

JOHNS HOPKINS STUDIES IN THE HISTORY OF  
TECHNOLOGY

General Editor: Thomas P. Hughes

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**INVENTING  
AMERICAN  
BROADCASTING**  
**1899–1922**

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stability, and profits, among wireless firms, the invention did not seem destined to revolutionize commercial communications as was once predicted. There were Americans, however, who had embraced the invention and were putting it to uses quite different from those Marconi had in mind. These individuals, the amateur operators, took Marconi's invention to places he had never dreamed of and used it in ignorance or defiance of his carefully planned corporate strategies.

## POPULAR CULTURE AND POPULIST TECHNOLOGY

### The Amateur Operators

1906–1912

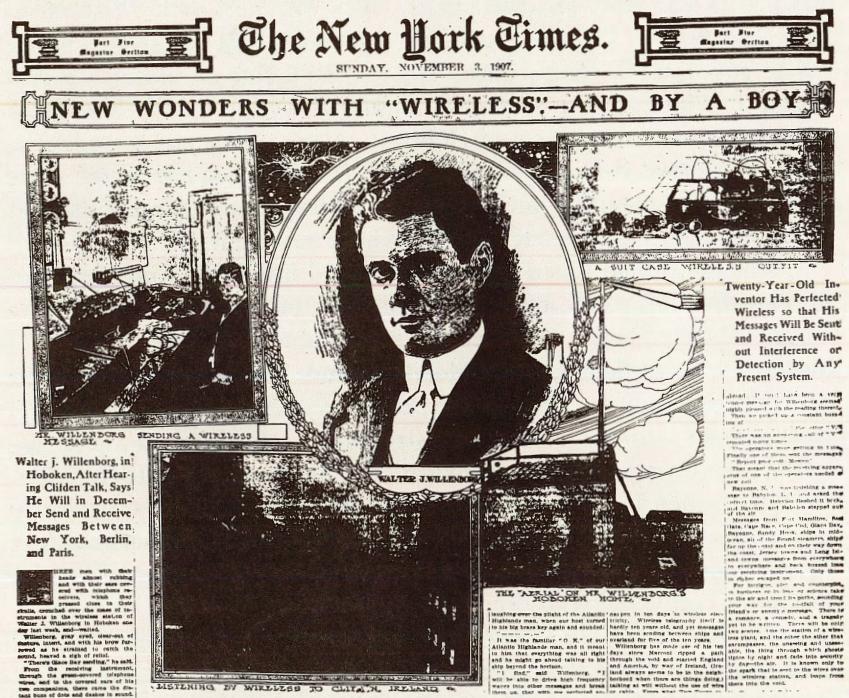
ON SUNDAY, NOVEMBER 3, 1907, two weeks after Marconi began his transatlantic wireless news service, the *New York Times Magazine* featured as its lead story an article titled “New Wonders with ‘Wireless’—And by a Boy!”<sup>1</sup> The large headline spanned all six columns, and the article covered the entire page. The youthful star of the article was Walter J. Willenborg, a previously unknown wireless experimenter, a twenty-six-year-old resident of Hoboken, New Jersey, and a student at Stevens Institute. A large oval portrait of Willenborg in the center of the page was surrounded by photographs of his home-built wireless station, which included transmitting and receiving equipment.

Willenborg had tuned his apparatus and fitted the *Times* reporter with headphones so the reporter could listen in to the dots and dashes being exchanged between Marconi’s two distant transatlantic stations at Glace Bay, Nova Scotia, and Clifden, Ireland. For the reporter, the air suddenly came alive: “Messages from everywhere to everywhere and back buzzed into our receiving instrument. Only those in cipher escaped.” The reporter became intoxicated by his brief foray into the ether. Newly returned from his adventures in the “great void,” he excitedly advised his readers: “For intrigue, plot and counterplot, in business or in love or science, take to the air and tread its paths, sounding your way for the footfall of your friend’s or enemy’s message. There is a romance, a comedy, and a tragedy yet to be written.” Only those with wireless apparatus would be privy to the unfolding melodrama, however. The *Times* reporter continued: “The millions below us knew nothing of this strange intercourse through the night above”—they were unawares, left out, tethered to more earthbound discourse. They had no idea that the

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"folds of the night" contained "hidden, mystic jabbering." They did not know that in the ether, "ghosts tiptoe by night." They did not know they were surrounded by an invisible and mystical realm to which youthful "wizards" such as Willenborg were privately gaining access.

Willenborg, an otherwise ordinary young man, had become a celebrity through mechanical tinkering. He told the reporter that he expected to be exchanging messages with Paris and Berlin within a month. He claimed that his system was superior to all others and that his messages would be "sent and received without interference or detection" by any other system. The young man's claims were not challenged; rather, they served as secondary headlines for the article. To certify the boy's success further, the reporter noted: "Young as he is, Willenborg has been employed by the United States to perfect wireless tests aboard ship, and has been highly paid for his work." The reporter affirmed that, although Willenborg's father was well-to-do, the inventor did not rely on his



Amateur operators like Walter J. Willenborg became inventor-heroes in the popular press.

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father's largesse: "He is so frequently called as an expert witness in so many important suits over electrical matters that his fees give him ample resources."

In the hands of the *Times* reporter, Willenborg became a role model for other boys. His ordinariness and diligence were emphasized: "He is no prodigy. What he has done has been done by hard work. He began at fifteen in a little closet-like room on the top floor of his house." His physical features also resembled those of a Horatio Alger hero, for he was "grey-eyed, clear cut of feature, intent," and he had a furrowed brow. He even showed admirable discretion and a touch of chivalry. At one point while he was listening in to the messages being exchanged between passing ocean liners, he overheard a "sweetheart message" sent between a man and a woman traveling in different ships. While Willenborg "enjoyed hearing it," he "said that it wouldn't be right to hand it around." Yet Willenborg was not prissy. His equipment was extremely powerful, and he had the ability to "destroy" the messages of others at will. The reporter asked for a demonstration. Willenborg scanned the ether for an appropriate target, and overheard an operator from the Atlantic Highlands beginning to transmit a message. Willenborg leaned on his transmitting key for thirty seconds or so and then switched on his receiver. "Lay off, New York" came the call from the Highlands man. Again Willenborg shoved out his air waves. 'Go to h - l' came from the Highlands man. 'Certainly' [Willenborg] replied, and again began the clamor. 'O.K.' finally sent the Highlands man, meaning that he would wait and [Willenborg] could proceed with [his] message." This victory prompted Willenborg and the reporter to begin "chatting and laughing over the plight of the Atlantic Highlands man."

Willenborg made excellent copy, which was not lost on the editors of *St. Nicholas*, "An Illustrated Magazine for Young Folks." In April 1908, a story about Willenborg appeared in its pages under the headline "A Young Expert in Wireless Telegraphy."<sup>2</sup> The author cautioned his readers: "Even today there are young folks who make the same mistake in thinking that all great things that are worth doing have been done; all the great discoveries made; all the grand inventions finished." They became discouraged and idle and were in danger of letting opportunities and knowledge slip by. But not Willenborg: "He decided to try in his own way to learn at home all that was already known and then he would try to learn more." The writer emphasized that Willenborg was "a rather quiet young man with a pleasant face" and "simple and natural manners." But "when he speaks," the writer reported, "we find he talks like a man of science." The article described Willenborg's apparatus, the dis-

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tances he was able to traverse by wireless, and his ability to listen to "the faint, as it were, whispered words spelled across the Atlantic." "Think of it!" exclaimed the author. "Only twenty and yet a man of science, an inventor and skillful operator in this new art. Could anything be more inspiring to every boy and man?"

