MARCONI RECEIVES THE FIRST TRANSATLANTIC TELEGRAPHIC RADIO TRANSMISSION

Category of event: Applied science
Time: December 12, 1901
Locale: Poldhu, England, and St. John's, Newfoundland, Canada

Marconi received the first transatlantic telegraph signal sent without a cable, demonstrating that long-distance electronic communication through open space was a reality

Principal personages:

GUGLIELMO MARCONI (1874-1937), an Italian scientist and inventor of a system of wireless telegraphy who was a cowinner of the 1909 Nobel Prize in Physics

JAMES CLERK MAXWELL (1831-1879), a Scottish scientist who pointed out that electricity and magnetism were really an instance of electromagnetic radiation

SAMUEL F. B. MORSE (1791-1872), an American portrait painter and scientist who invented the Morse code

JOSEPH HENRY (1797-1878), an American physicist who invented an electric relay, a telegraph, but did not patent it

HEINRICH HERTZ (1857-1894), a German physicist who was interested in the wavelength properties of electromagnetic radiation

Summary of Event

On December 12, 1901, Guglielmo Marconi was in St. John's, Newfoundland, Canada, to receive a Morse code signal to be transmitted to him from Poldhu, Cornwall, England, a distance of 3,440 kilometers across the Atlantic Ocean. Humankind was about to enter the era of worldwide electronic communication.

The principles of electric telegraphy had been discovered in the nineteenth century, and for years individuals worked to send the electric signal further and further through various wire conductors. According to David A. Hounshell of the Smithsonian Institution's National Museum of History and Technology: "The word telegraph originally identified a visual, manually operated signaling system, or semaphore, used to communicate information rapidly over a large distance." In the nineteenth century, however, as research into electricity progressed, the term was associated with signals sent and received over wires and then without wires.

Samuel F. B. Morse was an American artist and inventor who had sailed to Europe in 1832 to study art. On the return voyage, a fellow passenger and American, the chemist Charles T. Jackson, introduced Morse to the principles of electromagnetism, the basis for the telegraph. In 1835, Morse created a transmission device and a code, now known as the Morse code (a series of dots and dashes representing agreed-upon alphanumeric symbols), to be transmitted as an electric signal through

a wire and received at a distant location. On May 25, 1844, Morse demonstrated the principles of telegraphy by transmitting and receiving over an electric telegraph line (64 kilometers long) from Washington, D.C. to Baltimore, Maryland. From Washington, D.C., Morse transmitted the message in code, "What hath God wrought?"

Morse was not alone in his work in telegraphy; he borrowed ideas from another American, the physicist and inventor Joseph Henry who, in 1835, had invented an electrical relay that was the forerunner of Morse's telegraph. Unfortunately, Henry did not patent his electrical relay, and Morse's name is the common one heard today.

The application of telegraphic principles proceeded on both sides of the Atlantic. In 1837, the Great Western Railway in England used an early telegraphic signal (with wires strung adjacent to railroad lines) to indicate train speeds. In 1852, an agreement was made between Germany and France allowing telegraph wires to cross their borders for messages.

Morse and Henry, as well as the Scottish mathematician and physicist James Clerk Maxwell and the German physicist Heinrich Hertz, all made their contributions to the achievement of Marconi. No researcher works in a vacuum and everyone builds on and borrows from earlier and contemporary works. Maxwell pointed out that electricity and magnetism were really an instance of a single form of electromagnetic radiation, and he demonstrated that what is called "light" results from electromagnetic vibrations of a certain wavelength. What followed from this mid-nineteenth century discovery was that electromagnetic waves other than light waves could be propagated or transmitted through space. (In 1968, the International Astronomical Union adopted the figure that the speed of light was 299,792.5 kilometers per second.)

As electric energy is transmitted through a wire, it does not travel at the speed of light but travels at speeds determined by the properties of the conducting medium and associated equipment. Materials such as copper and silver make excellent conductors, but there is still resistance to the transmission of the electric energy, dictated by the laws of physics. If signals could be transmitted through space, without wires, the signal would be sent at the speed of light; this is what Marconi accomplished across the Atlantic Ocean on December 12, 1901.

After the initial successes of telegraphy by wire, individuals began to conceive of wires all around the globe. In 1850, a well-insulated copper wire was laid between France and England in the English Channel to carry telegraphic signals and in 1854 individuals began to consider laying a wire cable across the Atlantic Ocean. As James R. Chiles stated: "The first Atlantic cable, which took three attempts in 1857 and 1858 to lay, consumed 367,000 miles [590,503 kilometers] of iron wire and 300,000 miles [482,700 kilometers] of tarred hemp." On August 13, 1858, President James Buchanan of the United States and Queen Victoria of England exchanged telegraphic messages via this first Atlantic cable. It took sixteen and one-half hours for Queen Victoria's ninety word message to cross the Atlantic. The cable of 1858, however, only worked for one month and in the 1860's, two additional cables were laid across the Atlantic Ocean. In 1866, there were two functioning cables connect-

