Nikola Tesla

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Nikola Tesla (Serbian Cyrillic: Никола Тесла; 10 July 1856 – 7 January 1943) was a Serbian American[2][3][4] inventor, electrical engineer, mechanical engineer, and futurist best known for his contributions to the design of the modern alternating current (AC) electricity supply system.[5]

Tesla gained experience in telephony and electrical engineering before immigrating to the United States in 1884 to work for Thomas Edison in New York City. He soon struck out on his own with financial backers, setting up laboratories and companies to develop a range of electrical devices. His patented AC induction motor and transformer were licensed by George Westinghouse, who also hired Tesla for a short time as a consultant. His work in the formative years of electric power development was involved in a corporate alternating current/direct current "War of Currents" as well as various patent battles. Tesla went on to pursue his ideas of wireless lighting and electricity distribution in his high-voltage, high-frequency power experiments in New York and Colorado Springs and made early (1893) pronouncements on the possibility of wireless communication with his devices. He tried to put these ideas to practical use in his ill-fated attempt at intercontinental wireless transmission, which was his unfinished Wardenclyffe Tower project.[6] In his lab he also conducted a range of experiments with mechanical oscillators/generators, electrical discharge tubes, and early X-ray imaging. He also built a wireless controlled boat, one of the first ever exhibited.

Tesla was renowned for his achievements and showmanship, eventually earning him a reputation in popular culture as an archetypal "mad scientist."[7] His patents earned him a considerable amount of money, much of which was used to finance his own projects with varying degrees of success.[8]:121,154 He lived most of his life in a series of New York hotels, through his retirement. He died on 7 January 1943.[9] His work fell into relative obscurity after his death, but in 1960 the General Conference on Weights and Measures named the SI unit of magnetic flux density the tesla in his honor.[10] Tesla has experienced a resurgence in interest in popular culture since the 1990s.[11]

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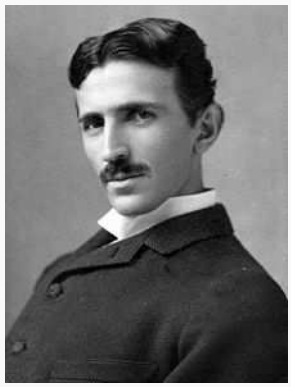


Tesla, aged 34, 1890, photo by Napoleon Sarony

Born	10 July 1856 Smiljan, Austrian Empire (modern-day Croatia)
Died	7 January 1943 (aged 86) New York City, New York
Cause of death	Coronary thrombosis
Citizenship	Austrian Empire (10 July 1856 – 1867) United States (30 July 1891 – 7 January 1943)
Education	Graz University of Technology (dropped out)
Engineering career	
Engineering discipline	Electrical engineering Mechanical engineering
Significant projects	Alternating current, high-voltage, high-frequency power experiments
Significant design	Induction motor Rotating magnetic field Tesla coil Radio remote control vehicle (torpedo)[1]:355
Significant awards	
Signature	

Contents

Early years (1856–1885)

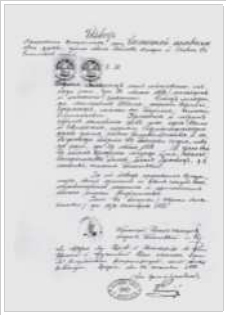
Tesla wearing a folk costume, c. 1880.

Nikola Tesla was born on 10 July (O.S. 28 June) 1856 to Serbian parents in the village of Smiljan, Austrian Empire (modern-day Croatia).[13][14] His father, Milutin Tesla, was an Orthodox priest.[15][16][17][18] Tesla's mother, Đuka Tesla (*née* Mandić), whose father was also an Orthodox priest,[13]:10 had a talent for making home craft tools, mechanical appliances, and the ability to memorize Serbian epic poems. Đuka had never received a formal education. Nikola credited his eidetic memory and creative abilities to his mother's genetics and influence.[8][19] Tesla's progenitors were from western Serbia, near Montenegro.[13]:12

Tesla was the fourth of five children. He had an older brother named Dane and three sisters, Milka, Angelina and Marica. Dane was killed in a horse-riding accident when Nikola was five.[20] In 1861, Tesla attended the "Lower" or "Primary" School in Smiljan where he studied German, arithmetic, and religion.[21] In 1862, the Tesla family moved to Gospić, Austrian Empire, where Tesla's father worked as a pastor. Nikola completed "Lower" or "Primary" School, followed by the "Lower Real Gymnasium" or "Normal School."[22]

Rebuilt, Tesla's house (parish hall) in Smiljan, Croatia, where he was born, and the rebuilt church, where his father served. During the Yugoslav Wars, several of the buildings were severely damaged by fire. They were restored and reopened in 2006.[12]

In 1870, Tesla moved to Karlovac, Croatia[23] to attend school at the Higher Real Gymnasium, where he was profoundly influenced by a math teacher Martin Sekulić.[13]:32[24] Tesla was able to perform integral calculus in his head, which prompted his teachers to believe that he was cheating.[25] He finished a four-year term in three years, graduating in 1873.[13]:33



Tesla's baptismal record, 28 June 1856.

In 1873, Tesla returned to his birthtown, Smiljan. Shortly after he arrived, Tesla contracted cholera; he was bedridden for nine months and was near death multiple times. Tesla's father, in a moment of despair, promised to send him to the best engineering school if he recovered from the illness[23][24] (his father had originally wanted him to enter the priesthood).[26]

In 1874, Tesla evaded being drafted into the Austro-Hungarian Army in Smiljan[27] by running away to Tomingaj, near Gračac. There, he explored the mountains in hunter's garb. Tesla said that this contact with nature made him stronger, both physically and mentally.[24] He read many books while in Tomingaj, and later said that Mark Twain's works had helped him to miraculously recover from his earlier illness.[23]

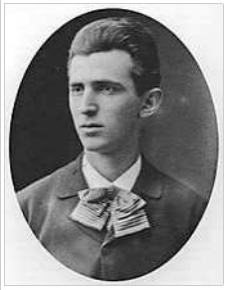
In 1875, Tesla enrolled at Austrian Polytechnic in Graz, Austria, on a Military Frontier scholarship. During his first year, Tesla never missed a lecture, earned the highest grades possible, passed nine exams[23][24] (nearly twice as many required[13]), started a Serbian culture club,[24] and even received a letter of commendation from the dean of the technical faculty to his father, which stated, "Your son is a star of first rank."[13] Tesla claimed that he worked from 3 a.m. to 11 p.m., no Sundays or holidays excepted.[23] He was "mortified when [his] father made light of [those] hard

won honors." After his father's death in 1879,[27] Tesla found a package of letters from his professors to his father, warning that unless he were removed from the school, Tesla would be killed through overwork.[23] During his second year, Tesla came into conflict with Professor Poeschl over the Gramme dynamo, when Tesla suggested that commutators weren't necessary. At the end of his second year, Tesla lost his scholarship and became addicted to gambling.[23][24] During his third year, Tesla gambled away his allowance and his tuition money, later gambling back his initial losses and returning the balance to his family. Tesla said that he "conquered [his] passion then and there," but later he was known to play billiards in the US. When exam time came, Tesla was unprepared and asked for an extension to study, but was denied. He never graduated from the university and did not receive grades for the last semester.[27]


Nikola Tesla's father Milutin, Orthodox priest in the village of Smiljan.