Willenborg was the young man the press chose to represent the many other nameless boy operators in America. He was the perfect role model for young men facing the beginning of the twentieth century. His story embodied several trends: the increasingly important role popular culture and journalism were playing in identifying and reinforcing acceptable norms of behavior, the boom in instructive hobbies with their many "amateur" practitioners, and the rise of the boy inventor-hero as a popular culture archetype. His story also captured a more subtle yet profound process: the gradual redefinition of what it meant to be a man, particularly a white, middle-class man, in America.

The boy on the verge of manhood who might want to emulate Willenborg was surrounded in 1907 by vivid yet often conflicting definitions of masculinity and success. On the one hand, the physical culture movement of the 1890s, the explosion in competitive sports with their "organized physical combat," the revival of boxing, and the glorification of the "strenuous life" by the nation's president all equated true masculinity with physical strength, which one should be more than willing to test and assert.<sup>3</sup> A new respect, even reverence, for man's "primitive" side was revealed in the success of Jack London's *Call of the Wild* and Edgar Rice Burroughs's *Tarzan*.<sup>4</sup> The first Boy Scout manual, which addressed a legion of new enthusiasts, warned boys not to become "flat-chested cigarette-smokers, with shaky nerves and doubtful vitality," but to be "robust, manly, self-reliant."<sup>5</sup> According to this ideal, it was not enough to be physically vigorous; men had to have forceful, commanding personalities, as well.<sup>6</sup> All of these traits, it was believed, were best cultivated by a more active life in which men were more directly in contact with nature.

On the other hand, it was clear that in the business world, physical strength mattered little: physical combat was a metaphor for other kinds of confrontations. Increasingly, what landed a young man a good job, what gave him an edge in the race for success, was intelligence, education, and certain skills. The increase in high school enrollments, the growing popularity of adult education, and the self-improvement craze all attested to the new importance attached to education and specialized knowledge.<sup>7</sup> Boys educated in both academic and corporate institutions learned that having a "forceful personality" was, in reality, often either

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unattainable or a liability. Despite the prevailing mythology, much of a man's life was spent indoors, in urban areas, away from the enlivening and therapeutic tonic of the outdoor life. In reality, being the master of one's environment, or having mastery over other men, was, for many, simply not possible.

For a growing subgroup of American middle-class boys, these tensions were resolved in mechanical and electrical tinkering. Trapped between the legacy of genteel culture and the pull of the new primitivism of mass culture, many boys reclaimed a sense of mastery, indeed masculinity itself, through the control of technology. The boys lacking "animal magnetism" could still triumph over nature if they controlled the right kind of machine. If they failed to recognize how the desire for adventure, combat, and the assertion of strength, on the one hand, could be reconciled with the need to prepare for life in the modern world, on the other, popular books and magazines were there to remind them. Everything could be achieved through technical mastery. Playing with technology was, more than ever, glorified as a young man's game. Even the Boy Scout manual urged boys to be "handy with tools."<sup>8</sup> Few inventions were more accessible to the young man than the latest marvel, wireless telegraphy. Just as articles giving instructions on "Building Your Own Wireless Set" began appearing with increasing frequency, so did stories and books that celebrated boy wireless experimenters. This was no insignificant development, for the popularization of wireless experimentation had, for a time, as decided an effect on radio's development as did the inventors, the navy, or the corporate world.

The stories about Willenborg captured the many attractions wireless experimentation might hold for a young man. On a practical level, if the boy was successful, he could make extra money from his pastime. He might become the center of attention and even get his picture in the newspaper. He would have technical knowledge and skills few others possessed. He learned a code. But beyond these advantages, the boy would enter a new realm in which science and romance commingled. He became an explorer. He both triumphed over and was in harmony with nature. Through wireless, the experimenter went through the looking glass, to a never-never land in which he heard the disembodied "voices" of ships' captains, newspaper men, famous inventors, or lovers passing in the night. This was an invisible, mysterious realm, somewhere above and beyond everyday life, where the rules for behavior couldn't be enforced—in fact, were not yet even established. The boy who entered it could, without detection, eavesdrop on the conversations of others. He could participate in contests of strength, power, and territory, and win

them without any risk or physical danger. He heard things others did not, and he did things maybe he should not have done. He could please his parents by acquiring this instructive hobby, and he could defy them by using it, without fear of being discovered, to misbehave. In this realm, in the “folds of the night,” by mastering a new technology while letting his imagination and his antisocial inclinations loose, he could be, simultaneously, a boy and a man, a child and an adult. He could also straddle old and new definitions of masculinity.

Willenborg was the latest incarnation of the boy-hero, a central figure in popular literature for decades. In the early 1900s the boy-hero remained a stock character; only the basis of heroism changed. Willenborg's early predecessors, in the 1870s and 1880s, were the young cowboy heroes of dime novels who, like “Deadwood Dick,” triumphed over the wild frontier with its animals, Indians, and foreign terrain. Dick, “a youth of an age somewhere between sixteen and twenty,” could count on his “muscular development and animal spirits” to achieve his victories.<sup>9</sup> He asserted his masculinity directly through physical endurance and conquest. Thus, he was quite different from the other boy-heroes so popular during the same era, the protagonists of Horatio Alger's stories. These heroes were hard working, morally upright, self-reliant, and physically sturdy. Instead of fighting train robbers or “redskins,” they sought to overcome villains ready to foreclose on the mortgage, supercilious rich boys, or the lure of the pool hall. Being a successful man in Alger's stories meant overcoming poverty and a chaotic, corrupt environment. More importantly, it meant becoming middle class, making money, and joining a business in which a boy could work his way up. Masculinity here meant solvency and respectability; it was measured by material success. It was made possible, in Alger's stories, through a fluke accident or lucky break, in which the hero saved a young girl from peril and then learned her father was an extremely grateful millionaire. By 1900, with the obvious consolidation and hegemony of the corporate sector, the prospect of the mythic lucky break seemed dated and naive. Young men had seen real rags-to-riches stories in the newspapers, but the vehicle had not always been luck: it had been, quite frequently, technical mastery.

In dime novels and other juvenile literature, heroes such as Ragged Dick and Deadwood Dick gave way to Nick Carter and Frank Merriwell, two heroes popular in the late nineteenth and early twentieth centuries. Carter, a young detective, possessed “strong muscles and terrible fists.” But, more importantly, he was highly intelligent. He was a master of disguise and spoke “almost every known language, as well as

many that are comparatively unknown.” His cases took him to hidden valleys in Nepal, to undersea kingdoms or lost civilizations in the Amazon. Frank Merriwell, who first appeared in 1896, had been to prep school and was attending Yale, although he occasionally had to leave Yale for financial reasons. He was an excellent athlete, always leading his school teams to victory. Of course he showed “courage, push, determination and stick-to-it-iveness.” He and his friends had numerous adventures as they tracked down various rascals.<sup>10</sup>

These characters had much in common with the earlier heroes. They were brave, resourceful, valiant, morally decent, cheerful, and hard working. Yet several important characteristics distinguished these boy-heroes from their predecessors and set the stage for the popularization of wireless. These turn-of-the-century boys were distinctly middle class. Specific mention was made of their educational background. Physical combat, when it did occur, took place more frequently on the playing field. Brute force or violence was less essential to their success than sharp analytical skills and mechanical flair. What set these boys apart from others was not luck, it was skill.

Concerns about technical mastery and the stock figure of the boy-hero came together in a new character: the boy inventor-hero. Tom Swift, of course, was the apotheosis of the boy inventor-hero. His roots lay not only in earlier juvenile literature and dime novels, but also in the science fiction of Jules Verne and H. G. Wells. Like the earlier heroes, Tom mastered his environment, but not with his fists or guns. He used machines. Like other turn-of-the-century heroes, Tom possessed foresight and vision and the power of thought and will.<sup>11</sup> He made a social contribution through his inventions. The stories about him and his inventive capacities were extravagant, but Tom was still a hero boys could emulate on a more modest scale, the way Willenborg had.