ing North America and England and by the end of the nineteenth century, more than ninety million telegrams a year were being transmitted across the Atlantic Ocean. In 1894, Marconi became familiar with Hertz's work on generating electromagnetic waves through space by using a transmitter. Marconi conceived of the idea of using these waves through space as a transmission signal or a form of wireless telegraphy: The signals would go through space at the speed of light and not be impeded by the resistance of any wire conductor. While in Italy, Marconi worked on his transmission and receiving equipment. After he received little support to continue his work on wireless telegraphy in Italy, Marconi was persuaded to go to England to pursue his work. Marconi thought that the transmission of signals through space to be received by ships at sea would be of importance to a maritime nation. Since England was the greatest maritime power, he went to England and on June 2, 1896, he applied for, and received, the first patent for wireless telegraphy in the world.

From 1896 to 1901, Marconi continued to experiment in transmitting and receiving wireless telegraph signals for greater distances, utilizing the code developed by Morse. In 1894, Marconi had succeeded in sending and receiving a wireless telegraph transmission 2.4 kilometers. He gradually perfected his techniques and was soon sending and receiving wireless signals 6.4 kilometers, 14.5 kilometers, 19 kilometers, 50 kilometers, 121 kilometers, and finally in January, 1901, he sent and received a signal on the south coast of England 299 kilometers.

Individuals expressed great interest in the ability to convey messages even greater distances, and Marconi attempted his transatlantic transmission at the end of 1901. Success was not guaranteed, and many thought it was impossible. At the transmission site in England, Marconi erected a transmission antenna 48 meters tall, consisting of fifty copper wires suspended between two towers 60 meters apart. In Canada, during a winter gale, Marconi sent aloft a kite which had a trailing antenna that was 152 meters in length. He received the letter "S" on December 12, 1901, when the signal was sent from Poldhu, Cornwall, England to St. John's, Newfoundland, Canada, a distance of 3,440 kilometers.

Impact of Event

When Marconi received the letter "S," the world was forever changed, since the transmission of information was no longer limited to a distinct physical medium and could now be transmitted through space at the speed of light. Even though Marconi achieved success on December 12, 1901, he was challenged immediately by individuals and corporations who claimed that his transmission from Poldhu to Newfoundland was an impossible achievement.

In February, 1902, Marconi replicated his December test by a series of transmission-reception tests between the origination station in Poldhu, and the S.S. *Philadelphia*, which was 3,232 kilometers away in the Atlantic Ocean, but there were still those who did not think highly of his achievements. Marconi's younger daughter wrote in 1989 that her father's "scientific work has not been without criticism" and that the point which his critics seemed to have in common was that "Marconi, rather than an

inventor of new devices, achieved his major successes by incorporating components already invented by others."

Critics and disbelievers notwithstanding, Marconi continued with his experimentations and transmissions and by the end of 1902, the first official messages, and not test transmissions, were being sent across the Atlantic Ocean. By the early part of 1903, newspaper stories from New York City were being sent for publication in *The Times* of London by means of Marconi's telegraphy, which was undeniably built on the work of Henry, Morse, Maxwell, Hertz, and other individuals.

A Nobel Prize, however, is not given to a committee and in 1909, Marconi and Karl Ferdinand Braun shared the Nobel Prize in Physics. Braun had introduced the first cathode ray tube in 1897, which earned for him the shared 1909 Nobel Prize in Physics. As Marconi stated in his 1909 Nobel Prize Physics Lecture: "The results obtained from these tests, which at the time constituted a record distance, seemed to indicate that electric waves produced in the manner I had adopted would most probably be able to make their way around the curvature of the Earth, and that therefore even at great distances, such as those dividing America from Europe, the factor of the Earth's curvature would not constitute an insurmountable barrier to the extension of telegraphy through space."

Marconi's telegraphic achievements coincided with other achievements occurring in electromagnetics. Sir John Ambrose Fleming became a scientific adviser to the company that Marconi founded, and in 1904 Fleming developed a "valve" that could control the flow of electrons in a tube. In 1906, Reginald Aubrey Fessenden invented a system to modulate electromagnetic radio waves that could be transmitted as a form of wireless telegraphy and radio was thus invented. In 1908, A. Swinton published a brief letter in *Nature* entitled "Distant Electric Vision," and television as a form of "wireless telegraphy" came about. The first public demonstrations of television occurred in England in 1926 and in the United States in 1927.

Marconi's contribution evolved into a global telecommunications system, allowing virtually instant access to anyone in the world, providing one has the appropriate technology. Fiber optics now substitute for copper wires and signals are transmitted through space at the speed of light to geosynchronous communications satellites orbiting the equator at 36,000 kilometers. Although not diminished in size since Marconi, the world has definitely "shrunk" in the manner in which information can be exchanged and shared since that first transatlantic telegraphic transmission on December 12, 1901.

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Charles F. Urbanowicz

Cross-References

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