

The Race for Wireless

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If you had been afloat in this town, with scarcely a dollar in your clothes, not knowing where the next meal was coming from, in daily contact with hard-headed businessmen, the leaders of American finance – with the idol of your life's ambition in jeopardy of being lost, thru this damnable delay and argument – then you, too, perhaps, would begin to realize that this is not the inventor's world; that things to us are not as we would like to hear them, but as they are.¹

*The Significance of Marconi
De Forest's Early Career
The Search for a Better Detector
The Wireless Business
A Silent Film Industry Emerges*

The early inventing life of Lee de Forest can be viewed as a prelude to his final invention of significance, his version of the talkies, the 1920s Phonofilm. His post-Yale years and his early wireless inventions will show a pattern of a man who is interested in communication systems using electricity. While at Yale, he learned about the theories of James Clerk Maxwell and how Heinrich Hertz turned those theories into practical applications when he sent a spark across the room and received it using a crude detector. At Yale he was a curious student, embellishing his lecture notes with ideas, questions, and diagrams, as he begins to understand the scientific world to which he now belongs. He has graduated and he is on his way to what will turn out to be a complicated life as a wireless inventor. In this endeavor, de Forest follows Marconi and attempts to build a better system.

De Forest had his motivations for his inventions, and often said that he was inventing for the public good, not just for personal profit, but perhaps he also had an economist's understanding that making a profit can only happen by satisfying public demand. Having just completed the electricity and physics curriculum at Yale, he ponders two-way communication, starting with the embryonic wireless of the spark gap and coherer. In the first years of the new century he will quickly establish himself as a leader in the invention and marketing of wireless systems. His technology and

the company formed to sell it are initially successful, but soon he will get into legal and financial trouble. He will discover that he has been betrayed by unsavory business colleagues, and he will end up penniless and accused of unethical business conduct. After this experience, he will quickly tire of coded messages and turn to devices for sending musical entertainment into homes and movie theaters.

The Significance of Marconi

As Lee de Forest was beginning his graduate work at Yale Sheffield Scientific School, another individual, who was 1 year younger, was already learning about Hertz and conducting his own experiments in wireless. He was the Italian, Guglielmo Marconi. Within a few years, de Forest and Marconi will be fighting it out, in the newspapers and in the courts, and in the contract negotiations for the wireless business of the US Navy.

It was said by Marconi during the early development of the wireless telegraph that a major purpose for such a system was the safety of ships at sea. Marconi was a yachtsman, and well understood that the current visual signaling systems did not work beyond the ability to see them. Any combination of flashing lights or semaphore flags that depended upon the weather were wholly impractical. As a business person, Marconi reasoned that if the commercial ships that were sailing in intercontinental waters with perishable food and dry goods could always be in touch with each other and shore stations along the way, they would be able to signal if there was bad weather or worse. He realized that by using such a system their cargo could be kept track of, thus insuring a more efficient business. Marconi viewed two-way wireless communication as a way to aid the safety and efficiency of commerce using ships at sea. He also believed that by using the dots and dashes of Morse code, the transactions of commerce would remain largely private.

Marconi was 1 year younger than Lee de Forest. Born in Italy in 1874, he was the son of an Italian father and Irish mother. His family had both wealth and friends in high places. His education was in private schools: "Even as a boy he took a keen interest in physical and electrical science and studied the works of Maxwell, Hertz, Righi, Lodge and others."² Marconi was early in wireless telegraphy, and the evidence suggests that he also saw early the possibility of it as a business. First, he replicates and improves upon the previous work of Hertz, and by 1895 he is able to send signals as far as a mile and a half. This was significantly farther than Hertz. In those early years, wireless was unproven and unheard of save for a few scientists. Hertz had conducted his famous experiments based on Maxwell's theory of electromagnetism, Oliver Lodge had added improvements, and it was

Figure 2.1 Guglielmo Marconi, from a series of 25 early twentieth century cigarette cards, one included in each pack. The series was called “Wireless Telegraphy” and it was sponsored by Lambert and Butler Cigarettes, Great Britain. From the Bart Lee collection.



this work on which Marconi built. Hertz and Lodge were academics while Marconi was the curious and bright son of a merchant who saw the possibility of wireless leading to a business of his own. In his native Italy, he had studied informally with the scientist Augusto Righi, who upon the death of Hertz in 1894 had written a newspaper obituary including the details of the Hertz's wireless experiments. It was from Righi that young Marconi learned about the principles of wireless communications (Fig. 2.1).

In the beginning, Marconi was unable to interest his own countries' government in his work causing him to try his luck in England. It is believed that he may not have been ultimately successful without the social and financial connections of his mother Anne. It was she who apparently opened doors for young Guglielmo, allowing him access to highly placed officials such as Director Preece of the British Post Office, his patent attorneys, and anyone else who could elevate his ideas and get them noticed. Shortly after that he established a company and set up regular communication between England and France, transmitting and receiving across the Channel. For his première before Preece he uses a spark similar to the one he had observed in Righi's lab, and for the detector/receiver he uses a modification of Branley's coherer. Historian Aitken said this of Marconi the inventor: “The original acts of creative insight were seldom his. Where he excelled was in the indispensable process of critical revision.”³

In his early experiments, Marconi used the Hertzian system of short dipole antennas, and while he did not realize it at the time, this system radiated at very high frequencies, causing signals to weaken after very short distances. His early wavelength was decades ahead of its practical use, and later it would be known as VHF or Very High Frequency. It was limited to line of sight and was not viable for long distance communications. Marconi began to experiment with antennas, at the time unknowingly moving his wireless signals down to lower frequencies where they could travel farther by following the curvature of the earth or reflect off of the ionosphere. Only then would his system become viable for early radio communication. Using the trial and error of inventing he discovered that long distance transmissions worked best if a long wire antenna and a wire buried in the earth were used as both the transmitter and the receiver. Thus begins experiments that will finally move beyond those of Hertz and toward a patentable system for Marconi, one unique enough to be sustained in a court challenge. The famous number “7777” series of British patents by Marconi, granted in April 1900, covered “tuning” and “Improvements to wireless telegraphy,” and they were also filed as an American patent, 763,772, issued in 1904.⁴

Now that patent protection is in place, Marconi’s next step is to set up stations on ships and shore. Commenting on his antenna revelations in his 1909 Nobel Prize speech, he told how he, “began to examine the relation between the distance at which the transmitter could effect the receiver and the elevation of the capacity areas above the earth, and I very soon definitely ascertained that the higher the wires of the capacity areas, the greater the distance over which it was possible to telegraph.”⁵ The issue of distance is one that haunts the memory of Marconi today. His major claim is that in December 1901 he sent the coded letter “S” or dit dit dit, from Poldhu, England to St. John’s Newfoundland in Canada, a distance of 2,100 miles. This received a great deal of press coverage and it was likely the first time that many citizens heard of communication without connecting wires. But the question that is asked 100 years later is this: Did Marconi in December of 1901 really receive in Newfoundland the message sent from England, or was it just random noise? This does not take away from his verifiable accomplishments and his obvious influence; but this very long distance early transmission could not be repeated for 7 years after 1901. Wireless historian Bart Lee writes, “It is, however, not at all clear, even now, how Marconi’s spark signals managed to get across the Atlantic, from Cornwall in England (at Poldhu on the Lizard Peninsula) to St. John’s in Newfoundland, more than 1,800 nautical miles, in the middle of the day.”⁶ Even today, the broadcasts of the most powerful short wave transmitters in the world are essentially deaf in the afternoon using the best possible receivers in optimum

locations. Lee suggests that the perfect propagation factors (no sunspots, no other stations on the air, an improved mercury coherer detector, minimal atmospheric interference) may have been in place such that the signal did bounce off the ionosphere and did reach Newfoundland, ideal conditions for early wireless. It would be difficult today to attempt to replicate the 1901 experiment because the radio frequencies used are overcrowded and there exists much more interference. Nonetheless, British and Canadian experimenters did achieve a successful midday medium frequency transatlantic crossing in 2006, leading to a further understanding of the technology during Marconi's time and the propagation conditions he enjoyed.⁷

In later years, Marconi received many accolades for his work, including honorary doctorates from several universities, and the Nobel Prize for Physics, which in 1909 he shared with Professor Karl Braun. "He was named a Senatore in the Italian Senate and appointed Honorary Knight Grand Cross of the Royal Victorian Order in England. He received the hereditary title of Marchese in 1929."⁸ In the end, Aitken best sums up the significance of the first wireless pioneer: "What differentiated Marconi from his contemporary rivals was not his scientific knowledge, nor, initially, the distinctive excellence of his technology. It was his sense of the market, of where a demand for this new technology existed or could be created. A creative genius in electronic engineering Marconi could have been; but he was also a commercial entrepreneur."⁹ But another new wireless inventor, Lee de Forest, has also heard of the successes of Marconi and is preparing to compete fiercely with him in inventing and in business. There will be a decade or more of intense rivalry between the de Forest and Marconi's interests, in the beginning over competing wireless systems, and later over a little-known but upcoming detector of wireless called the Fleming Valve. Marconi has licensed this device as a detector of code and the litigation-strewn revolution that leads to modern day electronics begins.

De Forest's Early Career

After graduation and before entering the job market as a newly minted Ph.D., Lee de Forest takes a side trip to Iowa to visit an old childhood girlfriend named Jessica Wallace. They had corresponded by letter while he was in college. He did spend time with her in Iowa in what appears to be a traditional and proper courtship, and this relationship marks the beginning of a pattern that he would follow many more times: She sings to him and he reads poetry to her. In his domestic future, three of the four de Forest wives were singers. With Jessica his intentions are obvious, and

during an evening on the lake he is moved to write, “It was an hour never to be forgotten: for we were one and infinitely happy; the light of love in our eyes grew with the dawning light of the moon, as the orb of our love and our happiness ascended.”¹⁰ This was obviously a summer romance, one of those moments in life that burns brightly and passionately, but burns out quickly. He is disappointed when the romance fails, but as is his custom, he is moved to write one of the hundreds of poems he will write throughout his life. This is a short, succinct, and sad poem about the end of love:

There is a flower that blooms once only,
When faded dies forever;
A bird which startled ne’er returns to its nest;
A tide which ebbing never more flows;
A star, which, falling, gleams no more – And my Love

De Forest recovers from this lost love as he will many more times in his life. The important task now is to begin the central purpose that Lee de Forest, Yale doctor of science, plans as his life’s work. It is the invention of a better wireless system and he is in a hurry to enter this new game. Following the successful experiments of Hertz, and the wireless system and business created by Marconi, de Forest now wonders where he will find his place in the new industry. He is fully aware of all of the ideas of the turn of the century inventors and he wants to be a part of it. He recalls that while a Yale student during the year Marconi’s first wireless patent was issued in England, he reads an article by Sir William Crookes titled, “Some Possibilities in Electricity,” and he remembers how it spoke to him about the possibilities of wireless: “Any two friends living within the radius of sensitivity of their receiving instruments, having first decided on their special wavelength and attuned their respective receiving instruments to mutual receptivity, could thus communicate as long and as often as they wished by timing the impulses to produce long and short intervals on the ordinary Morse code.”¹¹ This was wireless communication as described in 1896 by the scientist Crookes, a seemingly limitless view of its use a few years before the public would be introduced to its possibilities.

De Forest as Employee

The new college graduate needs a job. It is 1899 and de Forest’s first employer after his doctorate is Western Electric in Chicago where he is hired to wire telephone switchboards. It is an entry level position that will not offer the young inventor any challenge. But he is noticed, and eventually he does get promoted, and it is in this lab that he is able to work on his inventions during his nonworking hours. At least he is working in the

telephone business and he begins to see new uses for that humble device: "What finer task than to transfer the sound of a voice of song to one a 1,000-miles away. If I could do that tonight!"¹² Later in his career, he will make this come true, first with a wireless radio version of the telephone, and second, by inventing an amplifier that improves the wired telephone. More than clairvoyant, this is de Forest the dreamer, the romantic, a side to him opposite that of the scientist. He is the humanist who sees poetry and music where others like Marconi see only dots and dashes and dollars. De Forest in 1899 imagines the transmission of music as a use for what all others believe is only a serious two-way communication device, in this instance the telephone.