The boy inventor-hero, like the inventor-heroes constructed by the press, exemplified how mass entertainment symbolically made sense of technical change. Would-be Willenborgs were surrounded by popular culture celebrations of technical mastery. As Wild West shows and circuses declined in popularity, vaudeville, a genre oriented more toward the dilemmas posed by urbanization, mechanization, and immigration, reached its heyday. Vaudeville contained its share of animal acts and western motifs, but it also confronted technology head on. For example, one famous and favorite vaudeville routine performed during the first decade of the century consisted of a team of men taking apart and reassembling a Ford on stage in eight minutes.<sup>12</sup> At Coney Island, machines brought pleasure, wonder, and excitement.<sup>13</sup> Early films featuring auto-

mobiles, trains, and airplanes celebrated those who could control the machinery and made fun of those who could not. Through a range of action-filled tales, formulistic plots, and broad and sometimes vulgar humor, American culture symbolically addressed the tensions and contradictions brought about by the seeming flood of new machines and gadgets. The man who was befuddled by all this machinery was a clown, emasculated; the man who made technology his slave, a genius newly empowered.

The emergence of the boy inventor-hero is important to the early history of radio because the genre of popular juvenile writing surrounding this new hero provided information about wireless and encouraged boys to experiment with the invention. It also placed wireless work within the larger context of contemporary heroism. Most importantly, the popular writings glorifying boy experimenters presented ideas about wireless and the ether which were totally at odds with those held by Marconi and military officials. The stories about Willenborg cast wireless as a young man's toy and the ether as his playground. In the magical, almost other-wordly realm described by the *Times* reporter, the concepts of corporate monopoly or military preemption seemed alien, mean spirited, and completely unenforceable.

The growing audience of wireless enthusiasts mattered little to an entrepreneur such as Marconi. He had fixed his gaze firmly on the communications grid established by the cable companies, and he sought to mimic, elaborate on, and compete with it. The aspirations of many middle- and lower-class Americans, fanned by the country's democratic myths and participatory ideology, and symbolically represented in popular culture, were relatively foreign to Marconi. Certainly they did not fit into his corporate calculations. For him, the popular arts had nothing whatsoever to do with wireless telegraphy. It was this oversight that began to drive a wedge between Marconi's original vision of his invention's applications and the ultimate use to which it was put in the United States. Within fifteen years, radio would become the vehicle through which popular culture was imprinted on electrical communications and was brought more directly and brazenly into the home than ever before. The year 1906 marked the beginning of this revolutionary trend, for, just when stories such as the ones about Willenborg began to proliferate, certain technical opportunities emerged which made emulating the boy wonder much easier.

FROM 1906 TO 1912, when American wireless companies were on the verge of declaring or had in fact declared bankruptcy, and when the

corporate sphere publicly expressed indifference toward the invention, America experienced its first radio boom. Thousands of people, believing in a profitable future for the invention, bought hundreds of thousands of dollars worth of stock in the various fledgling wireless companies. Others took even more decisive action: like Willenborg, they began to construct and use their own wireless stations. These Americans came to be known as the amateur operators, and by 1910, their use of wireless was being described in newspapers and magazines around the country. The *Outlook* outlined the emerging communications network: "In the past two years another wireless system has been gradually developing, a system that has far outstripped all others in size and popularity. . . . Hundreds of schoolboys in every part of the country have taken to this most popular scientific fad, and, by copying the instruments used at the regular stations and constructing apparatus out of all kinds of electrical junk, have built wireless equipments that in some cases approach the naval stations in efficiency."<sup>14</sup>

Shortly after Marconi introduced his invention, the press predicted that eventually Americans would communicate with each other using their own apparatus and would not have to rely on the telegraph or telephone. The amateurs began making these predictions a reality. Unlike their doubting elders, who thought wireless too impractical or too unrewarding, these boys believed earnestly in the new marvel and were eager to explore its possibilities. Through the popular culture, these youngsters witnessed, unhindered as yet by acquired disbelief, the unrefined and unself-conscious aspirations of the culture, especially the hope that technology could serve as the vehicle for individual and societal progress. Businessmen and military men were not part of this world, and they no doubt considered such visions of wireless unrealistic. But the amateurs were captivated by the idea of harnessing electrical technology to communicate with others, and they were not deterred by a lack of secrecy or by interference from other operators. In fact, these features, considered a major disadvantage by institutional customers, increased the individual amateur's pool of potential contacts and the variety of information he could both send and receive.

How were the amateurs able to master this particular technology? The first and most tangible development was the availability, in 1906, of an inexpensive and simple radio receiver. This was the crystal set, a device that could, for reasons that had not yet been explained, detect radio waves. The events at a receiving station were the same as those at the transmitting station, but in reverse sequence. At the transmitting end, inventors had to devise the most efficient method of generating very high frequency alternating current from a direct current source. At the receiv-

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ing end, the problem was "rectifying" these oscillations: translating high-frequency alternating current back to a unidirectional pulsating current that could flow through a telephone receiver. Hertzian waves are of such a high frequency that the telephone diaphragm alone could not handle their speed or rapid reversal of direction. By 1906, both Fleming and De Forest had established the importance of rectifying incoming electromagnetic waves. Fleming's valve and De Forest's audion were sophisticated and expensive receivers that allowed the current to run in one direction only. The introduction of these receivers represented a major advance in wireless which rendered the invention less accessible, intellectually and financially, to the scientific dabbler. Wireless was becoming less simple. However, this apparent progression toward increasingly complex and expensive components did not continue unswervingly.

General H.H.C. Dunwoody of the army, also affiliated with American De Forest and then United Wireless, discovered in 1906 that carbondum (the compound of carbon and silicon), when used as a wireless detector, suppressed half of the incoming wave frequencies. A few months later, G. W. Pickard, co-founder (with John Firth) of the Wireless Specialty Apparatus Company, patented his silicon receiver based on the same principle. Inventors did not understand how the crystal worked, but they did know that it was a sensitive, durable, inexpensive receiver that was simple to operate and required no renewal of parts.<sup>15</sup> At the time, how and why the crystals worked as receivers was not as important as their simplicity and very low cost. Some spots on the crystal, especially the sharper edges, were more sensitive than others. The crystal was placed between two copper contact points that were adjustable so the pressure could be regulated and the most sensitive portion of the mineral selected. To keep the contact as small as possible, often a thin wire (known popularly as the catwhisker) made contact with the mineral. Because the catwhisker was "springy," it was less easily upset by vibrations or a ship's roll. Like its more sophisticated counterparts, the crystal could detect voice transmissions.<sup>16</sup>

The ramifications of the introduction of the crystal detectors cannot be overemphasized. The crystals contributed more than any other component to the democratization of wireless, the concomitant wireless boom, and the radio boom of the 1920s. The new receiver provided access to the airwaves to the new group of would-be Willenborgs, the amateurs. They were primarily young, white, middle-class boys and men who built their own stations in their bedrooms, attics, or garages. Although they existed throughout the country, they were most prevalent in urban areas. They earned no money as operators and had no particular

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corporate or professional affiliation. For them, wireless became a hobby—one that would shortly have national significance.

