned down Hubbard's offer. Orton's decision makes sense in terms of his mindset and the resources he had at his disposal in the fall of 1876. From Orton's viewpoint, the telephone was not suitable for Western Union's core business of sending short business messages between cities quickly and reliably. Bell's telephone in 1876 did not work reliably on circuits more than twenty miles and transmissions were somewhat muffled and indistinct.[21] Moreover, even though Bell invented it while pursuing a multiple telegraph, the telephone functioned in exactly the opposite way--rather than permitting several messages to be sent over a single wire, the telephone used an entire wire for one conversation. Hence, to Orton, the telephone would have reduced the throughput of his network rather than increasing it.

In the fall of 1876, Bell's technology portfolio was also not very impressive: all that Hubbard could show Orton were a few crude

[20]Hubbard's efforts to interest Western Union in Bell's inventions are mentioned in two letters to his wife, Gertrude, 16 Oct. and 16 Dec. 1876, Hubbard Papers. In these letters, Hubbard spoke of taking Bell's "inventions" to Western Union, meaning presumably both his harmonic telegraph and his telephone. These letters do not mention specifically that Hubbard offered Bell's patent for $100,000; this figure comes from Thomas A. Watson's [1926, p. 107] later recollections. See also Bruce, 1973, p. 229.

[21]Hubbard described using Bell's telephone in the following way: "Conversations can be easily carried on after slight practice and with the occasional repetition of a word or sentence. On first listening to the Telephone, though the sound is perfectly audible, the articulation seems to be indistinct; but after a few trials the ear becomes accustomed to the peculiar sounds and finds little difficulty in understanding the words." From "The Telephone," printed handbill, May 1877, Box 1097, AT&T Historical Collections.

instruments which were covered by three patents.[22] Of course, Orton had already seen Bell's harmonic telegraph eighteen months earlier and had concluded then that Bell's work was inferior to Gray's. Accustomed to the high-quality instruments developed by Edison, Gray, and other inventors and knowing the importance of carefully phrased patents, Orton probably found it difficult to take Hubbard's offer seriously. Orton decided that it would not be difficult to have Edison to continue his work on harmonic telegraphy, create a better device, and secure patents which could beat Bell in court. Consequently, at the end of 1876 Orton asked Edison to step up his investigation of harmonic telegraphy at Menlo Park. In March 1877, Edison signed a new contract with Western Union promising to develop new telephone patents [Israel, 1992, p. 141].

Rejected by Western Union, Hubbard next tried to convince several wealthy businessmen to form a company which would exploit Bell's patent [Bruce, 1973, p. 229]. In courting these investors, Hubbard argued that the telephone had the potential to remake the telegraph industry. Hubbard suggested that by substituting the telephone for Morse keys and sounders, telegraph operators could send and receive messages much more quickly. "An operator by the Morse instrument ordinarily transmits about fifteen words a minute," he claimed, "while he can speak & therefore transmit by Telephone from one hundred & fifty to two hundred" words per minute.[23] Likewise, Hubbard suggested that the telephone could be used on private lines to link two locations. Hubbard had already heard from a number of individuals who wanted

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[22]The crude nature of Bell's early telephones when compared with Edison's telegraph devices was made apparent to Mike Gorman and me in the course of studying artifacts from both inventors in the AT&T Historical Collections, Warren, NJ. In the fall of 1876, Hubbard would have had three patents to offer Orton: Bell's patent for harmonic telegraph and telephone (174, 465); "Improvements in Transmitters and Receivers for Electric Telegraphs," U.S. Patent 161,739 (filed 6 March 1875, granted 6 April 1875); and "Telephonic Telegraph Receivers," U.S. Patent 178,399 (filed 8 April 1876, granted 6 June 1876).

[23]Hubbard to John Ponton, 21 Feb. 1877, Ponton Collection. See also Hubbard to Bell, 22 Feb. 1877, Hubbard Family Papers.

to set up telephones between their homes and business establishments or between downtown offices and outlying factories. On these private lines, Hubbard believed that the telephone would be cheaper and quicker than printing telegraphs which often cost $250 each.

