Nikola Tesla, Inventor

by Shawn Lake

Nikola Tesla stood on the darkened stage with his hands on his hips and looked out at his audience. His white tuxedo seemed to shimmer in the dim light, and he was so tall and thin that he appeared to be walking on stilts. The year was 1891, and people filled every seat and stood in the aisles to listen to this elegant man with bright, blue eyes talk about electricity.

On tables nearby lay a dozen glass tubes that gave off an eerie glow. As Tesla stepped forward, the lights cast his shadow along the walls. He held up his hands to signal for silence. The audience leaned forward in their seats as he began to speak. In his careful, accented English, he told them about light bulbs and lightning, waterfalls and power, and how electricity was about to change everyone's future.

But Tesla had more than words in store for his audience. Taking hold of a wire, he spread his arms as tens of thousands of volts of electric power passed over his body. Streamers of blue light flowed over him, and sparks flew from his fingertips. When he picked up a long, glass tube, it began to glow. Tesla himself was the conductor of enough electricity to light up the bulb.

Nikola Tesla sounds like a nineteenth century sideshow performer, but he was one of the most brilliant inventors in history. In fact, every electrical appliance today uses at least one of Tesla's inventions.

conductor: something that allows an electrical current to flow through it

If you had seen him striding down the street, though, you would never have thought that he spent most of his time building inventions in a laboratory. He looked more like a diplomat, with his tidy white shirt buttoned at the throat and his hair slicked back. If you had happened to sit by him in a restaurant, you would have thought he was a bit odd. Tesla always ate as though he were at a formal dinner, with each cup and plate in its place. He had been afraid of germs since he was a boy, and he used stacks of napkins—preferably 18, a number divisible by 3, another one of his obsessions—with each meal to clean his hands and silverware. And although he often stayed up all night working on an experiment, he always tried to be alert the next day.

Tesla wasn't the only inventor staying up all night. Before the discoveries of the late 1800s, people still depended on oil lamps and steam engines. Dozens of inventors throughout the world were racing to be the first to create a dependable light bulb, send power from one city to another, and transmit messages without wires. It was a tangled and disorderly process, with each inventor building on the discoveries of others.

Nikola Tesla raced with the others, but he was usually one step ahead of them. Born at midnight between 9 and 10 July 1856 in Smiljan, Croatia, Tesla was, from his boyhood, able to solve complicated problems in his head. He called his mind his mental blackboard and he would use it to work out the details of an invention and then put it to use in real life. Tesla

obsessions: ideas or habits that become an unhealthy and excessive focus
dependable: reliable
disorderly: having no set rules or structure

even boasted of his early forays into inventing, "I needed no models, drawings, or experiments. I could picture them all as real in my mind."

Tesla had a good model for his creative mind. His mother invented kitchen tools and was famous for the fine needlework and weaving she did on a loom she designed herself. Tesla followed her example for original thinking. When he was very young, he caught frogs with a fishing rod he designed and built, complete with hook and line. He also built a motor powered by June bugs and experimented with a flying machine. When he saw a picture of Niagara Falls, he imagined a big wheel run by water like the ones he built in the creek near his home. The challenge to create a waterwheel that would harness and generate the awesome force of water flowing over Niagara Falls stayed with Tesla until he was an adult.

And Tesla could never pass up a challenge. When he was at college in Austria, he saw that the DC (direct current) electric motors people used then were inefficient and noisy. These motors sparked and rattled because they used a moving part called a commutator to convert electricity from the wires into the motion of a spinning shaft. Tesla told his professor that he could invent an AC (alternating current) motor that would work without a commutator, and the professor laughed at him, calling it "an impossible idea. Mr. Tesla may accomplish great things," the professor said, "but he will never do this."

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forays: attempts
harness: to rein in; to collect
generate: to bring about or produce
inefficient: wasteful of energy or resources
commutator: a series of metal bars that, as part of an electrical generator, produce direct current
shaft: a pole

But Tesla believed it could be done, and though he went on to other projects, he kept thinking about the AC motor. Just as he did when he was a boy, Tesla built the experiments in his mind instead of on a workbench. But one day in 1882 while he was walking in a park with a friend, the answer came to him as, he said, "a flash of lightning, and in an instant the truth was revealed."