It was while working for Western Electric in Chicago that de Forest rediscovers his interest in classical music, a passion and a diversion that will become an important part of his life and have a great deal of influence over his inventing. In a few years, he will imagine the radiotelephone as the perfect vehicle for the dissemination of his favorite music: "Beauties that are unknown to thought, to words or eye, hover invisibly in the air and kindle the soul through the avenue of sound. It is the dearest culture in all the world."¹³ De Forest also embraces opera, a genre that will prove to be his favorite. In the life of de Forest, there are several constants: one of these is that he did little for relaxation other than attend events of serious music and opera. He is a music lover, it is his art, and using his inventions he will succeed early in the presentation of several forms of entertainment art to new audiences.

He has a position but he is already becoming restless. While he would rather spend all of his time as an inventor, he has to earn a living. He is working in a field related to electricity, but at this early stage of his career he will not have the luxury of inventing full time. In his spare time, he visits the library and reads the scientific journals of the day, mostly those in the areas of physics, wireless telegraphy, detectors of wireless, even the radiotelephone. He reads that a professor Aschinnass has found a new detector of Hertzian waves that could replace the Branley Coherer. It was described as "the use of a thin piece of tin foil laid upon a plate of glass and cut in two with a razor. When a battery was connected across the terminals and a drop of water or alcohol placed over he gap he could hear in a telephone receiver in the circuit a weak ripping sound when a spark generator excited electric waves in the vicinity."¹⁴ From his research de Forest realizes that, "what wireless telegraphy required was a self-restoring detector which would permit the operator to hear in the headphones the sound, as it were, of the transmitter spark."¹⁵ He named his detector the "responder," as in responding to the dots and dashes of the spark transmitter. He believes his detector will be better than that of Marconi's coherer.

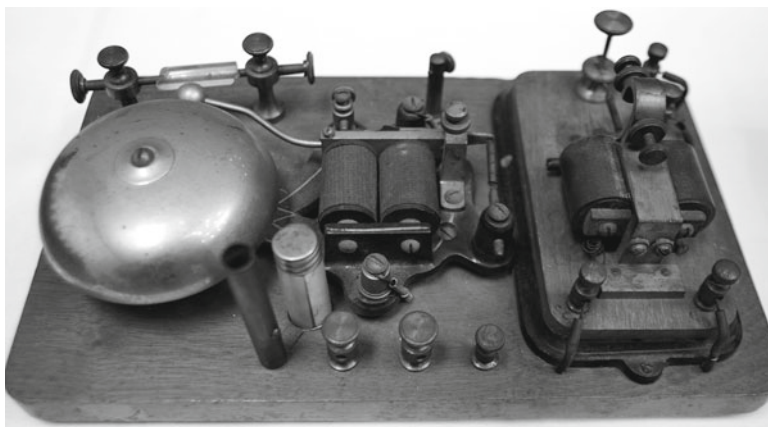


Figure 2.2 An early coherer detector. In the *upper left* hand corner, above the bell, is the small tube containing the conducting filings. When a signal is received, the bell rings and its tapper also causes the tube to de-cohere and thus break the circuit, making it ready for the next dot or dash. This device was very slow and undependable. From the author's photo taken at the Antique Wireless Association annual conference.

This was de Forest's early exploration into the liquid detector, and it was this idea that he began to adapt as his "responder." His new device allowed "listening" to the sounds of code on a telephone-like earphone similar to the sounder of the wired telegraph. While at Yale, he duplicated Marconi's experiment using the Branley Coherer and found it slow and clumsy. The coherer was a tube of iron filings in series with a battery that responded mechanically to the presence of wireless signals, which caused the filings to "cohere" and complete a circuit to ring a buzzer. He calls his liquid detector an "anticoherer" saying that its advantage is the faster reception of messages. In the existing wireless systems, it was the coherer detector that slowed everything down to a maximum of ten words per minute. It was also while working at Western Electric that he met and became friends with Edward Smythe, who according to de Forest was not knowledgeable in wireless science, but was willing to learn: "Ed Smythe now proved himself to be a practical, modern electrically minded engineer. He was swift to grasp the significance of my experiments, watched my work with interest, discussed the problems with me, and occasionally contributed helpful practical criticism and advice."¹⁶ Smythe would remain with de Forest for several years as a trusted laboratory assistant (Fig. 2.2).

In less than a year, he left Western Electric for what proved to be a temporary position in Milwaukee with a Professor Johnson, an inventor who

apparently shared de Forest's interest in developing a better wireless detector. Johnson's device proved to be a variation of the coherer, and almost immediately de Forest realized it was a step backward. He used his time in Milwaukee to continue work on his own invention of the responder, but when Johnson saw how much better the de Forest device was than his own, he claimed that he should own it since de Forest was working for him. De Forest was fired when he refused, and he returned to Chicago. This begins the era of the odd job and the struggle for money. First, he worked as an assistant editor for *Western Electrician*, where he translated French science texts, but it was a job that allowed him access to the scientific writing of the day. As a trade out for lab space, he teaches technical and electrical skills part time at the Armour Institute. He is following the path of most college graduates, taking any part time job just to survive, all while believing that a future inventing career awaits. More important, he is also discovering that his future cannot be one of working for and gradual advancement in a large company. He already knows he will be a lone inventor, an independent who avoids the secure position in order that he might have the time and freedom to invent, "twice have I renounced good and fairly promising positions for my faith in an idea and in myself."¹⁷

But this life of part time jobs and part time inventing is not without its problems. As de Forest begins to take stock of his life, at age 28 he sees himself aging, and he knows he has just enough money to pay the rent. And worse, because he has to have a part time job he cannot devote 100% of his time to inventing, and he cannot afford to buy the type of equipment needed to fully stock a real laboratory. This is his time for the reflections of the young, to consider those personal characteristics he sees in himself, like those of industry, diligence, courage and optimism, but as he reads about the wireless experiments of Marconi, he now sees this moment, in 1900, as the time to step up and take a chance. If he is going to be an inventor, he had better invent! It sounds good, but in the real life of Lee de Forest, "the clothes are tattered, the shoes run down, the meal ticket punched out."¹⁸

The Search for a Better Detector

The development, patenting, and the marketing of inventions will require money. Lee de Forest knows that before he can attract the capital with which to establish a wireless telegraph business, first he will have to solve the problem of the detector. He has identified the detector or receiver of wireless as the weakest part of the Marconi system. For months he has

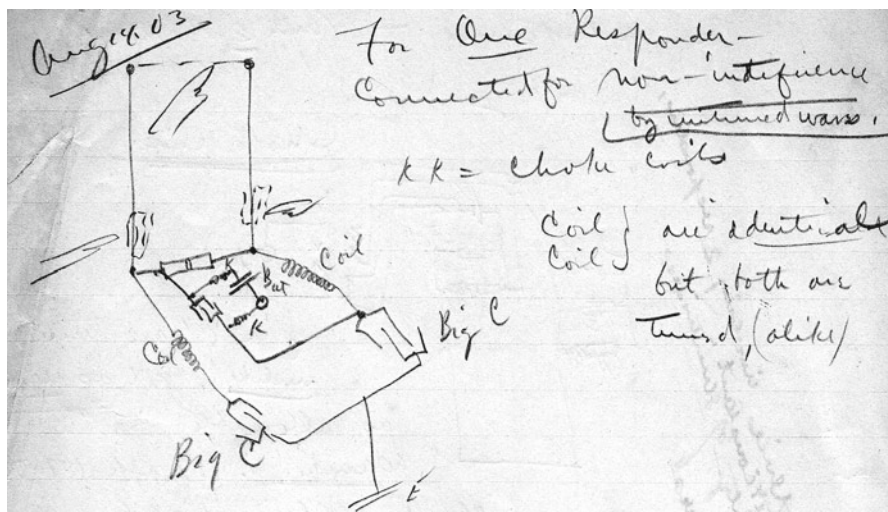


Figure 2.3 A 1903 schematic drawing of one of the many iterations of the de Forest detector, the “responder.” On this he notes: “for one responder connected for noninterference by un-tuned waves.” From the Perham de Forest papers, History San Jose.

worked part time on his responder while working full and part time jobs, but now he has to make some big decisions: Will he continue to work for others and allow them to profit from his ideas? Or does he work just enough to eat and pay the rent, giving him more time for his work? Or might he find a way to spend all his time on the wireless? The urgent question is, will he allow Marconi and other to pass him by? The answers are obvious: “Time is short. Marconi is headed towards America with his wireless detector and I alone can pilot this weather-beaten craft. If I cannot meet him next Spring, it may as well sink now. And if it sink, I sink deeply with it.”¹⁹ There is a race for wireless on the horizon and it will be between de Forest and Marconi, and at this point Marconi had clearly heard of de Forest. Before he finalizes a wireless system, he needs to spend more laboratory time experimenting with the two types of receiving apparatus that he has been thinking and reading about, a liquid detector and a flame detector (Fig. 2.3).

Records kept of the de Forest–Smythe detector experiments in 1900 show the very slow process of invention: “Even for long dots the signal sounded uneven and jagged, dashes would have been more uneven. At the receiving end, imperfectly to jiggled, but better than the day before. The spark was generally a straight bolt, not bunches, although these generally

accompanied this center spark a spray of fine ragged ones of small volume. The decohering engine worked poorly, either too fast or not at all.”²⁰ This description of a failed experiment is a day that some would consider wasted, but it is the scientific method of trial and error, and if the results are accurately written down the same mistakes will not be made again. Two days later another experiment did yield more information, and de Forest wrote, “With the coherer care must be taken not to get the end electrodes too near the edges of the other two, thus enough space must be left. This coherer is more sensitive when the aerial and ground lead to the pair of electrodes nearest each other and the battery to the other pair.”²¹ As one of the first wireless inventors, de Forest was working in an area with little previous information available. He was discovering new information.

De Forest is also experimenting with an open flame as a detector, writing in his notes, “In developing a hypothesis to fit the observed effect of the inductance coil discharge on the Welsbach light it was suggested that effect was due to an electrification and consequent expansion of the gasses of the flame.”²² Eventually the flame would prove to be useless as a detector, but only after repeated experiments: “If it should be found true that an electrification of a volume of gas causes expansion, a detector for transmitted impulses might consist of a volume of gas confined and provided with a sensitive instrument adapted by indicating slight changes in pressure.”²³ Early he is given some hope because the flame appeared to be affected by a spark produced in the same room, but after more experimentation it was found that the flame reacted only because the sound wave from the noise of the spark disturbed the air, thus causing the tiny flicker of the flame. It was not the spark’s electromagnetic waves itself but the spark’s acoustic effect that was causing the response: “On the evening of September 19, 1900 experiments were made to determine the manner in which the operation of the induction coil affects the light given off from a Welsbach burner, a phenomenon which had been first observed on the evening of September 10.”²⁴ The flame detector experiments were a failure.

At the same time he begins the systematic collection of information on the wireless work of other inventors. Sitting at his desk in Chicago, he writes on a single page the names of the inventors, a description of their work and the periodical in which it was published. This was his “index” to the collected wireless references that he would use to base his original patent applications.²⁵ De Forest the scholar knew that in order to invent a device that could be patented and stand up to patent challenges, he had to continuously survey the literature and make certain that his ideas were different enough to be legally original. In the beginning Marconi relied on the previous work of Hertz and Branley and Faraday and all those who

preceded him, just as de Forest was now doing. Like Marconi, de Forest is evaluating the previous wireless experiments of others, gathering information to create a unique and patentable solution for a wireless communication system.

