RADIO COMMUNICATION:

The Key to Understanding the Outcome of World War II

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Historical Paper

Paper Length: 2,106 words

Thesis

Radio waves were first discovered in 1886, and modern-day radios were developed 10 years later by Guglielmo Marconi. Its use became increasingly popular in the United States because of the spread of entertainment on radio stations and it's necessary communication, besides its cheapness and accessibility. However, during World War II, it became far more significant than its daily usage to broadcast music or simply talking to another person, its implementation into military technology was essential during the second World War. Both Allied and Axis Powers neither could emerge victorious or in disappointment, if radios were not in the front-lines of the war delivering encrypted messages in code and unknown languages amongst other nations.

A History of Radios

The existence of radio waves, before radios were built, was suggested by the proposed theory of Electromagnetism by Scottish physicist James Maxwell. But before the existence of electromagnetism itself, some argued, electricity and magnetism were thought to be separate forces acting independently. Electricity and Magnetism are both physical phenomenons of nature; Electricity can be defined as the flow of charges where the charges include Protons, positively charged subatomic particles and Electrons, negatively charged subatomic particles both found in an atom. Magnetism is described as a physical force caused by the *motion* of electric charges, where magnets of distinct charges can repel or attract each other depending on their magnetic forces. And Maxwell had gleaned that changing electric fields could create magnetic fields from the works of another physicist, Michael Faraday, who concluded that changing magnetic fields can generate electric fields, therefore Electromagnetism. Later, in his

Treatise on Electricity and Magnetism published in 1873, Maxwell predicted there were electromagnetic fields travelling in space approximately at the speed of light as electromagnetic radiation, also known as waves. Thus, being a radio wave (Lucas; “James Clerk Maxwell”).

Heinrich Hertz, a German physicist, applied Maxwell’s theory when he used basic tools with a spark gap, which produce low to high voltages bursts of electricity to pass between the conductors, and a Leyden Jar, an antique jar to store electric currents to form these electromagnetic waves. Hertz became the first person to transmit and receive radio waves on the electromagnetic spectrum. For his discovery, hertz was used to identify a unit of frequency for radio waves — one cycle per second (Lucas; “James Clerk Maxwell”). This, in the late 1880s, was widely recognized as a confirmation of the existence of radio waves and Maxwell’s Electromagnetism proposition.

Nikola Tesla and Guglielmo Marconi

Nikola Tesla, a Serbian-American scientist and Italian physicist, Guglielmo Marconi heavily contributed to the invention and advancements of the radio, but there is much controversy and debate on who truly created it, and few people today are well-informed on this issue. Both Tesla’s and Marconi’s battle to invent and patent the radio was surrounded by major scientific innovations, lawsuits, marketing of the radio, and ended as a Supreme Court case decision on who officially fabricated the radio. But previously, Tesla invented the induction coil, which allowed radio waves to be sent and received, after he had emigrated to the United States in 1884. Unfortunately, as Tesla prepared to send a radio signal from his lab to West Point, New York fire in 1895 destroyed his work (Briggs).

Meanwhile, Marconi, who was living in England, was consumed in his own experiments; he invented the system of wireless telegraphy and had successfully experimented over 2100 miles to prove the curvature of the Earth did not affect this method of communications (Wood). In 1896, he was sending and receiving Morse code through his radio signals covering about 4 miles and became the owner of the world's first patent in wireless telegraphy in England (Briggs).

The very next year (1897), Tesla applied for *his* two patents, both part of the induction coil, as well as Marconi, patenting for his tuned telegraphy, a wireless radio transmitter sending messages over long-distances. Initially, the United States Patent Office rejected Marconi as they relied on Tesla for his coils, however, Marconi used his family's wealth to form his own company, *Marconi Wireless Telegraph Co* to go after his desire to implement his radio patents, and in 1901 became the first person to conduct and successfully transmit the first transatlantic telegraph. As he gained the financial support and reputation among Andrew Carnegie, Thomas Edison and the benefit of having them invest in his company when he reapplied for his patent, the U.S. Patent Office abandoned their support for Tesla, and Marconi was patented for his invention of the radio (Briggs).

In 1909, Marconi was nominated and awarded the Nobel Prize in Physics alongside Ferdinand Braun (who built the electronics to disrupt radio signals as well as minimizing weak signals) "in recognition of their contributions to the development of wireless telegraphy" ("The Nobel Prize in Physics 1909"). Tesla was flabbergasted, and his opposition against Marconi grew because the U.S. Patent Office had stolen his title of inventing the radio and not being credited for his work of radios that Marconi had built off of. He sued Marconi's company for "patent infringement," with little effectiveness in 1915, and lost his battle (Hunt).

