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INTRODUCTION

DINNER AT DELMONICO'S

It was a hot summer night in New York in 1894, and the reporter had decided that it was time to meet the Wizard.

The reporter, Arthur Brisbane, was an up-and-coming newspaperman from Joseph Pulitzer's *New York World*. He had covered the mystery of Jack the Ripper in London, the Homestead Strike in Pittsburgh, and the first execution by electrocution at Sing Sing. Brisbane had an eye for detail and could tell a story that would intrigue a hundred thousand readers. He would go on to edit the *New York Journal* for William Randolph Hearst, help start the Spanish-American War, and define tabloid journalism.[1]

Brisbane specialized in writing features for the *World*'s new Sunday edition, and he had profiled prime ministers and popes, prizefighters and actresses. Now people were telling him to do a story about an inventor, Nikola Tesla. His name was on everyone's lips: "Every scientist knows his work and every foolish person included in . . . New York society knows his face." Not only would his inventions be used to generate electricity at the new plant under construction at Niagara Falls, but Tesla had taken 250,000-volt shocks through his body to demonstrate the safety of alternating current (AC). During such demonstrations, Tesla became "a most radiant creature, with light flaming at every pore of his skin, from the tips of his fingers and from the end of every hair on

his head" (Figure 0.1). A dozen reliable sources had told Brisbane that "there was not the slightest doubt about his being a very great man." "Our foremost electrician," people said. "Greater than Edison."[2] Brisbane was curious. Who was this man? What made him tick? Could Tesla be made into a good story for thousands of readers?

FIGURE 0.1. "Showing the Inventor in the Effulgent Glory of Myriad Tongues of Electric Flame After He Has Saturated Himself with Electricity."

From Arthur Brisbane, "Our Foremost Electrician," *New York World,* 22 July 1894, in TC 9:44–48, on 46.

The reporter had heard that the Wizard frequently dined at the most fashionable restaurant in Manhattan, Delmonico's on Madison Square. Delmonico's chefs had invented signature dishes such as Lobster Newberg, Chicken à la King, and Baked Alaska. But even more than the food, Delmonico's was the hub of New York society, the place to see and be seen. This is where the old social aristocracy, Ward McAllister's Four Hundred, dined alongside the *nouveau riche* of Wall Street and the rising middle class. It was where balls and cotillions, poker games and stag parties, ladies' luncheons and post-theater suppers were held. Without Delmonico's, observed the *New York Herald*, "the whole social machinery of entertaining would . . . come to a standstill."[3] Clearly, thought Brisbane, this Wizard had both ambition and style. What made him tick?

Brisbane found Tesla at Delmonico's late that summer evening, talking with Charles Delmonico, whose Swiss great-uncles had founded the restaurant in 1831. Having lived previously in Prague, Budapest, and Paris, Tesla found it easy to chat with the urbane Charley Delmonico. Most likely Tesla had put in a long day at his downtown laboratory and had stopped by for his supper before going home to his hotel, the Gerlach, around the corner.

The reporter carefully took in the physical appearance of the Wizard:

> 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. . . .
>
> 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. . . .
>
> 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.

As he studied Tesla's outward appearance, Brisbane began to assess his psychological makeup:

> 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 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 men who are written about and talked about in the fact that he has something to tell.

Like other reporters, Brisbane collected the usual background facts—that Tesla had been born in 1856 to a Serbian family in Smiljan, a small mountain village on the military frontier of the Austro-Hungarian Empire (in what is now Croatia), that he had started inventing as a boy, and that he had studied engineering at a school in Graz, Austria. Anxious to get ahead, Tesla had immigrated to America and arrived penniless in New York in 1884.

