NIKOLA TESLA: LIGHTNING MAN

with

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For further background on this presentation:
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Nikola Tesla (July 10, 1856 to January 7, 1943) was an engineer known for designing the alternating-current (AC) electric system, which is still the predominant electrical system used across the world today. He also created the "Tesla coil," which is still used in radio technology. Born in what is now Croatia, Tesla came to the United States in 1884 and briefly worked with Thomas Edison before the two parted ways. He sold several patent rights, including those to his AC machinery, to George Westinghouse.

EARLY YEARS: Nikola Tesla was born on July 10, 1856, in what is now Smiljan, Croatia. Nikola Tesla was one of five children, including siblings Dane, Angelina, Milka and Marica. Tesla's interest in electrical invention was spurred by his mother, Djuka Mandic, who invented small household appliances in her spare time while her son was growing up. Tesla's father, Milutin Tesla, was a Serbian orthodox priest and a writer, and he pushed for his son to join the priesthood. But Nikola's interests lay squarely in the sciences.

After studying at the Realschule, Karlstadt (later renamed the Johann-Rudolph-Glauber Realschule Karlstadt); the Polytechnic Institute in Graz, Austria; and the University of Prague during the 1870s, Tesla moved to Budapest, where for a time he worked at the Central Telephone Exchange. It was while in Budapest that the idea for the induction motor first came to Tesla, but after several years of trying to gain interest in his invention, at age 28 Tesla decided to leave Europe for America.
**Tesla and Thomas Edison:** In 1884 Tesla arrived in the United States with little more than the clothes on his back and a letter of introduction to famed inventor and business mogul Thomas Edison, whose DC-based electrical works were fast becoming the standard in the country. Edison hired Tesla, and the two men were soon working tirelessly alongside each other, making improvements to Edison's inventions. Several months later, the two parted ways due to a conflicting business-scientific relationship, attributed by historians to their incredibly different personalities: While Edison was a power figure who focused on marketing and financial success, Tesla was commercially out-of-tune and somewhat vulnerable.

**First Solo Venture:** In 1885, Tesla received funding for the Tesla Electric Light Company and was tasked by his investors to develop improved arc lighting. After successfully doing so, however, Tesla was forced out of the venture and for a time had to work as a manual laborer in order to survive. His luck would change two years later, when he received funding for his new Tesla Electric Company.

**AC Electrical System:** Tesla designed the alternating-current (AC) electrical system, which would quickly become the preeminent power system of the 20th century and has remained the worldwide standard ever since. In 1887, Tesla found funding for his new Tesla Electric Company, and by the end of the year he had successfully filed several patents for AC-based inventions. Tesla's AC system soon caught the attention of American engineer and businessman George Westinghouse, who was seeking a solution to supplying the nation with long-distance power. Convinced that Tesla's inventions would help him achieve this, in 1888 he purchased his patents for $60,000 in cash and stock in the Westinghouse Corporation. As interest in an AC system grew, Tesla and Westinghouse were put in direct competition with Thomas Edison, who was intent on selling his direct-current (DC) system to the nation. A negative-press campaign was soon waged by Edison, in an attempt to undermine interest in AC power. Unfortunately for Thomas Edison, the Westinghouse Corporation was chosen to supply the lighting at the 1893 World's Columbian Exposition in Chicago, and Tesla conducted demonstrations of his AC system there.

**Hydroelectric Power Plant:** In 1895, Tesla designed what was among the first AC hydroelectric power plants in the United States, at Niagara Falls. The following year, it was used to power the city of Buffalo, New York — a feat that was highly publicized throughout the world and helped further AC electricity’s path to becoming the world’s power system.

**The Tesla Coil:** In the late 19th century, Tesla patented the "Tesla coil," which laid the foundation for wireless technologies and is still used in radio technology today. The heart of an electrical circuit, the Tesla coil is an inductor used in many early radio transmission antennas. The coil works with a capacitor to resonate current and voltage from a power source across the circuit. Tesla himself used his coil to study fluorescence, x-rays, radio, wireless power and electromagnetism in the earth and its atmosphere.