On his mental blackboard, Tesla saw the spinning shaft of a motor powered by two out-of-step alternating currents, with no need for a commutator. Other inventors had solved parts of the problem, but no one had visualized a complete AC motor. Tesla was so excited that he grabbed a stick and drew a diagram in the dirt to explain the machine to his friend.

All generators make electricity by spinning the positive and negative poles of a magnet past a coiled wire, and the current they produce is alternating—that is, it jumps back and forth between positive and negative many times a second. Early scientists believed that such a current was useless, so they designed motors that changed it. These first motors used commutators that moved back and forth between the magnetic poles. Commutators switched the current so that it flowed only in one direction, thereby creating direct current. But commutators sparked and clattered as they worked.

Tesla's diagram—and his invention—took the alternating current from two different wires instead of just one. By timing the currents in the wires so they were out of step with each other, he used them to spin the shaft the way two legs pedaling a bicycle can spin the wheels. This eliminated the commutator and made the motors run more quietly and safely. Tesla patented the first of his AC motors in 1890, and today nearly all electric motors are based on his invention.

When he was still a young man, Tesla went to the United States to work for Thomas Edison in his New Jersey laboratory. By that time, 1884, Edison was already famous for a number of inventions, including the incandescent light bulb.

Edison immediately gave Tesla the job of repairing the DC generators used to power a large ship. Tesla not only did the job overnight, but he also told Edison that he could redesign the generators so that they would work better and save money. Edison was impressed by Tesla's work, but when Tesla tried to convince him that AC generators would work better than DC, Edison got angry, saying, "Spare me that nonsense. We're set up for direct current in America."

Edison was the opposite of Tesla in almost every way, and they soon came to dislike each other. While Tesla was neat and dignified, Edison often slept in his lab for days at a time, and his clothes were rumpled and dirty. Edison had a large home and family, while Tesla believed such things would distract him, and he never married. Tesla cared little for the business side of inventing, but Edison was a shrewd bargainer when it came to contracts and payments. Tesla was proud of his university degree while Edison was entirely self-educated. His method of invention was trial and error, which Tesla considered slow and inefficient. "If Edison had a needle to find in a haystack," Tesla said, "he would proceed at once with the diligence of the bee to examine straw after straw until he found the object of his search."

With all these differences, it was difficult for the two inventors to get along, and after a disagreement about payment for his work, Tesla walked out. The biggest dispute they had, however, was over electric power itself. Edison's bulbs operated on DC power, while Tesla believed that AC was the way of the future. Edison already operated the Edison Electric Company, which generated DC power for a small number of houses and factories in New York City, and Tesla soon opened the Tesla Electric Company to develop an AC power system. When investors chose sides and tried to convince the public that their way was better, a "battle of the currents" began.

Today we know that AC power is better for large users like cities while DC works best in batteries. Tesla was correct when he pointed out that DC could only be transmitted a few miles before the lights grew dim. AC could travel over hundreds of miles of wire and still light a home. In the end the facts won out, and AC power runs our cities and industries today.

Like most inventors, Tesla often solved parts of a problem, and others took his work further. While still at Edison's lab, he worked on an idea for creating light through a gas instead of a filament, and that idea became the fluorescent lights we use today. Tesla was able to send wireless transmissions—soon to be known as radio—in 1893, and the inventor Guglielmo Marconi later used his ideas to build a device that sent a radio signal across the Atlantic Ocean.

Although Tesla was one of the most famous people in the world at the turn of the century, and though he received many honors for his work, his name was often left out of early books and articles by scientists, usually because Tesla was careless about applying for patents and signing contracts with the manufacturers of his inventions. He had little patience with those who thought only of money.