It was Tesla's meteoric rise since 1884 that made for great newspaper copy. After working briefly for Edison, Tesla had struck out on his own, set up a laboratory, and invented a new AC motor that used a rotating

magnetic field. Even though Tesla tried to explain to Brisbane the principle behind the rotating magnetic field, the reporter had to conclude that it was "a thing which may be described but not understood." Instead, Brisbane highlighted how the entrepreneurs behind the massive hydroelectric project at Niagara had rejected Edison's direct current (DC) system and instead chosen Tesla's ideas for generating and transmitting electric power by employing multiphase AC. Tesla's work in power engineering was widely respected, but Brisbane might well have added that Tesla had lectured before distinguished scientific organizations and been awarded honorary degrees by Columbia and Yale. In ten short years, the inventor sitting in front of Brisbane had gone from being penniless and unknown to being America's foremost inventor. Here was one of the great rags-to-riches stories.

But what about the future, asked Brisbane, as the Wizard was only thirty-eight years old. Ah, "the electricity of the future"—here was a topic Tesla loved to discuss:

> When Mr. Tesla talks about the electrical problems upon which he is really working he become[s] a most fascinating person. Not a single word that he says can be understood. He divides time up into billionths of seconds, and supplies power enough from nothing to do all the work in the United States. He believes that electricity will solve the labor problem. . . . It is certain, according to Mr. Tesla's theories that the hard work of the future will be the pressing of electric buttons. A few centuries from now the criminal . . . will be sentenced to press fifteen electric buttons every day. His fellows, long since disused to work, will look upon his toil with pity and horror.

Brisbane listened with rapt attention as Tesla described how he was perfecting new electric lights using high-frequency AC to replace Edison's incandescent lamps. "The present incandescent system, compared to the Tesla idea," thought Brisbane, "is as primitive as an ox cart with two solid wooden wheels compared to modern railroading." The Wizard, though, was even more excited about his ideas for the wireless transmission of power and messages: "You may think me a dreamer and very far gone," he said, "if I should tell you what I really hope for. But I can tell you that I look forward with absolute confidence to sending messages through the earth without any wires.

I have also great hopes of transmitting electric force in the same wave without waste. Concerning the transmission of messages through the earth I have no hesitation in predicting success."

For hours the reporter talked with the Wizard, as "all that he said was interesting, both the electrical things and the others." Tesla spoke of his Serbian background and his love of poetry. He told Brisbane that he valued hard work but that marriage and love interfered with success. He didn't believe in mental telepathy, or "psychical electricity," but was fascinated by how the human mind works. "I talked with this Mr. Tesla of Smiljan," wrote Brisbane, "until the feeble daylight found Mr. Delmonico's scrub-ladies scrubbing his marble floor." They parted friends. Brisbane wrote a front-page story that made Tesla a household name and went on to become one of the most powerful newspaper editors in America.

So what happened to the Wizard? Although he could not know it at the time, Tesla was at his zenith that summer in 1894. Over the previous ten years, he had enjoyed a meteoric rise and was greatly admired by his fellow engineers and scientists. As the *Electrical Engineer* (London) proclaimed, "No man in our age has achieved such a universal scientific reputation in a single stride as this gifted young electrical engineer."[4] Such brilliance, such promise; what happened?

Over the following decade, 1894 to 1904, Tesla continued to invent, developing a high-frequency, high-voltage transformer (now known as a Tesla coil), new electric lamps, a combination steam engine and electric generator, and a host of other devices. Learning that Heinrich Hertz had detected invisible electromagnetic waves in 1885–86, Tesla was among the first to experiment with how to use these waves to create new technology, including an amazing radio-controlled boat. Tesla's grand dream, of course, was to transmit power and messages through the earth, thus rendering obsolete the existing electrical, telephone, and telegraph networks. In pursuit of this dream, he built experimental stations in Colorado Springs and Wardenclyffe, Long Island, ever confident that his system was feasible and that millions of dollars would roll in. Although Tesla boldly predicted as early as 1899 that he would transmit messages across the Atlantic, Guglielmo Marconi did it first in 1901, and so Marconi went into the history books as the inventor of radio. Between 1903 and 1905, Tesla could no longer find backers for his inventions, he encountered problems with his

equipment, and he ultimately suffered a nervous breakdown. Though he lived until 1943, by 1904 Tesla's best days were behind him. As Laurence A. Hawkins wrote in 1903, "Ten years ago, if public opinion in this country had been required to name the electrician of greatest promise, the answer would without doubt have been 'Nikola Tesla.' To-day his name provokes at best a regret that so great a promise should have been unfulfilled."[5]