In late 1900, along with W.W. Smythe, de Forest took out a patent for a detector, and called it “the Electrolytic Anti-Coherer.” Even though he believed that he had contributed the lion’s share of the science behind this invention, it was Smythe’s money that allowed it to happen, and thus de Forest agreed to the shared patent credit. By 1901, he writes of the results of a successful experiment using a spark transmitter consisting of an oil-insulated induction coil creating a spark of $\frac{1}{2}$ to $\frac{5}{8}$ th of an inch. The receiver this time was an improved de Forest Responder, described as “three responders of the tin filings discharge glycerin type connected in series.”²⁶ He writes that there was rain and thunder, and that it took a while to separate the false signals and interference from the transmitted signals less than a mile away. Finally, the received signals were regular and could be detected: “The sound in the telephone receiver was comparatively loud and of excellent quality.”²⁷ This early detector, the de Forest/Smythe responder, had already proved to be better than the slow coherer. Other detector inventors would strongly agree about the shortcomings of the coherer, among them another wireless competitor, Reginald Fessenden: “It is a question whether the invention of the coherer has not been on the whole a misfortune as tending to lead the development of the art astray into impractical and futile lines and thereby retarding the development of a really practical system.”²⁸ In a few years, Fessenden will accuse de Forest of patent infringement over his detector.

It would not be long before the de Forest wireless system was ready to compete with that of Marconi. As the testing continued, de Forest seemed to be taking another measure of his situation, “Oh, the loneliness, the difficulties of these days. I have no place to work. No facilities. And I have to earn my food. Smythe’s aid is and has been small enough for a task of this magnitude, an invention of this scope and difficulty. I am dwelling in a new realm. All in the dark. No precedents. No theory to guide. No apparatus. No co-workers. All things to be tried and tested. Thus, under such encouraging auspices and with such magnificent support, I began to lay the slow and tedious foundations of a lengthy and most difficult research.”²⁹

The first long distance test conducted by de Forest and Smythe using the improved responder was the transmission of the letter “H” or four dots. This test will be the prelude to that first contest between the de Forest and Marconi systems, one that would pit Marconi and his coherer against de Forest and his responder. Before that contest could take place, there was a

final test on Lake Michigan using a boat equipped with a spark transmitter sending to de Forest who was stationed on shore with his detector and earphone. The Chicago newspapers in 1901 carried stories of this test and for the first time de Forest receives public notice of his work. Based on this favorable press attention, there began to be interest in turning experiment into practice. His first wireless company was formed, and it included Smythe and another assistant and Western Electric colleague Freeman, and money from a Mr. Seidler. The American Wireless Telegraph Company was thus incorporated, and by August 1901 he and his assistants had brought their wireless technology to New York for the International Yacht Races. It will be the first bout of Marconi v. de Forest.³⁰

This is an important and early public trial run of wireless in America. Marconi equipment will cover the race for the Associated Press and de Forest arranges to cover it for the Publisher's Press Association, competing wire services that provide stories for newspapers. Both ships are wireless equipped with their respective systems with the goal to send up-to-date race results to two shore stations. What really happened on the day of the race was a never before phenomenon: interference! The Marconi and de Forest spark signals were so powerful that they canceled out each other, resulting in neither system working to report the races. In the beginning of wireless communication there were few to no wireless signals on the air, and because the transmitters were broadband and the concept of tuning was not fully developed, every receiver responded to every nearby transmitter. Nevertheless, the papers of the day had stories of how the race was reported by wireless, but in truth it was really by old-fashioned semaphore flags, the original method of signaling without wires!³¹

The American Wireless Telegraph Company did not survive and again de Forest is out of money. He writes to a family friend about borrowing \$100 from a friend of his mother's: "If you had been afloat in this town, with scarcely a dollar in your clothes, not knowing where the next meal was coming from, in daily contact with hard-headed businessmen, the leaders of American finance – with the idol of your life's ambition in jeopardy of being lost, thru this damnable delay and argument – then you, too, perhaps, would begin to realize that this is not the inventor's world; that things to us are not as we would like to hear them, but as they are."³² This first company did not last, but as a wireless inventor Lee de Forest had entered the business early, at least 2 years before it would begin to be profitable. More inventing and improving the pieces of the wireless system would have to happen before this communications technology would be viable enough to attract capital and support a business – and Lee de Forest.

De Forest, the Inventor Arrives

Lee de Forest is inventing. He reads articles about electricity and writes ideas in his notebooks. He begins to better understand and clarify the operation of his system, and this time he is working on a better version of the spark transmitter: “the Hertzian wave train consists of millions of varying frequencies, they decrease for a time and then increase. It must be the spark gap which is to blame for this imperfect attainment.” His solution: “use the spark merely to discharge a periodically two plates, without self-inductance.”³³ He continues to study the writings of previous scientists, who like him were learning about all things electrical. Articles like “Influence of Electrification on the Electrical Spark” seemed to guide him as he studied and made notes on the pages.³⁴ A 1902 *Electrical Review* article, “The Poulsen Wireless Telegraph Station at Cullercoats, England” interested him in the Poulsen arc, but as a transmitter of code as opposed to his later use of it as the basis for the radiotelephone. He underlined explanations about the wave lengths employed, the coupling to the antenna, and the use of the hot wire ammeter “When the arc is burning, the reading of this instrument is steady at nearly 10 amp.”³⁵ In the margin next to this, de Forest wrote in large letters “10 amp” and underlined it. This is the scientist at work (Fig. 2.4).

By now the coherer had been disgraced and nearly abandoned, and other systems were actively being explored. One is based on Sir Oliver Lodge’s invention of a steel wire against a metal surface called, “A Telephonic Detector of Hertz Waves.”³⁶ This was described as, “a coherer consisting of steel needles resting on carbon blocks.” How it works is especially important to de Forest as he collects ideas, “A telephone could be used in connection with it to detect the transient influence of the Hertz wave.”³⁷ The presence of a signal caused a buzzing in the telephone receiver, a device using coils surrounding a permanent magnet, so the current passing through the coils would vibrate the diaphragm, resulting in the buzzing. He has underlined the advantages of using such a telephone-based audible “coherer.” In a drawing by de Forest dated May 19, 1902, he shows a coherer based on a carbon pencil, steel wires, and electromagnet, possibly based on the Lodge device. “When coherence occurs magnet is energized, the two steel wires are thereby jarred slightly, and de-coherence results.”³⁸ This device is also slightly similar to the 1898 Telegraphone wire recorder device of Poulsen (Fig. 2.5).

So, while the wireless transmitter of the new century remains a spark across a gap, it was the receiver, the detector, that is getting most of the interest, with the goal a more accurate and faster system. And while de Forest was experimenting on improving the pieces of his system, rival

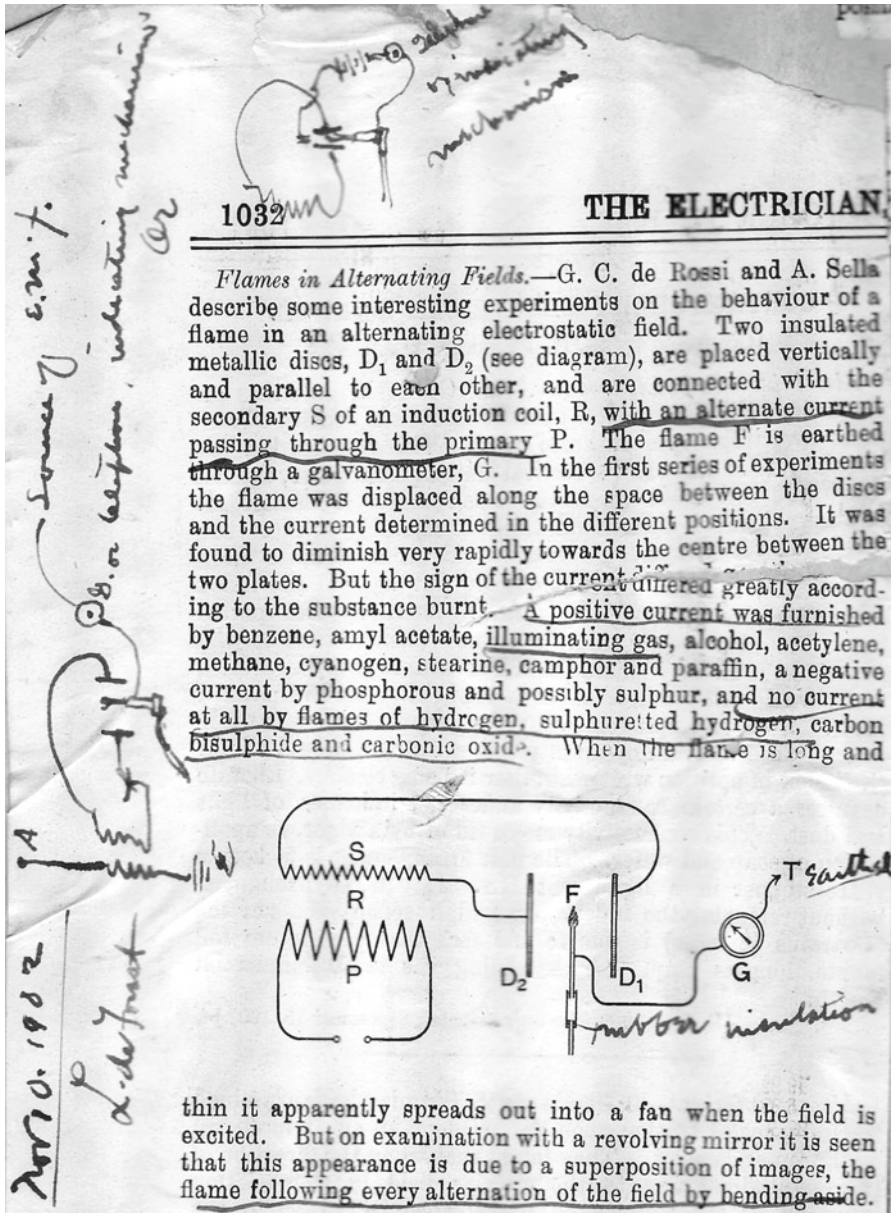
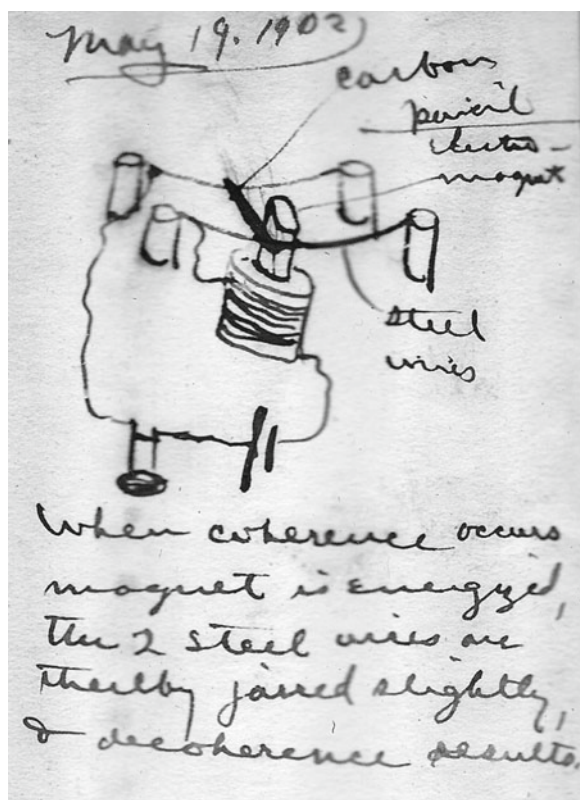


Figure 2.4 de Forest as the scholar. In his papers are many examples of what today is called a "literature search," or reading all that is known about a topic. In this page from a 1902 periodical, *The Electrician*, de Forest has made many notes on an article, "flames in alternating fields," and in the left margin he has drawn a diagram of a flame as a detector. From the Perham de Forest papers, History San Jose.

