

## Nikola Tesla as a phenomenon in the world of science

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**Abstract:** This article is dedicated to Nikola Tesla, who created a technically and intellectually highly developed civilization and who is a true companion to humanity in the historical process. The significance of its motives is a need, which drives to the activity towards a specific goal in favour of technical achievements applicable in practice. Of particular importance for understanding Tesla's actions is a moral awareness that represents the adopted principles of his thoughts that are logical, impeccably clear, and they are the proof that on their basis he made arguments and achieved new results.

**Keywords:** wireless power transmission, Wardencllyffe Tower, laws of nature, an engineering project.

'Verily a polluted stream is the human.  
One must be a veritable sea to absorb such  
a polluted stream without becoming unclean.  
'Behold, I teach to you the Overhuman: it is this sea,  
in this can your great despising submerge itself.

*Friedrich Wilhelm Nietzsche<sup>1</sup>*

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<sup>1</sup> F. Nietzsche, *Thus spoke Zarathustra*, Oxford University Press, 2005, p. 54.

## Introduction

In the history of mankind, there were people who, thanks to their extraordinary abilities, managed in a natural environment that was not particularly fond of human beings. Tesla was a man out of space and time who enabled mankind to step into a brighter future. Humanity faces with many secrets and great misapprehensions, but the answers to them are difficult to find because of the exaggeration in their valuation. Maybe it's because each of us has a different view of reality, and he wants to reconcile what he believes in, with what he sees around him. What matters in all of this is science, which not only affects technological progress, but also has its ethics and aesthetics, as well as a substantial influence on everything that surrounds us. In this sense, the scientist is trying to create consciousness, by analyzing real topics and understanding the ways of solving similar issues in different spheres and societies.

Tesla loved Nietzsche, a man who, like himself, possessed a gift for prediction. Visionary is reflected in the audacity of seeing the most distant things and opening new paths for humanity. The interest in Tesla's external appearance is imposing. Tall, skinny man, picky in everything, with keen taste in clothing. Classy, but not arrogant at all. His neatness mirrors also in the selection of exclusively white silk shirts, tight jackets, deer-skinned gloves that he changed weekly, an elegant bowler hat and a cane. And how that is with genius people, Tesla had his fears. He was panicking about microbes and it made his daily life difficult. They say he didn't shake hands in the time of cholera and other infectious diseases. He smoked a lot in his youth. But he had the willpower he needed to suppress his unhealthy habits, as well as the courage to prevent realization of their consequences. He stopped smoking.

Mr. Tesla is tall, with a clean-cut, refined face, and eyes that recall all the stories one has read of keenness of vision and phenomenal ability to see through things. He is an omnivorous reader, who never forgets and possesses the peculiar facility in languages. A more congenial companion cannot be desired when the conversation, dealing at first with things near, reaches out and rises to the greater questions of life, duty and destiny.<sup>2</sup>

Tesla, candidly but non-egotistically, wrote, 'It seems I have always been ahead of my time. I had to wait nineteen years before Niagara was harnessed by my system, and fifteen years before the basic inventions for wireless, which I gave to the world in 1893, were applied universally. I announced the cosmic ray and my theory of radio activity in 1896. One of my most important discoveries-terrestrial resonance-which is the foundation of wireless power transmission and which I announced in 1899, is not understood even today. Nearly two years after I had flashed an electric current around the globe,

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<sup>2</sup>N. Tesla, *Experiments with Alternate Currents of High Potential and High Frequency*, Public Domain Books, New York, 2004, pp. 6-7

Edison, Steinmetz, Marconi, and others declared that it would not be possible to transmit even signals by wireless across the Atlantic.<sup>3</sup>

## Life devoted to human welfare

Tesla entered manhood with a definite knowledge that nameless forces were shaping for him an unrevealed destiny. It was a situation he had to feel rather than be able to identify and describe in words. His goal he could not see and the course leading to it he could not discern. He very well knew the field in which he intended to spend his life, and using such physical laws as he knew he decided to plan a life which, as an engineering project, would be operated under principles that would yield the highest index of efficiency. He did not, at this time, have a complete plan of life drawn up, but there were certain elements which he knew intuitively he would not include in his operations, so he avoided all activities and interests that would bring them in as complications. It was to be a single-purpose life, devoted entirely to science with no possibilities whatever for private life. It was with this philosophy of life that Tesla in 1875, at the age of 19, went to Gratz, in Austria, to study electrical engineering at the Polytechnic Institute. He intended henceforth to devote all his energies to mastering that strange force, electricity, and to harness it for human welfare.<sup>4</sup>