In writing about Tesla, one must navigate between unfair criticism and excessive enthusiasm. On the one hand, we can follow Hawkins's lead and denigrate Tesla for not completing his inventions after 1894, especially his plan for wireless power. Surely someone so determined to pursue wireless power and challenge the status quo of big business and technological systems must have been either wrong or crazy. Yes, Tesla got it right with AC, but he sure got it wrong with radio, and that's why Marconi beat him out. For me, this approach sets up a misleading dichotomy: when inventors get it right, they are heralded as geniuses, and when they get it wrong, they must be insane.

On the other hand, it's easy to celebrate Tesla as a figure second only to Leonardo da Vinci in terms of technological virtuosity. Tesla has dedicated fans who believe that he single-handedly invented electricity and electronics.[6] As one fan stated on his webpage, "Tesla invented just about everything. As you work on your computer, remember Tesla. His Tesla Coil supplies the high voltage for the picture tube you use. The electricity for your computer comes from a Tesla-designed AC generator, is sent through a Tesla transformer, and gets to your house through 3-phase Tesla power."[7] I agree wholeheartedly that we need to understand how Tesla invented these key devices and that we should assess his role in the electrical revolution that reshaped society between 1880 and 1920.[8] But in doing so, we should be careful that we do not convert Tesla into a "superman" with fantastic intellectual powers.[9]

Previous biographies of Tesla have tended to be celebratory.[10] In this book, I want to strike a balance between celebrating and criticizing Tesla; as suggested, he had a spectacular ascent (1884–94) followed by an equally dramatic descent (1895–1905). The task for a Tesla biographer is to piece together his life so that both the ascent and descent make sense. Indeed, the factors that made for an individual's success should also explain that person's failures. One measure of a

good historical explanation is symmetry—that the framework used sheds light on both success and failure.

Moreover, while previous biographies have focused largely on Tesla's personality, this book seeks to take measure of both the man *and* his creative work. Throughout the book, I will seek to answer three basic questions: *How did Tesla invent? How did his inventions work? And what happened as he introduced his inventions?* To answer these questions, I will draw on Tesla's correspondence, business records, legal testimony, publications, and surviving artifacts. Some readers may be disappointed that their favorite Tesla story is not here and that there may be more technical discussion than they would like. However, as a historian, I have to tell Tesla's story based on the documents, not on the wishes and dreams we might like to project onto heroes like Tesla. In many ways, Brisbane had it right when he said that the purpose of his story was "to discover this great new electrician thoroughly; to interest Americans in [Tesla's] personality so that they may study his future achievements with proper care."

CONCEPTS AND THEMES

To tell the story of Tesla's dramatic rise and fall, then, we need a framework that allows us to piece the story together. In particular, since Tesla was an inventor, we need a way to think about invention. From my perspective, it's all too easy to associate invention with imponderables such as genius, mystery, and luck; in contrast, I view invention as a process that we can analyze and understand.[11]

Invention refers to the activities by which individuals create new devices or processes that serve human needs and wishes. To do so, an inventor must often investigate phenomena in nature. In some cases, an inventor need only observe nature closely to discover what will work, but in other cases, he or she must tease out new insights by experiment or ingenious manipulation. Because nature does not readily yield up her secrets, one could say that an inventor "negotiates" with nature.[12]

