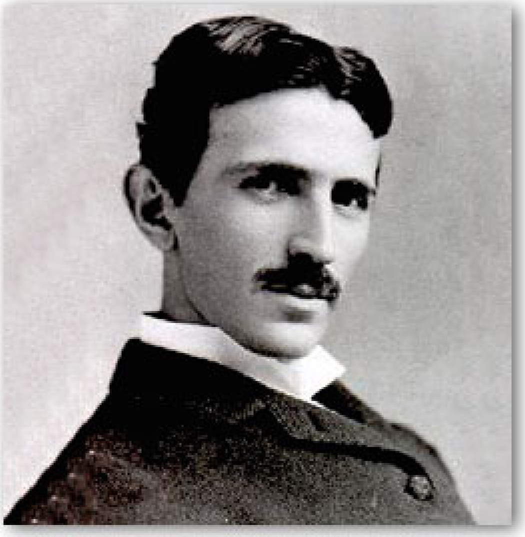
The Power that Made Radio Realistic

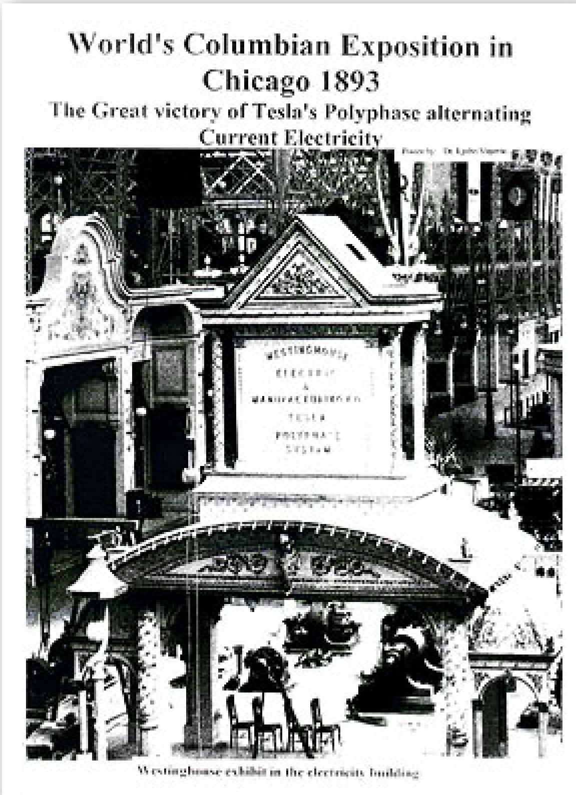
In 1909, when Marconi shared the Nobel Prize for Physics with Karl Braun, there was no question about the many significant innovations he had brought to the world of wireless radio. There was also no question that his achievements would likely not have been so great if not for the pioneering energy generation work done by Nikola Tesla, whom some consider the real father of radio.

Tesla, a Serbian-American of wide-ranging interests, immigrated to the United States at the age of 28 having already thought through one of his greatest scientific contributions - how to best use alternating current. Since Thomas Edison's company (later General Electric) was the primary advocate for and builder of direct current systems in the United States, it was natural that upon his arrival Tesla first went to work for Edison. But, it was not long before the two parted ways. Tesla then sold his patent rights for a polyphase system of alternating-current dynamos to Edison's biggest business rival - George Westinghouse.



Today we know that the alternating-current (AC) approach prevailed and that Tesla-type induction motors are found in almost all appliances and power operations. While alternating current prevailed because it minimizes power loss across great distances, at the time, the competition between direct and alternating current systems was fierce.

One of the factors that helped the alternating current approach was Westinghouse's winning the contract to provide electrical light at the World's Columbian Exposition at Chicago in 1893. This Expo is identified by many scholars as one of the key events in America's burgeoning sense of itself as a major industrial power, leading the way in new technologies.



The successful lighting of the Expo was then a factor in Westinghouse winning the contract to install the first hydroelectric power machinery at Niagara Falls. All of the enormous motors at the power station bore Tesla's name and patent numbers.

After selling his patents to Westinghouse in 1885, Tesla set up his own lab and worked on a wide variety of projects. These ranged from a carbon button lamp to experiments on the power of electrical resonance.

This last set of experiments, on what Tesla called "a simpler device" for the production of electric oscillations, resulted, in 1891, in the device known today as the Tesla Coil. A Tesla Coil is a transformer made up of two parts - a primary and secondary coil, one inside the other. When electrically charged the interaction between the two coils produces a voltage high enough to make the air conduct electric currents. Getting the power high enough to make the air an effective conductor of currents is key to wireless transmission of radio waves.

Tesla pursued the application of his coil technology to radio. By tuning a coil to a specific frequency he showed that the radio signal could be greatly magnified through resonant action. However, before he was able to fully demonstrate sending a radio signal 50 miles, his laboratory and equipment were destroyed in a fire.

Thus, when Marconi made his famous 1901 Trans-Atlantic transmission, the power portion of his system was based on Tesla's findings. In fact, Tesla and Marconi remained in legal battles for patent priority even after both men died.

Just as Tesla made the foundational breakthroughs in power generation which allowed radio to happen, Sweden's Ernst Alexanderson made the power breakthrough that allowed Fessenden to transmit the human voice across a long distance in 1906.

For the first two decades of radio (1885-1906), spark gap machines served as the transmitters for most wireless telegraphy. A spark gap transmitter worked in combination with an induction coil, a Morse key, some power source - usually a battery, an earth ground, and an aerial. Power was applied to the coil with the Morse key acting as the on/off device for the power. Once power was received, a capacitor was charged, which caused a spark to jump across the gap between the two metal balls of the spark gap transmitter. This, in turn, caused a current to flow in a tuned circuit, which produced oscillations. By adding an aerial and earth ground, these oscillations could be sent through the atmosphere. Tuning the frequency of the oscillations was dependent on the type and properties of the capacitor and coil.

Alexanderson came to the United States in 1902, at the age of 24, to work with General Electric on the new and exciting alternating current approaches to power generation. One of his early assignments was to build a transmitter that Reginald Fessenden could use to produce enough power to generate a continuous wave carrier. Fessenden's plan was to attach the sound waves from a human voice to this carrier wave and transmit this mix to radio receiving sets. To do this Fessenden knew that he needed a much higher frequency than the 60 Hertz produced by alternating generators of the time. To get a higher frequency he needed more power.

Through his own developments Fessenden had not been able to create a power generator that would produce even 1,000 Hertz. Nevertheless, in 1904, Fessenden contracted with General Electric for a machine which would generate a frequency of 100,000 Hertz.

The work took two years. In 1906 the Alexanderson Alternator, a 2 kilowatt, 100 kilohertz alternator, was used by Fessenden to carry out the first long distance broadcast of the human voice. Radio operators hundreds of miles in the Atlantic Ocean were astonished to hear a Bible and poetry reading. They were also treated to a woman singing opera, and a violin playing a Christmas carol.

Always knowing a good thing when he saw it, Marconi purchased 50 and 200 kilowatt Alexanderson Alternators for his trans-Atlantic transmissions. Marconi's Alexanderson Alternators, located in New Jersey, were used in 1918 to broadcast President Wilson's ultimatum to Germany at the close of WWI.

Unassuming Ernst Alexanderson produced over 300 patents and served as a leading figure in the development of facsimile communication and television as well as radio. Development of his alternators continued through the mid-1920's when 500,000 watt transmitters were developed. As great as these longwave alternators were they gave way in the late 1920's to vacuum tube shortwave transmitters that operated at a fraction of the cost and power.