The amateurs' ingenuity in converting a motley assortment of electrical and metal castoffs into working radio sets was quite impressive. With performance analogous to that of an expensive detector now made available to them in the form of the inexpensive crystals, the amateurs were prepared to improvise the rest of the wireless set. They had to in the early days, before 1908, for very few companies sold equipment appropriate for home use. Also, one of the crucial components, the tuning coil, was not supposed to be available for sale because it was part of the patented Marconi system. As the boom continued, children's books, wireless manuals, magazines, and even the Boy Scout manual offered diagrams and advice on radio construction. One author instructed: "You see how many things I've used that you can find about the house."<sup>17</sup>

Boys also exchanged technical information with one another at school and over the air. They were especially interested in information on improved reception and accurate tuning. The amateur measured his success by how many different and faraway stations he could pick up. The basic tuning coil, based on variable inductance, consisted of a cylinder wound with wire. Mounted around the wire were variable contacts called sliders, which could be moved to make a connection at any point along the coil, thus matching the inductance of the receiving station to that of the transmitting station. By moving the sliders back and forth, the amateur could listen to one station and exclude the others. Finding suitable cylindrical objects was not always easy; some boys used broken baseball bats or old curtain rods for lack of anything else. Later, when Quaker Oats began packaging its oatmeal in cylindrical cardboard containers, these tubes became the standard core for the tuning coil.<sup>18</sup>

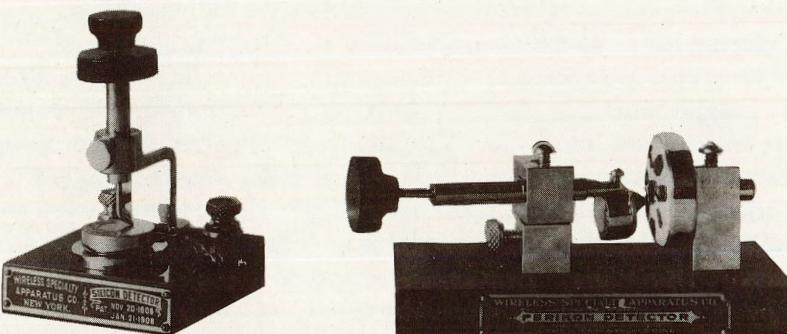
In the hands of the amateurs, all sorts of technical recycling and adaptive reuse took place. Discarded photography plates were wrapped with foil and became condensers. The brass spheres from an old bedstead were transformed into a spark gap, and were connected to an ordinary automobile ignition coil—cum-transmitter. Model T ignition coils were favorites. One amateur described how he made his own rotary spark gap from an electric fan. Another recalled that he "improvised a loudspeaker by rolling a newspaper in the form of a tapered cone and filled the room with the Arlington time signals. Everyone in the house gravely set their watches at noon each day by this means." Another inventor's apparatus was "constructed ingeniously out of old cans, umbrella ribs, discarded bottles, and various other articles." Amateurs used these umbrella ribs as well as copper or silicon bronze wire to erect inexpensive and relatively

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good aerials. Some amateurs, dissatisfied with the limited power that batteries provided, stole their power from the electric companies by tapping into outside electrical lines.<sup>19</sup> The one component that was too complicated for most amateurs to duplicate, and too expensive to buy, was the headphone set. Consequently, telephones began vanishing from public booths across America as the amateurs lifted the phones for their own stations.<sup>20</sup> Thus, the amateurs did not just accept and use this new technology; they adopted it as their own. They experimented with it, modified it, and sought to extend its range and performance.

The size of this burgeoning wireless network is hard to gauge. Estimates vary, but Clinton De Soto, in his history of amateur radio, asserts that "it was the amateur who dominated the air."<sup>21</sup> In 1911, *Electrical World* reported: "The number of wireless plants erected purely for amusement and without even the intention of serious experimenting is very large. One can scarcely go through a village without seeing evidence of this kind of activity, and around any of our large cities meddlesome antennae can be counted by the score." An operator for United Wireless wrote that one Boston manufacturer alone was selling thirty complete sets every month. The *New York Times* estimated in 1912 that America had several hundred thousand active amateur operators.<sup>22</sup>

Increasingly, magazines, newspapers, and popular fiction celebrated the wireless dabbling of these young men. Francis A. Collins, in his children's book *The Wireless Man*, wrote: "On every fair night after dinner-time and when, let us hope, the lessons for the next day have been prepared, the entire country becomes a vast whispering gallery."<sup>23</sup> In an



Two early crystal detectors. The contact point could be adjusted or changed to find the most receptive spot on the crystal.

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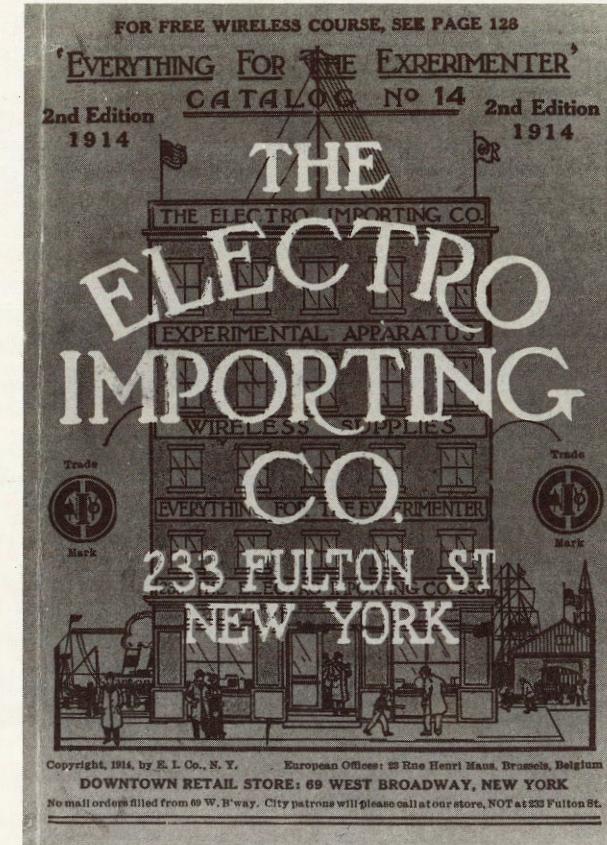
article he wrote for *St. Nicholas* titled "An Evening at a Wireless Station," Collins changed his metaphor without sacrificing vividness or drama: "Imagine a gigantic spider's web with innumerable threads radiating from New York more than a thousand miles over land and sea in all directions. In his station . . . our operator may be compared to the spider, sleepless, vigilant, ever watching for the faintest tremor from the farthest corner of his invisible fabric."<sup>24</sup> These operators, "thousands of miles apart," wrote Collins, "talk and joke with one another as though they were in the same room."<sup>25</sup> In *Tom Swift and His Wireless Message*, Tom saved himself and his companions who were shipwrecked on a volcanic island by devising a wireless set and sending for help: "Would help come? If so, from where? And if so, would it be in time? These are the questions that the castaways asked themselves. As for Tom, he sat at the key clicking away, while, overhead, from the wires fastened to the dead tree, flashed out the messages." Finally, "from somewhere in the great void," a reply came back and all were rescued.<sup>26</sup> Short stories with titles such as "In Marconiland," "Wooed by Wireless," and "Sparks" appeared in popular magazines.<sup>27</sup> Their young male protagonists saved property and lives and won the love of a previously unattainable and beautiful young woman, all through their skill with wireless. They also got some financial reward and a better job. It was through his mastery of this technology that the protagonist's true heroic qualities of courage, selflessness, and chivalry were ultimately revealed, while he simultaneously proved himself to be an invaluable organization man.