Through his experiments he had become convinced that there were ways to transmit unlimited amounts of electrical energy to any point on the globe without using any conventional transfer medium such as copper cable. Writing in 1900, he described how he had developed his ideas: "For a long time I was convinced that such a transmission on an industrial scale could never be realized, but a discovery which I made changed my view. I observed that under certain conditions the atmosphere, which is normally a high insulator, assumes conducting properties, and so becomes capable of conveying any amount of electrical energy." But in order to carry out all the experiments, he needed to first put in place the worldwide radio broadcasting station. He had already proved to his own satisfaction that he could broadcast and receive signals over seven hundred miles, and he offered J. P. Morgan the possibility of both transatlantic and transpacific radio communication. Tesla quickly purchased 200 acres of Long Island, which he christened "Wardenclyffe". The money was soon being spent on the transmitting tower that would be Tesla's landmark, the symbol of his life's vision. Wardenclyffe tower was 187 feet high and topped with a massive fifty-five-ton mushroom-like dome. This contained

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<sup>3</sup>The True 'Father of Electricity' - Nikola Tesla,  
<http://www.users.globalnet.co.uk/~noelh/Tesla.htm>, 12. 08. 2022.

<sup>4</sup>J. O'Neill, *Prodigal Genius: The Life of Nikola Tesla*, Cosimo Classics, San Diego, 2006, p. 35.

Tesla's most important component - the magnifying transmitter capable of generating oscillating signals of some hundreds of millions of volts.<sup>5</sup>

Nikola Tesla in an extended interview on his work with alternating currents said that Long Island Plant was built for wireless telephony.<sup>6</sup> At the top was the spiral coil which was moved all around and used as a tuning table. There were a telautomaton and mercury interrupters. That was much used in high frequency work. Wardenclyffe station was a commercial undertaking, but it required so much money that Tesla found impossible to realize it. He said that it is too bad that some people did not have the technical ability and experience to enable them to make a success from the start as he made. For instance, Marconi four times in succession he built a plant.

Tesla turned power into the antenna to make measurements and experiments, and transmit energy for the purpose of tests. He could operate from very low frequencies, from 1,000 cycles on to 100,000, 150,000, or 200,000. Tesla had every facility to operate with the lowest frequencies up to the highest. The low frequencies he usually got from an alternator, and then with other apparatus the higher frequencies. He actually operated with the frequencies up to 30,000, which he found to be most economical. The experiments were telephonic, telegraphic demonstrations and measurements of energy. There was not any receiver station built in connection with this Wardenclyffe apparatus, except that Tesla used transportable apparatus with which he made his measurements and received.<sup>7</sup>

Funded principally by J.P. Morgan, Tesla proceeded with the construction of a system of "World Telegraphy" at Wardenclyffe on Long Island upon his return from Colorado Springs in 1900. While he intended to use the facility publicly for communications, Tesla's secret aim was to implement wireless power transfer. The facility featured a wooden tower designed to support a 68 ft. diameter copper hemisphere, which was not completed because of

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<sup>5</sup>T.Valone, *Harnessing the Wheelwork of Nature: Tesla's Science of Energy*, Adventures Unlimited Press, 2002, p. 44.

<sup>6</sup> The surfacing of the transcript for this pre-hearing interview with Nikola Tesla by his legal counsel in 1916 resulted from an intensive search in archives of legal firms, some now defunct and others later acquired by contemporary interests. The interview was precipitated by numerous pending court cases as the fledgling radio industry entered a period of fierce competition. Tesla's counsel believed the interview necessary not only in order to prepare for the pressing of his own claims against the Marconi Company, but also to protect his own patent interests when called to give expert-witness testimony in the upcoming litigation foray pitting as adversaries a plethora of new communication companies and their captive radio pioneers. (N. Tesla, *Nikola Tesla on His Work with Alternating Currents and Their Application to Wireless Telegraphy, Telephony, and Transmission of Power: An Extended Interview*, 21st Century Books, 2002, p. XI.

<sup>7</sup> N. Tesla, *Nikola Tesla on His Work with Alternating Currents and Their Application to Wireless Telegraphy, Telephony, and Transmission of Power: An Extended Interview*, op. cit., pp. 148-155.

Tesla's difficulty in obtaining funding following Marconi's success in demonstrating transoceanic wireless communication with much simpler equipment (albeit using Tesla's patents in the process). The transmitter was to have operated at 30 MV, which Tesla claimed was sufficient for worldwide power distribution; however, the transmitter was designed to handle up to 100MV. Aside from its toroidal elevated capacitor, patent 1,119,732<sup>8</sup> shows the Wardenclyffe configuration of the transmitter, which incorporated the "extra coil" from the Colorado Springs experiments.

