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Honors Project: Nikola Tesla

Nikola Tesla, like most geniuses, seemed to have been born before his time. Throughout his life, Tesla drafted, mostly in his mind, several unique inventions. Some he was able to build, others only dream about. Coming from humble origins, Tesla accomplished many great things in his life such as inventing remote controls, creating manmade lightning, and harnessing the power of Niagara Falls. He even powered several lights wirelessly from miles away (Kosanovic 2000). He was friends with the great American writer Mark Twain and toward the end of his life was infatuated with pigeons. Originating from rural Eastern Europe, Nikola Tesla had a rough ride along the way to become one of the most monumental figures in the modern era of science.

Growing up in the small, quaint Croatian village of Smiljan, Tesla's father was a Priest, his mother a small time inventor (Vujovic 1998). He focused on inventions and engineering even at the young age of five when he built a miniature water wheel. Instead of the water wheel having paddles to keep spinning, Tesla's was smooth and able to spin at a constant pace. He also built a bug powered motor where June bugs were glued to the contraption and as they desperately tried to take off, their wings powered the device. Unfortunately one of Tesla's friends came over to his house and saw the device and just so happened to be fond of eating June bugs. Needless to say, the motor was a short lived success. Tesla had an older brother, Daniel, who died when Nikola was five. According to Tesla, Daniel was killed by a horse that was gifted

to their family. Although it was responsible for Daniel's death, the horse also saved Tesla's father's life during an accident in the mountains. After Daniel's untimely death, Tesla claimed that everything he did seemed dull and he started developing strong discipline that began to spark the beginning of the Tesla people know today (Tesla 1919).

Some say that there is a fine line between genius and insanity. This is clearly the case for Nikola Tesla as had several peculiar habits and phobias. Some of these include being afraid of pearl earrings on women, refusing to touch others hair, counting his steps while walking, and calculating the cubic contents of his food in order to enjoy it. Tesla also developed a strange phenomenon in which he could see certain objects when he thought of them as if they were real. When he touched the object his hand would go through it and it would stay suspended in air. In an attempt to avoid this, Tesla focused this ability on imagining fictional worlds with fictional people living in them. He claimed that these worlds and these people he made up meant just as much to him as the real world and the real people he knew (Cheney 1993). This remarkable gift that Tesla had developed would later help him when he became an inventor. He could imagine devices and look at them as if they were there, tweaking them and improving them. Because of this and the fact that Tesla worked with much theory before building, he claimed that after twenty years of inventing, every single invention worked the first time he built it (Tesla 1919). Not surprisingly, Tesla excelled in math while in school and used his special ability to blaze through problems. He was actually accused of cheating because of this.

Tesla had many bouts with illnesses during his youth. Among those was when he came under with cholera and was bedridden for nine months. His father was a man of the church and always wanted Tesla to do the same. This was obviously a problem for Nikola since he dreamed of pursuing a career in engineering and inventing. Near the end of his bout with cholera, when

Tesla's father was beside him, Tesla cleverly devised a plan to make his father accept what he dreamed of becoming. Tesla said, "Perhaps I may get well if you will let me study engineering." His father's compassion for his sick son compelled him to yield to his son's wishes. Tesla was finally able to take his first step toward becoming the inventor the world knows him as today (Cheney 1993).

In 1875, Tesla enrolled at the Austrian Polytechnic School in Graz. He wanted to complete two years of school in one and so he studied from three in the morning until eleven at night every day. His funding was through the Military Frontier Authority fellowship. Unfortunately, the Military Frontier was abolished the following year and hence Tesla lost all of his funding and was forced to drop. Before he dropped in his second year, Tesla began to formulate his idea of an alternating current. When he shared this theory with his German physics professor, the scholar claimed that "Tesla may accomplish great things but he will never do this." He went on to say that "it is a perpetual motion machine, an impossible idea" (Seifer 1998). After Tesla dropped and began to run out of money, the young Serb turned to the world of gambling. Although one might thing that with his great intellect in mathematics, Tesla would be a card shark, he actually lost money while playing cards. However, Tesla found talent in billiards and promptly became an addicted gambler. It is believed that while gambling, he audited classes at one of the universities in Czechoslovakia, making Tesla, for the most part, a self taught man. Tesla eventually overcame his addiction when he realized he almost gambled away all of his parent's money (Cheney 1993).