The most avid promoter of the hobby was Hugo Gernsback, most frequently referred to as the father of science fiction. Gernsback, an immigrant from Luxembourg who came to the United States in 1904 to market a dry battery he had invented, was also a wireless enthusiast.<sup>28</sup> By 1906 he had opened "that great emporium of the amateur world, the Electro-Importing Company" on Fulton Street in New York; this shop was probably the first in the United States to sell wireless apparatus appropriate for home use directly to the public.<sup>29</sup> To promote both the hobby and his sales, Gernsback began publishing the magazine *Modern Electrics* in 1908. The magazine contained technical information and wireless boosterism. Gernsback also wrote letters to newspapers such as the *New York Times* praising "the ambition and really great inventive genius of American boys." He advised parents to encourage the hobby: "This new art does much toward keeping the boy at home, where other diversions usually, sooner or later, lead him to questionable resorts; and for this reason well-informed parents are only too willing to allow their

sons to become interested in wireless."<sup>30</sup> How could the middle-class parent, concerned about pool halls or nickelodeons, resist such an argument?

Such celebrations of the boy wireless operator were powerfully reinforced whenever professional operators became heroes. On January 23, 1909, a dramatic and highly publicized accident emphasized the importance of wireless at sea. The White Star liner *Republic*, which was taking vacationing well-to-do Americans to the Mediterranean, was cruising in a thick fog twenty-six miles southeast of the Nantucket lightship when it was rammed by the Italian Lloyds ship the *Florida*, which was bringing hundreds of Italian immigrants to New York. The *Republic*'s engine room was pierced and immediately filled with water.<sup>31</sup> Two people whose sleeping berths were at the point of collision were killed instantly. Others were injured. The two ships were carrying, between them, more than twelve hundred passengers. The *Republic* began to sink and the crews from both ships started transferring the *Republic* passengers to the *Florida*. It was not clear whether the Italian ship, which was half the size of the *Republic* and had a severely damaged bow, would be able to reach port with such a heavy load. There was panic and chaos on both ships. But "then came the wonder of modern knowledge," reported *Harper's Weekly*: "Out of the heart of the fog, far and wide, to all points of the compass, Captain Sealby flashed by wireless telegraphy word of the peril and requests for assistance—a general ambulance call of the deep sea." Several ships responded; they "turned in their tracks and headed for the far-off voice that summoned them!" "What a wonder-tale it is," continued the *Harper's* editorial, "and how deeply moving—the cry for help thrown out into the air from a mast-tip, and caught, a hundred miles and more away. . . . It is a new story; there was never one quite like it before."<sup>32</sup> The *Baltic* reached the *Republic* and *Florida* first and took on all the survivors from both ships. The *Republic* sank, and the other two ships returned to New York. The "marvels of wireless telegraphy" were front-page news for four straight days, dominating the first three pages of the *New York Times*, which called the accident "the greatest shipwreck in years."<sup>33</sup> Wireless, announced *Harper's*, "has robbed accident by sea of half its terrors. No longer need the passengers of a wrecked ship scan the horizon hopelessly while the sea pours into the hold and, inch by inch, Death gains his footing. For an invisible network of ethereal communications unites ship to ship."<sup>34</sup>

But the real hero of the hour was a "youngster of twenty-six who became famous in a day," the *Republic*'s wireless operator, Jack Binns. The *Florida*, which was carrying poor Italian immigrants who were



Advertisement for Hugo Gernsback's Electro-Importing Company, which specialized in amateur wireless apparatus.

fleeing the recent disastrous earthquake in Sicily, was not equipped with wireless apparatus, so the duty of calling for help fell solely on Binns's shoulders. "With the wall of his metal cabin splintered and shattered by the knife-bow of the Italian liner," reported *Putnam's*, "Binns stuck to his instrument all through the dreary day, sending, sending, sending the hurry call of the sea—CQD! CQD!" When the *Republic*'s engine room flooded and the ship's power went off, Binns had to shift to reserve storage batteries for transmitting, and this cut the radius of his messages by one-half. Yet, he still "sat at the key for many hours without respite, till help arrived."<sup>35</sup> He communicated primarily with H. G. Tattersall, the operator on the *Baltic*, who sat at his key for fifty-two hours until he

collapsed. In the end, Binns was "drenched and hungry," "exposed to the weather, his hands so stiff from the cold that it was with difficulty that he could hold the key of his instrument."<sup>36</sup>

By the time he reached New York, Binns was lionized. Reporters hounded him for interviews; crowds followed and cheered him from the moment he set foot on dry land. Congressmen made speeches urging that he be immortalized.<sup>37</sup> Managers of music halls and museums "vainly tempt[ed] him to go on the stage and pose."<sup>38</sup> One vaudeville chain offered him one thousand dollars a week for ten weeks to appear on its billing.<sup>39</sup> Two days after Binns returned to New York, his friends dragged him onto the stage of the Hippodrome, where he was forced to make a speech and was then swarmed over by all the chorus girls, who tried to hug and kiss him.

Binns, like Marconi ten years earlier, was the perfect media hero. He fit perfectly the literary conventions and cultural expectations of his times. He was a real-life Tom Swift. It was through his technical mastery that he had proved himself a man. He had been selfless and vigilant, impervious to the threat of failure or the risks of danger. Physical combat had not been important; physical endurance had been critical. He was "young, boyish, quite immature in appearance, but possessed . . . iron nerve and dauntless resolution."<sup>40</sup> And he was modest, even self-effacing. He refused to admit "that he did any more than any of his fellow-operators would have done in like circumstances."<sup>41</sup> Under a large portrait of him in *Harper's Weekly* appeared the caption "Why, I didn't do anything."<sup>42</sup> He even refused the many offers to benefit financially from his newfound celebrity, which prompted one *New York Times* reader to write, "Good for you, Jack Binns! May your example be followed by future newspaper 'heroes'."<sup>43</sup> After the flood of attention, *Putnam's* reported that Binns confided to a friend, "I can't stand any more of this. I never want to see my own picture again."<sup>44</sup> By refusing "to become an object of gaping and vulgar curiosity," editorialized the *New York Times*, Binns showed "the delicacy and dignity which not a few real heroes have lacked."<sup>45</sup> "The true test of a hero," lectured *Putnam's*, "is the manner in which he takes his ovation."<sup>46</sup> Binns's aw-shucks approach served to fan the embers he hoped to douse.

Several publications used the incident to romanticize the work of all wireless operators. They noted that many amateurs went on to become professional operators, and that the variety and excitement to be found in wireless work made the job especially attractive to youth. These operators were reportedly educated men who had "technical college training" and came from a "superior class." On board ship, the operator was

"an important personage" who ranked as an officer and took his orders directly from the captain. But what operators liked best was "the sensation of sitting in a quiet cabin, with untold ohms of power beneath their fingers."<sup>47</sup> According to a *Harper's* reporter, all the operators were heroes: "Going around among them and hearing them talk of their work convinces one of the incalculable service they render daily to modern navigation. And it is a service that is rendered with an admirable *esprit de corps*."<sup>48</sup> It was repeatedly said that the operators formed a brotherhood.

Joining such a fraternity of tough, independent men who were always potentially at the edge of danger possessed no small portion of romantic allure. One could become part of the brotherhood without actually going to sea; taking to the air was sufficient stimulation for many. For, even though a young man might be secure in the comfort of his own home, his life did become more exciting through radio. The amateurs came to feel that their lives were intertwined with truly significant events, as they overheard messages about shipwrecks or political developments and transmitted these messages to others. As one amateur recalled, "We were undoubtedly romantic about ourselves, possessors of strange new secrets that enabled us to send and receive messages without wires."<sup>49</sup> Amateurs who heard Jack Binns's distress signals became celebrities by association. One remembered: "The few boys in school in the area who claimed to have received the distress call were local heroes for a time, and they made a number of converts to the radio amateur hobby among the more technically minded youngsters."<sup>50</sup> Hearing any news first, the night before other Americans would read it in the newspapers, imbued the amateur with an aura of privilege, of being "in the know." As Francis A. Collins wrote in *The Wireless Man*, "Over and over again it has happened that an exciting piece of news has been read by this great audience of wireless boys, long before the country has heard the news from the papers. . . . A wide-awake amateur often finds himself independent of such slow-going methods of spreading the news as newspapers or even bulletin boards."<sup>51</sup> Many amateurs learned of the outbreak of World War I from the Marconi Cape Cod station hours before the newspapers announced the story.<sup>52</sup> The amateurs were tapping point-to-point messages meant only for certain ears, not broadcasts intended for everyone. They could feel part of an inner circle of informed people because they heard the news as it happened.