The first private line telephone was purchased by Charles Williams who connected his shop in downtown Boston (where Bell had first experimented on his telephone) to his home in the suburb of Somerville in May 1877. Within a few months, Hubbard was contacted by entrepreneurs who wanted licenses to install similar private lines. Several of these entrepreneurs wanted to imitate existing messenger, burglar, and fire alarm telegraph companies and connect all of the telephones to a switchboard in a central office. The first of these exchanges was established in Boston in May 1877 by E.T. Holmes. Holmes had started a burglar alarm network and he added telephones as a second service for his customers [Rhodes, 1929, pp. 147-8]. Holmes found that his telephone business grew quickly because a portion of his network served a neighborhood in which many "large grocers, confectioners, and cookery merchants" were located, and these businessmen found it convenient to use the telephone to conduct transactions among themselves.[24]

Hubbard followed with great interest the efforts of Holmes and other local entrepreneurs as they struggled to install telephones on private lines and set up exchanges. These developments convinced Hubbard that there was indeed a market for telephones for use within cities. Rather than sell the telephone patent to other capitalists, Hubbard and his associates decided in July 1877 to form the Bell Telephone Company. This company was to hold the Bell patents and issue licenses to individuals who wanted to set up local telephone exchanges. Named as the company's trustee, Hubbard took it upon himself to promote the establishment of local telephone companies.[25] In the summer of 1877,

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[24]Gertrude M. Hubbard to Mabel [Bell], 19 Oct. 1877, Hubbard Family Papers.

[25]American Telephone and Telegraph Co., "The Early Corporate Development of the Telephone," printed pamphlet, [dated after 1935], Box 71, Western Union Collection, pp. 8-12.

Hubbard traveled across the United States as a member of the Special Commission on Railway Mail Transportation.[26] During this trip, Hubbard carried two telephones in his suitcase and enthusiastically demonstrated them to businessmen at every stop.

As Hubbard toured cross country and demonstrated the telephone, one wonders how he reconciled this new campaign with his larger struggle against Western Union. How did his emerging market strategy mesh with his mindset of the telegraph industry? Hubbard's new efforts with the telephone make sense if one thinks of his opposition in terms of Western Union as an intermediary between individuals and information. For Hubbard, the success of American democracy and business hinged on the ability of individuals to secure news and market prices. The problem with Western Union was that it was too large and intrusive, potentially preventing people from getting the information they needed. One way to minimize the intermediary was to place the technology squarely in the hands of the user and eliminate the telegraph operator who controlled messages by encoding them. Since the telephone was literally in the hands of the user, controlled and manipulated by him, Hubbard may have felt that the telephone eliminated the evils of the intermediary. Moreover, Hubbard also believed that the telephone would be used for domestic and social purposes, and thus a telephone network would be based on a more personal and democratic basis than Western Union's business-oriented telegraph system. In his correspondence and promotional efforts, Hubbard told of how middle and upper middle class people would use the telephone to coordinate servants, order groceries, and respond to social invitations. Although Hubbard saw the business applications for the telephone, it was the domestic uses that fired his imagination.[27]

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[26]I think that President Hayes appointed Hubbard to this commission as an attempt to get Hubbard to stop agitating for his postal telegraph scheme.

[27]For an early discussion of the domestic and social uses of the telephone, see Field, 1878.

Orton and Hubbard Meet Again

By the fall of 1877, both Hubbard and Orton had realized that the telephone had genuine commercial potential. Hubbard was delighted with the number of entrepreneurs setting up local companies and ordering telephones from the Bell Company in Boston. Hoping to discourage the manufacture of counterfeit telephones, Hubbard insisted on leasing rather than selling telephones outright. By year's end, Hubbard estimated that the company had leased 5000 telephones. Although the tiny Bell Company was hard pressed for the cash needed to manufacture these telephones, Hubbard was optimistic that leasing would eventually provide a steady flow of income.[28]

At Western Union, Orton was pleased with Edison's efforts at developing an improved telephone. During the spring and summer of 1877, Edison and his associates at Menlo Park sketched dozens of designs but came to focus on a loudspeaking carbon transmitter [Carlson, 1993]. At the end of August, Orton asked Edison to complete his design and produce 150 telephones.[29] At the same time, Orton asked electrical expert Franklin Pope to do an extensive review of acoustics and electricity and recommend what patents were needed to control the fields of harmonic telegraphy and telephony. On Pope's recommendation, Western Union purchased Gray's harmonic telegraph patents [Wolff, 1976, p. 50]. For good measure, Orton also secured a patent from Amos Dolbear, a Tufts College professor who had developed an improved version of Bell's instrument.