In December 1878, Tesla left Graz and severed all relations with his family to hide the fact that he dropped out of school.[27] His friends thought that he had drowned in the Mur River.[28] Tesla went to Maribor (now in Slovenia), where he worked as a draftsman for 60 florins a month. He spent his spare time playing cards with local men on the streets.[27] In March 1879, Milutin Tesla went to Maribor to beg his son to return home, but Nikola refused.[29] Nikola suffered a nervous breakdown at around the same time.[28]

On 24 March 1879, Tesla was returned to Gospić under police guard for not having a residence permit. On 17 April 1879, Milutin Tesla died at the age of 60 after contracting an unspecified illness[30] (although some sources say that he died of a stroke[31]). During that year, Tesla taught a large class of students in his old school, Higher Real Gymnasium, in Gospić.[30]


Tesla aged 23, c. 1879

In January 1880, two of Tesla's uncles put together enough money to help him leave Gospić for Prague where he was to study. Unfortunately, he arrived too late to enroll at Charles-Ferdinand University; he never studied Greek, a required subject; and he was illiterate in Czech, another required subject. Tesla did, however, attend lectures at the university, although, as an auditor, he did not receive grades for the courses.[32][33][34]

In 1881, Tesla moved to Budapest to work under Ferenc Puskas at a telegraph company, the Budapest Telephone Exchange. Upon arrival, Tesla realized that the company, then under construction, was not functional, so he worked as a draftsman in the Central Telegraph Office instead. Within a few months, the Budapest Telephone Exchange became functional and Tesla was allocated the chief electrician position.[35] During his employment, Tesla made many improvements to the Central Station equipment and claimed to have perfected a telephone repeater or amplifier, which was never patented nor publicly described.[23]

Working for Edison

In 1882, Tesla began working for the Continental Edison Company in France, designing and making improvements to electrical equipment.[36] In June 1884, he relocated to New York City[13]:57–60[37] where he was hired by Thomas Edison to work for his Edison Machine Works. Tesla's work for Edison began with simple electrical engineering and quickly progressed to solving more difficult problems.[38]

Tesla was offered the task of completely redesigning the Edison Company's direct current generators. In 1885, he said that he could redesign Edison's inefficient motor and generators, making an improvement in both service and economy. According to Tesla, Edison remarked, "There's fifty thousand dollars in it for you—if you can do it"[8]:54–57—this has been noted as an odd statement from an Edison whose company was stingy with pay and who did not have that sort of cash on hand.[1]:110 After months of work, Tesla fulfilled the task and inquired about payment. Edison, saying that he was only joking, replied, "Tesla, you don't understand our American humor."[13]:64[39] Instead, Edison offered a US$10 a week raise over Tesla's US$18 per week salary; Tesla refused the offer and immediately resigned.[8]

Middle years (1886–1899)

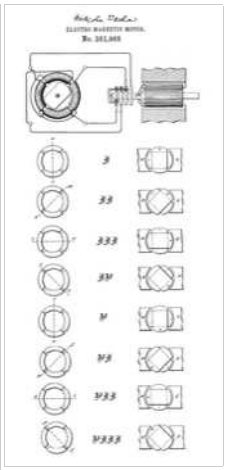
After leaving Edison's company Tesla partnered with two businessmen in 1886, Robert Lane and Benjamin Vale, who agreed to finance an electric lighting company in Tesla's name, Tesla Electric Light & Manufacturing.[40] The company installed electrical arc light based illumination systems designed by Tesla and also had designs for dynamo electric machine commutators, the first patents issued to Tesla in the US.[1]

The investors showed little interest in Tesla's ideas for new types of motors and electrical transmission equipment and also seemed to think it was better to develop an electrical utility than invent new systems.[41] They eventually forced Tesla out leaving him penniless. He even lost control of the patents he had generated since he had assigned them to the company in lieu of stock.[41] He had to work at various electrical repair jobs and even as a ditch digger for $2 per day. Tesla considered the winter of 1886/1887 as a time of "terrible headaches and bitter tears." During this time, he questioned the value of his education.[1][42]

AC and the induction motor

In late 1886 Tesla met Alfred S. Brown, a Western Union superintendent, and New York attorney Charles F. Peck. The two men were experienced in setting up companies and promoting inventions and patents for financial gain.[43] Based on Tesla's patents and other ideas they agreed to back him financially and handle his patents. Together in April 1887 they

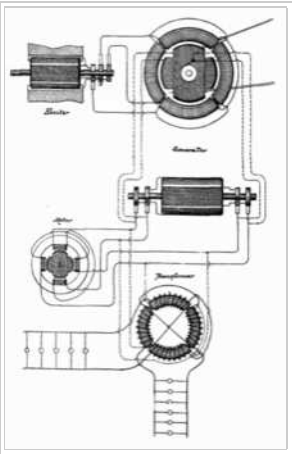
formed the Tesla Electric Company with an agreement that profits from generated patents would go 1/3 to Tesla, 1/3 to Peck and Brown, and 1/3 to fund development.[43] They set up a laboratory for Tesla at 89 Liberty Street in Manhattan where he worked on improving and developing new types of electric motors, generators and other devices.



Drawing from U.S. Patent 381,968 (https://www.google.com/patents/US381968), illustrating principle of Tesla's alternating current induction motor

One of the things Tesla developed at that laboratory in 1887 was an induction motor that ran on alternating current, a power system format that was starting to be built in Europe and the US because of its advantages in long distance high voltage transmission. The motor used polyphase current which generated a rotating magnetic field to turn the motor (a principle Tesla claimed to have conceived of in 1882).[44][45][46] This innovative electric motor, patented in May 1888, was a simple self-starting design that did not need a commutator, thus avoiding sparking and the high maintenance of constantly servicing and replacing mechanical brushes.[1]:161[47]

In 1888, the editor of *Electrical World* magazine, Thomas Commerford Martin (a friend and publicist), arranged for Tesla to demonstrate his alternating current system, including his induction motor, at the American Institute of Electrical Engineers (now IEEE).[48] Engineers working for the Westinghouse Electric & Manufacturing Company reported to George Westinghouse that Tesla had a viable AC motor and related power system—something to which Westinghouse had been trying to secure patents. Westinghouse looked into getting a patent on a similar commutatorless rotating magnetic field based induction motor presented in a paper in March 1888 by the Italian physicist Galileo Ferraris but decided Tesla's patent would probably control the market.[1]:160–162[49]



Nikola Tesla's AC dynamo-electric machine (AC Electric generator) in an 1888 U.S. Patent 390,721 (https://www.google.com/patents/US390721).

In July 1888, Brown and Peck negotiated a licensing deal with George Westinghouse for Tesla's polyphase induction motor and transformer designs for $60,000 in cash and stock and a royalty of $2.50 per AC horsepower produced by each motor. Westinghouse also hired Tesla for one year for the large fee of $2,000 ($52,500 in today's dollars[50]) per month to be a consultant at the Westinghouse Electric & Manufacturing Company's Pittsburgh labs.[51]

During that year, Tesla worked in Pittsburgh, helping to create an alternating current system to power the city's streetcars. He found the time there frustrating because of conflicts between him and the other Westinghouse engineers over how best to implement AC power. Between them, they settled on a 60-cycle AC current system Tesla proposed (to match the working frequency of Tesla's motor), although they soon found that, since Tesla's induction motor could only run at a constant speed, it would not work for street cars. They ended up using a DC traction motor instead.[52][53]

War of Currents

Tesla's demonstration of his induction motor and Westinghouse's subsequent licensing of the patent, both in 1888, put Tesla firmly on the "AC" side of the so-called "War of Currents,"[54] an electrical distribution battle being waged between Thomas Edison and George Westinghouse that had been simmering since Westinghouse's first AC system in 1886 and had reached the point of all out warfare by 1888.[55][56][57] This started out as a competition between rival lighting systems with Edison holding all the patents for DC and the incandescent light and Westinghouse using his own patented AC system to power arc lights as well as incandescent lamps of a slightly different design to get around the Edison patent.[58] The acquisition of a feasible AC motor gave Westinghouse a key patent in building a completely integrated AC system, but the financial strain of buying up patents and hiring the engineers needed to build it meant development of Tesla's motor had to be put on hold for a while.[59] The competition resulted in Edison Machine Works pursuing AC development in 1890 and by 1892 Thomas Edison was no longer in control of his own company, which was consolidated into the conglomerate General Electric and converting to an AC delivery system at that point.