As important as being privy to such spectacular but rare transmissions was the novelty of contacting other people, strangers, through space. One operator claimed that amateurs using only "a wire strung up

Publicity photograph of Jack Binns, hero of the *Republic* disaster.

like a clothesline between trees" were able to pick up "many long-distance messages." He added, "I know one boy who catches messages sent out from Panama."<sup>53</sup> Although many operators hoped to hear dots and dashes coming from "thousands' of miles away," making contact over a distance as short as ten or fifteen miles was reportedly a "thrilling experience."<sup>54</sup> In a culture that was becoming more urbanized, and whose social networks were becoming increasingly fragmented, many

strangers became friends through wireless. The amateurs loved the contact with invisible others in a realm where one was faceless and yet known at the same time. The fraternity that emerged possessed the fellowship felt among pioneers. These young men were exploring and comparing their findings on a relatively uncharted and mysterious territory. As one amateur explained, "The eagerness and frankness in distributing the results of our findings undoubtedly molded the form of fellowship which is such a striking quality of the amateurs."<sup>55</sup> Yet the fraternity was also exclusive. Working-class boys with neither the time nor the money to tinker with wireless could not participate as easily. Neither could girls or young women, for whom technical tinkering was considered a distinctly inappropriate pastime and technical mastery a distinctly unacceptable goal. This fraternity, whether self-consciously or accidentally, brought together roughly similar men in a region uninhabited by those so different from them: women, immigrants, blacks, and boys ignorant about electrical technology. That the amateurs engaged in contests of strength and speed with one another did not undercut the mutuality of the enterprise; in fact, the contests simply strengthened the bond.

A revolutionary social phenomenon was emerging. A large radio audience was taking shape whose attitude and involvement were unlike those of other, traditionally passive, audiences. Collins summarized the development in *The Wireless Man*: "An audience of a hundred thousand boys all over the United States may be addressed almost every evening by wireless telegraph. Beyond doubt this is the largest audience in the world. No football or baseball crowd, no convention or conference, compares with it in size, nor gives closer attention to the business at hand."<sup>56</sup> This was an active, committed, and participatory audience. Out of the camaraderie of the amateurs emerged more formal fraternities, the wireless clubs, which were organized all over America. One of the first of such clubs, the Junior Wireless Club, Ltd., was formed in January 1909, just after the *Republic* disaster. It began in New Jersey with only five members; elected as president was eleven-year-old W.E.D. Stokes, Jr. In the same year Hugo Gernsback started the Wireless Association of America, which by 1910, Gernsback claimed, had ten thousand members. The Children's Museum, under the direction of the Brooklyn Institute of Arts and Sciences, erected its own wireless plant so youngsters could investigate wireless, learn how to build their own sets, and meet other young operators. Many high schools established wireless clubs to promote the hobby.<sup>57</sup> By 1912, the *New York Times* estimated that 122 wireless clubs existed in America.<sup>58</sup> Most of the club meetings took place "in the air," on a prearranged wavelength. The chairman called the

## INVENTING AMERICAN BROADCASTING

meeting to order by sending out his call letters, and the members signified their attendance by answering with their own. During these meetings, the amateurs usually shared technical problems and solutions, discussed technical advances, and drilled one another on transmission skills. A Chicago wireless club broadcast a program every evening, "as a matter of practice for amateur operators in receiving. The bulletin usually consisted of an article of some electrical or telegraphic interest . . . [and] sometimes the program was varied by sending passages in foreign languages, to quicken the receiving ears of the amateur operators."<sup>59</sup>

Gradually, an informal wireless network was established as the different clubs relayed messages for one another to points too far to reach with most amateur sets. One historian has noted: "Message handling—for pleasure, for friends, in time of emergency—was rapidly becoming the predominant theme in amateur radio." In March of 1913, a severe windstorm in the Midwest blew down the telegraph and telephone lines, but local amateurs were able to maintain the region's communication by relaying messages in and out of the area. Such impromptu public service gestures led some amateurs to advocate better organized intercommunication among operators. One radio enthusiast, the inventor Hiram Percy Maxim, believed that the amateurs needed a national organization to establish a formal relay system or network to serve all amateurs. Through his Hartford Radio Club, he contacted amateurs in March 1914, inviting them to join a league and to convert their stations into official relay stations. The name of his organization was the American Radio Relay League (ARRL). The response to his invitations was so enthusiastic that within four months the league boasted two hundred official relay stations across the United States.<sup>60</sup> Thus, in 1914, there existed in America a grass-roots, coast-to-coast communications network. When ARRL was formed, *Popular Mechanics* proclaimed "the beginning of a new epoch in the interchange of information and the transmission of messages." Wireless telegraphy had "made it possible for the private citizen to communicate across great distances without the aid of either the government or a corporation."<sup>61</sup>

For the first time in America, men were being invisibly bound together by and in the airwaves, not by necessity, but for fun, to learn from and to establish contact with others. Those involved in the new hobby saw larger-than-life reflections of themselves in popular books, magazines, and newspapers. We cannot tell whether popular culture helped increase participation, but we do know, from the reminiscences of amateurs operating at the time, that popular culture articulated the hopes and dreams invested in wireless. Technology gave the amateurs the means to

## Popular Culture and Populist Technology

communicate without wires. Popular culture sustained their visions of being on the cutting edge of technological progress and of being the kind of men truly prepared for modern society.

THE INCREASED PRESENCE of amateurs in the airwaves led to a struggle for control of the ether, a struggle that pitted the amateurs against the U.S. Navy. The nature of this struggle was only hinted at in the stories about Walter Willenborg. Willenborg's conquest of the Atlantic Highlands operator, who was forced to stop transmitting until Willenborg was good and ready to let him proceed, was portrayed by the *New York Times* reporter as amusing and even enviable ethereal jousting. It was boyish prankishness, and boys, after all, will be boys. As long as the boy wireless heroes were cast in the mold of fictional characters like Frank Merriwell and Tom Swift, a few good-natured pranks could do no harm. However, the sort of deliberate interference that Willenborg practiced began to get out of control, and to the military, in particular, it ceased to be in any way innocent or amusing. Not all amateurs, it turned out, were selfless heroes like Jack Binns.

