4.

THE THRILL ELECTRIC

"We are one!" said the nations, and hand met hand,
in a thrill electric from land to land.
—from "The Victory," a poem written in tribute to
Samuel Morse, 1872

No invention of modern times has extended its influence so rapidly as that of the electric telegraph," declared *Scientific American* in 1852. "The spread of the telegraph is about as wonderful a thing as the noble invention itself."

The growth of the telegraph network was, in fact, nothing short of explosive; it grew so fast that it was almost impossible to keep track of its size. "No schedule of telegraphic lines can now be relied upon for a month in succession," complained one writer in 1848, "as hundreds of miles may be added in that space of time. It is anticipated

that the whole of the populous parts of the United States will, within two or three years, be covered with net-work like a spider's web."

Enthusiasm had swiftly displaced skepticism. The technology that in 1845 "had been a scarecrow and chimera, began to be treated as a confidential servant," noted a report compiled by the Atlantic and Ohio Telegraph Company in 1849. "Lines of telegraph are no longer experiments," declared the *Weekly Missouri Statesman* in 1850.

Expansion was fastest in the United States, where the only working line at the beginning of 1846 was Morse's experimental line, which ran 40 miles between Washington and Baltimore. Two years later there were approximately 2,000 miles of wire, and by 1850 there were over 12,000 miles operated by twenty different companies. The telegraph industry even merited twelve pages to itself in the 1852 U.S. Census.

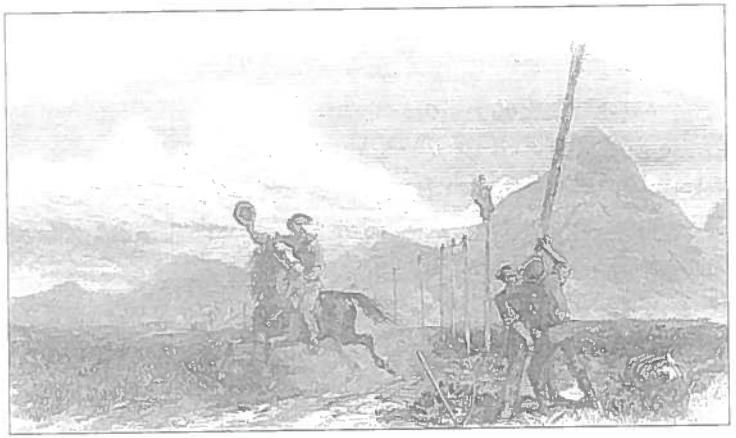
"The telegraph system [in the United States] is carried to a greater extent than in any other part of the world," wrote the superintendent of the Census, "and numerous lines are now in full operation for a net-work over the length and breadth of the land." Eleven separate lines radiated out from New York, where it was not uncommon for some bankers to send and receive six or ten messages each day. Some companies were spending as much as $1,000 a year on telegraphy. By this stage there were over 23,000 miles of line in the United States, with another

10,000 under construction; in the six years between 1846 and 1852 the network had grown 600-fold.

"Telegraphing, in this country, has reached that point, by its great stretch of wires and great facilities for transmission of communications, as to almost rival the mail in the quantity of matter sent over it," wrote Laurence Turnbull in the preface to his 1852 book, *The Electro-Magnetic Telegraph*. Hundreds of messages per day were being sent along the main lines, and this, wrote Turnbull, showed "how important an agent the telegraph has become in the transmission of business communications. It is every day coming more into use, and every day adding to its power to be useful."

Arguably the single most graphic example of the telegraph's superiority over conventional means of delivering messages was to come a few years later, in October 1861, with the completion of the transcontinental telegraph line across the United States to California. Before the line was completed, the only link between East and West was provided by the Pony Express, a mail delivery system involving horse and rider relays. Colorful characters like William "Buffalo Bill" Cody and "Pony Bob" Haslam took about 10 days to carry messages over the 1,800 miles between St. Joseph, Missouri and Sacramento. But as soon as the telegraph line along the route was in place, messages could be sent instantly, and the Pony Express was closed down.