Armed with Edison's telephone and patents from Gray and Dolbear, Orton decided to call Hubbard in for a conference. Orton did so for two reasons. First, Orton wanted to have these inventors finish (if possible) the "next generation" multiple-message system so that it could

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[28]Hubbard to Bell, 20 Nov. 1877; Hubbard to Bell, 4 Dec. 1877; and Gertrude Hubbard to Mabel Bell, 30 Nov. 1877, Hubbard Family Papers.

[29]Edison and Charles Batchelor to Franklin Badger, 17 Sept. 1877, Edison microfilm edition, reel 28, frames 162-3.

be introduced on Western Union lines. Orton appears to have seen the harmonic telegraph and telephone as being closely related, and so if he wanted to secure the harmonic telegraph for Western Union, he needed to talk with Hubbard about Bell's patents for both inventions[30] Burned by his experience in fighting with Atlantic and Pacific over the ownership of the quadruplex, Orton was probably determined to secure complete control of harmonic telegraphy before proceeding.

Second, Orton met with Hubbard in order to protect the Gold and Stock Company. Like Hubbard, Orton realized that the telephone had great potential in the intracity market. Just as Holmes was installing telephones on his burglar alarm network in Boston, so Orton realized that Gold and Stock could add telephones to its stock ticker networks in various cities. Because improved stock tickers used fewer wires (new versions used three instead of five wires), Gold and Stock may have had excess line capacity. The telephone was receiving extensive newspaper coverage, and Orton may have felt that this popular invention might attract more business customers to the Gold and Stock networks and hence to Western Union. Consequently, rather than let Hubbard get a toehold in Gold and Stock's market, Orton probably decided that it was better to use Edison and Gray's work to force Hubbard into cooperating with Western Union.

As a result, Hubbard met several times with Orton, Gray, and various Western Union officials in the fall of 1877. Hubbard agreed to meet with the opposition because he was aware that the Bell company lacked the resources to introduce the telephone in cities across the country.[31] Western Union possessed such resources, and Hubbard perhaps believed that if Western Union built telephone exchanges, the new technology would make electrical communications cheaper and available to more people.

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[30]Cheever to Norvin Green, 4 Feb. 1878, Hubbard Family Papers.

[31]Hubbard to Gertrude Hubbard, 15 Sept. 1877; Gertrude Hubbard to Mabel [Bell], 21 Sept. 1877; Hubbard to Bell, 18 Oct. 1877; and Cheever to Norvin Green, 4 Feb. 1878, Hubbard Family Papers.

Hubbard, however, refused to be intimidated by Orton's technology portfolio. He refused to concede that Edison's loudspeaking telephone was better than Bell's, claiming instead that Edison's instrument failed to reproduce the voice distinctly. Hubbard insisted that Bell alone had invented the telephone and that his single 1876 patent broadly covered the field. For a time, Hubbard and Orton discussed creating a third company which would be jointly controlled by Bell Telephone and Western Union and which would pool the patents and resources of the two firms.[32] However, they could not agree on the exact proportions of ownership, and Hubbard may have demanded too much in terms of guaranteed royalties. Moreover, both sides refused to give any ground on the question of who really possessed patent control of the telephone. Sensing that there was substantial demand for telephones, both Hubbard and Orton decided to settle the issue through competition in the marketplace and in the courts.

Accordingly, Orton organized the American Speaking Telephone Company in December 1877. This firm installed telephones on Gold and Stock networks in the cities throughout the U.S.[33] Orton pushed Edison to improve the articulation of his carbon transmitter by offering him additional resources.[34] In April 1878, with ample newspaper coverage, Edison demonstrated his improved carbon telephone for Orton and other telegraph industry leaders. To confirm that his telephone worked better than Bell's in actual commercial operation, Edison conducted the test on the New York-to-Philadelphia line, which was the busiest line in the Western Union network.[35] Based on this

[32]Hubbard to Gertrude Hubbard, 22 Aug. 1877; Gertrude Hubbard to Mabel, [Sept. 1877]; and Cheever to Norvin Green, 4 Feb. 1878, Hubbard Family Papers.

[33]"The American Speaking Telephone Company," *Journal of the Telegraph*, 10 (1 Dec. 1877), p. 357.

[34]Gertrude Hubbard to Mabel [Bell], 23 Nov. and 21 Dec. 1877, Hubbard Family Papers.