The "Tesla Polyphase System"

At the beginning of 1893 Westinghouse engineer Benjamin Lamme had made great progress developing an efficient version of Tesla's induction motor and Westinghouse Electric started branding their complete polyphase phase AC system as the "Tesla Polyphase System", noting how they believed Tesla's patents gave them patent priority over other AC systems.[60]

A Westinghouse display of the "TESLA POLYPHASE SYSTEM" at Chicago's 1893 Columbian Exposition

In 1893, George Westinghouse won the bid to light the 1893 World's Columbian Exposition in Chicago with alternating current, beating out a General Electric bid by one million dollars.[61] This World's Fair devoted a building to electrical exhibits. It was a key event in the history of AC power, as Westinghouse demonstrated the safety, reliability, and efficiency of a fully integrated alternating current system to the American public.[62][63] At the Columbian Exposition, under a banner announcing the "Tesla Polyphase System", Tesla demonstrated a series of electrical effects previously performed throughout America and Europe,[8]:76 included using high-voltage, high-frequency alternating current to light a wireless gas-discharge lamp.[8]:79 An observer noted:

> Within the room was suspended two hard-rubber plates covered with tin foil. These were about fifteen feet apart, and served as terminals of the wires leading from the transformers. When the current was turned on, the lamps or tubes, which had no wires connected to them, but lay on a table between the suspended plates, or which might be held in the hand in almost any part of the room, were made luminous. These were the same experiments and the same apparatus shown by Tesla in London about two years previous, "where they produced so much wonder and astonishment".[64]

Tesla also explained the principles of the rotating magnetic field in an induction motor by demonstrating how to make a copper egg stand on end using a device he constructed known as the *Egg of Columbus*.[65]

Niagara and patents

In 1893 Richard Dean Adams, who headed up the Niagara Falls Cataract Construction Company sought Tesla's opinion on what system would be best to transmit power generated at the falls. Over several years there had been an off again - on again series of proposals and open competitions on how best to utilize power generated by the falls with many systems being proposed by several US and European companies including two phase and three phase AC, high voltage DC, and even compressed air. Adams pumped Tesla for information about the current state of all the competing systems, with Tesla advised Adams that a two phased system would be the most reliable and that there was a Westinghouse system to light incandescent bulbs using two phase alternating current. Based on Tesla's advice and Westinghouses demonstration that they could build a complete AC system at the Colombian Exposition, a contract for building a two phase AC generating system at the Niagara Falls was awarded to Westinghouse Electric. A further contract to build the AC distribution system was awarded to General Electric..[66]

The mid 1890s saw the conglomerate General Electric, backed by financier J. P. Morgan, involved in take over attempts and patent battles with Westinghouse Electric. Although a patent sharing agreement was signed between the two companies in 1896[67] Westinghouse was still cashed strapped from the financial warfare. To secure further loans Westinghouse was forced to revisit Tesla's AC patent, which bankers considered a financial strain on the company[68][69] (at that point Westinghouse had paid out an estimated $200,000 in licenses and royalties to Tesla, Brown, and Peck[70]). In 1897, Westinghouse explained his financial difficulties to Tesla in stark terms, saying that if things continue the way they were he would no longer be in control of Westinghouse Electric and Tesla would have to "deal with the bankers" to try to collect future royalties. Westinghouse convinced Tesla to release his company from the licensing agreement over Tesla's AC patents in exchange for Westinghouse Electric purchasing the patents for a lump sum payment of $216,000;[8]:73–74 this provided Westinghouse a break from what, due to alternating current's rapid gain in popularity, had turned out to be an overly generous $2.50 per AC horsepower royalty.[51]

American citizenship

On 30 July 1891, at the age of 35, Tesla became a naturalized citizen of the United States,[71] and established his South Fifth Avenue laboratory, and later another at 46 E. Houston Street, in New York. He lit electric lamps wirelessly at both locations, demonstrating the potential of wireless power transmission.[72] In the same year, he patented the Tesla coil.[73]

Tesla served as vice president of the American Institute of Electrical Engineers, the forerunner (along with the Institute of Radio Engineers) of the modern-day IEEE, from 1892 to 1894.[74]

X-ray experimentation

Starting in 1894, Tesla began investigating what he referred to as radiant energy of "invisible" kinds after he had noticed damaged film in his laboratory in previous experiments[75][76] (later identified as "*Roentgen rays*" or "X-Rays"). His early experiments were with Crookes tubes, a cold cathode electrical discharge tube. Soon after, much of Tesla's early research—hundreds of invention models, plans, notes, laboratory data, tools, photographs, valued at $50,000—was lost in the 5th Avenue laboratory fire of March 1895. Tesla is quoted by *The New York Times* as saying, "I am in too much grief to talk. What can I say?"[77] Tesla may have inadvertently captured an X-ray image (predating Wilhelm Röntgen's December 1895 announcement of the discovery of x-rays by a few weeks) when he tried to photograph Mark Twain illuminated by a Geissler tube, an earlier type of gas discharge tube. The only thing captured in the image was the metal locking screw on the camera lens.[8]:134


X-ray of a hand taken by Tesla.

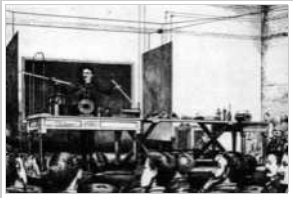
In March 1896, after hearing of Wilhelm Röntgen's discovery of X-ray and X-ray imaging (radiography),[78] Tesla proceeded to do his own experiments in X-ray imaging, developing a high energy single terminal vacuum tube of his own design that had no target electrode and that worked from the output of the Tesla Coil (the modern term for the phenomenon produced by this device is *bremsstrahlung* or *braking radiation*). In his research, Tesla devised several experimental setups to produce X-rays. Tesla held that, with his circuits, the "instrument will ... enable one to generate Roentgen rays of much greater power than obtainable with ordinary apparatus."[79]

Tesla noted the hazards of working with his circuit and single-node X-ray-producing devices. In his many notes on the early investigation of this phenomenon, he attributed the skin damage to various causes. He believed early on that damage to the skin was not caused by the Roentgen rays, but by the ozone generated in contact with the skin, and to a lesser extent, by nitrous acid. Tesla incorrectly believed that X-rays were longitudinal waves, such as those produced in waves in plasma. These plasma waves can occur in force-free magnetic fields.[80][81]

On 11 July 1934, the *New York Herald Tribune* published an article on Tesla, in which he recalled an event that would occasionally take place while experimenting with his single-electrode vacuum tubes; a minute particle would break off the cathode, pass out of the tube, and physically strike him. "Tesla said he could feel a sharp stinging pain where it entered his body, and again at the place where it passed out." In comparing these particles with the bits of metal projected by his "electric gun," Tesla said, "The particles in the beam of force ... will travel much faster than such particles ... and they will travel in concentrations."[82]

Radio

Tesla's theories on the possibility of the transmission by radio waves go back as far as lectures and demonstrations in 1893 in St. Louis, Missouri, the Franklin Institute in Philadelphia, Pennsylvania, and the National Electric Light Association.[83] Tesla's demonstrations and principles were written about widely through various media outlets.[84] Many devices such as the Tesla Coil were used in the further development of radio.[85]



Wireless transmission of power and energy demonstration during his 1891 lecture on high frequency and potential.

In 1898, Tesla demonstrated a radio-controlled boat (U.S. Patent 613,809 (https://www.google.com/patents/US613809) — *Method of an Apparatus for Controlling Mechanism of Moving Vehicle or Vehicles*).

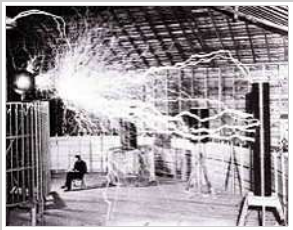
Tesla's radio wave experiments in 1896 were conducted in Gerlach Hotel (later renamed The Radio Wave building), where he resided.[86]

In 1898, Tesla demonstrated a radio-controlled boat—which he dubbed "teleautomaton"—to the public during an electrical exhibition at Madison Square Garden.[1] The crowd that witnessed the demonstration made outrageous claims about the workings of the boat, such as magic, telepathy, and being piloted by a trained monkey hidden inside.[87] Tesla tried to sell his idea to the U.S. military as a type of radio-controlled torpedo, but they showed little interest.[88] Remote radio control remained a novelty until World War I and afterward, when a number of countries used it in military programs.[89] Tesla took the opportunity to further demonstrate "Teleautomatics" in an address to a meeting of the Commercial Club in Chicago, whilst he was travelling to Colorado Springs, on 13 May 1899.[21]