In Britain, where the telegraph was doing well but had



Construction of the transcontinental telegraph along the route of the Pony Express, 1861. When the telegraph line was complete, the horse-and-rider relay service was rendered obsolete.

not been quite so rapidly embraced, there was some bemusement at the enthusiasm with which it had been adopted on the other side of the Atlantic. "The American telegraph, invented by Professor Morse, appears to be far more cosmopolitan in the purposes to which it is applied than our telegraph," remarked one British writer, not without disapproval. "It is employed in transmitting messages to and from bankers, merchants, members of Congress, officers of government, brokers, and police officers; parties who by agreement have to meet each other at the two stations, or have been sent for by one of the parties; items of news, election returns, announcements of deaths, inquiries respecting the health of families and individuals,

daily proceedings of the Senate and the House of Representatives, orders for goods, inquiries respecting the sailing of vessels, proceedings of cases in various courts, summoning of witnesses, messages for express trains, invitations, the receipt of money at one station and its payment at another; for persons requesting the transmission of funds from debtors, consultation of physicians, and messages of every character usually sent by the mail. The confidence in the efficiency of telegraphic communication has now become so complete, that the most important commercial transactions daily transpire by its means between correspondents several hundred miles apart."

Just as the old optical telegraphs were understood to be the preserve of the Royal Navy, the new electric telegraph was associated in British minds with the railways. By 1848, about half of the country's railway tracks had telegraph wires running alongside them. By 1850, there were 2,215 miles of wire in Britain, but it was the following year that things really took off. The domination enjoyed by Ricardo and Cooke's Electric Telegraph Company came to an end as rival companies arrived on the scene, and thirteen telegraph instruments based on a variety of designs were displayed at the Great Exhibition of 1851 in London, fueling further interest in the new technology. These developments gave the nascent industry the jolt it needed to emerge from the shadow of the railways.

The telegraph was doing well in other countries, too. By 1852, there was a network of 1,493 miles of wire in

Prussia, radiating out from Berlin. Turnbull, who compiled a survey of telegraph systems around the world, noted that instead of stringing telegraph wires from poles, "the Prussian method of burying wires beneath the surface protects them from destruction by malice, and makes them less liable to injury by lightning." Austria had 1,053 miles of wire, and Canada 983 miles; there were also electric telegraphs in operation in Tuscany, Saxony and Bavaria, Spain, Russia, and Holland, and networks were being established in Australia, Cuba, and the Valparaiso region of Chile. Competition thrived between the inventors of rival telegraph instruments and signaling codes as networks sprung up in different countries and the technology matured.

Turnbull was pleased to note that the wonders of the telegraph had managed to rouse the "lethargic" inhabitants of India into building a network. He was even ruder about the French, whom he described as "inferior in telegraphic enterprise to most of the other European companies." This view was unfounded, for the French had not only invented the telegraph but named it too. But their lead in the field of optical telegraphy had actually worked against them, and the French were reluctant to abandon the old technology in favor of the new. François Moigno, a French writer, compiled a treatise on the state of the French electric telegraph network, whose size he put at a total of 750 miles in 1852—and which he condemned for leading to the demise of the old optical telegraphs.

Sending and receiving messages—which by the early 1850s had been dubbed "telegrams"—soon became part of everyday life for many people around the world. But because this service was expensive, only the rich could afford to use the network to send trivial messages; most people used the telegraph strictly to convey really urgent news.

Sending a message was a matter of going into the office of one of the telegraph companies and filling in a form giving the postal address of the recipient and a message—expressed as briefly as possible, since messages were charged by the word, as well as by the distance from sender to receiver. Once the message was ready to go, it would be handed to the clerk, who would transmit it up the line.

Telegraph lines radiated out from central telegraph offices in major towns, with each line passing through several local offices, and long-distance wires linking central offices in different towns. Each telegraph office could only communicate with offices on the same spoke of the network, and the central telegraph office at the end of the line. This meant that messages from one office to another on the same spoke could be transmitted directly, but that all other messages had to be telegraphed to the central office and were then retransmitted down another spoke of the network toward their final destination.