Figure 2.5 A drawing, dated 1902, by de Forest of a carbon detector, perhaps inspired by Sir Oliver Lodge. It may possibly be a variation of Marconi's Magnetic Detector. Both of these devices may be based on the 1898 telegraphone wire recorder device of Valdemar Poulsen. From the Perham de Forest papers, History San Jose.



Marconi would channel his experimentation toward higher and higher powered transmitters, longer antennas, but still using the spark.

The Wireless Business

“Those who once enter this work, on whom the enticing spell of the wireless once falls, never quit it, no matter what the demands on patience or how great the sacrifices, always hopeful, always in effort, fascinated forever.”³⁹ Even though de Forest was poor and had essentially followed the lone inventor's promise of poverty, in order to get his wireless system in shape for the next yacht race, he will need money. At the end of 1901, de Forest moves his tiny wireless operation from Chicago to New York, leaving behind Smythe and his other Western Electric colleagues. He is still hoping that there will be someone who believes in his work and will invest hoping to gain in a future when wireless will be an important and reliable



Figure 2.6 Lee de Forest, seated at the operating position of his wireless telegraph with Abraham White, standing, right. This may have been taken at the de Forest exhibit at the 1904 St Louis World's Fair. From the Perham de Forest papers, History San Jose.

communications technology. The event that would stimulate investor's interest was Marconi's first transcontinental wireless message in December 1901. De Forest will benefit from it and interest a group of capitalists to raise money to start a company around the de Forest wireless system. The following month, January 1902, de Forest was introduced to Abraham White, ironically known as "Honest Abe," who had been known for his success with stock gambles, and he offered to help de Forest. The American De Forest Wireless Telegraph Company was formed. De Forest said of White: "He readily saw the possibilities, the unusual opportunities for wealth, for which he was seeking. He undertook to aid me, realizing at once that a new and larger corporation would be essential."⁴⁰ Like many if not most of de Forest's associates in business and science, White would begin as the great savior but quickly move to the enemies list (Fig. 2.6).

Shortly after the company is formed he receives public notice in the form of positive press, a 1902 story in the Pittsburgh Press under the headline, "Wireless Telegraphy is not an Experiment." This is a time when very few know or even understand the wireless, but this reporter seems to get it

right based on an interview with its inventor: “Wireless telegraphy has been taken out of the realm of theory and experiment and made a profitable commercial possibility by the invention of Dr. Lee de Forest, an American inventor and a graduate of Yale, who has perfected the de Forest receiver, or ‘responder,’ which consists of a small glass tube, open at both ends and holding in its bore two small wires. Between the ends of these wires is placed a small amount of special paste, which ordinarily offers a passage for the local current. When the electrical wave from the sending machine traverses the responder, on its way from the upright wire to ground, it increases the resistance of this device, but its conductivity is automatically restored the instant the electrical wave has passed.”⁴¹ The story explains that a record was set with this technology of 52 words per minute: “This is by far the fastest speed yet attained by the wireless telegraph; being 5 times as rapid as is ordinarily attained by the Coherer system, such as Marconi commonly uses, which only has a speed of 10–12 words per minute.”⁴² There is also a small subtext in this story, one that appears in other articles of the time, and these are references to “de Forest the American Inventor.” Is it possibly a swipe by reporters at Marconi the foreigner?

By the end of 1902, the de Forest system had been the topic of more favorable press, resulting in tests completed by the largest potential buyer of wireless systems, the US Navy. The three systems tested were those of Marconi, Fessenden, and de Forest. In its report the Navy wrote, “The stations of both the Marconi and Fessenden systems were practically inoperative from the start, and the entire burden of the three fell to the de Forest system, which system, though handicapped by insufficient equipment, as well as by the adverse conditions prevalent in warfare, performed its work in so eminently successful a manner that General Greely personally congratulated the inventor in complementary terms, stating, ‘the de Forest system was the only one, of the three represented, fruitful of results, and therefore the only one of any benefit during the operations.’”⁴³ This is the prologue to commercial success for Lee de Forest and Abraham White.

This is also a period of delirium mixed with hope in the de Forest story. This is a time in the inventor’s life when it must seem as if there are no limits to what could be accomplished. Early in the century when wireless telegraph held for young people a certain excitement and the feeling of being in the right place at the right time, you might even believe that you were ahead of your time. The sending of messages from one city to another, and without wires, had to convince you that you were one of the special ones, and that maybe this period of technology would never be equaled in your lifetime. De Forest was clearly qualified to speak for all

wireless inventors, “It was the game, the fun, the unequalled satisfaction of traversing new lands, of overcoming strange new obstacles, of doing what no one else had done, that spurred them on. Wireless! Messages transmitted without wires, across cities, over waters wide and ever-widening!”⁴⁴ An obviously elated de Forest writes in 1902 of his success: “I am sitting in our little station here, telephone to my ear, awaiting a message from our tug boat lost somewhere on the broad waters of the Sound. Wherever it is I will soon hear its mysterious call speeding over waters and islands – invisible, bodiless – yet awakening responses in this tiny tube which rests on this case before me and always listens. It is a marvelous thing, this etheric language, and when not too much engrossed in the mechanics and business of it all, my mind is lost in admiration of its infinite mystery.”⁴⁵ Who else but de Forest could add this level of romance and drama to the wireless experience, who better than he could mix science and prose in that way? When he writes about the “tiny tube” it is not yet the Audion to which he refers, but his liquid detector, now called the “spade electrode” detector. As it turns out, it was not de Forest’s according to the courts, and in a long-running patent infringement suit, its provenance would be awarded to Reginald Fessenden.

De Forest Makes New Enemies

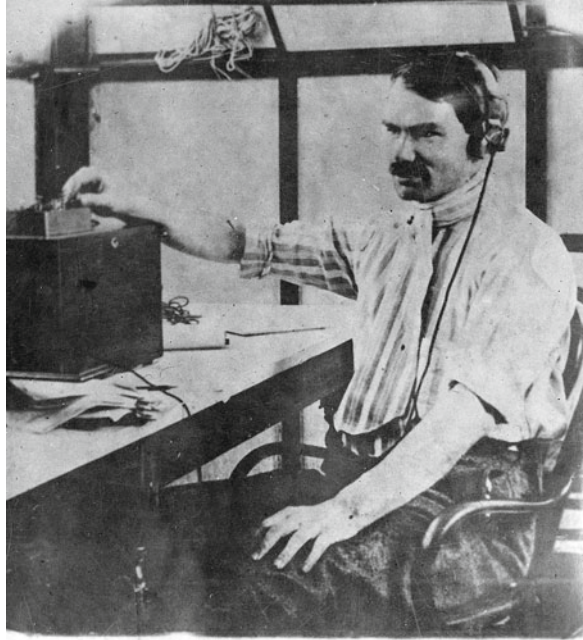
The story of de Forest and Fessenden and the Liquid Barretter detector begins with de Forest’s visit to the Fessenden lab and a meeting with Fessenden assistant, Dr. Frederick Vreeland. According to de Forest, “during that visit Vreeland confidentially informed me that he and not Professor Fessenden, was the inventor of this novel type of detector.”⁴⁶ Soon de Forest began to use the Fessenden/Vreeland principle for his own detector. Both of the inventors’ detectors were of similar design, and had been for several years, but the original impetus for it was said by de Forest to have come from an article in *Electrical World* written by Professor Michael Pupin. Before the lab visit of 1903, both inventors had been using for their noncoherer detectors electrodes in liquid in series with earphone and battery. De Forest had always insisted that he attempted to remake his own based on the unpatented idea of Pupin, with the goal to make it better while at the same time not infringing up the Fessenden patent. De Forest’s patent attorney had agreed and for his system’s receiving apparatus the responder was replaced by a “spade” detector, a Pupin and Fessenden inspired device.

After a 3-year court battle, de Forest was charged with patent infringement and fined. Fessenden had won. But whether of de Forest or Fessenden or Pupin or Vreeland design, this device marked another important technical development in radio and wireless. The electrolytic detector was a rectifier,

meaning that it changed AC into DC, or more practically for wireless, it recovered the lower audio frequency modulations impressed on the higher, and inaudible, radio frequencies. Later, this method of detection would be valuable for receiving voice over wireless – the radiotelephone. And while de Forest was prohibited from using the infringing version of the Fessenden liquid detector, both his and Marconi's wireless had discovered a better receiving device, the crystal detector of General H.H.C. Dunwoody. According to wireless historian and attorney Bartholomew Lee, "Dunwoody's crystal detector saved Lee de Forest from a federal injunction sued out by Reginald Fessenden, and then saved the Marconi Company from the long-wave static that challenged the first transatlantic circuit from Ireland to Nova Scotia in 1907 and subsequent years."⁴⁷ Dunwoody discovered a less mechanically fussy detector in the form of a rock, man-made carborundum, one of the first semiconductors. After that, wireless telegraphy operators had no need for the slow coherer or the unpredictable liquid detectors or even the Fleming Valve diode used by Marconi. In a few years, the de Forest three-element Audion would replace them all for commercial use, but the crystal detectors of Dunwoody, Greenleaf and Pickard, and others would live on for more than a century as a hobbyist's first radio receiver (Fig. 2.7).

"Marconi Company Protests, Notice of patent rights sent to de Forest concern – what the latter's president says," was a 1902 *New York Times* story based on the Marconi company's threat of a suit over patent infringement. A representative of the Marconi company visited the de Forest operation, after which he told the reporter, "We wanted to show them the difference between our system and theirs.... We do not want to steal any man's brains nor do we wish to utilize any invention to which we are not justified and legally entitled, but we do not intend to be deprived of any of the rights or privileges that the United States Patent Office has already allowed us under 58 consecutive claims."⁴⁸ De Forest is clearly frustrated over the patent system, writing to friend Jessica Wallace on the de Forest wireless company letterhead: "I had rather be in the laboratory discovering something new, or learning more of the dark secrets which lurk there, rather than to prove to the fossils of the patent office that I have found something." He continues, in what sounds like a cross between the Zen of inventing and bipolar disorder, "I half-believe I hear faint voices calling to me – whispering some great secret! If I could only hear them clear, and understand!"⁴⁹ This sheds some light on one of the recurring but confusing parts of the de Forest story – his penchant for legal trouble. Too many times he will say that he would rather be in his lab than in the business office. Too many times he will blame his legal troubles on others, always saying that he did not have

Figure 2.7 De Forest poses with shirt sleeves rolled up, his hand poised over a wireless key, as if sending a message. What is wrong with this picture? Simply that according to de Forest assistant Frank Butler, de Forest did not know the code and therefore could not send or receive it. This promotional photo is signed. From the Perham de Forest papers, History San Jose.



Lu de Forest

time for business. This part of the de Forest story, a murky ethics record, is the major reason why opinions of him are sharply divided to this day (Fig. 2.8).

Nevertheless, he was a largely successful wireless inventor, having applied for and received more than 40 patents for wireless telegraphy between 1902 and 1906. Wireless became one of the first big businesses of the new century, the signaling without wires between ships at sea and shore stations. De Forest was a major figure in wireless telegraphy, and he sold to the Navy and US Army Signal Corps, he acted as a communications conduit for the press, and traveled worldwide to demonstrate his system. De Forest's competition, Fessenden and Marconi, were also having success, but it was the de Forest and Fessenden's companies that had long abandoned the coherer used by Marconi, thus allowing sending and receiving at up to 35 words per minute as opposed to the 15 word per minute of the



Figure 2.8 A young and confident-looking de Forest poses with an unknown colleague in front of a de Forest wireless telegraph company office. In this image de Forest is smoking a cigar but that had to have been largely symbolic, say of good times ahead. It is known that de Forest neither smoked nor drank alcohol. From the Perham de Forest papers, History San Jose.

original coherer. De Forest and Fessenden will gradually leave wireless telegraphy for other research areas, while Marconi would stay in the radio communications business until the end.