[35]"Edison's Carbon Telephone," *Journal of the Telegraph*, 11 (16 April 1878), p. 114.

demonstration, American Speaking Telephone pressed ahead and began installing telephones and setting up exchanges.[36] In many cases, American Speaking Telephone raced with the local Bell agents to be the first to open an exchange in various cities. While this new business went slowly for American Speaking Telephone during the spring of 1878, business picked up, and eventually the company installed 56,000 telephones in 55 cities.[37]

Hubbard Takes the Telephone to Court

In the meantime, Hubbard and Bell Telephone struggled to keep up with American Speaking Telephone. Although Hubbard doubted that Edison could secure a patent on his carbon transmitter without infringing on Bell's existing patent, the company nonetheless purchased a patent for a carbon transmitter from Emile Berliner.[38] To raise capital to cover their manufacturing costs, Hubbard and his associates were forced in July 1878 to reorganize Bell Telephone as joint-stock company and to begin selling shares [Bruce, 1973, p. 259].

Faced with vigorous competition and difficulty raising sufficient capital, Hubbard was forced to play his trump card. In August 1878, Bell Telephone sued Western Union for infringing Bell's patent. Specifically, Bell Telephone accused Peter Dowd, a Western Union agent in Springfield, Massachusetts, of illegally installing telephones which used Bell's patented principle. Suing Dowd for infringement was risky since neither Hubbard nor anyone else knew whether the courts would fully back Bell's broad claims to the telephone. Moreover, Western Union possessed the lawyers and resources to pursue lengthy

[36]Hubbard to Gertrude Hubbard, 11 June and September 1878, Hubbard Family Papers.

[37]The number of telephones and exchanges is based on the terms of the Dowd settlement; see Brooks, 1975, p. 71. I have been unable to find an estimate for how many telephones and exchanges were installed by Bell Telephone in 1878-9, but I would guess it was on the order of 20,000 to 30,000 instruments.

[38]Hubbard to Gertrude Hubbard, [May?] 1878, Hubbard Family Papers.

litigation while Bell Telephone's resources were quite limited [Brooks, 1975, pp. 69-70].

Over the next fourteen months, both sides amassed a huge amount of testimony and supporting evidence.[39] George Gifford and the other attorneys for Western Union organized their case around Gray's work on the harmonic telegraph and telephone, arguing that Gray had covered much of the same ground as Bell had in 1875-6. Bell Telephone built their case around the testimony of Bell himself, who proved to be a superb witness. Bell provided ample detailed testimony in which he carefully narrated each step of how he developed the telephone.

The actual court hearing for the Dowd case was scheduled for the fall of 1879, but as the starting date drew near, a series of events led Western Union to offer to settle out of court. In April 1878, Orton died suddenly, leaving Western Union without strong leadership. Orton was succeeded by Norvin Green who lacked Orton's commitment to using technological innovation strategically [Israel, 1992, p. 143]. In the spring of 1879, Gould launched a second takeover attack on Western Union. Gould formed a new company, American Union Telegraph, and used his formidable clout in the railroad industry to persuade several major railroads to let American Union erect lines along their right-of-ways. Gould ultimately gained control of Western Union in 1881, but of course, his victory was not assured in 1879 [Asmann, 1980, pp. 97-8; Israel, 1992, pp. 147-9]. Nevertheless, based on the previous episode with Atlantic and Pacific, Green probably knew in 1879 that competition with American Union would be costly and require much of his attention. And finally, as Gifford and the Western Union lawyers listened to Bell and other witnesses give their depositions, they became increasingly convinced that the court would probably sustain Bell's broad patent.

In light of these developments, Gifford recommended that Western Union settle with Bell Telephone out of court, and he negotiated an agreement between the two parties in the fall of 1879.

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[39]*American Bell Tel. Co. v. Peter A. Dowd*; a Bill (No. 1040) in equity filed 12 September 1878 in the U.S. Circuit Court, District of Massachusetts. Part I, *Pleadings and Evidence;* Part II, *Exhibits* (Boston, 1880). Copies are available in Bell Family Papers and at the Edison National Historic Site, West Orange, NJ.

Western Union agreed to withdraw from the telephone field, let Bell Telephone use the patents of Gray and Edison, and sell its existing telephone exchanges to Bell Telephone. In return Bell Telephone agreed to leave the telegraph field, particularly the long-distance, intercity market. Bell Telephone agreed to pay Western Union a royalty of twenty percent of the telephone rentals from American Speaking Telephone's former exchanges for seventeen years [Rhodes, 1929, pp. 52-3]. Estimates of this royalty income vary, but Western Union earned between $3.5 and 7 million on this agreement [Josephson, 1959, p. 148; Wolff, 1976, p. 51]. For Bell Telephone, the settlement of the Dowd case eliminated its most formidable rival and gave it a decade or so to firmly establish the telephone business.