In 1900, Tesla was granted patents for a "system of transmitting electrical energy" and "an electrical transmitter." When Guglielmo Marconi made his famous first-ever transatlantic radio transmission in 1901, Tesla quipped that it was done with 17 Tesla patents. This was the beginning of years of patent battles over radio with Tesla's patents being upheld in 1903, followed by a reverse decision in favor of Marconi in 1904. In 1943, a Supreme Court of the United States decision restored the prior patents of Tesla, Oliver Lodge, and John Stone.[90] The court declared that their decision had no bearing on Marconi's claim as the first to achieve radio transmission, just that since Marconi's claim to certain patents were questionable, he could not claim infringement on those same patents[91] (there are claims the high court was trying to nullify a World War I claim against the U.S. government by the Marconi Company via simply restoring Tesla's prior patent).[90]

Colorado Springs

On 17 May 1899, Tesla moved to Colorado Springs, where he would have room for his high-voltage, high-frequency experiments;[21] his lab was located near Foote Ave. and Kiowa St.[93] He chose this location because the polyphase alternating current power distribution system had been introduced there and he had associates who were willing to give him all the power he needed without charging for it.[94] Upon his arrival, he told reporters that he was conducting wireless telegraphy experiments, transmitting signals from Pikes Peak to Paris. The 1978 book *Colorado Springs Notes, 1899–1900* contains descriptions of Tesla's experiments.



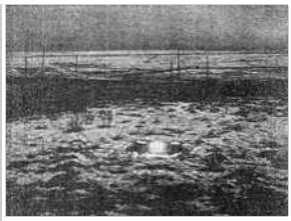
A multiple exposure picture (one of 68 Colorado Springs images created by of *Century Magazine* photographer Dickenson Alley) of Tesla sitting in his laboratory with his "Magnifying transmitter" generating millions of volts. The 7-metre (23 ft) long arcs were not part of the normal operation and were produced for effect by rapidly cycling the power switch[92]

On 15 June 1899, Tesla performed his first experiments at his Colorado Springs lab; he recorded his initial spark length at five inches long, but very thick and noisy.[21]

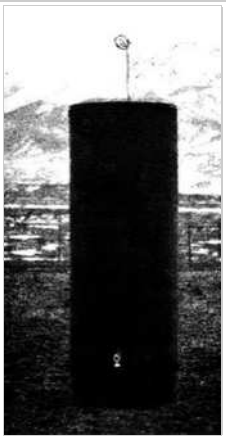
Tesla investigated atmospheric electricity, observing lightning signals via his receivers. Tesla stated that he observed stationary waves during this time.[95] The great distances and the nature of what Tesla was detecting from lightning storms confirmed his belief that the earth had a resonant frequency.[96][97]

He produced artificial lightning (with discharges consisting of millions of volts and up to 135 feet long).[98] Thunder from the released energy was heard 15 miles away in Cripple Creek, Colorado. People walking along the street observed sparks jumping between their feet and the ground. Sparks sprang from water line taps when touched. Light bulbs within 100 feet of the lab glowed even when turned off. Horses in a livery stable bolted from their stalls after receiving shocks through their metal shoes. Butterflies were electrified, swirling in circles with blue halos of St. Elmo's fire around their wings.[99]

While experimenting, Tesla inadvertently faulted a power station generator, causing a power outage. In August 1917, Tesla explained what had happened in *The Electrical Experimenter*: "As an example of what has been done with several hundred kilowatts of high frequency energy liberated, it was found that the dynamos in a power house six miles away were repeatedly burned out, due to the powerful high frequency currents set up in them, and which caused heavy sparks to jump through the windings and destroy the insulation!"[100]



Another Alley photograph at Colorado Springs documenting 3 lights receiving power by means of electrodynamic induction from an oscillator 60 feet (18 m) from the bulbs (placed on the ground outside the building to demonstrate they had no connection to the power source)[92]



An Alley Colorado Springs photo of a grounded tuned coil in resonance with a transmitter illuminates a light near the bottom of the picture.[101] Tesla did not disclose how far away the transmitter was.[92][101]

During his time at his lab, Tesla observed unusual signals from his receiver which he concluded may be communications from another planet. He mentioned them in a letter to reporter Julian Hawthorne at the Philadelphia North American on 8 December 1899[102] and in a December 1900 letter about possible discoveries in the new century to the Red Cross Society where he referred to messages "from another world" that read "1... 2... 3...".[103][104] Reporters treated it as a sensational story and jumped to the conclusion Tesla was hearing signals from Mars.[105] He expanded on the signals he heard in a 9 February 1901 Collier's Weekly article "Talking With Planets" where he said it had not been immediately apparent to him that he was hearing "intelligently controlled signals" and that the signals could come from Mars, Venus, or other planets.[106] It has been hypothesized that he may have intercepted Marconi's European experiments in July 1899—Marconi may have transmitted the letter S (dot/dot/dot) in a naval demonstration, the same three impulses that Tesla hinted at hearing in Colorado[107]—or signals from another experimenter in wireless transmission.[108]

In 1899, John Jacob Astor IV invested $100,000 for Tesla to further develop and produce a new lighting system. Instead, Tesla used the money to fund his Colorado Springs experiments.[109]

On 7 January 1900, Tesla left Colorado Springs. His lab was torn down in 1904, and its contents were sold two years later to satisfy a debt.[110][111]

The Colorado experiments had prepared Tesla for the establishment of the trans-Atlantic wireless telecommunications facility known as Wardenclyffe near Shoreham, Long Island.[112]

Wardenclyffe years (1900–1917)

In 1900, with $150,000 ($4,252,200 in today's dollars[50]; 51% from J. Pierpont Morgan), Tesla began planning the Wardenclyffe Tower facility.[113]

TESLA READY FOR BUSINESS.

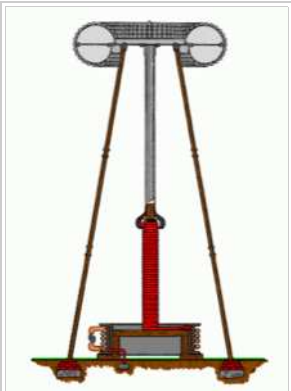
HE HAS BOUGHT THE LAND FOR HIS WIRELESS TELEGRAPHY STATION AND LET THE CONTRACTS FOR THE BUILDINGS.

Nikola Tesla's plans for a transatlantic wireless telegraphic system are now so well in hand that he has bought a site for the station on the Long Island shore, and has agents looking for a suitable place for a station on the British coast. The station in this country will be at Wardenclyffe, on the

Tesla Ready for Business – 7 August 1901 New-York tribune article

Tesla later approached Morgan to ask for more funds to build a more powerful transmitter. When asked where all the money had gone, Tesla responded by saying that he was affected by the Panic of 1901, which he (Morgan) had caused. Morgan was shocked by the reminder of his part in the stock market crash and by Tesla's breach of contract by asking for more funds. Tesla wrote another plea to Morgan, but it was also fruitless. Morgan still owed Tesla money on the original agreement, and Tesla had been facing foreclosure even before construction of the tower began.[108]

In December 1901, Marconi successfully transmitted the letter S from England to Newfoundland, terminating Tesla's relationship with Morgan. Over the next five years, Tesla wrote over 50 letters to Morgan, pleading for and demanding additional funding to complete the construction of Wardenclyffe. Tesla continued the project for another nine months. The tower was erected to its full 187 feet (57 m).[108] In July 1903, Tesla wrote to Morgan that in addition to wireless communication, Wardenclyffe would be capable of wireless transmission of electric power.[113] On 14 October 1904, Morgan finally replied through his secretary, stating, "It will be impossible for [me] to do anything in the matter," after Tesla had written to Morgan when the financier was meeting with the Archbishop of Canterbury in an attempt to appeal to his Christian spirit.[108]



The Tesla coil wireless transmitter **U.S. Patent 1,119,732 (https://www.google.com/patents/US1119732)**

In June 1902, Tesla's lab operations were moved to Wardenclyffe from Houston Street.[113]

On his 50th birthday in 1906, Tesla demonstrated his 200 horsepower (150 kilowatts) 16,000 rpm bladeless turbine. During 1910–1911 at the *Waterside Power Station* in New York, several of his bladeless turbine engines were tested at 100–5,000 hp.[114]