Once received at the nearest telegraph office, the mes-

sage was transcribed on a paper slip and taken on foot by a messenger boy directly to the recipient. A reply, if one was given, would then be taken back to the office; some telegraph companies offered special rates for a message plus a prepaid reply.

Young men were eager to enter the business as messengers, since it was often a stepping-stone to better things. One of the duties of messenger boys was to sweep out the operating room in the mornings, and this provided an opportunity to tinker on the apparatus and learn the telegrapher's craft. Thomas Edison and steel magnate and philanthropist Andrew Carnegie both started out as telegraph messenger boys. "A messenger boy in those days had many pleasures," wrote Carnegie in his autobiography, which includes rather rose-tinted reminiscences of the life of a messenger boy in the 1850s. "There were wholesale fruit stores, where a pocketful of apples was sometimes to be had for the prompt delivery of a message; bakers and confectioners' shops where sweet cakes were sometimes given to him. He met very kind men to whom he looked up with respect; they spoke a pleasant word and complimented him on his promptness, perhaps asking him to deliver a message on the way back to the office. I do not know a situation in which a boy is more apt to attract attention, which is all a really clever boy requires in order to rise."

Though its business was the sending and receiving of messages, much like e-mail today, the actual operation of the telegraph had more in common with an on-line chat

room. Operators did more than just send messages back and forth; they had to call up certain stations, ask for messages to be repeated, and verify the reception of messages. In countries where Morse's apparatus was used, skilled operators quickly learned to read incoming messages by listening to the clicking of the apparatus, rather than reading the dots and dashes marked on the paper tape, and this practice soon became the standard means of receiving. It also encouraged more social interaction over the wires, and a new telegraphic jargon quickly emerged.

Rather than spell out every word ("PHILADELPHIA CALLING NEW YORK") letter by letter in laborious detail, conventions arose by which telegraphers talked to each other over the wires using short abbreviations. There was no single standard: different dialects or customs arose on different telegraph lines. However, one listing of common abbreviations compiled in 1859 includes "I I" (dot dot, dot dot) for "I AM READY"; "G A" (dash dash dot, dot dash) for "GO AHEAD"; "S F D" for "STOP FOR DINNER"; "G M" for "GOOD MORNING." This system enabled telegraphers to greet one another and handle most common situations as easily as if they were in the same room. Numbers were also used as abbreviations: 1 meant "WAIT A MOMENT"; 2, "GET ANSWER IMMEDIATELY"; 33, "ANSWER PAID HERE." All telegraph offices on a branch line shared one wire, so at any time there could be several telegraphers listening in to wait for the line to become available. They could also chat, play chess, or tell jokes during quiet periods.

ALTHOUGH THE TELEGRAPH, unlike later forms of electrical communication, did not require the consumer who was sending or receiving a message to own any special equipment—or understand how to use it—it was still a source of confusion to those unfamiliar with it. And just like the apocryphal story of the woman who tried to send her husband tomato soup by pouring it into the telephone handset, there are numerous stories of telegraph-inspired confusion and misunderstanding.

One magazine article, "Strange Notions of the Telegraph," gives several examples of incomprehension: "One wiseacre imagined that the wires were hollow, and that papers on which the communications were written were blown through them, like peas through a pea shooter. Another decided that the wires were speaking tubes." And one man in Nebraska thought the telegraph wires were a kind of tightrope; he watched the line carefully "to see the man run along the wires with the letter bags."

In one case a man came into a telegraph office in Maine, filled in a telegraph form, and asked for his message to be sent immediately. The telegraph operator tapped it out in Morse to send it up the line and then spiked the form on the "sent" hook. Seeing the paper on the hook, the man assumed that it had yet to be transmitted. After waiting a few minutes, he asked the telegrapher, "Aren't you going to send that dispatch?" The operator explained that he already had. "No, you haven't," said the man, "there it is now on the hook."