**Nikola Tesla’s Free Electricity Project:** Having become obsessed with the wireless transmission of energy, around 1900 Nikola set to work on his boldest project yet: to build a global, wireless communication system — to be transmitted through a large electrical tower —
for sharing information and providing free electricity throughout the world. With funding from a
group of investors that included financial giant J. P. Morgan, in 1901 Tesla began work on the
project in earnest, designing and building a lab with a power plant and a massive transmission
tower on a site on Long Island, New York, that became known as Wardenclyffe. However,
doubts arose among his investors about the plausibility of Tesla's system. As his rival, Guglielmo
Marconi — with the financial support of Andrew Carnegie and Thomas Edison — continued to
make great advances with his own radio technologies, Tesla had no choice but to abandon the
project. The Wardenclyffe staff was laid off in 1906, and by 1915 the site had fallen into
foreclosure. Two years later Tesla declared bankruptcy and the tower was dismantled and sold
for scrap to help pay the debts he had accrued.

**Death:** Poor and reclusive, Nikola Tesla died on January 7, 1943, at the age of 86, in New
York City, where he had lived for nearly 60 years. After suffering a nervous breakdown
following the closure of his free energy project, Tesla eventually returned to work, primarily as a
consultant. But as time went on, his ideas became progressively more outlandish and impractical.
He grew increasingly eccentric, devoting much of his time to the care of wild pigeons in New
York City's parks. He even drew the attention of the FBI with his talk of building a powerful
"death beam," which had received some interest from the Soviet Union during World World II.

**Tesla Motors & the Electric Car:** In 2003, a group of engineers founded Tesla
Motors, a car company named after Nikola Tesla dedicated to building the first fully electric-
powered car. Entrepreneur and engineer Elon Musk contributed over $30 million to Tesla in
2004 and serves as the company’s co-founder CEO. In 2008, Tesla unveiled its first electric car,
the Roadster. A high-performance sports vehicle, the Roadster helped changed the perception of
what electric cars could be. In 2014, Tesla launched the Model S, a lower-priced model that, in
2017, set the Motor Trend world record for 0 to 60 miles per hour acceleration at 2.28 seconds.
Tesla’s designs showed that an electric car could have the same performance as gasoline-
powered sports car brands like Porsche and Lamborghini.

**Tesla Science Center and Wardenclyffe:** Since Tesla's original forfeiture of his
free power project, ownership of the Wardenclyffe property has passed through numerous hands.
Several attempts have been made to preserve it, but in 1967, 1976 and 1994 efforts to have it
declared a national historic site failed. Then, in 2008, a group called the Tesla Science Center
was formed with the intention of purchasing the property and turning it into a museum dedicated
to the inventor's work. In February 2009 the Wardenclyffe site went on the market for nearly
$1.6 million, and for the next several years, the Tesla Science Center worked diligently to raise
funds for its purchase. In 2012, public interest in the project peaked when Matthew Inman of
TheOatmeal.com collaborated with the TSC in an Internet fundraising effort, ultimately
receiving enough contributions to acquire the site in May 2013. Work on its restoration is still in
progress, and the site is closed to the public “for the foreseeable future” for reasons of safety and
preservation, according to the Tesla Science Center.

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Did You Know? During the 1890s Mark Twain struck up a friendship with inventor Nikola Tesla. Twain often visited him in his lab, where in 1894 Tesla photographed the great American writer in one of the first pictures ever lit by phosphorescent light.

14 Amazing Things Nikola Tesla Gave the World

1. Alternating Current: Tesla didn’t exactly invent Alternating Current (AC), but he made AC practical and usable for the entire planet. It wasn’t until wealthy investor George Westinghouse got behind him that Tesla’s work on AC began to be taken seriously, and the AC/DC wars were on. It was a question of practicality in truth. Thomas Edison’s Direct Current (DC) needed many power plants to provide electricity to large numbers of people, while Tesla’s AC used thinner wires and was able to transmit over great distances. Edison embarked on a very public smear campaign against AC, going so far as using AC to electrocute cats and dogs, but Tesla won out in the end. It is Alternating Current that Tesla is arguably best known for, and it was this that helped catapult the Serb into the scientific stratosphere.