Tesla invented a steam-powered mechanical oscillator—Tesla's oscillator. While experimenting with mechanical oscillators at his Houston Street lab, Tesla allegedly generated a resonance of several buildings. As the speed grew, it is said that the machine oscillated at the resonance frequency of his own building and, belatedly realizing the danger, he was forced to use a sledge hammer to terminate the experiment, just as the police arrived.[13]:162–164 In February 1912, an article—"Nikola Tesla, Dreamer" by Allan L. Benson—was published in *World Today*, in which an artist's illustration appears showing the entire earth cracking in half with the caption, "Tesla claims that

in a few weeks he could set the earth's crust into such a state of vibration that it would rise and fall hundreds of feet and practically destroy civilization. A continuation of this process would, he says, eventually split the earth in two."[82]

Tesla theorized that the application of electricity to the brain enhanced intelligence. In 1912, he crafted "a plan to make dull students bright by saturating them unconsciously with electricity," wiring the walls of a schoolroom and, "saturating [the schoolroom] with infinitesimal electric waves vibrating at high frequency. The whole room will thus, Mr. Tesla claims, be converted into a health-giving and stimulating electromagnetic field or 'bath.'"[115] The plan was, at least provisionally approved by then superintendent of New York City schools, William H. Maxwell. [115]

Tesla's Wardenclyffe plant on Long Island in 1904. From this facility, Tesla hoped to demonstrate wireless transmission of electrical energy across the Atlantic.

Before World War I, Tesla sought overseas investors. After the war started, Tesla lost the funding he was receiving from his patents in European countries. Eventually, he sold Wardenclyffe for $20,000 ($470,900 in today's dollars[50]).[113] In 1917, around the time that the Wardenclyffe Tower was demolished by Boldt to make the land a more viable real estate asset, Tesla received AIEE's highest honor, the Edison Medal.[116]

In the August 1917 edition of the magazine Electrical Experimenter Tesla postulated that electricity could be used to locate submarines via using the reflection of an "electric ray" of "tremendous frequency," with the signal being viewed on a fluorescent screen (a system that has been noted to have a superficial resemblance to modern radar).[117] Tesla was incorrect in his assumption that high frequency radio waves would penetrate water[118] but Émile Girardeau, who helped develop France's first radar system in the 1930s, noted in 1953 that Tesla's general speculation that a very strong high frequency signal would be needed was correct stating "*(Tesla) was prophesying or dreaming, since he had at his disposal no means of carrying them out, but one must add that if he was dreaming, at least he was dreaming correctly*."[8] :266[119]

Nobel Prize rumors

On 6 November 1915, a Reuters news agency report from London had the 1915 Nobel Prize in Physics awarded to Thomas Edison and Nikola Tesla; however, on 15 November, a Reuters story from Stockholm stated the prize that year was being awarded to Sir William Henry Bragg and William Lawrence Bragg "for their services in the analysis of crystal structure by means of X-rays."[8]:245[120][121] There were unsubstantiated rumors at the time that Tesla and/or Edison had refused the prize.[8]:245 The Nobel Foundation said, "Any rumor that a person has not been given a Nobel Prize because he has made known his intention to refuse the reward is ridiculous"; a recipient could only decline a Nobel Prize after he is announced a winner.[8]:245

There have been subsequent claims by Tesla biographers that Edison and Tesla were the original recipients and that neither was given the award because of their animosity toward each other; that each sought to minimize the other's achievements and right to win the award; that both refused ever to accept the award if the other received it first; that both rejected any possibility of sharing it; and even that a wealthy Edison refused it to keep Tesla from getting the $20,000 prize money.[8]:245[19][122]

In the years after these rumors, neither Tesla nor Edison won the prize (although Edison did receive one of 38 possible bids in 1915 and Tesla did receive one of 38 possible bids in 1937).[123]

Later years (1918–1943)

In 1928, Tesla received his last patent, U.S. Patent 1,655,114 (https://www.google.com/patents/US1655114), for a biplane capable of taking off vertically (VTOL aircraft) and then be "*gradually tilted through manipulation of the elevator devices*" in flight until it was flying like a conventional plane.[124] Tesla thought the plane would sell for less than $1,000.[8]:251 Although the aircraft was probably impractical, it may be the earliest known design for what became the tiltrotor/tilt-wing concept as well as the earliest proposal for the use of turbine engines in rotor aircraft.[125]

Starting in 1934, the Westinghouse Electric & Manufacturing Company began paying Tesla $125 per month as well as paying his rent at the Hotel New Yorker, expenses the Company would pay for the rest of Tesla's life. Accounts on how this came about vary. Several sources say Westinghouse was worried about potential bad publicity surrounding the impoverished conditions their former star inventor was living under.[1] :365[126][127] It has been described as being couched in the form of a "consulting fee" to get around Tesla's aversion to accept charity, or by one biographer (Marc Seifer), as a type of unspecified settlement.[127]

In 1935, in an annual birthday celebration interview, Tesla announced a method of transmitting mechanical energy with minimal loss over any terrestrial distance, a related new means of communication, and a method of accurately determining the location of underground mineral deposits. [82]

In the fall of 1937, after midnight one night, Tesla left the Hotel New Yorker to make his regular commute to the cathedral and the library to feed the pigeons. While crossing a street a couple of blocks from the hotel, Tesla was unable to dodge a moving taxicab and was thrown heavily to the ground. Tesla's back was severely wrenched and three of his ribs were broken in the accident (the full extent of his injuries will never be known;

Tesla refused to consult a doctor—an almost lifelong custom). Tesla didn't raise any question as to who was at fault and refused medical aid, only asking to be taken to his hotel via cab. Tesla was bedridden for some months and was unable to continue feeding pigeons from his window; soon, they failed to come. In the spring of 1938, Tesla was able to get up. He at once resumed the pigeon-feeding walks on a much more limited scale, but frequently had a messenger act for him.[13]

Directed-energy weapon

Later in life, Tesla made claims concerning a "teleforce" weapon after studying the Van de Graaff generator.[128][129] The press called it a "peace ray" or death ray.[130][131] Tesla described the weapon as being able to be used against ground-based infantry or for antiaircraft purposes.

Tesla gives the following description concerning the particle gun's operation:

> [The nozzle would] send concentrated beams of particles through the free air, of such tremendous energy that they will bring down a fleet of 10,000 enemy airplanes at a distance of 200 miles from a defending nation's border and will cause armies to drop dead in their tracks.[132][133]

In total, the components and methods included:

- An apparatus for producing manifestations of energy in free air instead of in a high vacuum as in the past.
- A mechanism for generating tremendous electrical force.
- A means of intensifying and amplifying the force developed by the second mechanism.
- A new method for producing a tremendous electrical repelling force. This would be the projector, or gun, of the invention.[134][135][136]

Tesla claimed to have worked on plans for a directed-energy weapon from the early 1900s until his death.[137][138]

In 1937, at a luncheon in his honor concerning the death ray, Tesla stated, "But it is not an experiment ... I have built, demonstrated and used it. Only a little time will pass before I can give it to the world." His records indicate that the device is based on a narrow stream of small tungsten pellets that are accelerated via high voltage (by means akin to his magnifying transformer).[129]

During the same year, Tesla wrote a treatise, *The Art of Projecting Concentrated Non-dispersive Energy through the Natural Media*,[139] concerning charged particle beam weapons.[140] Tesla published the document in an attempt to expound on the technical description of a "superweapon that would put an end to all war." This treatise is currently in the Nikola Tesla Museum archive in Belgrade. It describes an open-ended vacuum tube with a gas jet seal that allows particles to exit, a method of charging particles to millions of volts, and a method of creating and directing non-dispersive particle streams (through electrostatic repulsion).[140] Tesla tried to interest the US War Department,[141] the United Kingdom, the Soviet Union, and Yugoslavia in the device.[142]

During the period in which the negotiations were being carried on, Tesla said that efforts had been made to steal the invention. His room had been entered and his papers had been scrutinized, but the thieves, or spies, left empty-handed. He said that there was no danger that his invention could be stolen, for he had at no time committed any part of it to paper. The blueprint for the teleforce weapon was all in his mind.[143]

Death

On 7 January 1943, Tesla, 86, died alone in room 3327 of the New Yorker Hotel. His body was later found by maid Alice Monaghan after she had entered Tesla's room, ignoring the "do not disturb" sign that Tesla had placed on his door two days earlier. Assistant medical examiner H.W. Wembly examined the body and ruled that the cause of death had been coronary thrombosis.[22] Tesla's remains were taken to the Frank E. Campbell Funeral Home at Madison Ave. and 81st St. A long-time friend and supporter of Tesla, Hugo Gernsback, commissioned a sculptor to create a death mask, now displayed in the Nikola Tesla Museum.[22]

Gilded urn with Tesla's ashes, in his favorite geometrical object, a sphere, Nikola Tesla Museum, Belgrade.