It is important to remember that by 1910, the amateurs surpassed both the U.S. Navy and United Wireless in numbers and, often, in quality of apparatus. Between 1906 and 1910, the navy had installed wireless on many of its ships, and while the invention was still not well integrated into naval operations, it was being used more frequently. There were hundreds of high-power amateur stations, however; navy and commercial stations comprised only 15 or 20 percent of the total.<sup>62</sup> Many homemade stations could transmit only up to fifteen miles and pick up messages from forty miles away, but some commercially produced apparatus, which cost thirty dollars or less, was guaranteed to receive and send messages up to three hundred or four hundred miles.<sup>63</sup> In addition to this power, the amateurs, who were able to ignore patents, also had tuning. As one historian has noted, "The fact that amateurs had tuners prior to 1910—even though they were nothing more than long coils of wire with a sliding contact—lent them a tremendous advantage over the inadequately equipped stations of United Wireless and the U.S. Navy, which used obsolete untuned, or at best direct-coupled equipment for several years thereafter."<sup>64</sup>

The spectrum became more crowded as too many enthusiasts, many of them beginners, clogged the air with all sorts of transmissions. They "gossip about everything under the sun," reported one operator. "They ask each other for the baseball or football scores, make appointments to

meet the next day, compare their lessons. And they quarrel and talk back and forth by wireless in regular boy-fashion."<sup>65</sup> Amateurs spoke with one another and with willing commercial operators. The United operators aboard the coastal ships worked long, uneventful hours, and they were more than happy to have the amateurs keep them company. As one amateur recalled (painting an image contrary to the glamorous one of Binns and his compatriots), "The operators on those ships put in bore-some hours. . . . People were not great users of wireless ship-to-shore messages as they are today. . . . There was absolutely no limit to the conversation service we would get from the ships."<sup>66</sup> Francis Hart, a wireless operator in New York City from 1907 to 1911, described the congestion in his logbook: "The different kids around here raise an awful noise, all try to talk at once, call when anybody is in and never use any sense, half can't read 4 words a minute and sit calling everybody within 20 miles and can't hear 800 feet from another station." He commented on one amateur's conversations: "FH is a very good reader, but he tries to say too much at one time, then the poor reader makes him repeat it and they keep that blooming business up for hours."<sup>67</sup> While this sort of interference increased, so did "malicious" interference, which began to give the amateurs as a group a bad reputation.

Some amateurs deliberately sent false or obscene messages, especially to the navy. The temptation to indulge in such practical joking was enhanced by the fact that detection was virtually impossible. Amateurs would pretend to be military officials or commercial operators, and they dispatched ships on all sorts of fabricated missions. Navy operators would receive emergency messages about a ship that was sinking off the coast. After hours of searching in vain, the navy would hear the truth: the "foundering" ship had just arrived safely in port. In January 1910, approaching the Nantucket lightship, the steamer *Bremen* asked for a report on weather conditions and location. The *New York Times* gave this account of what ensued: "She was answered, and was much shocked and surprised to find that the reckoning as computed by her navigator was apparently in error. Information that was untrue was also given regarding weather conditions. On reaching New York the matter was looked into, and it was discovered that the lightship had been sunk a week prior to the sending of the messages, and the work was that of amateurs." Navy operators at the Newport Naval Yard complained that amateurs sent them profane messages. *Electrical World* reported: "Attempts to report the recent naval experiments in Chesapeake Bay by wireless met all kinds of trouble from the omnipresent amateur, with his often crude, but sometimes perniciously effective, sending apparatus."

The *Outlook* warned: "The efficiency of a number of the coastal stations of the Navy has been cut in half because of the presence of dozens of small amateur stations. Boston is the head of some five hundred amateur operators, a number of whom can put the Charlestown Navy Yard completely out of commission as regards the receiving of messages."<sup>68</sup>

Some amateurs charged that commercial operators helped create the malicious interference and were taking advantage of the amateurs' increasingly bad press. *Electrical World* repeated the claim: "Much of the present day trouble arising from interference is attributable less to the activities of amateur operators than to the studied attempts of certain of the operating companies to interrupt the continuity of messages being sent by [their] rivals."<sup>69</sup> The chief electrician of the New York Navy Yard maintained that the signals from some commercial stations were so loud that if the receiver was "anyway near on their tune the telephone [could] be laid on the table and the sound heard at any distance in the room away from them."<sup>70</sup> Hart's logbook for 1909 contains many complaints about interference by Marconi operators. A Marconi operator aboard the *St. Louis*, Hart recorded, had been "breaking everybody for the last three nights, while lying at dock sending 'Vs' and general nonsense which is not uncommonly done by the Marconi people in the harbor." Hart resented being treated in that "absolutely pigheaded English way." He was especially irritated by the Marconi interference, because the Marconi Company, he wrote, already had a monopoly.<sup>71</sup>

The situation was untenable: too many people wanted access to the airwaves at the same time, and there were no guidelines for establishing priority. The commercial wireless companies did not take this contest into the public arena; interfering with one another was part of business, and they could often tune out or overpower the amateurs. When technical might failed, gentlemen's agreements prevailed. For example, the one hundred members of a wireless club in Chicago worked out an air-sharing agreement with the local commercial operators which was designed to reduce interference for both groups.<sup>72</sup> For the private companies, especially Marconi, public arguments over interference and congestion were undesirable because they suggested that wireless was still unreliable and prompted mention of regulation. The amateurs resented getting blamed for commercial operators' mischief, but their argument was basically not with the private wireless companies. Rather, as the battle lines over ethereal right of way became more clearly drawn, the amateurs began to defend themselves against a public campaign waged by the U.S. Navy.

Military officials began lobbying in Washington for stricter regula-

tion of or elimination of the amateur. Their justification for such suppression was difficult to dispute: safety at sea and national security. In its cover story on the U.S. revenue cutter *Gresham*, "life-saver of the rocky New England coast," *Scientific American* echoed the military position that the ship "depends on her wireless apparatus to keep informed of the location of wrecks, and her urgent dispatches have at times been delayed for hours by the working of amateur stations." Naval operators asserted that because they transmitted important official messages, they should have priority and should not be interfered with by children. A New York City naval operator considered having to yield the airwaves to youngsters when he was trying to conduct government business preposterous. He was prevented from transmitting one evening while "a couple of kids in New Jersey compared the results of their arithmetic lessons."<sup>73</sup> The navy now had another chance to try to take over the operation of America's wireless stations. Amateur meddling in "official government transmissions," which included emergency messages, provided an excellent argument for military control. The navy continued issuing statements about the grave danger posed by the amateurs, and cited many instances of unpatriotic interference. The Navy Department's 1909 *Annual Report* noted the increased numbers of "seemingly semi-intelligent and wholly irresponsible operators" who "at any time through carelessness or stupidity may render hopeless the case of a shipwreck." The only solution, the navy argued, was for "laws governing the conduct of all wireless stations" to be passed.<sup>74</sup>

The anonymity made possible by wireless had a leveling effect on the status and power of naval officials: in the airwaves, rank was irrelevant; only technical strength mattered. The wireless amateurs expressed traditional American delight in flouting authority, and their target was irresistible. If you wanted to challenge authority and show how tough, how manly, how unafraid, you were, who better to take on than the new navy?

The amateurs fought the navy's efforts to restrict their activity. They argued with navy operators in the air and tried to embarrass the navy in the press. The *Outlook* reported that during what naval operators claimed was an emergency situation, amateurs refused to clear the air, "some of the amateurs even arguing with the Navy men over the ownership of the ether." In another instance, a Boston amateur, "told by a naval operator to 'butt out' made the following classic remark: 'Say, you navy people think you own the ether. Who ever heard of the navy anyway? Beat it, you, beat it.'"<sup>75</sup>

Many amateurs were justifiably rankled by the navy's charges. The

press agreed that most amateurs were polite and considerate and did not transmit false or obscene messages. Many amateurs had, in fact, helped to save lives or relay critical messages, only to be blamed for interfering. The May 1912 issue of *Electrician and Mechanic* recounted one such incident, in which the naval ship *Terry* transmitted distress signals to the New York area: "The first news that the Brooklyn Navy Yard had of the *Terry*'s distress was picked up by an amateur in Bayonne, New Jersey, and relayed to the government operator." Rather than appear incompetent because he had failed to pick up the *Terry*'s initial call himself, the naval operator blamed the local amateurs for interfering.<sup>76</sup> A wireless amateur wrote to *Scientific American* to cite another instance in which amateur aid would have been crucial: "While experimenting with my receiving set at a point on Buzzards Bay, Massachusetts, I once heard a ship call every naval and commercial station from . . . Fire Island, New York to Boston, for an hour, without getting a reply. Suppose this had been an urgent distress call? That ship would have gone down with the call unanswered unless I or some other 'meddler' had given the alarm."<sup>77</sup>

The amateurs issued charges of their own. They claimed that the navy relied on antiquated apparatus and that most naval operators were incompetent. The amateurs believed that they were becoming scapegoats for the navy's internal problems. To illustrate that the navy was slow to update its equipment, amateur operators made comparisons between the performance of amateur and commercial apparatus and that of the navy equipment. Demanded one amateur, "Why can the majority of amateurs in Washington, D.C. pick up messages from longer distances than the naval station, which is equipped with an aerial five to ten times larger than theirs? . . . Why do the majority of amateurs here get long distance signals louder than the government station?"<sup>78</sup> The answer, the amateurs charged, was that the navy's equipment consisted of "non-receivers"—outdated transmitters of insufficient power—and that naval apparatus had only the crudest form of tuning.