Tesla outlined the requirements for wireless power distribution in patent 787.412, describing the earth as "...behaving like a perfectly smooth or polished conductor of inappreciable resistance with capacity and self-induction uniformly distributed along the axis of symmetry of wave propagation".<sup>9</sup> He described reflections of signals from antipodes, the points on the globe diametrically opposite from the transmitter, as being similar to those from the end of a conducting wire, thus creating stationary waves on the conductive surface.<sup>10</sup>

The results attained by Tesla have made his scheme of intelligence transmission, for which the name of "World Telegraphy" has been suggested, easily realizable. It constituted, in its principle of operation, means employed and capacities of application, a radical and fruitful departure from what has been done heretofore. Tesla has no doubt that it would prove very efficient in enlightening the masses, particularly in still uncivilized countries and less accessible regions, and that it would add materially to general safety, comfort and convenience, and maintenance of peaceful relations. It involved the employment of a number of plants, all of which are capable of transmitting individualized signals to the uttermost confines of the earth. Each of them would be preferably located near some important center of civilization and the news it receives through any channel would be flashed to all points of the globe. A cheap and simple device, which might be carried in one's pocket, may then be set up somewhere on sea or land, and it would record the world's news or such special messages as may be intended for it. Thus the entire earth would be converted into a huge mechanism, as it were, capable of response in every one of its parts. Since a single plant of but one hundred horse-power can operate hundreds of millions of instruments, the system would have a virtually infinite working capacity, and it must needs immensely facilitate and cheapen the transmission of signals.<sup>11</sup>

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<sup>8</sup> US Patent No. 1,119,732 "Apparatus for Transmitting Electrical Energy", Application filed January 18, 1902.

<sup>9</sup> US Patent No. 787,412, " Art of Transmitting Electrical Energy through the Natural Media", Application filed on May 16, 1900.

<sup>10</sup> T. Valone, *Harnessing the Wheelwork of Nature: Tesla's Science of Energy*, op. cit., pp. 149-150.

<sup>11</sup>N. Tesla, "The Transmission of Electric Energy Without Wires", *Electrical World and Engineer*, March 5th, 1904, pp.429-431.

Wardenclyffe Tower was designed and constructed mainly for wireless transmission of electrical power, rather than telegraphy. The most popular concept known is Tesla Theory in which it was firmly believed that Wardenclyffe would permit wireless transmission and reception across large distances with negligible losses. In spite of this he had made numerous experiments of high quality to validate his claim of possibility of wireless transmission of electricity. But this was an unfortunate incidence that people of that century was not in a position to recognize his splendid work, otherwise today we may transmit electricity wirelessly. This was to be the first broadcasting system in the world. Tesla wanted to transmit electricity from this Tower to the whole globe without wires using the Ionosphere.<sup>12</sup>

Consider the earth as a large spherical capacitor or cavity resonator, comprising the terra firma as the inner conductor, the lower atmosphere as the insulating dielectric, and the upper atmosphere (electrosphere) and ionosphere as the outer conductor. Power is coupled into the cavity via either direct conduction/displacement, or radiation, with high power RF oscillators or transmitters tuned to the cavity's resonant frequency. A remote receiver, also tuned to this resonant frequency, then extracts this power wirelessly. The propagation loss in the earth-ionosphere cavity increases with frequency but, at the fundamental frequency, is about 11% less than the equivalent loss on a 200KV power line. The described wireless concept differs from that used in microwave wireless power transmission in that the latter beams power along a line of sight path, normally from outer space to earth.<sup>13</sup>

## **Advantages of wireless transmitting of electricity**

There are laws of nature in the world and a person must live and do everything according to them. Then it will be much easier for him to live.<sup>14</sup> Unlike his father, the Priest, Tesla believed that God is nature, which is not far from religious. His thinking and belief that nature punishes us for all the misdeeds we do during our life has a deep religious approach in man's understanding of the environment. He was convinced that the entire cosmos is united, both in material and spiritual view. The operation of nuclear power plants produces large amounts of radioactive materials, causing radiation pollution. Discharge of liquid wastes from nuclear power plants must be monitored, controlled, and reported to the control authorities. Radioactive material can be detrimental from a distance and in that sense it differs from

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<sup>12</sup>S. Reddy *et al.*, "Wireless transmission of electricity-development and possibility" , *International Journal of Advances in Engineering Research*, 2/ 2012 , pp. 31-32.