At the same time, invention is not simply discovering how to make something; an inventor must also connect his or her invention with society. In some situations, needs are well-known and society readily

takes up a new invention. Since railroads in the mid-nineteenth century needed stronger rails and armies wanted stronger cannon barrels, there was a ready demand for Henry Bessemer's new steel-making process in 1856. In other situations, though, there is no preexisting need and an inventor must convince society of an invention's value. For example, when Alexander Graham Bell invented the telephone in 1876, he found few people willing to buy it; indeed, it took the Bell Telephone Company decades to convince Americans that every home should have a telephone. Bell and his successor companies had to invent not only the telephone but also a marketing strategy that reflected the interests of users. In this sense, inventors "negotiate" with society.[13]

What makes invention interesting is that inventors stand astride the natural and social worlds. On the one hand, they must be willing to engage nature, to find out what will work; on the other hand, inventors must also interact with society, exchanging their inventions for money, fame, or resources. To succeed, inventors must be creative on both sides—in how they negotiate with both nature and society.

In moving between nature and society, inventors develop their own worldview and creative method, reflecting their personality, education, experience, and context. Inventors find their own ways to probe nature, fashion their discoveries into working devices, and ultimately convince other people that their creation is useful or valuable. As Tesla's story unfolds, you will see that his approach was influenced by his religious background, his friends and backers, and his problems with emotional depression. As Thomas Hughes has suggested, inventors—like artists—evolve a unique style.[14]

Tesla's style as an inventor can be described as a tension between ideal and illusion. I have borrowed this tension from the allegory of the cave found in *The Republic* by Plato.[15] Plato developed this allegory to illustrate the difference between ignorance and enlightenment, between how ordinary people and philosophers perceived the world and truth. To explain how ordinary people had a limited understanding of the truth, Plato imagined a group of individuals trapped in the cave who were shackled to chairs and their heads locked in braces so they could not turn around and see how light (or truth) came into the cave. Trapped in this way, they spent their lives debating the flickering shadows projected on the wall by people and things passing in front of a fire behind them. For Plato, then, ordinary people could only

deal with illusions. In contrast, the philosopher for Plato was like a prisoner who, freed from the shackles, came to understand that the shadows on the wall were not reality at all, as he could now perceive the true form of reality in the way that the fire and the moving objects created the shadows. Plato's philosophers could look directly at the fire and even the sun outside the cave to know the truth. Only philosophers, concluded Plato, could fathom universal truths, *ideals*.

As we shall see, Tesla was like Plato's philosopher, someone who chose to seek out and understand ideals. As Tesla told one biographer, he was inspired by a saying from Sir Isaac Newton: "I simply hold the thought steadily in my mind's eye until a clear light dawns upon me."[16] In harnessing nature for his inventions, Tesla spent a great deal of time and energy trying to discern the fundamental principle on which to base an invention and then worked to manifest that ideal as a working device. With his AC motor, the ideal was the rotating magnetic field; similarly, the ideal of electromagnetic resonance lay behind his devices related to broadcasting electric power without wires.

On several occasions, Tesla elaborated on his idealist approach to invention; here is how he described it to his fellow electrical engineers when he was awarded the Edison Medal in 1917:

> I have unconsciously evolved what I consider a new method of materializing inventive concepts and ideas, which is exactly opposite to the purely experimental of which undoubtedly Edison is the greatest and most successful exponent. The moment you construct a device to carry into practice a crude idea you will find yourself inevitably engrossed with the details and defects of the apparatus. As you go on improving and reconstructing, your force of concentration diminishes and you lose sight of *the great underlying principle*. You obtain results, but at the sacrifice of quality.
>
> My method is different. I do not rush into constructive work. When I get an idea, I start right away *to build it up in my mind*. I change the structure, I make improvements, I experiment, I run the device in my mind. It is absolutely the same to me whether I operate my turbine in thought or test it actually in my shop. It makes no difference, the results are the same. In this way, you see, I can rapidly develop and perfect an invention, without touching anything. When I have gone so far that I have put into the device every possible improvement I can think