The amateurs were also quick to point out that navy operators were amateurs themselves, who were often very slow and were unfamiliar with both the wireless code and the apparatus. While many of the amateurs had been transmitting as well as tinkering with their own apparatus for years, and then had trained for five years to become first-class commercial operators, naval operators only went through a two-month training course before manning a wireless station. (Prior to 1912, the training period for naval operators was often less than two months.)<sup>79</sup> John Purssell, a Washington, D.C., amateur, sent his account of a navy operator's ineptitude to *Scientific American*. One evening Purssell was

listening to communication between Baltimore and the Washington Navy Yard. Purssell had received Baltimore's message without any difficulty.

After some time the navy operator said "Please go ahead a little slower," and Baltimore thereupon repeated the message slowly in perfect Continental. The navy yard then got part of it, but asked him to repeat a portion of the middle. This time the navy operator got a word or two more, but had to have the message four times before he got it all. . . . On another occasion the navy operator at Norfolk, after trying several times to get a message through to Washington at a rate of about five words per minute, gave up in disgust, and said: "For the love of Mike, get an operator."<sup>80</sup>

Purssell alleged that the naval stations operated at an average speed of twelve words a minute, a rate Marconi had established at the turn of the century. Another *Scientific American* reader wrote to the editor to corroborate the claim that naval operators used the amateurs as scapegoats: "Whenever an operator in one of the government stations has any difficulty with his apparatus, or misses out on a message through his own inability, a very simple and efficient excuse is, 'Couldn't get a thing through the amateurs.'"<sup>81</sup>

Finally, the amateurs, who often eavesdropped on "official" messages, challenged the navy's assertion that it should have automatic priority in the air. The amateurs charged that many of the government's messages were no more urgent or weighty than anyone else's. Francis Clay, NESCO's attorney, supported this charge with an example of his own. His clients were trying to transmit crucial information concerning an important lawsuit involving a considerable sum of money. When the operator sought to send the message, "he was held up and informed that the League Island Navy Yard was using the air in sending a message and that it had priority. It was afterward learned that the wife of an officer stationed at the League Island Navy Yard, who had gone downtown to do some shopping, had a message sent asking for her Mackintosh and rubbers. She feared that she would get wet, as a rainstorm was coming."<sup>82</sup>

The amateurs received some support in their complaints, which were not without merit. The wireless companies, which for years had been complaining about the ineptitude of naval operators, echoed the amateurs' criticisms. Since 1904, NESCO had been urging the navy to train its operators properly so they would stop damaging the apparatus and would send messages coherently to other operators. And, while the

press did not condone the amateurs' mischief, it did not consider the navy to be blameless. *Electrical World* described, for example, how "some high school boys . . . threw the Newport naval wireless station into a succession of fits with an old Morse key, a broken incandescent lamp and a few batteries." These youngsters, continued the journal, "gave incidentally a valuable demonstration of the need of improvement, to which we trust the Navy Department will give due heed. If such rudimentary equipment accomplished so considerable a disturbance, what would happen if a hostile fleet went deliberately to work with powerful and skillfully devised apparatus? . . . The Navy system as now used could be hopelessly tangled up, without going to much trouble."<sup>83</sup>

Corroboration of these criticisms came from within the navy itself. In 1911 and early 1912, Lieutenant Stanford C. Hooper was assigned to observe the use of wireless during naval target practice and submit a report to the Navy Department. Hooper had many criticisms of the navy's failure to integrate wireless into its strategic operations, and the operators were not spared: "About one-third of the operators are not operators and delay the general business about one-half," reported Hooper. "The speedier operators often 'burn it in' a little too hard just to show off, now and then, causing needless repetition." He urged that the operators master the Continental code and increase their transmission speed from their current ten to eighteen words per minute, noting that the navy's standard was about half that of commercial operations. Hooper blamed this low standard on insufficient training, lenient examinations, slowness in weeding out inept operators, and the great disparity between naval and commercial operators' salaries. Hooper, turning the navy's complaints back on the navy, warned the department: "The wireless is running away from us in certain regards. Three times during the past week have I heard the commercial stations legitimately complaining about the fleet's interference."<sup>84</sup> Hooper could not believe that the navy had not yet adopted cipher, especially given the lack of secrecy in wireless transmissions and the ability of any youngster to send messages claiming he was an admiral. He also acknowledged that the national security argument, which claimed that naval messages should have priority because they were official messages, was a fig leaf covering naval misuse of the invention. Hooper later recalled that officers exerted little control over wireless and, thus, that each operator was free "to send whatever he pleased. . . . There were more personal than official messages and more operator conversation than messages."<sup>85</sup>

The amateurs could not accept the navy suddenly stepping in and claiming the airwaves for itself in the name of national security when the

navy had done little to ensure that wireless would help preserve that security. According to the amateurs, several intermediate steps, such as adopting cipher, improving the quality and power of the apparatus, training the operators, and developing tuning, should be taken by the navy before it asked for regulatory measures to ban individuals from the air. But the navy did not base its claim on its contributions to or investments in wireless. Rather, the navy argued for priority on the basis of its assigned role as a defender of American society. The amateurs, on the other hand, asserted that they had as much, if not more, right to explore the ether because they had worked and experimented to earn that right. The ether was a national resource, they argued, a newly discovered environment, and the amateurs considered that their enthusiasm and technical spadework entitled them to a sizable portion of the territory. Much as nineteenth-century pioneers had obtained squatters' rights by cultivating the property on which they settled, the amateurs had developed a proprietary attitude toward the airwaves they had been working in for the past five years. There were a few outlaws in the group, but their alleged violations should not mean, argued the amateurs, that all individual operators were to be excluded by the government.

THE EMERGENCE OF this grass-roots network of boys and young men marks the introduction of yet another way of using and thinking about wireless and the ether which contributed to the social construction of broadcasting. To the amateurs, the ether was neither the rightful province of the military nor a resource a private firm could appropriate and monopolize. The ether was, instead, an exciting new frontier in which men and boys could congregate, compete, test their mettle, and be privy to a range of new information. Social order and social control were defied. In this realm the individual voice did not have to defer to the authority of business or the state. This realm, argued the amateurs, did not belong to hierarchical bureaucracies: it belonged to "the people." Thinking about the ether in this way, and acting on such ideas on a daily basis, was a critical step in the transformation of wireless into radio broadcasting.

As their battle with the navy intensified between 1910 and 1912, the amateurs and their spokesmen relied increasingly on democratic rhetoric that described the air as being free and the property of the people, for whom the amateurs tried to suggest they were the proper surrogates. But the amateurs ignored the fact that the spectrum was a common property resource with boundaries both around and within it. As over-

population and overuse of this resource intensified, its value to all users diminished, but at the time, no standards existed for allocating property rights in the "folds of the night." The enthusiasm with which legions of amateurs took to the air alerted some in the government to the fact that such standards would have to be established soon. The nation would have to come to terms with the question "Who owns the airwaves?"