Thomas Alva Edison opened a branch a branch of his world renowned workshops in Budapest in 1881. Tesla immediately travelled there, hoping for work. He was hired, albeit at the Central Telegraph Office of the Hungarian government. It was during this time that Tesla first visualized the schematics for an alternating current motor by way of a rotating magnetic field (Kosanovic 2000). While working at the telegraph office, Tesla suffered what doctors diagnosed as a nervous breakdown. Tesla's senses have been far from normal throughout his life, but this time they were nothing short of bizarre. During this so-called breakdown, his senses were super

acute. He could hear a watch ticking from three rooms away and a fly landing on a table in the same room. From twenty miles away, a train whistling would cause the chair he was sitting in to vibrate enough to cause pain. He felt the ground constantly shaking and so when he went to bed he had to have a rubber mat underneath his bed to absorb the vibrations. Tesla's life is full of unexplained oddities but this one is up there with the most unexplained phenomena. He later wrote that



one of his biggest regrets was not requesting professional psychologist to study the state he was in during this breakdown. After Tesla recovered, he returned to playing with the idea of alternating current, formulating how exactly he could make it work. Miraculously an idea came to him. He found he could create an alternating current motor by creating a rotating magnetic field with the use of two out of step currents. It would be years before he would actually be able to build this design, however.

Tesla immigrated to America in 1884. Instead of going to the hiring hall looking for work, as most immigrants did, he strolled along in the streets of New York searching for Edison's workshop with nothing more than a letter of recommendation and an address in his pocket. When he finally found Edison, he asked Tesla what he could do, to which Tesla responded with his idea of an induction motor with alternating current. Edison quickly shut him down saying this country uses direct current, people like it, and it's not going to change (Cheney 1993). He then asked Tesla if he could go fix the lighting on a ship. To Edison's surprise, Tesla boarded the ship the same day and worked through the night, finally making all the necessary repairs at daybreak (Tesla 1919). After seeing how Edison's dynamos functioned, Tesla offered to Edison a plan on how to improve the efficiency of them. Edison, thinking it couldn't be done, offered Tesla fifty thousand dollars if he could do it. Accepting the offer, Tesla worked hard for months on the project. After about a year, he presented his solution to Edison. Edison was shocked. Tesla, wasting no time, proceeded to ask Edison for his promised fifty thousand dollars to which Edison replied with "Tesla, you don't understand our American humor." Frustrated with Edison and his company, Tesla threatened to resign. Edison offered Tesla a raise from eighteen dollars per week to twenty eight dollars per week. This was apparently not good enough for the young Serb as he then proceeded to walk out on Edison (Cheney 1993).

Fortunately for Tesla, his reputation became big enough that a group of investors approached him, wanted to form a company around his name. Finally realizing he could bring the concept of alternating current to the world, Tesla accepted with excitement. Much to his chagrin, when Tesla told the investors about his idea they quickly shot him down, saying "No, we want the arc lamp. We don't care for this alternating current of yours" (Tesla 1919). Consequently, the Tesla Electric Light Company was formed in Rahway, New Jersey under the intention to improve arc lights. To no surprise, Tesla came up with a new, elegant design for arc lights and they were put into use in the streets of Rahway. It was a success. Unfortunately, Tesla

was being pushed out of control of his own company and had little to show for it. It seems as though the Serb was cheated out of yet another great opportunity. As luck would have it, though, the manager of the Western Union Telegraph Company, A. K. Brown, found Tesla and was interested in the idea of alternating current. Brown saw the potential of this new technology and wanted to form a company around Nikola. Thus, the Tesla Electric Company was formed in 1887 with workshops just a few blocks away from Edison's.

Within just four years of opening his company, Nikola Tesla was granted forty patents. After seeing Tesla's alternating current motor, an electrical engineering professor at Cornell University suggested that the design of the motor could possibly be the start of a whole new technology. The recognition from the Cornell professor let to Tesla receiving an invitation in 1888 to lecture to the American Institute of Electrical Engineers. Tesla's lecture on alternate current motors and transformers was subject to great critical appraise because he presented the information clearly and concisely and already had all of the mathematics and theory worked out. This grabbed the attention of one George Westinghouse. Westinghouse was a wealthy inventor and businessman that was intrigued by Tesla's work and was determined to partner with the young Serb. When he visited Tesla's workshop he was amazed at the designs of the machines that populated the shops. The two inventors both craved the idea of alternating current to be the new standard for America's energy concerns as well as utilizing the hydroelectric potential of Niagara Falls. Suffice it to say, the two quickly became good friends and business partners, with Tesla receiving royalties from Westinghouse. Thus marks the beginning of what will come to be referred to as "The War of the Currents" (Cheney 1993).

When news came to Edison of the Tesla/Westinghouse partnership, he immediately felt the pressure to start convincing people of the superiority of his direct current. Had Edison's ego

not have been so big, he may have accepted the advantages Tesla's alternating current had over his own. As he had done with the gas companies, Edison began to spread propaganda against Tesla's alternating current. He claimed that it was a danger to society and demonstrated by gruesomely electrocuting cats and dogs with it. He gathered these animals getting young boys around the neighborhood to steal local pets and bring them to his workshop by paying them a quarter per animal retrieved. In his propaganda Edison dubbed death by alternating current as being "Westinghoused" (Brewer 2008). At first, Westinghouse took no stock in these absurd claims, but later decided to alert the public of the truth behind the not so lethal threat of alternating current. Edison even went as far as sending one of his lab assistants to Sing Sing Prison to convince the warden to execute one of his death row inmates by way of Tesla's alternating current. Although this method worked for Edison on several small animals, it was not quite powerful enough to kill a human being. In effect, the process of electrocution had to be done twice. One can only speculate on what a horrible sight this must have been. This same lab assistant went on the road for Edison and Westinghoused several animals in front of spectators.

