# The Titanic and the Wireless

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When the RMS Titanic set to sea on April 10, 1912 it was equipped with the most up-to-date technical means of ship-to-shore and ship-to-ship communication – the wireless-- housed in what was called the Marconi Room. Jack Phillips, age 25, and Harold Bride, age 22, were the operators. They were employees of the Marconi International Marine Company and were not considered part of the ship's crew.

Soon after the disaster, there were two governmental inquiries, one by the British Wreck Commission and the other by the United States Senate and Bride provided testimony at both. (1). He recounted that as part of their jobs the operators sent and received messages to and from other ships and the shore. In addition, the receiver picked up messages that were sent by other ships, but not destined for the Titanic. But, as described by Bride, the main occupation of the operators was transmitting telegraph messages to and from the passengers and their correspondents on land.

Records show that on April 13th and 14th several ships reported sighting icebergs and these reports were sent to Titanic Captain Edward John Smith, including one at about 5p.m. on the 14th from the California. But at 11:15 that evening, Phillips was deeply involved with relaying a large number of passenger messages to Cape Race, Newfoundland and when the California sent the message "We are stopped and surrounded by ice," Phillips replied "Shut up. I'm busy. I am working on Cape Race."

According to Bride's account, he was in bed at 11:40 when the iceberg was struck and was awakened soon after. At that time Phillips told him that the boat had been damaged and that he expected that it might have to return to the builders in Ireland for repairs. Phillips was about to retire for the evening when the Captain came into the Marconi room and ordered a distress call. The first called repeated "CGD DE MGY" six times. DE MGY indicated that the message was from the Titanic and CQD was then the commonly used signal calling for help: CQ -- calling all ships-- and D for distress. Later calls included the new signal, SOS. The Carpathia was one of the ships that received the message and it immediately changed course and arrived some hours later to save many of those afloat in lifeboats. Unfortunately, the California, which was closer by, did not receive the message because the wireless operator had already gone to bed and the wireless was shut down for the night.

Phillips continued sending distress calls, along with updates on the condition of the boat, even as the electrical power weakened, until the Captain told both operators they should leave. Phillips died en route to the Carpathia, presumably from hyperthermia, and was buried at sea. Bride was rescued.

The British inquiry into the disaster resulted in recommendations for safer sea travel. Among the many suggestions for improved safety, they recommended that all ships have wireless systems and that the wireless be manned around the clock. The wireless was credited with saving the lives of those rescued by the Carpathia.

There is a long history of technological advancement that eventually resulted in ships communicating via wireless telegraphy. In earlier times a fire, often located for easier viewing in a tower – a lighthouse, may have been used to indicate "safe" or "not safe." Fire, lanterns, horns or bells were also used for ship-to-ship signals, announcing "come aboard" or "stay away." A flag of a particular color or in a particular position also conveyed a message. By the seventeenth century flags were used for more-detailed coded messages—semaphores. But all of these methods of communication required the recipient to be within visible or audible range and communication was limited by distance and weather.

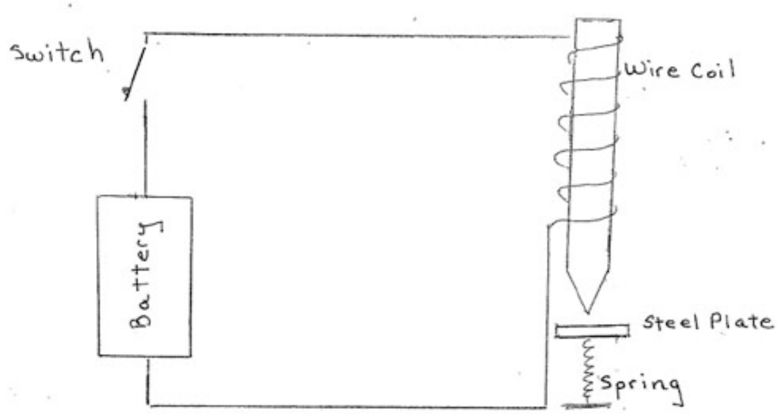
Meanwhile, without giving thought to helping shipboard communication, scientists and inventors were busy exploring electromagnetism. A brief summary of their story begins with the ancient Greeks who investigated the magnetic properties of lodestone, observing how it attracted small pieces of iron. And by the fifth century BC the Greeks also noted that rubbing amber with fur resulted in the amber's ability to attract small objects, thus giving us terms like "electric" which are based on the Greek word for amber -- "elektron." Although we now know that rubbing amber with fur results in the transfer of subatomic charged particles we call electrons and that electrical phenomena are due to forces by and on these particles, electrons weren't discovered until 1891 and electronic technology was well on its way before then.

By 1600 William Gilbert described properties of magnetic forces in a series of books, De Magnete, and the eighteenth century saw various experiments on electrical forces including studies of electrical current – the flow of electrical charge -- by Benjamin Franklin among others. But the study of electrical currents really took off after the invention and improvement of the voltaic cell (the battery) by Alessandro Volta in 1800. In particular, the voltaic cell made it possible to produce large enough currents to observe that electrical currents produce magnetic effects.