The 1904 St. Louis World's Fair

Wireless has matured and the 1904 St. Louis World's Fair provides a platform for the de Forest company to show off its successes and its improved technology. The de Forest wireless tower was the tallest of the fair buildings, and on the ground floor was a working wireless station. "Eager crowds see messages flash from the wireless tower, and the flash of 20,000 volts every time the operator presses his key is to them a thing of fascination. It is so loud that the operator must keep his ears full of cotton. It fairly deafens visitors."⁵⁰ This was likely the first time that many fairgoers had ever seen a wireless operation, as previously the activity had been confined to the Eastern Seaboard, and mostly for commercial and government communication between ships and shore stations. Most city to city communication was still undertaken by the wired telegraph and telephone. Under "Honest Abe" White's direction several highly publicized stunts were conducted,



Figure 2.9 The de Forest wireless tower at the 1904 St. Louis World's Fair. From The Perham de Forest papers, History San Jose.

including sending a coded message from the exposition to a hot air balloon, a feat previously believed not possible. For their St. Louis to Chicago transmission, the de Forest wireless won both the Grand Prize and the Gold Medal on “electricity” day. Seeing that success, the US Navy purchased more de Forest wireless equipment (Fig. 2.9). De Forest presents in 1904 a paper to the Electrical Congress of St. Louis, titled, “Electrolytic Receivers

in Wireless Telegraphy.” This is a scientific paper about the device he is alleged to have stolen during the visit to the Fessenden laboratory. He begins with a historical summary of the problems of the Branley Coherer of 1891, “that the effect of electrical oscillations upon a body of metallic filings was to produce a marked increase in the conductivity of the mass, a conductivity which persisted until the particles were broken apart again by mechanical jar.”⁵¹ He gives credit to the modifications to the coherer by Popoff and Lodge, and explains how it resulted in the first system employed by Marconi. De Forest the scholar explains that there were two schools of thought as to how this worked: One believed it was by electrostatic attraction, while the other camp believed it a breakdown by minute sparks of the dielectric film existing between opposing surfaces of the filings. He explains that the coherer, no matter its numerous improvements, is only capable of receiving 12–15 words per minute. His solution he calls the auto-coherer, or the so-called microphonic contact, allowing wireless signals to be “heard” using an earphone. He describes how his detector raises the receiving speed to 25–35 words a minute. He also spends a great amount of time differentiating his device from that of the Fessenden Liquid Barreter. While this was billed as a scientific paper, it was partly a reiteration of the superiority of the de Forest choices in wireless technology, as well as an attempt to add his own context to the as yet unresolved Fessenden patent interference suit.

After the success of St. Louis and the resulting Naval contracts, there was disagreement among the principals of the American de Forest Wireless Company as to whether it would be a good time to expand greatly the number of stations. On one side was de Forest, who in 1905 wrote, “Along with certain honest and sagacious directors of that company, Charles Galbraith in particular, I began now to argue against pushing further the ambitious plans of White, Wilson, and some of the other stock salesmen, who advocated planting wireless stations all over the land as the promptest method of selling wireless ‘securities.’”⁵² In de Forest’s opinion, because of the newly discovered problem of static interference, it would be best technically to concentrate on building shore to ship stations rather than overland. He is the scientist in disagreement with the capitalists. And for the first time in their relationship, de Forest seems to be distancing himself from Abraham White, the man who would become a focal point for years of legal problems for Lee de Forest. For the first time de Forest uses the word “honest” in describing himself and those who are not in the Abe White camp. The end of this relationship – and the company – is near.

Success at Sea

It seemed that everyday new uses were being discovered for the wireless. De Forest was the first to provide wireless coverage of the small 1904 Russo-Japanese war. The de Forest system, after tested by him near Dublin, Ireland, was installed on an English press ship and sent to the war zone, and a tense stand off resulted as the Russians threatened that the ship carrying the wireless would be boarded and the reporters would be arrested and treated as spies and their outfits confiscated. Two papers, the *London Times* and *New York Times* printed the story of the threat and because it received worldwide unfavorable press, the Russians backed down from their threats. Said de Forest, "Russia's claims that the Japs might be benefited is absolutely groundless. The Japs use the coherer and tape system of receiving, and can take only about six words per minute. Our correspondents use the telephone receiver, and can take 20 or 30 words a minute. If the Japanese tried to take what the correspondents send they would get nothing but a streak of ink on the strip of tape."⁵³ This may have been an early if not the first use of wireless to cover a war. "This equipment is the only newspaper wireless service in the Far East, and it has exclusive privileges north of Hang-Kow, which includes the whole war area. The Japanese have a system of their own on their war vessels, and the Russian ships are equipped with the Popoff wireless system."⁵⁴ Apparently the two latter systems both used coherers. De Forest would receive much favorable publicity because of this war: "Those who know him pronounce him one of the hardest workers they have known. But he also must be one of the most expeditious when at work, for he submits to an interview as if not afraid of being robbed of needed time. He is only 30 years of age, and appears no older in spite of the amount of work he has crowded into the last 4 years."⁵⁵

To always be available for the press is how de Forest becomes an inventor-celebrity. In a longer feature story about the de Forest system used in the war there are maps to illustrate how information is routed through several stations to get to the United States stations, like from Japan to China to the Philippines by cable to Hawaii and by cable to San Francisco. This achievement according to government experts, "was possible only by the utilization of 'syntonic aerography' in which the de Forest attuning apparatus is employed. It is a source of pardonable pride that this remarkable instrument is the product of the inventive genius of Lee de Forest, Ph.D., Yale, a young American, who has been responsible for so much of the wonderful progress made in wireless work within the past 10 years."⁵⁶ There is that reference again, de Forest as an "American" inventor of wireless, as

opposed to the Italian Marconi and the Canadian Fessenden. A few years later de Forest's wireless equipment was put to another novel use, this time during a strike of coal workers. The owners of the mine, concerned that the miners were, "aroused to a pitch of desperation," wanted the system in case of attack, so that "wires cannot be cut and assistance can be speedily summoned."⁵⁷ It was reported that President Theodore Roosevelt, a favorite of de Forest, was keeping abreast of the Coal Strike, also using the American de Forest Wireless. Wireless had come into international prominence and de Forest remained in the vanguard.

But not everyone was pleased with the wireless, even though there would be no scientific basis for this claim: "Scores of Aerograms shoot through human body; result, damaged nerves."⁵⁸ The unnamed experts warned that thousands of these messages penetrate your body at all times: "But if it will add to your peace of mind, the statement may be made that no one aerogram lingers long enough to allow others to collect in your body and form a blockade of messages."⁵⁹ Before you scoff at the idea of radio waves going through the body, recall that the jury is still out, scientifically speaking, on the cancer-causing possibilities of radio frequencies. It has been reported that perhaps having the cell phone next to your ear for long periods of time could cause brain tumors although it has not been proved. Of course all this may change as the now cultural tendency to text rather than talk will cause hands and fingers to get the bulk of the electromagnetic radiation. Nevertheless, when a radio or television or other transmitting facility is federally licensed, there are rules about how far it must be located from civilization, so even after 100 years the possible deleterious health effects of these unseen waves are still being debated without resolution.

De Forest vs. Marconi: Again

"A war to the knife and the knife to the hilt." A fake story, charges and countercharges, and an overreactive press promises that early 1906 will be an interesting but trying time for the two leading wireless telegraph companies. Several articles in the newspapers detailed the long-simmering de Forest v. Marconi fight over wireless systems: "de Forest Company will Fight Marconi," a story declared, and "A war to the knife has been declared between wireless telegraph concerns."⁶⁰ Led by President Abe White, this was a preemptive strike by the de Forest company to accuse Marconi of fraud, "on the grounds that the parties mentioned were using the mails to defraud the public by circulating advertisements falsely stating that an important decision had been rendered by the US Supreme Court and an injunction had been granted against the de Forest Company."⁶¹ These stories

reporting a Supreme Court decision were not true. But the press continued to report it and raised concerns about the effect of the court action on national security because Marconi was a foreign company. In many of the major papers on one day in March, 1906, it was reported that Supreme Court Justice Fuller declared that “the de Forest Wireless Telegraph Co. has been strictly enjoined to forever desist from the manufacture, sale or operation of any system of wireless telegraphy.”⁶² Not only did this guarantee a monopoly to American Marconi and force de Forest out of business, but it was a major headache for the U S Navy: “The government has been the chief patron of the undertaking as far as Mr. de Forest is concerned, and now that the decision has been rendered the United States will be left without a service unless it takes the Marconi.”⁶³ All untrue. It was a major hoax reported erroneously in hundreds of newspapers in one 24-hour news cycle. In the de Forest papers are a large collection of the March 22, 1906 stories with headlines proclaiming, “De Forest barred,” “U S Supreme bench grants final injunction against wireless company,” “de Forest wireless enjoined, Naval stations hit.” A cruel joke that the newspapers apparently did not check for credibility (Fig. 2.10).⁶⁴

This news story appeared across the country for at least a day, detailing a story about a trial that never existed, a story that was believed to have been planted by Marconi operatives. When asked to confirm Supreme Court Clerk McKenney replied that “no case between the Marconi Wireless telegraph Company of America, and the American De Forest Wireless Telegraph Company has ever been decided by this court, nor is there such a case now pending on the docket of the Court.”⁶⁵ De Forest was vindicated and White promptly sought a court injunction prohibiting the Marconi Company from this false advertising. Were it not for the fact that it would all come crashing down soon under an ethics cloud, the de Forest Company seemed to be riding high. The newspapers of early April 1906 carried stories of the success of the de Forest system of wireless telegraphy: “Wireless Messages Clearly Transmitted by De Forest Method,” “Overseas Wireless a Fact, says De Forest,” “Ireland Takes Wireless Message from New York – de Forest Feat Occurred,” all good news for the de Forest Wireless telegraph Company.⁶⁶

The End of de Forest Wireless

Lee’s brother Charles de Forest who had been one of the company investors wrote to White in 1906: “Permit me to express myself as strongly in favor of further fighting the Fessenden interests in the patent litigation.”⁶⁷ Earlier the patent for de Forest’s Electrolytic Receiver was judged to be in interference with that of Fessenden for the similar device. But Charles de

Constitution, Atlantic City, 3/28/06

ANNOUNCEMENT

Constitution Atlantic City

There has positively been no Adverse decision rendered by the U. S. Supreme Court (as maliciously and falsely stated recently) affecting the

AMERICAN DEFOREST WIRELESS TELEGRAPH CO. OR THE PRESENT DEFOREST WIRELESS SYSTEM.

The official acceptance by the Navy Department of the United States recently, after a series of tests covering sufficient time to indicate the reliability of the DeForest Wireless Service, of the long distance Wireless stations in Panama, Cuba, Porto Rico and Key West, embracing direct Wireless circuits over one thousand miles in length, again demonstrates the superiority of the system owned by the

AMERICAN DEFOREST WIRELESS TELEGRAPH CO.

By consent and with the authority of the Chief of the Bureau of Equipment, Navy Department of the United States Government, the statement is made that not a single Marconi Wireless Instrument is employed in the service of the United States Government.

For efficiency of Wireless Service we refer by permission to the UNITED STATES GOVERNMENT, STANDARD OIL COMPANY and the many STEAMSHIP LINES using our Service.

AMERICAN DEFOREST WIRELESS TELEGRAPH CO.

Long Distance Wireless "DeForest System."

Address Bureau of Equipment, Navy Department, and refer to No. 131,373. Enclosures, SSR-S.	DEPARTMENT OF THE NAVY Bureau of Equipment, Washington, D. C. March 13, 1906.
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Gentlemen:-

1. The Bureau is in receipt today by mail from the Canary Islands of the enclosed copies of messages received on the GLACIER from your Cape Hatteras station in January, and the distances at which they were received.
2. The Bureau wishes to express its appreciation of the courtesy extended by your company to the Dry Dock Expedition.

Very respectfully,
(Signed) WM. S. COWLES,
Chief of Bureau of Equipment.