But this propaganda from Edison was short lived due to a decline in funding. The J. P. Morgan Company had already bought out the Thomson-Houston Electric Company and turned its eyes towards Edison's. Reluctantly, Edison was forced into a merger organized by J. P. Morgan with the Thomson-Houston Company to form the General Electric Company. With intentions toward monopolizing the electric industry, J. P. Morgan looked towards buying out the Westinghouse Company. Westinghouse's only chance and keeping ownership of his company rested in the hands of Nikola Tesla and his contracted royalties. Westinghouse explained to Tesla the situation he was in and grudgingly asked Tesla to give up the contract in order to save the Westinghouse Company. Tesla, remembering how Westinghouse had faith in him when nobody else did, tore up the contract, effectively giving up millions of dollars already earned by royalties as well as millions more that could have been made. This was a big deal and shows a lot about the kind of character Nikola Tesla had. Westinghouse was not ungrateful for this and continued supporting Tesla and his ideas in the years to come.

Jumping ahead to 1899, Tesla decided he needed a more suitable laboratory. More suitable, meaning a laboratory that isn't in the middle of a busy city, where he can carry out

experiments with high frequencies and high voltage, and not receive noise complaints. At this time, his coils were producing four million volts. A man by the name of Leonard Curtis from Colorado Springs offered Tesla land and energy both free of charge in his town. Nikola, without hesitation, began ordering and moving supplies to the small town of Colorado Springs. He was able to stay at



the Waldorf-Astoria Hotel and could build his workshop a mile east of the town. The land was about six thousand feet above sea level creating a suitable, dry environment for experiments involving electricity. It was close to Pike's Peak and luckily for Tesla his closest neighbor was the Colorado School for the Deaf and Blind. There was a fence surrounding the lab that read

"Abandon hope all ye who enter here." While there, his goals were to develop a worldwide wireless communication system and to wirelessly send energy efficiently across the Earth. Once he had everything set up, he was able to generate electrical arcs more intense than nature could produce. These experiments could be witnessed from twelve miles away. While experimenting, people in the town would gather at a safe distance and watch. It was reported that the thunder made from Tesla's electric sparks could be heard miles away and that distant spectators could see sparks between grains of sand. When they lifted their feet from the ground, they could see sparks between their heels and the ground. Consequently, horses that were trotting would feel a small shock between the ground and their metal shoes. Tesla's transmitter coil would suck butterflies into the vortex created by the massive twenty-six foot radius coil. It was in Colorado Springs that Tesla made the prediction that the Earth's resonance frequency was 6, 18, and 30 Hz, which is awfully close to the current accepted values of 8, 14, and 20 Hz (Cheney 1993).

Tesla's greatest achievement while at Colorado Springs only lasted around sixty seconds. While watching a storm roll through the plains, Tesla realized that the lightning arcs were forming at regular time intervals. He recorded the data and discovered that he was observing stationary waves. This implied that the Earth could be used as a conductor and would be extremely responsive to electrical vibrations (Kosanovic 2000). The test required millions of volts and a large amount of current. The main idea of the experiment was to close the switch on the large circuit that made up his facility that had a high mast rising from the building with a metal ball on top. When his assistant closed the switch, he saw blue light fill the station and heard a roaring sound come from above. Nikola Tesla stood outside as he witnessed a remarkable spectacle. He had created lightning. Tesla stared in astonishment at his incredible feat. Lighting shot from the top of the mast into the heavens over and over. After about a minute, the process stopped and Tesla, thinking his assistant must have opened the switch, yelled for him to close this switch. Angrily, Tesla, thinking they must have shut his power off, called the Colorado Springs Electric Company and demanded they turn it back on. Their reply was that

Tesla had overloaded their dynamo and now their generator was on fire. As a result, Tesla was responsible for the blackout of the entire town of Colorado Springs. In order to get back to his experiments as quickly as possible, Tesla, at his own



expense, sent over a team of engineers to repair the generator. After a week, everything was back to normal and Tesla could get back to his research (Cheney 1993).

Nikola Tesla was arguably the most influential man worldwide during the turn of the century. He has contributed many technologies that society continues to use to this day. One could only speculate where the world would be without a man of his stature. With all of his remarkable contributions to the scientific community, it is hard to believe that the Serb never won a Nobel Prize. At Tesla's funeral in 1943, the Vice President of the Institution of Electrical Engineers fittingly referred to Tesla's discoveries by saying "nature and nature's laws lay hid by night. God said 'Let Tesla be' and all was light" (Vujovic 1998).

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