Although the sources of electric and magnetic forces appeared to be very different, there were some intriguing similarities in their ability to sometimes attract and sometimes repel. And they both were observed to "act at a distance." For example, two magnets need not touch each other to exert forces on each other. Further interconnections were made with the discovery in 1820 by Hans Christian Oersted that compass needles were deflected by nearby electric currents and, soon after, William Sturgeon found that he could make a strong magnet, now called an electromagnet, by winding wire around a piece of non-magnetized iron and connecting the wire across a battery. Thus, charges were seen to produce electric effects and, in addition, moving charges were seen to produce magnetic effects.

Oersted's discovery and Sturgeon's electromagnet led the way for long distance communication, i.e. telegraphy. Almost immediately, scientists saw the possibility of using a long wire to send a current that would end in an electromagnet that could interact with something containing iron. The most successful of these devices was the telegraph devised by Samuel Morse, a professor of arts and design at New York University.

Figure 1 is a schematic that illustrates the basic principles of a telegraph. This is a simple circuit with a battery, a switch and a wire coil surrounding a non-magnetic iron core. Below the coil is a steel plate. At the transmitting end a telegraph operator uses a "telegraph key" (the switch) to close and open the circuit. When the switch is closed the coil is magnetized and it attracts the steel plate below. When the switch is opened the coil is no longer magnetized and a spring returns the steel plate to its original position.



In the earliest telegraphs the coil carried a marker that inscribed a strip of paper that was pulled between the coil and steel strip. Depending on whether the switch was closed for a shorter or a longer time, the result was a dot or a dash and information was communicated long distance via Morse code. Later models used a sounder that produced a "click" when the current was turned on and the steel hit the electromagnet and a "clack" when the current shut and the coil returned to its resting position. Telegraph operators listened for long and short intervals between the click and clack and became adept at recognizing rhythms that corresponded to common words and could "read" up to 50 words per minute. In 1844 the first long distance message was sent from Washington, DC to Baltimore, MD and by 1866 the first transatlantic cable connected the United States and Europe.

Although the telegraph revolutionized communication on land it was of no use to sailing ships. Sailing ships needed a wireless telegraph and this had to wait for more scientific investigation and technological inventiveness.

In 1831 Michael Faraday in England and, independently, Joseph Henry in the United States demonstrated they could create a current in wires without batteries as long as the wires were in the vicinity of a changing magnetic field. In particular, if a wire loop is placed in a magnetic field and the strength of the field is varied, or if the loop is moved in certain directions, a current arises in the loop. This is called electromagnetic induction. Electromagnetic induction further enforced the connection between electricity and magnetism. Electric currents could produce magnetic fields and changing magnetic fields could result in electric currents. In 1864 James Clerk Maxwell combined the mathematical connections among charges, currents and electric and magnetic fields into four equations and he realized that the solution to those equations is an electromagnetic wave that travels at the speed of light. In 1888, Heinrich Hertz experimentally verified the existence of these waves when he demonstrated that they could be produced by a spark and received by a distant coil of wire. These were originally called Hertzian waves but are now known as radio waves, part of the electromagnetic spectrum.

Following Hertz's experiments, many inventors saw the practical possibility of wireless communication and were granted patents for various parts of what would be called the wireless telegraph. For example, Oliver Lodge demonstrated that a coherer, previously developed by Edouard Branly, could detect radio waves. A coherer consisted of two small metal plates with wires attached, placed inside each end of a glass tube containing loose metallic filings. When radio waves reached the filings, they lined up (cohered) and were able to conduct electricity and close a circuit. When the radio waves ceased and the coherer was "tapped," the filings were again disordered and the electricity stopped. Thus, if a coherer replaced the switch in Figure 1, we'd have a schematic for the receiving end of a wireless telegraph. Unlike the original telegraph circuit with miles of wire between the key and the receiver, the miles in this case were covered "wirelessly" by the electromagnetic wave. An operator would send a message by producing radio waves of either short or long duration, resulting in dots and dashes at the receiver as the coherer closed the circuit for shorter or longer time intervals.

The name most associated with wireless telegraphy is Guglielmo Marconi whose skill rested in making important improvements to what had come before. These improvements, beginning in 1895, greatly increased the distance with which signals could be sent, with ship-to-shore transmission demonstrated in 1899. By 1902 seventy ships were equipped with 'wireless" provided by the Marconi International Marine Company. Finally, there was a means of ship-to-ship and ship-to-shore communication that operated over long distance and in all types of weather.

If the Titanic were to sail today communication would bounce off satellites and use equipment that conforms to the Global Maritime Distress and Safety System (GMDSS), an international system that mandates the use of multiple ship-board radio systems, satellite EPIRB (emergency position indicating radio beacons --which float free from a sinking ship and alert rescue teams), and "one button" preformatted distress messages that do not require experienced radio operators.

But even in this electronic age, the "International Regulations for the Prevention of Collision at Sea" established by the International Maritime Organization include references to such distress signals utilizing bells, gongs, foghorns, signal flags as well as signal lamps that flash messages via Morse code. (2)

## Endnotes

1. The Titanic Inquiry Project, http://www.titanicinquiry.org
2. Conventions on the International Regulations for the Prevention of Collision at Sea, http://www.imo.org/about/conventions/listofconventions/pages/colreg.aspx