Two days later, the FBI ordered the Alien Property Custodian to seize Tesla's belongings,[22] even though Tesla was an American citizen.[71] Tesla's entire estate from the Hotel New Yorker and other New York City hotels was transported to the Manhattan Storage and Warehouse Company under Office of Alien Property (OAP) seal.[22] John G. Trump, a professor at M.I.T. and well-known electrical engineer serving as a technical aide to the National Defense Research Committee, was called in to analyze the Tesla items in OAP custody.[22] After a three-day investigation, Trump's report concluded that there was nothing that would constitute a hazard in unfriendly hands, stating:

> [Tesla's] thoughts and efforts during at least the past 15 years were primarily of a speculative, philosophical, and somewhat promotional character often concerned with the production and wireless transmission of power; but did not include new, sound, workable principles or methods for realizing such results.[144]

In a box purported to contain a part of Tesla's "death ray," Trump found a 45-year-old multidecade resistance box.[145]

On 10 January 1943, New York City mayor Fiorello La Guardia read a eulogy written by Slovene-American author Louis Adamic live over the WNYC radio while violin pieces "Ave Maria" and "Tamo daleko" were played in the background.[22] On 12 January 2,000 people attended a state funeral for Tesla at the Cathedral of Saint John the Divine. After the funeral, Tesla's body was taken to the Ferncliff Cemetery in Ardsley, New York, where it was later cremated. The following day, a second service was conducted by prominent priests in the Trinity Chapel (today's Serbian Orthodox Cathedral of Saint Sava) in New York City.[22]

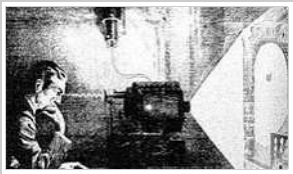
Estate

In 1952, following pressure from Tesla's nephew, Sava Kosanović, Tesla's entire estate was shipped to Belgrade in 80 trunks marked N.T.[21] In 1957, Kosanović's secretary Charlotte Muzar transported Tesla's ashes from the United States to Belgrade.[21] The ashes are displayed in a gold-plated sphere on a marble pedestal in the Nikola Tesla Museum.[146]

Despite having sold his AC electricity patents, Tesla died impoverished and in debt.[147][148][149][150]

Patents

Tesla obtained around 300 patents worldwide for his inventions.[151] Some of Tesla's patents are not accounted for, and various sources have discovered some that have lain hidden in patent archives. There are a minimum of 278 patents[151] issued to Tesla in 26 countries that have been accounted for. Many of Tesla's patents were in the United States, Britain, and Canada, but many other patents were approved in countries around the globe.[8]:62 Many inventions developed by Tesla were not put into patent protection.



Newspaper representation of Tesla's theoretical invention, the thought camera, which would photograph thoughts. Circa 1933.

Personal life

Tesla worked every day from 9:00 a.m. until 6:00 p.m. or later, with dinner from exactly 8:10 p.m., at Delmonico's restaurant and later the Waldorf-Astoria Hotel. Tesla would telephone his dinner order to the headwaiter, who also could be the only one to serve him. "The meal was required to be ready at eight o'clock ... He dined alone, except on the rare occasions when he would give a dinner to a group to meet his social obligations. Tesla would then resume his work, often until 3:00 a.m."[13]:283, 286

For exercise, Tesla walked between 8 to 10 miles per day. He squished his toes one hundred times for each foot every night, saying that it stimulated his brain cells.[152]

In an interview with newspaper editor Arthur Brisbane, Tesla said that he did not believe in telepathy, stating, "Suppose I made up my mind to murder you," he said, "In a second you would know it. Now, isn't that wonderful? By what process does the mind get at all this?" In the same interview, Tesla said that he believed that all fundamental laws could be reduced to one.[153]

Near the end of his life, Tesla walked to the park every day to feed the pigeons and even brought injured ones into his hotel room to nurse back to health.[154][155] He said that he had been visited by a specific injured white pigeon daily. Tesla spent over $2,000, including building a device that comfortably supported her so her bones could heal, to fix her broken wing and leg.[27] Tesla stated,

> I have been feeding pigeons, thousands of them for years. But there was one, a beautiful bird, pure white with light grey tips on its wings; that one was different. It was a female. I had only to wish and call her and she would come flying to me. I loved that pigeon as a man loves a woman, and she loved me. As long as I had her, there was a purpose to my life.[156][157]

Tesla became a vegetarian in his later years, living on only milk, bread, honey, and vegetable juices.[129][158]

Appearance

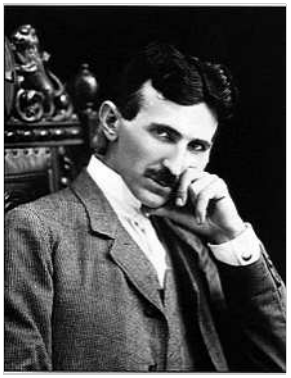
Tesla was 6 ft 2 in (1.88 m) tall and weighed 142 pounds (64 kg), with almost no weight variance from 1888 to about 1926.[13]:292 He was an elegant, stylish figure in New York City, meticulous in his grooming, clothing, and regimented in his daily activities.

> This was not because of personal vanity. Neatness and fastidiousness in clothes were entirely in harmony with every other phase of his personality. He did not maintain a large wardrobe and he wore no jewelry of any kind ... He observed, however, that in the matter of clothes the world takes a man at his own valuation, as expressed in his appearance, and frequently eases his way to his objective through small courtesies not extended to less prepossessing individuals.[13]:289

Arthur Brisbane, a newspaper editor for the *New York World*, described Tesla's appearance:

> Nikola Tesla is almost the tallest, almost the thinnest and certainly the most serious man who goes to Delmonico's regularly ... He has eyes set very far back in his head. They are rather light. I asked him how he could have such light eyes and be a Slav. He told me that his eyes were once much darker, but that using his mind a great deal had made them many shades lighter. I have often heard it said that using the brain makes the eyes lighter in color. Tesla's confirmation of the theory through his personal experience is important.
>
> He is very thin, is more than six feet tall and weighs less than a hundred and forty pounds. He has very big hands. Many able men do—Lincoln is one instance. His thumbs are remarkably big, even for such big hands. They are extraordinarily big. This is a good sign. The thumb is the intellectual part of the hand. The apes have very small thumbs. Study them and you will notice this.
>
> Nikola Tesla has a head that spreads out at the top like a fan. His head is shaped like a wedge. His chin is as pointed as an ice-pick. His mouth is too small. His chin, though not weak, is not strong enough. His face cannot be studied and judged like the faces of other men, for he is not a worker in practical fields. He lives his life up in the top of his head, where ideas are born, and up there he has plenty of room. His hair is jet black and curly. He stoops—most men do when they have no peacock blood in them. He lives inside of himself. He takes a profound interest in his own work. He has that supply of self-love and self-confidence which usually goes with success. And he differs from most of the men who are written and talked about in the fact that he has something to tell.[153]

Tesla's portrait – Blue Portrait – from 1916, painted by then-Hungarian princess, Vilma Lwoff-Parlaghy.