2. Induction motor: Some 63 years after French mathematician François Arago argued the existence of rotating magnetic fields, Tesla utilized these to create the first AC induction motor. The invention made a world of difference to the efficiency of energy generation, and in many ways was responsible for kick-starting a second industrial revolution. The lights in your home, your electric toothbrush and your vacuum cleaner? It all comes back to Tesla’s induction motor.

3. Tesla Coil: How can one talk about Nikola Tesla without mentioning the coil that takes his name? The Tesla Coil is used to produce high-voltage, low-current, high-frequency electricity; in other words, it’s a contraption that creates flying arcs of electrical energy. That sounds quite dangerous, but Tesla wasn’t one to shirk in the face of potential electrocution. His
coil created huge amounts of energy and allowed him to light bulbs without using wires, among other things.

4. **Remote Control:** Tesla was awarded a patent for remote control in 1898, after using a battery-powered boat as a demonstration. Years passed before the technology was used in any meaningful way, but it is difficult to imagine a modern world without remote control tech. Tesla’s invention saw a boat controlled by radio signals, which subsequently powered the rudders and propellers. It was another of Nikola’s inventions that went way over the heads of many at the time.

5. **Radio:** The credit for inventing the radio initially went to Italian engineer Guglielmo Marconi, but it was later revealed that Tesla had come up with the invention first. Tesla had two radio patents accepted in the late 19th century, but the financial clout of Marconi’s backers saw the Italian awarded the patent that mattered. Radio was one example of Tesla’s overactive mind and creative tendencies getting the better of him, allowing someone else to swoop in and get the credit for the Serb’s creation. It wasn’t until 1943—a few months after Tesla’s death—that the U.S. Supreme Court upheld Tesla's radio patent number 645,576. The Court had a selfish reason for doing so. The Marconi Company was suing the United States Government for use of its patents in World War I. The Court simply avoided the action by restoring the priority of Tesla's patent over Marconi.

6. **Wireless communication:** It is difficult to imagine a world without remote control, but one without wireless technology? Unthinkable. Tesla had a dream that one day every single person on the planet would be able to receive free energy. He set about building a tower that would use natural frequencies to transmit data across the globe – undoubtedly a precursor to the world wide web. Tesla was well on his way to finishing the tower when his backer, J. P. Morgan, pulled the plug, citing the lack of profitability in the project as his reason. Modern wireless communication is still traced back to Tesla however. With radio waves distances can be short, such as a few meters for Bluetooth or as far as millions of kilometers for deep-space radio communications. It encompasses various types of fixed, mobile, and portable applications, including two-way radios, cellular telephones, personal digital assistants (PDAs), and wireless networking. Other examples of applications of radio wireless technology include GPS units, garage door openers, wireless computer mice, keyboards and headsets, headphones, radio receivers, satellite television, broadcast television and cordless telephones.
7. Violet Ray: It may be obsolete today, but at the beginning of the 20th century electrotherapy was all the rage, if ‘all the rage’ is an acceptable thing to say about revolutionary medicine. People soon grew tired of having electric currents thrust through their bodies, and the practice stopped. It was revolutionary back in 1900, however, and Tesla’s violet ray was at the center of it all. He introduced it at the Chicago’s World Fair in 1893.

8. Fluorescent and Neon Lighting: There was a time in the 20th century when you couldn’t walk down a city high street without being bombarded by neon signs of all shapes and sizes. The technology can be traced back to Nikola Tesla, who developed and used fluorescent and neon bulbs some four decades before they became popularized. Tesla didn’t invent neon lights themselves, but it was his work that ultimately led to their creation, a byproduct of his experiments with wireless lighting.