<sup>13</sup>T. Valone, *Harnessing the Wheelwork of Nature: Tesla's Science of Energy*, op.cit.,p. 147.

<sup>14</sup>V. Slavković, "Conspiratorial myth as a specific phenomenon of social awareness", *Журнал Белорусского государственного университета. Философия. Психология*, № 1/2022, Минск, pp. 59-67.

toxins that require absorption or inhalation to cause damage. In fact, chemical toxins must enter our body to cause chemical changes that damage cells and biological processes, while radioactive materials release energy particles that can travel distances. The effects of radionuclides would be the result of the spread of radioisotopes on land, in the air and in water, and the subsequent absorption or inhalation of these isotopes. In general, radioisotope concentrations have been reported to be too low for soil, water, or air to cause a significant direct radiation dose to a person nearby. However, when radioactive isotopes are swallowed or inhaled and then spend a lot of time in the body, they cause harmful effects that the public fears.<sup>15</sup>

Unlike fossil fuel-fired power plants, nuclear reactors do not produce air pollution or carbon dioxide while operating. However, the processes for mining and refining uranium ore and making reactor fuel all require large amounts of energy. A major environmental concern related to nuclear power is the creation of radioactive wastes such as uranium mill tailings, spent (used) reactor fuel, and other radioactive wastes. These materials can remain radioactive and dangerous to human health for thousands of years.<sup>16</sup>

On the other hand, wireless power transfer (WPT) is the transmission of electrical power from a power source to a consuming device without using solid wires or conductors. Wireless transmission is useful to power electrical devices in cases where interconnecting wires are inconvenient, hazardous, or are not possible. In wireless power transfer, a transmitter device connected to a power source, such as the mains power line, transmits power by electromagnetic fields across an intervening space to one or more receiver devices, where it is converted back to electric power and utilized.<sup>17</sup>

Wireless Electricity transmission is based on strong coupling between electromagnetic resonant objects to transfer energy wirelessly between them. This differs from other methods like simple induction, microwaves, or air ionization. The system consists of transmitters and receivers that contain magnetic loop antennas critically tuned to the same frequency. Due to operating in the electromagnetic near field, the receiving devices must be no more than about a quarter wavelengths from the transmitter. Unlike the far field wireless power transmission systems based on traveling electromagnetic waves, Wireless Electricity employs near field inductive coupling through magnetic fields similar to those found in transformers except that the

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<sup>15</sup>J. Iqbal et. al, Chapter 20 – “Assessment of radiation pollution from nuclear power plants”, Editor: O. Abdel-Mohsen, *Pollution Assessment for Sustainable Practices in Applied Sciences and Engineering*, 2021, p. 1039.

<sup>16</sup> Nuclear power and the environment - U.S. Energy, <https://www.eia.gov/energyexplained/nuclear/nuclear-power-and-the-environment.php>, 01. 08. 2022.

<sup>17</sup> Н. В. Байрамов, Ю. В. Титова, “Wireless Electricity”, *Сборник научных трудов- ЯЗЫК, КУЛЬТУРА, ИСТОРИЯ*, 2015, p. 105.

primary coil and secondary winding are physically separated, and tuned to resonate to increase their magnetic coupling.<sup>18</sup>

Towards the close of 1898 a systematic research, carried on for a number of years with the object of perfecting a method of transmission of electrical energy through the natural medium, Tesla recognized three important necessities: First, to develop a transmitter of great power; second, to perfect means for individualizing and isolating the energy transmitted; and, third, to ascertain the laws of propagation of currents through the earth and the atmosphere<sup>19</sup>. Tesla demonstrated "the transmission of electrical energy without wires" that depends upon electrical conductivity as early as 1891. In 1893, he validated the illumination of vacuum bulbs without using wires for power transmission at the World Columbian Exposition. The Wardenclyffe tower was proposed and constructed by Tesla mainly for wireless transmission of electrical power rather than telegraphy.<sup>20</sup>

Nikola Tesla established a foundation in the field of wireless transmission of electrical power, led the first experiment in late nineteenth century. It was the first system that could wirelessly transmit power. From 1891 through 1898, he experimented with wireless transmission in his "experimental station" in Colorado. He experimented with the transmission of electrical energy using a tesla coil<sup>21</sup> radio frequency resonant transformer, which created a high voltage of high frequency alternating currents, allowing him to transfer power over short distances without the use of wires. He used a resonant circuit which is earthed on one end to successfully light a small incandescent lamp. Outside the premises of laboratory, a coil with the bottom end grounded and the higher end unbound. The current which induced in the three turns of wire wound around the lower end of the coil ignites the lamp. Tesla planned the Wardenclyffe tower for trans-Atlantic radio telecommunications as well as to demonstrate wireless electrical power transmission.<sup>22</sup>

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<sup>18</sup> Y. N. Burali, C. B. Patil, "Wireless Electricity Transmission Based On Electromagnetic and Resonance Magnetic Coupling", *International Journal Of Computational Engineering Research*, 7/2012, p.48.