Nevertheless, in 1943, Marconi sued the United States Government for patent infringement during World War I due to their illegal usage of *his* inventions, with also very little effectiveness. To elude from all conflicts, the Supreme Court reinstated Tesla as the inventor of the radio, but alas, Tesla had already passed away the same year this was decreed. Inevitably, Guglielmo Marconi is still, in fact, observed as the "father of radios" although Tesla is praised for some of his apparent contributions to the formulation and advancements of radios (Briggs).

Despite their rivalrous relationship and competition, Nikola Tesla and Guglielmo Marconi ultimately credited for their developments of basic-structured radios, resonating radio waves to a tuned frequency and creating powerful wireless signals that could transmit a signal for many miles long. Their invention of wireless radio waves not only fueled the creation and expansion of modern-day radios but is used heavily on the general infrastructure of ships and inflaming mechanical movements through electromagnetic signals. These new innovations of wireless radio communication were pivotal in the fight in WWI and WWII; soldiers on the ground, on the ocean and on planes required these inventions in order to stay connected with their fellow soldiers, country, and allies.

Pre-World War I and Broadcasting

Prior to the first World War, radios were typically used to contact ships in the sea, but when WW1 and WWII began, it became a valuable tool used to navigate soldiers, ships, planes and deliver important messages. Civilians implemented the radio to their use, and broadcasting emerged. In Chicago, United States, its city's first radio station, KYW was founded by the Westinghouse Electric and Manufacturing Company in 1921, which initially aired opera music. It later adopted more forms of music, news, weather reports, political commentary, and gained

popularity, therefore, expanding its usage from public telecommunications to military transmission, and making more advancements in radio technology. Families both living in rural areas such as the image below and in urban areas gathered near the radio to listen to the latest broadcast within their city and country (Wood; Osburn; "[Farm families sitting in rocking chairs listening to radio; men are dressed in coveralls]").

The usage of radio had led to a whole new field, Broadcasting. Broadcasting on radios became and has become today, essential in our lives. People during the late 19th century simply used radios to relay music, but their utilization broadened to airing audio *and* visual contents. It has not only become the source of communication during the Great War, but a source of communication for the common people. America became more united and interconnected due to the spread of culture, entertainment, news, sports, and happenings in society leading to the rise of the News industry and unfolded the opportunity of broadcasting what we see every day.

Communication and Impact in World War 2

As World War 2 was rapidly brewing in Europe, the United States had remained neutral. However, on December 8, 1941, America had a change of heart. Anyhow, the morning before at Pearl Harbor, Hawaii, a Japanese aircraft surprised attacked this territory of the island, which was a US naval base. About 20 American navy vessels were bombed, along with 300 planes. Over 2,400 American soldiers and civilians with 1,000 people wounded. This historic day was the day that fueled America's involvement in World War II. And President Franklin D. Roosevelt made *his* historic speech as he declared war against Japan. A live radio broadcast was streamed throughout the entire country where President Roosevelt announced, "Yesterday, December 7,

1941—a date which will live in infamy—the United States of America was suddenly and deliberately attacked by naval and air forces of the Empire of Japan" (History.com Editors).

At the beginning of World War 2, radio technology had advanced immensely in the United States; they were built smaller, affordable, portable, and accessible to the public. In the US military, soldiers took hand-held radio equipment on the ground that could deliver messages over long distances to communicate and report back to military bases, ships, submarines and planes. Although communication was easy and attainable when urgent news had to be spread, transmissions could be intercepted by both allies and enemies if they tuned into their frequencies. In order to secure this communication within allied nations, codes and languages were taught to American soldiers and soldiers of the Allied Powers ("Golden Age of Radio in the US").

The Morse Code was heavily depended on by the US Navy; radio frequencies were much more limited on the sea, and voice telephoned transmissions could travel longer distances. Radiomen, who communicated these messages through the radios were in the front lines of Pacific battles with Japan, who could never crack the Morse code during the war ("Golden Age of Radio in the US"). Native American languages were further used to transmit messages amongst Americans and Allied Powers. The United States experimented with Navajo Code Talkers because transmissions of these indigenous languages were never understood by the Axis Powers, since there were very few Navajo speakers. Philip Johnston, who grew up in a Navajo nation, and was also a World War I veteran, introduced the idea of applying his own home language to be used as a military strategy to transmit encrypted codes. Not only was the language largely undocumented and known by a few making it difficult to translate, there were many young Navajo men who also spoke English in the United States making the translation to America easy. 29 young men were later recruited by the Marine and were highly trained to

become efficient code interpreters through their language and work under pressure as the war continued (Gohn).

As World War 2 reached its end, the United States concluded the entire war with the use of Atomic bombs developed in the Manhattan Project. Radio communication by the United States has its drawbacks. With this powerful device to transmit messages from bases to ships to aircraft and to people across vast oceans and continents, the United States could bomb the Japanese cities of Nagasaki and Hiroshima. While some argue, this helped end World War 2, it had cost the lives of thousands more than Pearl Harbour and shattered Japan due to the death, aftermath and tragedy it caused. And yes, it may have revealed the last chapters of World War 2, but these are the many downsides of communication, too.