Tesla, aged 40. c. 1896

Eidetic memory

Tesla read many works, memorizing complete books, and supposedly possessed a photographic memory.[8]:33 He was a polyglot, speaking eight languages: Serbo-Croatian, Czech, English, French, German, Hungarian, Italian, and Latin.[13]:282 Tesla related in his autobiography that he experienced detailed moments of inspiration. During his early life, Tesla was stricken with illness time and time again. He suffered a peculiar affliction in which blinding flashes of light would appear before his eyes, often accompanied by visions. Often, the visions were linked to a word or idea he might have come across; at other times they would provide the solution to a particular problem he had encountered. Just by hearing the name of an item, he would be able to envision it in realistic detail. Tesla would visualize an invention in his mind with extreme precision, including all dimensions, before moving to the construction stage, a technique sometimes known as picture thinking. He typically did not make drawings by hand but worked from memory. Beginning in his childhood, Tesla had frequent flashbacks to events that had happened previously in his life.[8]:33

Sleep habits

Tesla claimed to never sleep more than two hours.[13]:46 However, Tesla did admit to "dozing" from time to time "to recharge his batteries."[152]

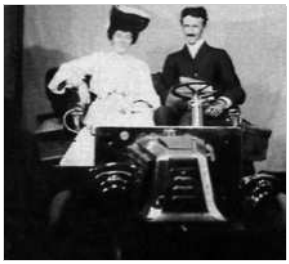
During his second year of study at Graz, Tesla developed a passion for (and became very proficient at) billiards, chess and card-playing, sometimes spending more than 48 hours in a stretch at a gaming table.[13]:43, 301 On one occasion at his laboratory, Tesla worked for a period of 84 hours without sleep or rest.[13]:208

Kenneth Swezey, a journalist whom Tesla had befriended, confirmed that Tesla rarely slept. Swezey recalled one morning when Tesla called him at 3 a.m.: "I was sleeping in my room like one dead ... Suddenly, the telephone ring awakened me ... [Tesla] spoke animatedly, with pauses, [as he] ... work[ed] out a problem, comparing one theory to another, commenting; and when he felt he had arrived at the solution, he suddenly closed the telephone."[152]

Relationships

Tesla never married, saying that his chastity was very helpful to his scientific abilities.[8]:33 However, toward the end of his life, he told a reporter, "Sometimes I feel that by not marrying, I made too great a sacrifice to my work ..."[27] There have been numerous accounts of women vying for Tesla's affection, even some madly in love with him. Tesla, though polite and soft-spoken, did not have any known relationships.

Tesla was asocial, and prone to seclude himself with his work.[159][160][1][161] However, when he did engage in a social life, many people spoke very positively and admiringly of Tesla. Robert Underwood Johnson described him as attaining a "distinguished sweetness, sincerity, modesty, refinement, generosity, and force."[27] His loyal secretary, Dorothy Skerrit, wrote: "his genial smile and nobility of bearing always denoted the gentlemanly characteristics that were so ingrained in his soul."[13] Tesla's friend, Julian Hawthorne, wrote, "seldom did one meet a scientist or engineer who was also a poet, a philosopher, an appreciator of fine music, a linguist, and a connoisseur of food and drink."


Tesla with an unknown woman

Tesla was a good friend of Robert Underwood Johnson,[162] Francis Marion Crawford, Stanford White,[163] Fritz Lowenstein, George Scherff, and Kenneth Swezey.[164][165][166] In middle age, Tesla became a close friend of Mark Twain. They spent a lot of time together in his lab and elsewhere.[162] Twain notably described Tesla's induction motor invention as "the most valuable patent since the telephone."[167] In the late 1920s, Tesla befriended George Sylvester Viereck, a poet, writer, mystic, and later, a Nazi propagandist. Tesla occasionally attended dinner parties held by Viereck and his wife.[168][169]


Mark Twain in Tesla's lab, early 1894

Tesla could be harsh at times, openly expressing disgust for overweight people, such as when he fired a secretary because of her weight.[8]:110 He was quick to criticize clothing. On several occasions, Tesla directed a subordinate to go home and change her dress.[8]:33

When Thomas Edison died in 1931, Tesla contributed the only negative opinion to the *New York Times*, buried in an extensive coverage of Edison's life:

> He had no hobby, cared for no sort of amusement of any kind and lived in utter disregard of the most elementary rules of hygiene ... His method was inefficient in the extreme, for an immense ground had to be covered to get anything at all unless blind chance intervened and, at first, I was almost a sorry witness of his doings, knowing that just a little theory and calculation would have saved him 90 percent of the labor. But he had a veritable contempt for book learning and mathematical knowledge, trusting himself entirely to his inventor's instinct and practical American sense.[170]

On experimental and theoretical physics

Tesla exhibited a pre-atomic understanding of physics in his writings;[171] he disagreed with the theory of atoms being composed of smaller subatomic particles, stating there was no such thing as an electron creating an electric charge (he believed that if electrons existed at all, they were some fourth state of matter or "sub-atom" that could only exist in an experimental vacuum and that they had nothing to do with electricity).[13]:249[172] Tesla believed that atoms are immutable—they could not change state or be split in any way. He was a believer in the 19th century concept of an all pervasive "ether" that transmitted electrical energy.[173]

Tesla was generally antagonistic towards theories about the conversion of matter into energy.[13]:247 He was also critical of Einstein's theory of relativity, saying:

> I hold that space cannot be curved, for the simple reason that it can have no properties. It might as well be said that God has properties. He has not, but only attributes and these are of our own making. Of properties we can only speak when dealing with matter filling the space. To say that in the presence of large bodies space becomes curved is equivalent to stating that something can act upon nothing. I, for one, refuse to subscribe to such a view.[174]

Tesla claimed to have developed his own physical principle regarding matter and energy that he started working on in 1892,[13] and in 1937, at age 81, claimed in a letter to have completed a "dynamic theory of gravity" that *"[would] put an end to idle speculations and false conceptions, as that of curved space."*[175] He stated that the theory was "worked out in all details" and that he hoped to soon give it to the world.[176] Further elucidation of his theory was never found in his writings.[8]:309

On society

Tesla, like many of his era, became a proponent of an imposed selective breeding version of eugenics. His opinion stemmed from the belief that humans' "pity" had interfered with the natural "ruthless workings of nature," rather than from conceptions of a "master race" or inherent superiority of one person over another. His advocacy of it was, however, to push it further. In a 1937 interview, he stated:

> ... man's new sense of pity began to interfere with the ruthless workings of nature. The only method compatible with our notions of civilization and the race is to prevent the breeding of the unfit by sterilization and the deliberate guidance of the mating instinct ... The trend of opinion among eugenists is that we must make marriage more difficult. Certainly no one who is not a desirable parent should be permitted to produce progeny. A century from now it will no more occur to a normal person to mate with a person eugenically unfit than to marry a habitual criminal.[177]

In 1926, Tesla commented on the ills of the social subservience of women and the struggle of women toward gender equality, indicated that humanity's future would be run by "Queen Bees." He believed that women would become the dominant sex in the future.[178]

Tesla is widely considered by his biographers as a humanist regarding his worldview.[1]:154[179][180][181][182]

Tesla made predictions about the relevant issues of a post-World War I environment in a printed article, "Science and Discovery are the great Forces which will lead to the Consummation of the War" (20 December 1914).[183] Tesla believed that the League of Nations was not a remedy for the times and issues.

On religion

Tesla was raised as an Orthodox Christian. Later in his life, he did not consider himself to be a "believer in the orthodox sense," and opposed religious fanaticism.[184] Despite this, he had a profound respect for both Buddhism and Christianity.[23][184]

In his article, "The Problem of Increasing Human Energy," published in 1900, Tesla stated:

> For ages this idea [that each of us is only part of a whole] has been proclaimed in the consummately wise teachings of religion, probably not alone as a means of insuring peace and harmony among men, but as a deeply founded truth. The Buddhist expresses it in one way, the Christian in another, but both say the same: We are all one.[185]

However, his religious views remain uncertain due to other statements that he made.[186][187][188] For example, in his article, "A Machine to End War", published in 1937, Tesla stated:

> There is no conflict between the ideal of religion and the ideal of science, but science is opposed to theological dogmas because science is founded on fact. To me, the universe is simply a great machine which never came into being and never will end. The human being is no exception to the natural order. Man, like the universe, is a machine. Nothing enters our minds or determines our actions which is not directly or indirectly a response to stimuli beating upon our sense organs from without. Owing to the similarity of our construction and the sameness of our environment, we respond in like manner to similar stimuli, and from the concordance of our reactions, understanding is born. In the course of ages, mechanisms of infinite complexity are developed, but what we call "soul" or "spirit," is nothing more than the sum of the functionings of the body. When this functioning ceases, the "soul" or the "spirit" ceases likewise.[184]

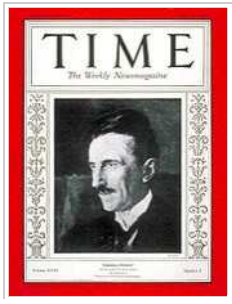
Literary works

Nikola Tesla on 100 Serbian dinar banknote

Tesla wrote a number of books and articles for magazines and journals.[189] Among his books are *My Inventions: The Autobiography of Nikola Tesla*, compiled and edited by Ben Johnston; *The Fantastic Inventions of Nikola Tesla*, compiled and edited by David Hatcher Childress; and *The Tesla Papers*.