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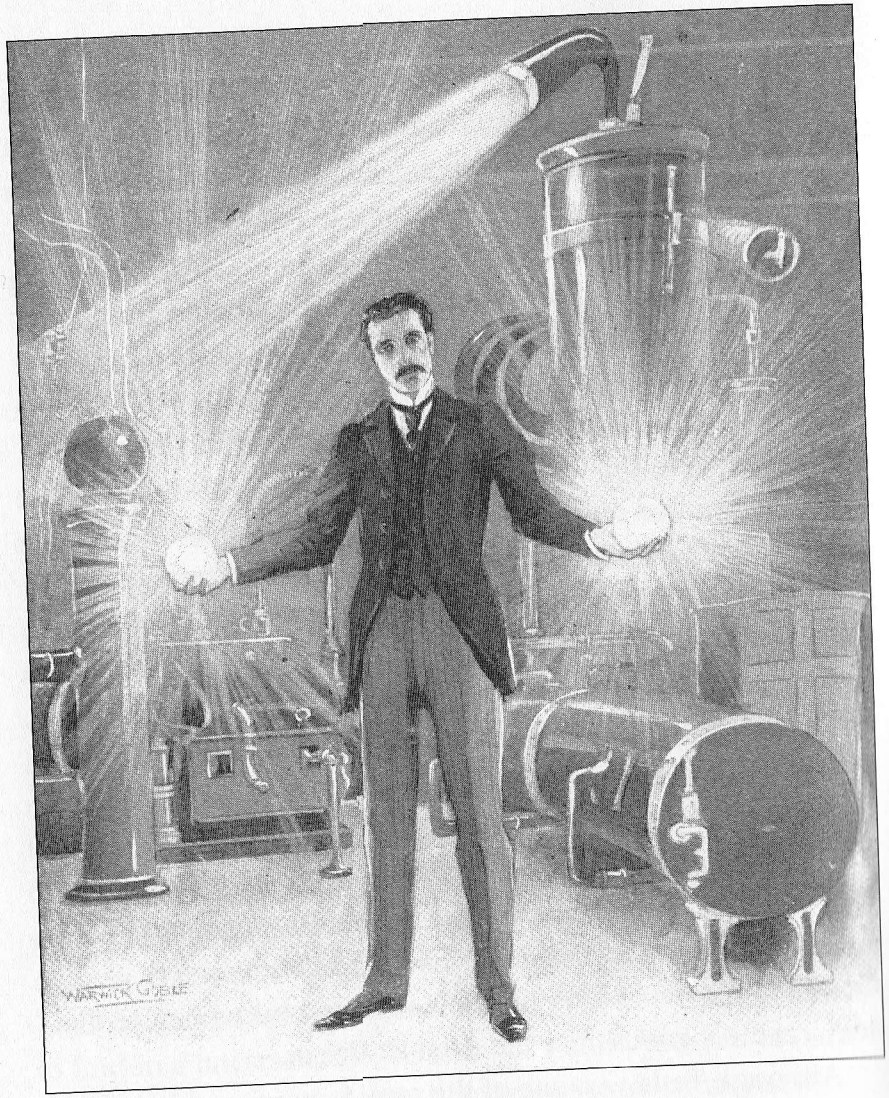
incandescent: glowing as a result of intense heat
diligence: careful attention
dispute: an argument
filament: a small wire that glows when an electrical current passes through it



But some of Tesla's ideas seemed so bizarre that people decided they shouldn't believe in his work. He built a laboratory in Colorado where he tried to generate one hundred million volts of electricity in order to use what he called the earth's "resonant frequency" to send signals around the world without wires. He even said that if the inhabitants of Mars knew how to receive his signals, he could talk to them, too. At one point, he sent lightning bolts 135 feet in the air, and the nearby city of Colorado Springs went dark when he shorted out their power system.

Tesla could also be arrogant and impatient with people he worked with, and some newspaper reporters called him crazy and unreliable. But there was a little truth in even his most outrageous ideas, and his peculiar personality was the flip side of his genius. Tesla laughed at his critics.

"The present is theirs," Tesla said. "The future, for which I really worked, is mine."

Today Tesla's achievements speak for themselves. AC power, the system the world runs on today, uses motors and generators based on Tesla's inventions. If you visit Niagara Falls, you will see that he fulfilled his childhood dream of the waterwheel. His name appears nine times on the dedication plaque there, for nine separate inventions used in his great AC dynamos. The tesla, a unit of magnetic induction, is named for him. And every TV and radio uses a device called a Tesla coil that boosts the household current. This same device is also used for Hollywood special effects, like the blue lightning arching up the buzzing metal coil in Frankenstein movies. His work with electricity and magnetism formed some of the building blocks for lasers, radar, fax machines, and electron microscopes.

arrogant: conceited; full of oneself