The creation of radios to transmit codes over to long-distanced and isolated areas has affected the entire outcome of World War II because without radios would have meant weak communication and collaboration within the Allied and Axis Powers and failures from both sides. The United States' association with World War II would have never occurred as well as Japan's destructive bombing of Pearl Harbour if Maxwell, Hertz, Tesla and Marconi hadn't provided their strong efforts and even competition. If there were no radio communication, no victory of World War II would have gone to the Allied Powers, meaning the reign of Axis Powers might have widened. But not only did radios help communicate these messages amongst the United States and Allied Powers' military, but it informed home in America the status of the war and human connection through the beginnings of broadcasting, and had become a vital and rapid link of sharing information in World War II. But truly think. No radio communication would mean the termination of our daily lives today, and possibly a different or worse outcome of World War II.

[Farm families sitting in rocking chairs listening to radio; men are dressed in coveralls]

Farm Families Sitting in Rocking Chairs Listening to Radio; Men Are Dressed in Coveralls. [Between 1925 and 1930?] Photograph. Retrieved from the Library of Congress, <www.loc.gov/item/2006677937/>.

This primary source was used to show the ascendance of broadcasting, and how it gained popularity all over the United States, not just the Urban areas, but Rural places too and how it interconnected the entire country.

Annotated Bibliography

Briggs, Josh. “Who Invented the Radio?” *HowStuffWorks Science*, HowStuffWorks, 30 June 2020, https://science.howstuffworks.com/innovation/inventions/who-invented-the-radio.htm.

This secondary source was used to exemplify the entanglement between who created the radio: Tesla or Marconi? It explained both inventions, the controversy, the competition between the two and what their legacy is today.

Gohn, Sandi. “How Navajo Code Talker Marines Used Their Indigenous Language to Help Win World War II.” United Service Organizations, The USO, 10 Oct. 2019, www.uso.org/stories/2511-how-navajo-code-talker-marines-used-their-indigenous-language-to-help-win-world-war-ii.

This secondary source website was used to exemplify how without the radio, Navajo Code Talkers in WWII wouldn’t have played their major role in being codebreakers during World War II

“Golden Age of Radio in the US.” Radio on the Frontlines: WWI and WWII | DPLA, www.dp.la/exhibitions/radio-golden-age/radio-frontlines.

This source was used as general background information on the radio usages in WWI and in radio broadcasting in America.

History.com Editors. “Pearl Harbor.” *History.com*, A&E Television Networks, 29 Oct. 2009, www.history.com/topics/world-war-ii/pearl-harbor.

This website was used to give a short introduction to how the United States joined World War II, which was due to the Attack on Pearl Harbour. And additionally, how President

Rossoevelt used radio broadcasting to define the events that took place to the rest of the country, and it shows that radio was essential even before World War II .

Hunt, Inez Whitaker. "Nikola Tesla". *Encyclopedia Britannica*, 3 Jan. 2021, https://www.britannica.com/biography/Nikola-Tesla. Accessed 21 February 2021.

This secondary source was used to briefly summarize Nikola Tesla's reaction to the patent infringement that Marconi committed.

"James Clerk Maxwell." MagLab, www.nationalmaglab.org/education/magnet-academy/history-of-electricity-magnetism/pioneers/james-clerk-maxwell.

This website was used to discuss Maxwell's Electromagnetism theory, and Hertz application of Maxwell's theories.

Lucas, Jim. "What Are Radio Waves?" LiveScience, Purch, 27 Feb. 2019, www.livescience.com/50399-radio-waves.html.

Used this source to give a scientific background about radio waves and radios. Also, some other information about Maxwell and Hertz was applied with this website.

Osburn, Karen. "Radio in the 1920s." Geneva Historical Society, 7 July 2020, www.genevahistoricalsociety.com/recreation/radio-in-the-1920s/.

This website is found to include information on broadcasting in Chicago and how broadcasting slowly changed into places of news commentary.

Robinson, Frank Neville H. , Kashy, Edwin and McGrayne, Sharon Bertsch. "Electromagnetism". *Encyclopedia Britannica*, 10 Nov. 2020, https://www.britannica.com/science/electromagnetism.

This source was useful when explaining the science behind Electromagnetism; used this to break down the entire theory into simpler and digestible pieces such as explaining electricity, magnetism, and concluding it in total.

"The Nobel Prize in Physics 1909." *NobelPrize.org*, Nobel Prize, www.nobelprize.org/prizes/physics/1909/braun/facts/.

Used this primary source to show what Marconi was recognized for, with who, and why he was awarded the Nobel Prize.

Wood, Joe. "History of the Radio: From Inception to Modern Day." History of the Radio: A Complete Radio Timeline, www.techwholesale.com/history-of-the-radio.html.

This secondary source was used to include some information about radio usage in WWI and WWII, and some short information about Nikola Tesla and Guglielmo Marconi and their discoveries.