Another story concerned a woman in Karlsruhe, Prussia, who went to a telegraph office in 1870 with a dish full of sauerkraut, which she asked to have telegraphed to her son, who was a soldier fighting in the war between Prussia and France. The operator had great difficulty convincing her that the telegraph was not capable of transmitting objects. But the woman insisted that she had heard of soldiers being ordered to the front by telegraph. "How could so many soldiers have been sent to France by telegraph?" she asked.

As one magazine article of the time pointed out, much confusion resulted from the new electric jargon, which imposed new meanings on existing words. "Thus, when it is said that a current of electricity flows along a wire, that the wire or the current carries a message, the speaker takes language universally understood, relating to a fluid moving from one place to another, and a parcel or a letter transported from place to place." One young girl asked her mother how the messages "get past the poles without being torn." The mother is said to have replied, "They are sent in a fluid state, my dear."

And there was a widespread belief that it was possible to hear the messages as they passed along the wires. According to a book, *Anecdotes of the Telegraph*, published in 1848, "a very general but erroneous idea, even among the better order of folks, is that the humming aeolian harp-like effect of the wind on the suspended wire is caused by the messages passing." A typical story concerned a tele-

graph operator who worked in a station in the Catskill Mountains, where the wind often whistled through the wires. One day a local man asked how business was doing. "Lively," said the operator. "Well, I didn't think so," said the man, "I ain't heard a dispatch go up in three or four days."

The retranscription of the message at the receiving station also confused some people. One woman preparing to send a telegram is said to have remarked as she filled out the telegraph form, "I must write this out afresh, as I don't want Mrs. M. to receive this untidy telegram." Another woman, on receiving a telegram from her son asking for money, said she was not so easily taken in; she knew her son's handwriting very well, she said, and the message, transcribed at the receiving office, obviously hadn't come from him.

As telegraph networks sprung up in different countries, the benefits of joining them soon became apparent. The first interconnection treaty was signed on October 3, 1849, between Prussia and Austria, so that messages could be sent from Vienna to Berlin. It was an inefficient system; rather than running a wire across the border, a special joint telegraph office was constructed, staffed by representatives of each country's telegraph company, who were connected to their respective national networks. When a message needed to be

passed from one country to another, it was transcribed by the clerks at one end of the office, who then physically handed it over to their opposite numbers at the other end of the office for retransmission.

Similar agreements were soon in place between Prussia and Saxony, and Austria and Bavaria. In 1850, the four states established the Austro-German Telegraph Union to regulate tarriffs and set common rules for interconnection. The following year, the Morse telegraph system was adopted as a standard to allow direct connections to be established between the four networks. Soon interconnection agreements had also been signed between France, Belgium, Switzerland, Spain, and Sardinia. But if Britain was to be connected to the growing European network, a significant barrier would have to be overcome: the English Channel.

Actually, experiments with sending messages along underwater telegraph cables had been going on almost since the earliest days of electric telegraphy. Wheatstone had tried it out in Wales, sending messages from a boat to a lighthouse, and in 1840 he proposed the establishment of a cross-Channel telegraph. But at that time the telegraph had yet to prove itself over short distances on land, let alone across water.

Morse, too, had a go at underwater telegraphy. In 1843, after coating a wire in rubber and encasing it in a lead pipe, he sent messages along a submerged cable between Castle Garden and Governors Island in New York

Harbor. He also succeeded in using water itself as the conductor, with metal plates dipped in the water on each bank of a river and connected to the telegraph wires. (Wheatstone did some similar experiments across the river Thames in the presence of Prince Albert the same year.) At any rate, Morse was sufficiently pleased with the results across a few feet of water that, in typical indefatigable Morse fashion, he predicted that it wouldn't be long before there would be telegraph wires across the Atlantic.

For advocates of cross-Channel telegraphy, however, there were practical problems to be overcome. Laying a rubber-coated wire inside a lead pipe was possible in New York Harbor; laying a pipe along the seabed across the English Channel was another matter entirely. And if the cable was to last any length of time, an alternative to coating it in rubber would have to be found, since rubber quickly deteriorated in water.