American DeForest W. T. Co.,
Commonwealth Trust Bldg.,
St. Louis, Mo.

Forest believed strongly that the invention was his original idea and he wanted to contest it because, “Lee de Forest has enough claim for originality in the electrolytic receiver to make us morally entitled to its use,” and he did contest it with all his resources, saying, “I do not believe for a minute that he knowingly appropriated what was rightly the Fessenden property.”⁶⁸ It is a long and persuasive argument that details the work of lab assistant Babcock who worked on the development of the de Forest version of the electrolytic detector. Charles de Forest did put money into his brother’s company and so his letter had to be very persuasive. He pleaded that this had to be solved quickly in order to fulfill back orders for wireless equipment. It is doubtful that the Fessenden victory was ever challenged again as later in the year the entire company would be broke and gone, but based on a lifetime of court reversals in de Forest’s favor, he might have prevailed if there had been enough money to fight it again. What really happened in this case of conflicting detector claims is that both systems were made obsolete first by the less expensive and more dependable crystal detector, and later by the Audion vacuum tube.

It is less than one month after the elation caused by the vindication of de Forest after the false Supreme Court story planted by Marconi, but that joy has turned into fear. The business is going downhill quickly. It is April, 1906 and stories appeared alleging fraud by the de Forest company and a spate of headlines like “Claim Wireless Agent Sold \$2 Stock for \$10,” caused investors to complain, and those who believed they were defrauded came forward to tell of purchasing stock at a high price, stock that was now worth considerably less. This is the first harbinger of a formerly successful business gone bad. By June the fingers were pointing at company President Abraham White, who it turned out was originally named “Schwartz,” and that he changed his name to conceal other stock sale wrongdoing. The suit that was filed against White/Schwartz and the de Forest Company in the US District Court demanded the appointment of a receiver to determine what White did. It was alleged that White concealed from the creditors and stockholders the transfer of the stock of the American De Forest Wireless Company to a newly created United Wireless Telegraph Company. This meant that the de Forest company suddenly had no money and de

← **Figure 2.10** “Announcement,” an advertisement in the *Atlanta Constitution* of March 28, 1906 telling the public that the de Forest and Marconi news story saying the Supreme Court outlawing de Forest’s wireless was a fake. This was a story that lasted about 24 hours before it was proved to be a “plant,” a false story. It never happened and was likely placed by Marconi partisans to discredit de Forest. This was both an ad and a clarification. From the Perham de Forest papers, History San Jose.

Forest as Chief Engineer had neither position nor income. This would lead to the dissolution of the once successful company that carried the name of Lee de Forest.⁶⁹

Initially White was unscathed by the charges. Later in a story, "De Forest Hungry as White Reveled" it was described how the poor inventor was living in poverty while White lived in luxury. "Fate did not change its proverbial shabby treatment of inventors in the case of Dr. Lee de Forest, inventor and developer of the wireless telegraph system which bears his name, though promoters of his invention were rolling in wealth, opening champagne in the Waldorf-Astoria and buying magnificent mansions."⁷⁰ But the money is now gone, and de Forest tells how he had lived in poverty during the past year so he could father a successful and profitable company, and that debt was piling up, and that he was literally starving while waiting for his wireless ship to come in. He claimed that he wanted to make it right, that he had not been aware of White's malfeasance, and that he, de Forest was innocent of any of this. In the New York Press of September 9, 1907, "United States Officers on a Hunt for President of De Forest Wireless," it was reported that White used the previous stock sale money to purchase a Long Island mansion and give lavish parties, but he was now in contempt of two courts. White was said to have converted the assets of the de Forest Wireless Company to his own use and thus the stockholders were left holding worthless paper.⁷¹

There was a newspaper feature profile of White before the news of his indictment, showing him posed with a stock ticker, under the headline, "How I Won a Million in One Day."⁷² Is it any wonder that de Forest is confused and angry: "Once again let me get the power, once let me be the dictator – and I will dictate. Then and only then may I hope to succeed, free from the shackles and impediments of those who surround me. Never was one so tied and handicapped in the promotion of one of the most logical business ideas that have ever appeared before the microscopic mentalities of the men to whom I am forced to appeal. All of them, if they only knew it, could make for themselves a place in the history of communications as well as great wealth. I am left to do it all, to be diplomat, inventor, executive. Errand boy. I draw \$5 a week if I am lucky. Three months of this have shown me the measureless disparity between the inventor's and the investors point of view."⁷³

De Forest Resigns from His Company

But it would not yet be resolved. Before he will resign, de Forest in April 1906 travels to Europe to sell his wireless telegraphy system to the Irish government, and while there he successfully sends and receives messages



Figure 2.11 An actual American De Forest wireless telegraph company stock certificate, signed by Abe White, dated 1906, From the Bart Lee Collection.

over long distances. Surely, his system was as perfected as he cared to make it for telegraphed messages. Upon his return he learned of the arrest warrant for him and White in the Fessenden patent infringement matter. De Forest said to a New York Times reporter, “I know nothing about the order for my arrest, except what I heard on my arrival this morning. It all happened while I was at sea. However I can say that the use of the electrolytic detector has been absolutely discontinued by the de Forest company, I have invented a new receiver of a different plan. It is not like the electric coherer, nor is it like the magnetic detector. It promises to be better than any of them.”⁷⁴ The end was coming quickly, as both the White stock fraud investigation and the earlier Fessenden suit were converging upon a hapless and now hopeless Lee de Forest (Fig. 2.11).

Finally, it was just too much: In a November 28, 1906 letter from de Forest on American De Forest Wireless Telegraph Company letterhead, he writes “Gentlemen, I herewith tender my resignation as vice president and as director of the American de Forest Wireless telegraph company, the same to take effect immediately.” On the carbon copy saved in the de Forest papers he added to the formal typed letter in his own hand, “This is the funeral of my first born child! This is the finis to the hopes and efforts

which has made up my strenuous life for the first 5 years. That which I had wrought with the fair and ceaseless endeavor to make grand and lasting and triumphant is frustrated, sand-bagged, throttled and despoiled by the robber who has fattened off my brains. But my work goes on while I live.”⁷⁵ Even though no one really saw this note, but just the letter itself, it was directed at the president of the company, Abraham White, whom de Forest blamed for both his poverty and loss of reputation. But de Forest will rise again. Unknown to White, during this time de Forest had quietly been developing his next great invention, and when his wireless company was legally disbanded, he left with little money, less than \$500, but in the fine print of the legal dissolution he retained control of the new patents for his signature invention, the Audion (Fig. 2.12).

What Would Tesla Say?

Meanwhile, the scientist that de Forest most looked up to while a Yale student, and the man he had asked for a postgraduation job was in the press that same year. Those who have said over the years that Nicola Tesla was an under recognized genius would do well to read the story written by him in an unattributed 1906 news article in the de Forest papers. This story details Tesla’s plan to build a billion horsepower generator using Niagara Falls to generate voltage high enough to reach the planet Mars. Tesla wrote: “Whether we get an answer or not depends on who is there. More than likely the first answer from our neighbor will be: ‘Well, well, at last. We have been calling you the last 10,000 years.’”⁷⁶ This is a parallel story to that of the soon-to-be-invented radiotelephone, but Nikola Tesla has the more grandiose intergalactic vision, “It will be as simple as telephoning from one part of a city to another after the preliminary attuning of instruments on the two planets and the study and interpretation of each other’s codes and languages are done. As the Martians are probably the most advanced and skilled they will take our code and language and learn it first and then teach us theirs in plain English. Difficult as this fact would seem, it in reality would not be comparable with the achievement of teaching a deaf, dumb and blind child to understand. Yet this is only a matter of patience.”⁷⁷ This may have led to the origin of the expression, “What planet are you from?”

Back on Earth it is 1906 and inventor Lee de Forest had just participated in a 6-year race for wireless, from which he had walked away as the loser. In this remarkable and brief period of time he had been successful as an inventor but failed as a businessman. As a new inventor just 6 years out of college, he quickly became one of the two or three most important figures in the emerging electronic communications industry. He now has little to

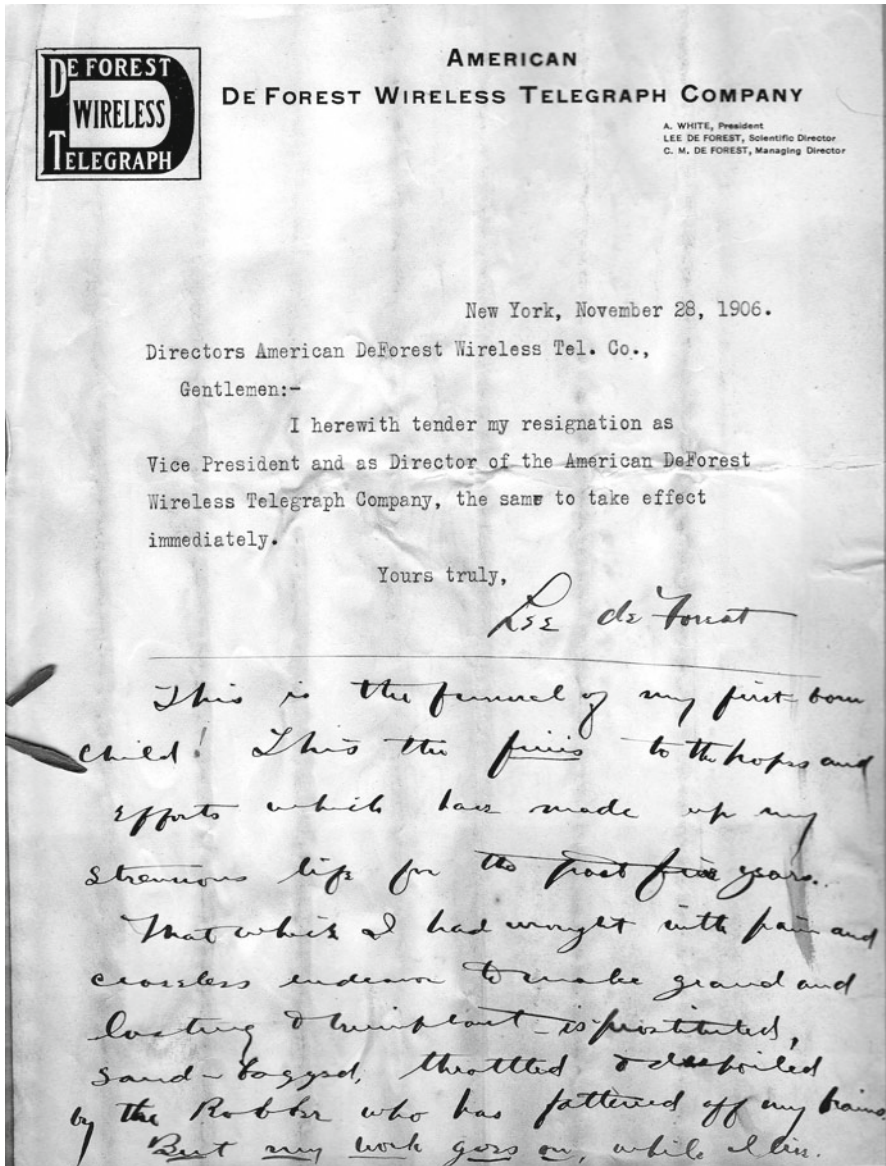


Figure 2.12 In this letter to White and the Directors of De Forest wireless, de Forest resigns as the president and writes in his own hand at the bottom of his typed file copy, "This is the funeral of my first born child!" From the Perham de Forest papers, History San Jose.

show for it. The bad news is that he is back to the financial position of a college student, with just enough for rent and a few meager meals. He cannot even afford to attend the opera. The good news is that in the legal dissolution from Abraham White, he has walked away with some notes and some patents on a device that again will make him a star in the invention of electronic media entertainment technology. He is about to develop a glass tube that he calls the Audion, and this device will be one more piece needed for his future and final invention of significance, that of the motion picture with sound.