Western Union's decision to abandon the telephone field has often been regarded as a terrible mistake. In accusing Western Union of a blunder, one is faulting Western Union for failing to see the future of telephone in 1879, and the widespread success of the telephone lay at least 30 years into the future.[40] As suggested here, the commercial potential of telephone was not obvious in the early years, and entrepreneurs such as Hubbard and Orton spent much time puzzling over how to introduce the telephone.

Western Union's decision to abandon the telephone in 1879 made sense in terms of Orton's strategy. The telephone was not useful in terms of Western Union's core market--sending short business messages between cities. Bell's telephone did not work well on long-distance lines; moreover, from Western Union's standpoint, Bell's instrument would have been a wasteful way to deploy long-distance lines since only one telephone message could be sent over each wire. In 1879, the telephone's potential lay in the intracity market as an adjunct to the stock ticker. Orton recognized the value of this market for Western Union's subsidiary Gold and Stock, and he tried to convince Hubbard in 1877 to share this market with him. However, Western Union did not view the intracity market as being as important or lucrative as the

[40]Here I am implying that the telephone does not prove to be a genuine rival to the telegraph until Theodore Vail took over American Telephone & Telegraph in 1907. As Galambos [1992] has demonstrated, it was Vail who created the nationwide telephone system that we have today.

long-distance market, and when pressed by other circumstances, Green was willing to let Hubbard have a portion of the intracity business. Of course, the circumstance that led Green not to defend the intracity market was Gould's second attack. Knowing that Gould's attack could be a long battle for control of the long-distance market, Green sensibly wound up the fight with Bell Telephone in order to devote Western Unions' full resources to holding off American Union. Finally, Green might have guessed that competition with American Union would mean reduced revenues, and so he probably concluded that it was best to use Western Union's portfolio of telephone patents to generate some income.

One can criticize Green for taking an unduly narrow view of Western Union's business and for failing to see how intracity telephone exchanges could complement Western Union's intercity telegraph network. However, I would suggest that the enormous energy and effort required to create a successful nationwide telegraph network effectively limited Orton, Green, or any of the other Western Union managers from being able to think about the telephone in new ways; far too much of their business expertise was wrapped up in the existing telegraph technology. Hence, based on the strategy, structure, and technology brought together by Orton, it made sense for Western Union to let Bell Telephone assume the risks of introducing the telephone.[41]

Conclusion

This paper has shown that the "end use" of the telephone did not automatically spring from Bell's invention in 1876. Rather, the introduction of the telephone was strongly shaped by leaders of the telegraph industry in the 1870s. In particular, two men, William Orton and Gardiner Hubbard, fought over the telephone and defined how it was deployed in the United States.

In battling over the telephone, Orton and Hubbard were guided by the business-technological mindsets they had developed about the

[41]David [1991] developed a similar argument about Edison's decision to leave the electric power industry in the late 1880s.

telegraph industry in the early 1870s. Orton believed that the major application for the telegraph was sending short business messages between cities, and he directed the structure, strategy, and technology of Western Union toward that goal. For Orton, multiple-message telegraphy was the "cutting edge" technology which would permit Western Union to maintain and expand its control of the business message market. The telephone was simply a curious spinoff to multiple message telegraphy, and Orton only took an interest in it in 1877 when he was trying to consolidate his control of harmonic telegraphy. Orton and his successor Green also had to fight off hostile financiers such as Jay Gould; when confronted in 1879 with the choice of fighting the puny Bell Telephone or the mighty Gould, Green chose to concentrate on the larger fight for the intercity business market. In not switching from the telegraph to the telephone, Orton and Green were working within their mindset of protecting Western Union's core business.

While Orton's mindset saw telegraphy as a technology to be used by private interests to serve the businessman, Hubbard saw telegraphy as public technology which should serve the average citizen. Hubbard opposed Western Union because he saw the company coming between citizens and the news and information they needed. Initially, Hubbard tried to redress the problems with telegraphy by lobbying Congress to create an alternative telegraph system, only to be stopped by Orton. Consequently, Hubbard turned to a technological solution, the telephone invented by his son-in-law. In the telephone, Hubbard was able to create a telecommunications system that overcame the defects he saw in Western Union. Literally in the hands of the user, the telephone seemed to eliminate Western Union and its operators as a meddlesome intermediary. Installed in homes, shops, and offices, individuals could use the telephone for both social and business messages. And finally, Hubbard eagerly encouraged entrepreneurs to set up local exchanges. In doing so, Hubbard may have felt he was aiding democracy by taking a "grass roots" approach and letting individuals deploy the telephone in ways suitable to their communities.