9. Robotics: Nikola Tesla is the ‘father’ of many things, and another discipline that he is credited with kicking off is the typically futuristic world of robotics. The magical combination of science and engineering had existed since the days of Yan Shi1 of course, but it was Tesla who brought it into popular culture. When Tesla demonstrated the first radio-controlled boat in 1898, he paved the way for the robotic explosion that took place in the 20th century. When asked about the boat’s potential as an explosive-delivery system, Tesla retorted, ”You do not see there a wireless torpedo; you see there the first of a race of robots, mechanical men which will do the laborious work of the human race.” If you’ve ever enjoyed Isaac Asimov, you have Tesla to thank. No Tesla, no Robot Wars.

10. Death Ray (Laser Technology): We can’t quite decide whether it sounds like the coolest thing on the planet or the scariest. The likelihood is both, but Tesla’s invention had both eyes firmly fixed on peace as opposed to war. The idea was to make nations entirely impregnable to attack. The existence of death rays would make war obsolete, although such thinking is quite clearly steeped in problems. Tesla’s invention of what we now call laser technology has nonetheless helped evolve medical practices.

11. Shadowgraph: X-ray technology is another invention that is credited to someone else (Wilhelm Conrad Roentgen in 1895) but it came about thanks in no small part to the genius of Nikola Tesla. It was some throwaway experiments in 1894 with discharge tubes that led to the discovery when Nikola noticed that photographic plates nearby were damaged as a result of his noodling. Two years later, in 1896, Tesla produced some of the first images of the human body using X-rays. He produced the first x-ray image in the United States when he attempted to obtain an image of Mark Twain with the vacuum tube. Surprisingly, instead of showing Twain, the resulting image showed the screw for adjusting the camera lens. Later, Tesla managed to obtain images of the human body, which he called shadowgraphs. Tesla sent his images to Roentgen shortly after Roentgen published his own discovery on November 8, 1895. Although Tesla gave

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1 The Lie Zi text is an ancient philosophical volume of stories which is believed by Chinese and Western scholars to have been composed sometime in the 4th century BC. The text contains numerous stories, one of which featuring an astounding account of what may be an ancient engineering marvel, much older than the text itself. The text describes a sort of engineer, an ‘artificer’ named Yan Shi. Sometime around 1023 to 957 BC, Yan Shi presented a marvelous invention before the fifth king of the Chinese Zhou Dynasty, King Mu. Yen Shi had created a life-sized automaton which was able to move and perform several impressive functions. The automation could move in a like-like manner and could sing.
Roentgen full credit for the finding, Roentgen congratulated Tesla on his sophisticated images, wondering how he had achieved such impressive results. Moreover, Tesla described some clinical benefits of x-rays—for example, determination of foreign body position and detection of lung diseases—noting that denser bodies were more opaque to the rays.

12. RADAR Technology: Everyone has heard of RADAR, but few people know that the men who built the first primitive RADAR units in 1934 were following principals, mainly regarding frequency and power level, that were first established by Tesla in 1917.

13. Cryogenic Engineering: Cryogenic engineering is a sub stream of mechanical engineering dealing with very low temperature processes such as air liquefaction, cryogenic engines (for rocket propulsion), cryosurgery. Generally, temperatures below freezing come under the purview of cryogenic engineering. As Tesla created more and more powerful motors and hypothesized enormous electrical grids, he realized that cooling wires and pipes to sub-freezing levels would aid in the transference of power and the efficiency of certain kinds of mechanical systems.

14. Geothermal and Hydrothermal Energy Conversion: Nikola Tesla believed that the thermo-dynamic process, i.e., the burning of fossil fuels, was “wasteful and barbarous.” He foresaw the limitations on supply and the inherent dangers to man and the environment (though even Tesla couldn’t anticipate the impacts of fossil fuels on climate change). “Whatever our resources of primary energy may be in the future,” Tesla argued, “we must, to be rational, obtain it without consumption of any material.” He believed that natural, renewable, sources of energy could “eliminate the need of coal, oil, gas or any other of the common fuels.” Two of the renewable energy sources that he investigated were hydrothermal and geothermal energy. Tesla recognized that natural heat differentials exist in all three compartments of the environment – the oceans, the earth, and the atmosphere. Tesla saw the potential for a whole new source of energy from nature.

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![Geothermal Energy Plant, Iceland](image)