What the Boys and Girls Knew

One question that will be asked throughout this book about the wireless telegraph, the wireless telephone, radio, and the motion picture is, "What did the boys and girls know, and how did they know it?" It was obvious how the technology of sending messages through space without wires and a career in wireless captivated the young person of the early part of the twentieth century. There were magazines for the boys, probably also read by their sisters, and there were the many series of adventure books that told exciting tales of how "boys just like you" learned about, invented, constructed, and used the wireless and later the radio and film to save lives, save the town from flood, and save the woman and children from fire and pestilence. According to Historian Susan Douglas, "The boy inventor-hero, like the inventor-heroes constructed by the press, exemplified how mass entertainment symbolically made sense of technical change."⁷⁸

One of the most read of the inventor-heroes was Tom Swift. An early story was *Tom Swift and His Wireless Message*, 1911, by Victor Appleton, a pseudonym for Howard Garis of the Stratemeyer Syndicate. This publisher of many juvenile series used contract authors for each volume, writing under a single house name. In this Tom Swift book about wireless, the sixth volume in the series, Tom uses the wireless to save himself and others who are stranded on an island. And because Tom somehow predicted that the island would soon sink due to an earthquake, he must hurry to save all its inhabitants. The character Tom Swift was both scientifically accurate and prescient in some stories, but clearly science fiction in others. It happened that there was a wrecked ship, and on that ship was enough equipment to build a wireless transmitter. He was able to use the gasoline engine, and the dynamo used for generating electricity, and constructing a home made telegraph key, he believed he could send out a message for help, an S.O.S. When the question was asked of this young man about how he could receive an answer, he replied using the proper jargon, "I have made a receiving instrument, though it is even more crude than the sending plant, for it

had to be delicately adjusted, and I did not have the magnets, carbons, coherers and needles that I needed. But I think it will work.”⁷⁹ He explains that because their airship that crashed on the island and stranded them there in the first place had a telephone, that device could be used for the receiver. Obviously it worked, and if you were a young person in that day you wanted to believe in Tom, “when he set the gasoline motor going, and the dynamo whizzed and hummed, sending out great, violet-hued sparks, they were all convinced that the young inventor had accomplished wonders, considering the materials at his disposal.”⁸⁰ The romance of wireless was captivating.

The story of *Bert Wilson, Wireless Operator*, 1913, used the familiar Marconi theme, the safety of ships at sea and the use of wireless to rescue a sinking ship, to foil pirates and save women and children from a watery grave. The saving of lives at sea was a popular story, and this one was published 1 year after the Titanic disaster and the common belief that if a nearby wireless operator had been on duty many lives would have been spared. There was a “teaching moment” in all of these technology-themed boys series, and more often than not it was real science, at least enough to interest most youth in the excitement of the device. Tom Swift’s moment came when asked the question, how does it work? He replied, “The theory is very simple, said the young inventor. To send a message by wire, over a telegraph system, a battery or dynamo is used. This establishes a current over wires stretched between two points. By means of what is called a ‘key’ this current is interrupted, or broken, at certain intervals, making the sounding instrument send out clicks.... In telegraphing without wires, the air is used in place of a metallic conductor. To send a wireless message a current is generated by a dynamo. The current flows along until it gets to the ends of the sending wires, which we have just strung. Once the impulses, or electric currents, are sent out into space, all that is necessary to do is to break, or interrupt them at certain intervals, to make dots and dashes and spaces.”⁸¹

While the Tom Swift series dealt with all communications media as well as airplanes and submarines, there were also theme-specific series that only had stories of the wireless. Most of those with wireless telegraphy as a theme were published in the mid-teens, 1912–1915, although some were released later in the 1920s when wireless telegraphy was nearly an antique technology. These books were to the youth of the early part of the twentieth century what radio, movies, and television would later become, as they told the same stories of triumph over technology. And because of it, they were, like film and radio would become, a shared experience. Writes Douglas about this literature: “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.”⁸² This reading audience of young people would evolve into the listening audience for the next new mass media, radio.⁸³

A Silent Film Industry Emerges

At the time Lee de Forest began in the fledgling business of wireless communication, another industry is about to be born, that of entertainment using the technology of film being projected on a screen in a darkened room for a paying audience. It was 1900, and the motion picture film is beginning to evolve from a technical curiosity into a viable entertainment medium. In the last century, Edison demonstrated that there was public interest and a profit to be made from showing movies to an audience of one. His 1893 Kinetoscope took advantage of the existing “penny arcade” venues, and based on his experience with the public’s willingness to deposit a coin to hear a phonograph record, he believed that his film device would also be popular. There were no theaters devoted to motion pictures, and until then, the technology of projection would not have been ready for public exhibition. Film historian Peter Kobel makes the case that after 1895 and the work of the Lumiere Brothers and Edison with his projector, the Vitascope, “A new industry was born, with remarkable possibilities. It presaged great wealth, but even more important, a kind of communal waking dream shared in darkness. The cinema would open new worlds and would reveal our own secrets to ourselves.”⁸⁴ By 1900, the projection of film for an audience was being noticed and the silent movies would soon become the first great new entertainment art and technology of the new century.

The First Silent Films

The other part of the story of de Forest and the talkies begins with the film itself, and its development purely from a technical curiosity into a viable art form with its own unique language. To understand this parallel story of film, there are opportunities existing today to put yourself in the theater seat of a century ago. There are some very good collections of discovered and restored silent films, beginning in the Edison era and culminating at the beginning of the 1930s when all movies were talkies. There is the Museum of Modern Art collection of Edison shorts, restored

in cooperation with the Library of Congress, with some of these based on a paper film duplicate used for copyright. There is the “Treasures from the American Film Archives” and “More Treasures from the American Film Archives” series, and there is the Turner Classic Movie cable channel and their “Silent Sundays.” The public’s interest and foundation funding in recent years has helped to reintroduce 30 years of silent film classics, as museums and libraries now have access to the technology needed to create a more complete version of those scraps of films once screened in film schools. They can now be viewed in their newly preserved form, at the correct speed, with the missing pieces, and with some of the scratches and wear electronically removed. After over a century it is possible to see film classics in a form close to their original.⁸⁵ By watching the early silent films accompanied by music as they were originally presented, you can begin to see the development of the art, the language, and the narrative story and documentary uses for the film, as it gains prominence as an industry.

The Edison Films

The most important name in the early film business was Thomas A. Edison. The Edison Company received patents for most of the early film technology, and as de Forest would do in later years Edison made the films to accompany his devices. The most important person in the Edison operation was William Kennedy Laurie Dickson, a European transplant who moved to America to work for Edison, and as an experienced photographer he led in the development of Edison’s early motion picture camera and player. Dickson was the first film director, making hundreds if not thousands of short films for the Kinetoscope. Subjects for these 30 second film loops were chosen to attract audience favor and their pennies, and it was content, some of it a bit risqué, that could not be seen in magazines or on the stage of the day. Topics included cockfights, boxing, dancing girls, kissing, shooting, Indians – any topic that could work in the 30 second peep show format. Some of these ideas were suggested by the men who worked for Edison and Dickson himself. Dickson functioned as Edison’s producer-director, and made hundreds of brief silent movies, like “Annie Oakley,” “Buffalo Dance,” and others between 1893 and 1895. All of these were preprojection, designed for the Kinetoscope, a device which was popular and profitable in penny arcades, at fairs, on sidewalks or any place where vending machines were used. The Kinetoscope died out quickly, to be replaced by the projection of films in theaters for audiences. Dickson left the employ of Edison in 1895 to start his own company, American Mutoscope and Biograph (Fig. 2.13).

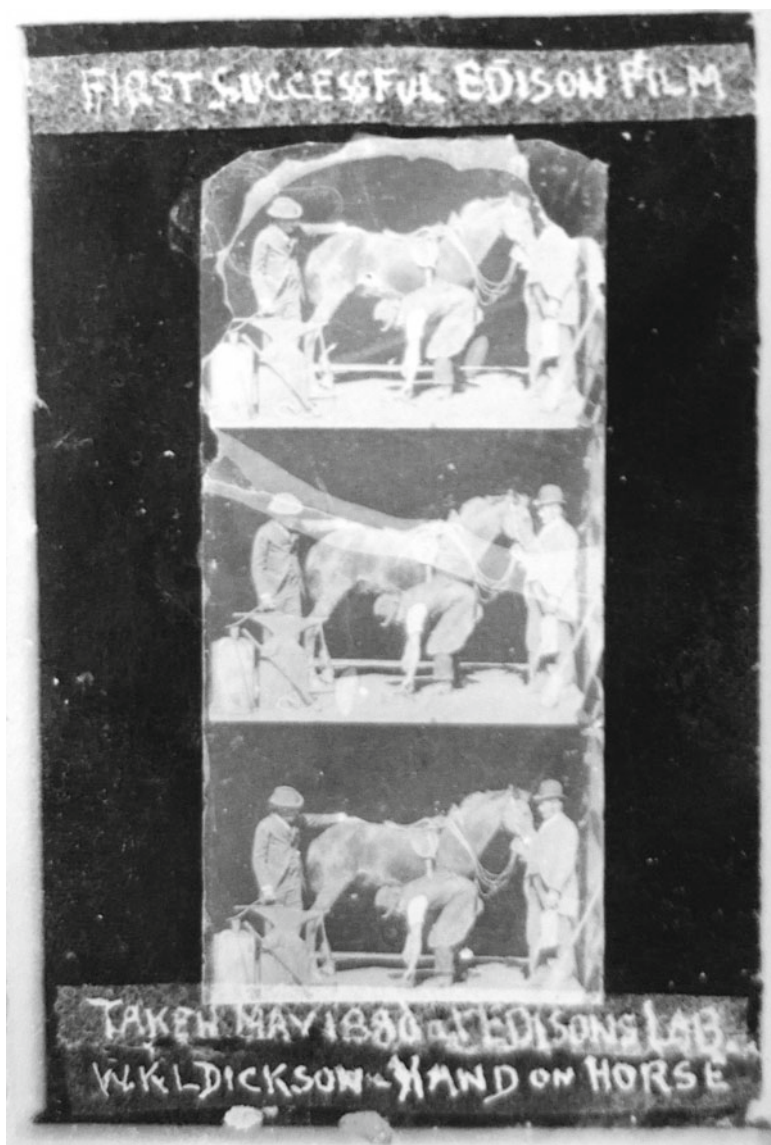


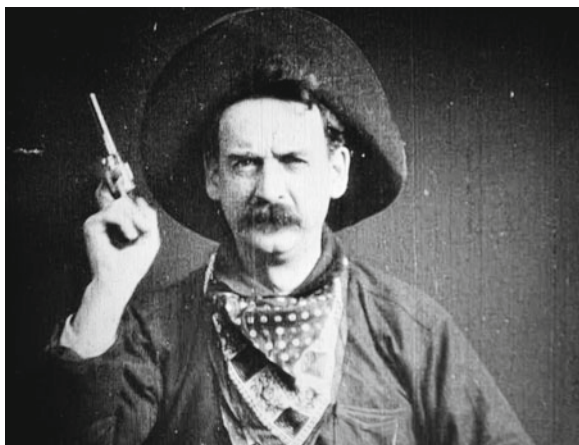
Figure 2.13 These frames from one of the first Edison films were saved by his assistant W.K.L. Dickson. It is titled "first successful Edison film," and it is dated 1889. From the W.K.L. Dickson papers, Seaver Center, Los Angeles County Natural History Museum.

By the beginning of the twentieth century, Edison the businessman owed most of the important patents for film devices, in addition to his film production and distribution company. The Edison Company made thousands of so-called one and two-reel films of 10–20 minutes in length and rented them for showing in theaters. This was the real beginning of the American film industry. The first Edison films were not story-driven, but rather simple portrayals of events. According to Edison's biographer Paul Israel, "Edison had almost no involvement in his other major business, motion pictures, because they had already evolved into an art form and the important innovators were film makers, not inventors of new technology."⁸⁶ So Edison hired a director to replace W.K.L. Dickson. Edwin S. Porter was an important early director of films for the Edison brand, and while they were not all that innovative, they were popular with the public, and they likely encouraged others to make films, start companies, and generally improve the state of the art. Even Porter himself learned and progressed as a director.