Clearly, Hubbard played a pioneering role in defining the telephone. It was Hubbard who closely monitored Bell's early experiments and pushed him to patent his inventions. It was Hubbard

who sorted through a range of marketing possibilities--such as selling the patents to Western Union, building private lines, selling versus leasing telephones, or establishing exchanges. Hubbard was a classic entrepreneur who coordinated the resources necessary for promoting telephone exchanges. He recruited local agents, convinced Charles Williams to manufacture telephones, raised capital from other New England businessmen, and helped found the Bell Telephone Company. Endlessly optimistic about the telephone, Hubbard's enthusiasm infected local entrepreneurs and Boston investors, and permitted the Bell group to get an early lead in 1877 over Western Union in installing telephones.

One lesson that may be drawn from Hubbard's efforts is to note the ubiquitous role of the state. Throughout his struggle with Western Union, Hubbard employed different elements of the state. He lobbied Congress for his postal telegraph scheme, promoted the telephone while traveling on government business, and of course, resorted to the courts to protect Bell's patent monopoly. Significantly, Hubbard did not see the government as an externality with which he had to cope but rather as a set of resources which he could partly control and direct toward his goals. Although it is tempting to see nineteenth century America as an unregulated, free-market paradise in which heroic individuals built great technological systems and business empires without interference from the government, the early development of the telephone reveals that major technological changes were intimately bound up with the evolving political and legal environment. Consequently, if we are to understand how inventors and entrepreneurs created the technology of the Second Industrial Revolution, then we must pay more attention to how entrepreneurs interacted with the state.[42]

Given all that Hubbard did, why then consider Orton in this paper? Orton is important because he provides the story with a sense of contingency. It is very easy to assume that the telephone obviously had to be developed, and that Hubbard and Bell would prevail. Yet, the story of the telephone could well have turned out differently, had "normal" business thinking predominated. Orton's mindset is the typical

[42]Galambos has consistently encouraged historians to examine how managers and entrepreneurs have interacted with the political environment; see his history of business and government relations with Pratt [1988] as well as his paper with Abrahamson [1994].

way American businessmen look at innovation, in the sense of narrowly considering how an invention will or will not support the existing structure and strategy of a firm. Orton and Green's decision to "stick to their knitting" and concentrate on Western Union's core business is the usual way that businessmen respond to new technology. Hence, by comparing the mindsets of Orton and Hubbard, we are able to see just how difficult and risky it was for Hubbard to conceptualize the telephone in new ways.

But even more contingency, the juxtaposition of Orton and Hubbard underline the importance of individual action, of agency, in narratives of business and technological change. As suggested by Paul David [1985; 1988], economists and historians have begun to use path-dependent models which permit individuals to make choices and define the path or trajectory of an innovation. These models, however, assume that once the path is chosen, but powerful economic or technical forces take over and shape the course of an innovation. In contrast, the story of Orton and Hubbard suggests that individuals may not only define the path of an innovation at the outset but continue to influence the path by altering the economic, political, and social environment. To be sure, there are economic and technical constraints informing any technological design or business decision, but the case of the telephone reveals the need for conceptual frameworks which better balance broad structural forces and individual agency. Indeed, I would argue that this is the larger theoretical task which new case studies of entrepreneurship can help address.

As the twentieth century draws to a close, Americans often wish their society was as creative as it was at the end of the nineteenth century. In doing so, Americans often fantasize that individuals driven by personal ambition should somehow come up with new technologies that will automatically make American business more efficient and competitive in the global economy. However, I would caution Americans against concentrating too much on the mysterious forces of motivation. What we need to understand are the skills and mindsets used by individuals to shape vague inventions into successful products. We also need to comprehend the balance of individual effort and broad political, economic, and technological forces. For these reasons, the time is ripe for business historians to revisit the entrepreneur and

examine the mindsets he (or she) uses to create new markets for technology.[43]

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[43]Livesay [1989] has made a similar call for reintegration of the entrepreneur into business history .

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