<sup>19</sup>N. Tesla, "The Transmission of Electric Energy Without Wires ",op.cit., pp.429-431.

<sup>20</sup>S. Bharti, "Investigation To Increase Transmission Distance Of Wireless Power System", *International Journal of Engineering Research and General Science*, 3/2015, p. 1293

<sup>21</sup>The Tesla Coil is an electrical resonant transformer circuit. It is a radio frequency oscillator that drives a transformer to produce high voltages at low currents. The coil works through the principle of electromagnetic induction in which a conductor is placed in a changing magnetic field and produces a voltage across the conductor. Tesla put out demonstrations showing how the coil could be used to wirelessly power light bulbs located far away. (How Far Are We From Wireless Electricity? <https://medium.com/predict/how-far-are-we-from-wireless-electricity-94dbd48529a4>, 12. 08. 2022).

<sup>22</sup>B. Manohar,"An Overview of Wireless Power Transmission System and Analysis of Different Methods", *International Journal for Research in Applied Science and Engineering Technology*, 3/2022, p.1818

In the two years or so that it took Tesla to build the transmitter, two major problems have arisen. With escalating costs and long delays he was now in desperate financial straits. His second problem was Marconi, who had, on 12 December 1901, sent the first wireless signal from Cornwall, England, to Newfoundland. What Morgan, and many others, did not know was that Marconi was using Tesla's radio patents, which were to become the focus of much dispute before Tesla's primacy was established in 1943. Nor did Morgan appreciate how Marconi was able to achieve this with much less equipment and cost than Tesla was employing. He also didn't know, but was about to find out, Tesla's hidden power agenda. Tesla had already filed a patent No. 787,412 relating to the wireless transmission of power and would later apply for a more important patent, No. 1,119,732, based on his work at Wardenclyffe. In his comprehensive vision every person on the planet would have a receiver, which, just like a radio, they could tune to receive unlimited, unmetered power.<sup>23</sup>

## Conclusion

Science is not an individual but a collective experience, based on an accepted understanding of phenomena in a particular area. In order to individually become general, it is necessary to disclose what enables the assessment of the quality of its significance. Only a reasonable man tries to observe and interpret all phenomena correctly and first to notice and evaluate their general meaning, and only afterwards to examine the extent to which they can relate to him.<sup>24</sup>

Nikola Tesla is someone who invented radio and shown us he is indeed the "Father of Wireless". He is the one who first conceived the idea Wireless Power Transmission and demonstrated "the transmission of electrical energy without wires" that depends upon electrical conductivity as early as 1891. In 1893, Tesla demonstrated the illumination of vacuum bulbs without using wires for power transmission at the World Columbian Exposition in Chicago. The Wardenclyffe tower was designed and constructed by Tesla mainly for wireless transmission of electrical power rather than telegraphy.<sup>25</sup>

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<sup>23</sup>T. Valone, *Harnessing the Wheelwork of Nature: Tesla's Science of Energy*, op.cit., 44-45.

<sup>24</sup>I. Andrić, *Znakovi pored puta*, Svjetlost, Sarajevo, 1976, str. 36.

<sup>25</sup>Wireless electricity, [https://www.academia.edu/9752080/Wireless\\_Electricity](https://www.academia.edu/9752080/Wireless_Electricity), 03. 08. 2022.

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**Sažetak:** Ovaj rad je posvećen Nikoli Tesli, koji je stvorio tehnički i intelektualno visoko razvijenu civilizaciju i istinski je pratilac čovečanstva u istorijskom procesu. Značaj njegovih motiva je potreba, koja pokreće na aktivnost ka određenom cilju u korist tehničkih dostignuća primenljivih u praksi. Od posebnog značaja za razumevanje Teslinih postupaka je moralna svest, odnosno usvojena načela njegovih razmišljanja, koja su logična, besprekorno jasna i dokaz su da je na osnovu njih izneo argumente i postigao nove rezultate.

**Кljučне речи:** bežični prenos energije, Vardenklifski toranj, zakoni prirode, inženjerski projekat.

## Nikola Tesla kao fenomen u svetu nauke

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