> of, that I can see no fault anywhere, I then construct this final product of my brain. Every time my device works as I conceive it should and my experiment comes out exactly as I plan it [emphasis added].[17]

I suspect that Tesla came to this idealist approach partly through his religious background. As Chapter 1 will reveal, Tesla's father and uncles were all priests in the Serbian Orthodox Church and Tesla absorbed something of that faith's beliefs that through the Son of God, the Word or Logos, everything in Creation is endowed with an underlying principle.[18] In this sense, Tesla was much like the great British scientist Michael Faraday, whose research in electricity and chemistry was strongly influenced by his religious beliefs; Faraday was a member of the Sandemanian Church, a Christian sect founded in 1730 that gave Faraday a strong sense of the unity of God and nature.[19]

In taking an idealist approach to invention, Tesla was exhibiting what the economist Joseph Schumpeter called subjective, as opposed to objective, rationality (see Chapter 2). For Schumpeter, engineers and managers come up with incremental innovations by going out and assessing existing needs whereas entrepreneurs and inventors introduce radical and disruptive innovations by responding to ideas that come from within.[20] With objective rationality, the individual shapes ideas in response to the outside world (the market) whereas with subjective rationality, the individual reshapes the outside world to conform to his or her internal ideas. With both the rotating magnetic field and electromagnetic resonance, we will see that the ideals came from within and Tesla struggled to reorder the social world in order to make his inventions a reality.

Tesla's style as an idealist inventor was both similar to and different than that of other inventors. Tesla was very much like Alexander Graham Bell, who called himself a "theoretical inventor" since he preferred to edit and shape inventions in his mind. In contrast, Thomas Edison was almost opposite in style, preferring to develop his ideas by physical means, either by sketching or manipulating devices on the workbench.[21]

Having identified the ideal behind an invention, Tesla was willing to write it up as an article or patent, and he took great delight in demonstrating it to the public. However, Tesla was not especially interested in the nitty-gritty work of converting his inventions into profitable products. Moreover, he was often frustrated that ordinary people

did not grasp the ideals underlying his inventions, and so he resorted to illusions to convince them of the value of his creations. Tesla came to believe that along with identifying the ideal for an invention, he also had to create the right illusion—about the exciting and revolutionary changes that his invention would bring about for society. Through demonstrations, technical papers, and newspaper interviews, Tesla sought to capture the imagination of the public as well as the entrepreneurs who would purchase and develop his inventions. Illusions were the means by which Tesla negotiated with society and secured the resources he needed to convert his ideals into real machines.

In using the term "illusion" here, I must emphasize that Tesla was not attempting to deceive potential backers by lying or giving them inaccurate information. Rather, the interaction between an inventor and his backers is analogous to what takes place between an actor and the audience: the actor may say certain things and make certain gestures, but it is the audience who interprets the statements and gestures and shapes them into an impression. In doing so, members of the audience merge what the performer offers with what they know from the larger culture.[22] In his public lectures, Tesla provided his audiences with just the right sort of information—a blend of wizardry, scientific facts, and social commentary—such that they drew the conclusion that his invention would change the world. What Tesla did was encourage people to see in his inventions whole new worlds of possibility. In fact, I would argue that all inventors and entrepreneurs have to generate illusions about their creations—that we can never know in advance what impact an invention will have and so the discussion about a new technology often turns on illusion. As the science-fiction writer Arthur C. Clarke aptly noted, "Any sufficiently advanced technology will appear as magic."[23]

Inventors, then, succeed by harnessing nature in a new device and connecting that device to people's hopes and wishes. Many inventors and entrepreneurs strive to create the right illusion for untested technologies and novel business plans, but Tesla was extraordinary in linking inventions and cultural wishes.[24] What is unfortunate is that during the second decade of his career (1894–1904)—when he was at the height of his creative powers—Tesla concentrated more on creating illusions than converting his ideals into working machines. Tesla's story, as we shall see, was a struggle between ideal and illusion.

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Page numbers in italics refer to illustrations in the book.