Many of Tesla's writings are freely available on the web,[190][191][192] including the article "The Problem of Increasing Human Energy," published in *The Century Magazine* in 1900,[193][194] and the article "Experiments With Alternate Currents Of High Potential And High Frequency," published in his book *Inventions, Researches and Writings of Nikola Tesla*.[195][196]

Legacy and honors



Tesla's legacy has endured in books, films, radio, TV, music, live theater, comics and video games. The lack of recognition received during his own lifetime has cast him as a tragic and inspirational character, well suited to dramatic fiction. The impact of the technologies invented or envisioned by Tesla is a recurring theme in several types of science fiction.

For example, on Tesla's 75th birthday in 1931, *Time* magazine put him on its cover.[197] The cover caption "All the world's his power house" noted his contribution to electrical power generation. He received congratulatory letters from more than 70 pioneers in science and engineering, including Albert Einstein.[198]

Things named after Tesla

Tesla on cover of *Time Magazine* for 20 July 1931.

- The Tesla Society, founded in 1956.[199]
- Tesla, a 26 kilometer-wide crater on the far side of the moon.[200]
- 2244 Tesla, a minor planet.[200]
- Tesla, an SI-derived unit of magnetic flux density (or magnetic inductivity)
- TPP Nikola Tesla, the largest power plant in Serbia.
- Tesla, an electrotechnical conglomerate in the former Czechoslovakia.
- Tesla Motors, an electric car company.[201]
- The Belgrade Nikola Tesla Airport.[202]
- The Nikola Tesla Award[203]
- The Nikola Tesla Museum Archive in Belgrade[204][205]
- Nikola Tesla Day in Croatia, 10 July
- In 2008, a total of 128 streets in Croatia were named after Nikola Tesla, making him the eighth most common person eponym of streets in the country.[206]

Nikola Tesla Museum in Belgrade, Serbia

Plaques and memorials

- The Nikola Tesla Memorial Centre in Smiljan, Croatia, opened in 2006. It features a statue of Tesla designed by sculptor Mile Blažević.[12][207][208]
- On 7 July 2006, on the corner of Masarykova and Preradovićeva streets in the Lower Town area in Zagreb, Croatia, a monument of Tesla was unveiled. This monument was designed by Ivan Meštrović in 1952 and was transferred from the Zagreb-based Ruđer Bošković Institute where it had spent previous decades.[209][210]
- A monument to Tesla was established at Niagara Falls, New York. This monument portraying Tesla reading a set of notes was sculpted by Frano Kršinić. It was presented to the United States by Yugoslavia in 1976 and is an identical copy of the monument standing in front of the University of Belgrade Faculty of Electrical Engineering.
- A monument of Tesla standing on a portion of an alternator, was established at Queen Victoria Park in Niagara Falls, Ontario, Canada. The monument was officially unveiled on 9 July 2006 on the 150th anniversary of Tesla's birth. The monument was sponsored by St. George Serbian Church, Niagara Falls, and designed by Les Drysdale of Hamilton, Ontario.[211][212] Drysdale's design was the winning design from an international competition.[213]
- In 2012, Jane Alcorn, president of the nonprofit group Tesla Science Center at Wardenclyffe, and Matthew Inman, creator of web cartoon *The Oatmeal*, raised a total of $2,220,511 – $1,370,511 from a campaign and $850,000 from a New York State grant—to buy the property where Wardenclyffe Tower once stood and eventually turn it into a museum.[214][215] The group began negotiations to purchase the Long Island property from Agfa Corporation in October 2012.[216] The purchase was completed in May 2013.[217]
- A commemorative plaque honoring Nikola Tesla was installed on the façade of the New Yorker Hotel by the IEEE.[218]
- An intersection named after Tesla, Nikola Tesla Corner, is at the intersection of Sixth Avenue and 40th Street in Manhattan, New York City. The placement of the sign was due to the efforts of the Croatian Club of New York in cooperation with New York City officials, and Dr. Ljubo Vujovic of the Tesla Memorial Society of New York.[219]
- A bust and plaque honoring Tesla is outside the Serbian Orthodox Cathedral of Saint Sava (formerly known as Trinity Chapel) at 20 West 26th Street in New York City.[220]
- A full-size, crowdfunded statue honoring Tesla with free Wi-Fi and a time capsule (to be opened on the 100th anniversary of Tesla's death, 7 January 2043) was unveiled on 7 December 2013 in Palo Alto, California (260 Sheridan Avenue).[221]

Nikola Tesla Corner in New York City

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Milutin, Nikola's father, was a well-educated priest of the Serbian Orthodox Church.
16. ^ Tesla: Man Out of Time by Margaret Cheney Simon and Schuster, Nov 8, 2011 page 25
The tiny house in which he was born stood next to the Serbian Orthodox Church presided over by his father,the Reverend Milutin Tesla, who sometimes wrote articles under the nom-de-plume "Man of Justice".
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Following a reprimand at school for not keeping his brass buttons polished, he quit and instead chose to become a priest in the Serbian Orthodox Church
18. ^ Nikola Tesla: Physicist, Inventor, Electrical Engineer by Michael Burgan, Capstone, Jan 1, 2009 page 17
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- Lomas, Robert (1999). *The Man Who Invented the Twentieth Century: Nikola Tesla, forgotten genius of electricity*. London: Headline. ISBN 978-0-7472-7588-6
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- Biography: *Nikola Tesla (http://cdl.library.cornell.edu/cgi-bin/moa/pageviewer?frames=1&coll=moa&view=50&root=%2Fmoa%2Fcent%2Fcent0047%2F&tif=00592.TIF&cite=http%3A%2F%2Fcdl.library.cornell.edu%2Fcgi-bin%2Fmoa%2Fmoa-cgi%3Fnotisid%3DABP2287-0047-151)*, The Century Magazine, November 1893, Vol. 47

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Video

- *Nikola Tesla* (http://www.imdb.com/title/tt0273375/) – 1977 ten-episode TV series featuring Rade Šerbedžija as Tesla.
- *Tajna Nikole Tesle (The Secret of Nikola Tesla)* (http://www.imdb.com/title/tt0079985/)' – 1980 Documentary directed by Krsto Papić, featuring Petar Božović as Tesla and Orson Welles as J.P. Morgan
- *Tesla: Master of Lightning* (http://www.pbs.org/tesla/) – 2003 Documentary by Robert Uth, featuring Stacy Keach as the voice of Tesla.

External links

- The Nikola Tesla Museum (http://www.tesla-museum.org/meni_en.htm)
- Tesla Resource Surrounding the PBS "Master of Lightning" documentary (http://www.pbs.org/tesla/)
- World of Scientific Biography: Nikola Tesla (http://scienceworld.wolfram.com/biography/Tesla.html), by Wolfram Research
- Tesla's grand-nephew William H. Terbo's site (http://www.teslamemorialsociety.org/)
- References to Tesla in European newspapers (http://www.theeuropeanlibrary.org/tel4/newspapers/search?query=nikola%20tesla) - The European Library
- Online archive of many of Tesla's writings, articles and published papers (http://www.teslaresearch.com/)
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- Works by Nikola Tesla (http://www.gutenberg.org/author/Nikola+Tesla) at Project Gutenberg
- Nikola Tesla's FBI file (http://www.lostartsmedia.com/images/teslafbifile.pdf) in pdf
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