The solution was to use gutta-percha, a kind of rubbery gum obtained from the gutta-percha tree, which grows in the jungles of Southeast Asia. One useful property of gutta-percha is that it is hard at room temperature but softens when immersed in hot water and can be molded into any shape. The Victorians used it much as we use plastic today. Dolls, chess pieces, and ear trumpets were all made of gutta-percha. And although it was expensive, it turned out to be ideal for insulating cables.

Once the question of what to use for insulation had been resolved, John Brett, a retired antique dealer, and his

younger brother Jacob, an engineer, decided to embark upon building a telegraph link between England and France. They got the appropriate permission from the British and French governments and ordered a wire coated with a quarter of an inch of gutta-percha from the Gutta Percha Company in London. Their plan was breathtakingly low-tech: They intended to spool the wire (which was about the thickness of the power cable of a modern domestic appliance) out of the stern of a boat as it steamed across the Channel. They would then connect telegraph instruments at each end, and their company, the grandly named General Oceanic and Subterranean Electric Printing Telegraph Company, would be in business. On August 28, 1850, with their cable wound onto a vast drum and mounted on the back of a small steam tug, the *Goliath*, they set out for France.

Things did not go according to plan. For starters, the wire was so thin that it wouldn't sink; it simply floated pathetically in the water behind the boat. The Bretts' response was to clamp weights around the wire at regular intervals to get it to sink. By the evening, they had arrived at Cap Gris-Nez near Calais in France, where they wired up their newfangled telegraph instrument—the very latest automatic printing model—and waited for the first test message to be sent from England. It came out as gibberish.

The cable was working, but the messages were being garbled because the surrounding water changed the cable's electrical properties in a way that was poorly understood

at the time. Effectively, it meant that the staccato pulses of electricity were smoothed out, and the Bretts' high-speed automatic machines transmitted so fast that succeeding pulses overlapped and became indistinct. But, using an old-fashioned single-needle telegraph, they were eventually able to send a few messages manually, in much the same way that a preacher in a resonant cathedral must speak slowly and distinctly in order to be understood. However, the next day the cable met a watery end; a French fisherman snagged it in his net, and when he brought it to the surface he hacked off a piece to see what it was. Deciding that it was a hitherto unknown form of seaweed with a gold center, he took it to show his friends in Boulogne.

It took the Bretts over a year to raise the money for another cable, and they would probably have had to give up altogether but for the intervention of Thomas Crampton, a railway engineer. He put up half the £15,000 needed, and also designed the new cable. He wanted to protect his investment, so the new cable consisted of four gutta-percha-covered wires twisted together and wrapped in tar-covered hemp, and then encased in a cladding of tar-covered iron cords. It was far tougher than the first cable, and it weighed thirty times as much. This meant it was harder to lay—not because it wouldn't sink, like the first cable, but because it was so heavy it ran off the drum on the back of the boat faster than the Bretts wanted it to. It was so hard to control, in fact, that all the cable had been paid out

before the boat carrying it reached France. Fortunately, the Bretts had brought along a spare piece of cable, which they spliced on, and in November 1851, after a few weeks of testing, the cable was opened to the public. The first direct message from London to Paris was sent in 1852.

The success of the Channel cable led to a boom in submarine telegraphy—to the delight of the directors of the Gutta Percha Company. With a virtual monopoly on the supply of gutta-percha, they suddenly found they were sitting on a gold mine. The problem of laying a telegraph link across a stretch of water seemed to have been cracked: It was simply a matter of making sure that the cable was properly insulated, strong enough not to break, and heavy enough to sink, and that messages weren't sent too quickly along it. Before long Dover had been linked to Ostend, and after two failed attempts England was linked to Ireland in 1853. Further underwater links across the North Sea directly connected Britain with the coasts of Germany, Russia, and Holland. John Brett soon turned his attention to linking Europe with Africa and succeeded in connecting Corsica and Sardinia to Genoa on the European mainland in 1854. But the following year, he failed in his attempt to reach the North African coast, which involved laying a cable across the deepest and most mountainous part of the Mediterranean seabed. Brett lost a lot of money, and his failure proved that there were limits to submarine telegraphy after all. The prospect of linking Europe and North America seemed as far away as ever.