Director Edwin S. Porter, an Accidental Artist

The Edison Films are made mostly in Orange New Jersey. With Porter as director, the film evolves quickly, and soon the art becomes more important than the science. But it is likely that Porter did not consider himself an artist: "Porter was essentially a cameraman and a technician, who delighted in tinkering and solving narrative problems via mechanical means. Often he did not realize that those mechanics overlapped into art and could be formulated into a language of film."⁸⁷ Under Porter, stories are now being "directed." One example was a film based on an existing story was the 10 minute "Jack in the Beanstalk" from 1902. It was true to the fairy tale with costumes like you might have seen in the storybooks of the era. The countryside "backdrops" were obvious large hanging paintings of outdoor and farm scenes. And though it did tell a story, it was staged like a play. It featured some in-camera effects like dissolves, meaning one picture fades out as the one replacing it fades in, and people disappearing from the frame, fantasy-like, becoming the first optical effects seen in Edison films. There were few intertitles used in 1902. In Porter's 1903 short, "The Life of an American Fireman," he uses for the first time close up camera shots and performs some basic editing. This "editing" could more accurately be described as physically gluing one scene to another for continuity, rather than for pacing or to increase dramatic tension as editing would be about a decade later. In Porter's 1903 "Uncle Tom's Cabin," titles were now used to introduce each scene. In this film about slavery, the blacks outwit the whites, showing Porter's views about race and class, a recurring perspective that will show up in his later films. The staging is still theater-like, and

Figure 2.14 The famous final frame of the 1903 Edison film, “The Great Train Robbery,” directed by Edwin S. Porter. Frame from the author’s collection of old educational films.



the scenes are mostly long shots, with the action taking place within the static frame of a nonmoving camera. There is a slave auction and the flogging of Tom, but the white “handler” who manages the slaves does get killed in the end. Uncle Tom dies too. Abraham Lincoln appears briefly at the end and declares “Emancipation,” thus freeing the slaves.⁸⁸

When the name Edwin S. Porter is invoked, it is almost always in reference to his signature film, “The Great Train Robbery,” an early western and chase film made in 1903. This was one of many “railroad films,” a popular subject at the turn of the century. This film closes with the famous medium close up shot of the lead bandit shooting (blanks, it is assumed) directly into the camera, thus at the audience. There is lots of death by firearm in this film, but it is just a basic chase film, bad guys vs. good guys, while a moving camera follows the chase scenes. Film historians have claimed that the oddly out of context medium shot of an actor looking right into the lens must have given future film makers some idea of how to get beyond the static long shot, but there is no real evidence of why Porter used this technique (Fig. 2.14). Some film writers have repeated the folklore about how the audiences of the day might have felt cheated if the film frame cut off a part of the body, and just showed the person from the waist up, and that for this reason every shot was a long shot. There is no evidence that this is true either. The real significance of this film was that “it opened the door to a new kind of fictional and narrative filmmaking, in which story and plot are as important as location and cinematography. It proved the viability of commercial cinema and set the standard for the next decade of one-reel movies”⁸⁹ “Train Robbery” was Porter’s greatest commercial success, and in what must have been the first film “sequel,” he followed up in 1905

with "The Little Train Robbery," featuring an all-child cast reenacting his hit of 1903. In the latter version 12 year olds rob a miniature train of children and steal their little train and their lunches. These are bad boys.⁹⁰

It was not all "shoot 'em up" for the Edison Company. Porter's 1904 comedy "European Rest Cure," is a clever 14 minute one-joke story about a man who is told to take a trip for his health and relaxation. By now there are very basic intertitles used to denote scene changes, and stage-like sets for interiors and appropriate exteriors are constructed specifically for this story. In this film exteriors like the Alps and the Great Pyramid are obvious studio sets with mountain drawings used for set backgrounds. The protagonist of the film, an old gentleman who is on the "rest cruise" finds himself not resting, but falling down mountains, off the Great Pyramid, off walls, the subject of an aggressive mud bath, plus he is robbed and beaten. There are no close ups or medium shots, as this film is really a stage play in all long shot. The attraction is the scenery and slapstick. In the "The Ex-Convict," 1904, Porter makes a social statement. This too is based on a play and shot like a play, with many exteriors and minimal titles. We are asked by Porter to believe that since the subject of the film has returned from serving his sentence, we should treat him as if he were normal and he should be permitted to start over. But the obvious happens: the police and family do not trust him, no one will give him a job, but in the end he saves the life of a neighbor girl and is redeemed. Very complete narrative stories are now being told in a single reel of film of 10-12 minutes, a "one-reeler." That classification denotes the size of the unexposed reel of film that fits both camera and projector.⁹¹

In another common social theme of Porter, rich vs. poor, he directs "The Kleptomaniac" in 1905. In this 10 minute story of class, a wealthy woman steals clothing in a department store out of adventure while a poor woman steals a loaf of bread to feed her starving family. Porter tells this as a parallel story, cutting back and forth between the two woman. In court the judge sets the wealthy woman free, while the poor woman is jailed. To exaggerate the situation the wealthy woman is shown living in high style with her servants, while the poor woman weeps in her obviously shabby home with her ill-clothed children. She is destitute and desperate. From the arrest through the court system the poor woman is treated roughly while the rich one is treated with deference. Most important, the language of story telling using film beyond that of just photographing a stage play is slowly developed by Porter as more intertitles are used, there is minimal editing to cut between the two persons who steal, and effective set design is used to depict the very different home environments of the two. Further development of film's unique language can be seen in the 1905 Porter travel short,

"Coney Island at Night." For this the moving camera pans the park lights from right to left on a stationary tripod, then tilts up and down the buildings. These are camera movements showing a language unique to film, as Porter begins to free film from its stage conventions, and instead of a static camera recording events, he gives them a different presentation using the camera and its mounting device.⁹²

What Edison and Porter filmed was very much influenced by the box office returns of the time. The theaters showing these films would evolve from the use of existing vaudeville houses and stages into dedicated venues, often storefront operations known as "Nickelodeons." Both films and their audiences were being noticed: "The increased production of fiction films helped make possible the rapid spread of nickelodeons, which in turn increased production pressure on filmmakers. With nickelodeons spreading like mushrooms after an autumn rain, and with the common perception that they appealed to the lower classes, reformers began to be concerned about film content."⁹³ A belief that the film was becoming a media for the working man likely led to the popular and profitable themes of the early films, the struggle between the social classes, everyday stories of struggle, as well as simple children's stories for the entire family.

Porter must have had a great deal of creative freedom as a director as long as audiences paid to attend his films. In "The Dream of a Rarebit Fiend" in 1906, he uses some early special effects like split screen and superimposition attained by printing two films together onto a third negative, and there is animation, stop action, all very early in-camera and optical printer tricks. This film is a fantasy on the dangers of overeating and overdrinking, as the main character staggers out of a restaurant after eating and drinking to excess and goes home into bed where bad dreams happen. Continuing the use of never before seen visual effects, there is Porter's 1907 "College Chums." For this he does not use intertitles, but there is an "animated phone call," a static picture with two people speaking in little circles on opposite sides of the frame, and in between little words are spelled out in animated form, a letter at a time, moving from sender to receiver and back. This animated conversation not only sets up the plot, but shows that pictures could "speak" in a way other than cutting to a title page, and thus away from the action.⁹⁴ These early films show experimentation, one film at a time, in order to discover a visual language and art for the film media.

Between 1901 and 1907 Porter becomes the first real film "director," as he constructs dramatic narratives and tells simple stories in 10–12 minutes. His films often tackle social problems, primarily the disparity between the rich and poor. He takes the side of the worker over the owner and that of

the poor over the wealthy. He accomplishes this through gestures, dress, and obvious attitudes of authorities about socioeconomic class. What is fascinating about the Porter era is you can see the dress, the buildings, the transportation, the neighborhoods, and the road being shared with horse and car. You get to see the nature of work, of school, of class, and of manners. You see the environment and the look of the people of the early twentieth century. Porter's use of titles is spare, mostly only to designate a scene change rather than for dialogue. If you look closely at his titles, they seem to be white plastic letters individually pushed into grooves on a black felt background, as used by the store signs of the day to announce a special sale. This is the evolution of the film as practiced by one director, Edwin S. Porter, who while he worked for Edison, he seemed to have maximum freedom to define the medium. By 1908, Porter's style and earlier innovations will seem dated and he is retired by Edison as a director. But in 1908 Porter discovered the next important star director, David Wark Griffith.⁹⁵

Other Directors, Other Companies

Among other films from the early silent era, there was the 1910 "The Wonderful World of Oz," produced by Selig-Polyscope as a 13-minute silent version of the L. Frank Baum children's book. This film did employ some early mechanical stage-based special effects, as the cyclone moves against the sky background. Dorothy and her little playmates are blown to Oz which with palm trees looks like California, and there the Wizard is fighting the evil witch. Overall, there are too many men in bad animal suits, and at least a half dozen in Dorothy's ensemble, many more than the 1939 classic. "Oz" has not developed the film language at all, using long and medium shots, like a bad stage play. The claim of this picture is lavish sets and costumes and casts of hundreds, surely a silent film full employment act, and a bad witch which dissolves from the scene. The Wizard returns to Kansas in a hot air balloon. Like films today, there were good, better and best, and while many would like to believe that there was an orderly progression from the early Edison Kinetoscope shorts to the maturation of the silent film and its storytelling art, it really happened in nonconnected little events, films with a close up or an optical effect, or an editing revolution. The language of film is being learned slowly. The audiences are becoming more sophisticated and will demand more from this new media.

In one of the early European films to experiment with techniques other than the basic establishing shot is seen in what remains of the 1902 Georges Méliès film, "A Trip to the Moon." This is a fantasy using multiple exposure and stop action, all in the service of a bizarre film about a group of somewhat aged bearded scientists, obviously professors in an institution.

They build a rocket ship that is rather tiny and tinny, too small in fact for the large number of passengers that board. Their goal is to go to the moon, and in a great fantasy scene, the rocket ship is crudely animated using stop action, shooting a single frame, moving the ship slightly and shooting another frame, as it is moved toward the moon, a trip of just a few seconds. The ship lands in the right eye of the man in the moon. Once on the surface of the moon, the natives are revealed as nubile women and angry mutants, all of which scare off the scientists-explorers-professors, who promptly jump in the rocket just as it falls off the flat surface of the moon, and in a method reminiscent of modern day space reentries, the ship parachutes to the ocean where it sinks to the floor. This must have been a dream. At the beginning of the twentieth century there were many films being made. Most of these were just the long shots being spliced together in some loose storytelling, some more effective than others, and all of them just one reel, the typical program consisting of two or three of these reels.⁹⁶

Soon, the movies will move production from New York to Southern California, they will be feature-length, and they will tell more complex stories, all using the newly emerging language and art of the new cinema. It is the popularity of this new media that will give Lee de Forest an idea or two. But first he has two more battles to fight, his new invention of the Audion and his foray into radio broadcasting. At the beginning of the new century de Forest has tried and succeeded, however briefly, in the business of wireless telegraphy. But he cannot remain in one place for long or concentrate on a single invention. While wireless for him was fading to black, he has already begun to create a radiotelephone system to replace the earlier dots and dashes of the Morse Code, and he writes about sending fine music into homes as entertainment, as a way to uplift the masses. He is an inventor who is becoming a cultural promoter, believing his tastes in entertainment should be used as content for the new media he seeks to invent. Lee de Forest has several good acts yet to come.

Lee de Forest

King of Radio, Television, and Film

Adams, M.

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