Excerpted from the “Light” chapter of How We Got To Now, by Steven Johnson

The strange thing about the electric lightbulb is that it has come to be synonymous with the “genius” theory of innovation— the single inventor inventing a single thing, in a moment of sudden inspiration—while the true story behind its creation actually makes the case for a completely different explanatory framework: the network/systems model of innovation. Yes, the lightbulb marked a threshold in the history of innovation, but for entirely different reasons. It would be pushing things to claim that the lightbulb was crowdsourced, but it is even more of a distortion to claim that a single man named Thomas Edison invented it.

The canonical story goes something like this: after a triumphant start to his career inventing the phonograph and the stock ticker, a thirty-one-year-old Edison takes a few months off to tour the American West—perhaps not coincidentally, a region that was significantly darker at night than the gaslit streets of New York and New Jersey. Two days after returning to his lab in Menlo Park, in August 1878, he draws three diagrams in his notebook and titles them “Electric Light.” By 1879, he files a patent application for an “electric lamp” that displays all the main characteristics of the lightbulb we know today. By the end of 1882, Edison’s company is powering electric light for the entire Pearl Street district in Lower Manhattan.

It’s a thrilling story of invention: the young wizard of Menlo Park has a flash of inspiration, and within a few years his idea is lighting up the world. The problem with this story is that people had been inventing incandescent light for eighty years before Edison turned his mind to it.

A lightbulb involves three fundamental elements: some kind of filament that glows when an electric current runs through it, some mechanism to keep the filament from burning out too quickly, and a means of supplying electric power to start the reaction in the first place. In 1802, the British chemist Humphry Davy had attached a platinum filament to an early electric battery, causing it to burn brightly for a few minutes. By the 1840s, dozens of separate inventors were working on variations of the lightbulb. The first patent was issued in 1841 to an Englishman named Frederick de Moleyns. The historian Arthur A. Bright compiled a list of the lightbulb’s partial inventors, leading up to Edison’s ultimate triumph in the late 1870s. The list has more than twenty names on it. At least half of the men had hit upon the basic formula that Edison ultimately arrived at: a carbon filament, suspended in a vacuum to prevent oxidation, thus keeping the filament from burning up too quickly. In fact, when Edison finally began tinkering with electric light, he spent months working on a feedback system for regulating the flow of electricity to prevent melting,

before finally abandoning that approach in favor of the vacuum—despite the fact that nearly half of his predecessors had already embraced the vacuum as the best environment for a sustained glow.

The lightbulb was the kind of innovation that comes together over decades, in pieces. There was no lightbulb moment in the story of the lightbulb. By the time Edison flipped the switch at the Pearl Street station, a handful of other firms were already selling their own models of incandescent electric lamps. The British inventor Joseph Swan had begun lighting homes and theaters a year earlier. Edison invented the lightbulb the way Steve Jobs invented the MP3 player: he wasn't the first, but he was the first to make something that took off in the marketplace.

So why does Edison get all the credit? It's tempting to use the same backhanded compliment that many leveled against Steve Jobs: that he was a master of marketing and PR. It is true that Edison had a very tight relationship with the press at this point of his career. (On at least one occasion, he gave shares in his company to a journalist in exchange for better coverage.) Edison was also a master of what we would now call "vaporware": He announced nonexistent products to scare off competitors. Just a few months after he had started work on electric light, he began telling reporters from New York papers that the problem had been solved, and that he was on the verge of launching a national system of magical electrical light. A system so simple, he says, "that a bootblack might understand it."

Despite this bravado, the fact remained that the finest specimen of electric light in the Edison lab couldn't last five minutes. But that didn't stop him from inviting the press out to Menlo Park lab to see his revolutionary lightbulb. Edison would bring each reporter in one at a time, flick the switch on a bulb, and let the reporter enjoy the light for three or four minutes before ushering him from the room. When he asked how long his lightbulbs would last, he answered confidently: "Forever, almost."

But for all this bluffing, Edison and his team did manage to ship a revolutionary and magical product, as the Apple marketing might have called the Edison lightbulb. Publicity and marketing will only get you so far. By 1882, Edison had produced a lightbulb that decisively outperformed its competitors, just as the iPod outperformed its MP3-player rivals in its early years.

In part, Edison's "invention" of the lightbulb was less about a single big idea and more about sweating the details. (His famous quip about invention being one percent inspiration and ninetynine percent perspiration certainly holds true for his adventures in artificial light.) Edison's

single most significant contribution to the electric lightbulb itself was arguably the carbonized bamboo filament he eventually settled on. Edison wasted at least a year trying to make platinum work as a filament, but it was too expensive and prone to melting. Once he abandoned platinum, Edison and his team tore through a veritable botanic garden of different materials: “celluloid, wood shavings (from boxwood, spruce, hickory, baywood, cedar, rosewood, and maple), punk, cork, flax, coconut hair and shell, and a variety of papers.” After a year of experimentation, bamboo emerged as the most durable substance, which set off one of the strangest chapters in the history of global commerce. Edison dispatched a series of Menlo Park emissaries to scour the globe for the most incandescent bamboo in the natural world. One representative paddled down two thousand miles of river in Brazil. Another headed to Cuba, where he was promptly struck down with yellow fever and died. A third representative named William Moore ventured to China and Japan, where he struck a deal with a local farmer for the strongest bamboo the Menlo Park wizards had encountered. The arrangement remained intact for many years, supplying the filaments that would illuminate rooms all over the world.

Edison may not have invented the lightbulb, but he did inaugurate a tradition that would turn out to be vital to modern innovation: American electronics companies importing their component parts from Asia. The only difference is that, in Edison’s time, the Asian factory was a forest.

The other key ingredient to Edison’s success lay in the team he had assembled around him in Menlo Park, memorably known as the “muckers.” The muckers were strikingly diverse both in terms of professional expertise and nationality: the British mechanic Charles Batchelor, the Swiss machinist John Kruesi, the physicist and mathematician Francis Upton, and a dozen or so other draftsmen, chemists, and metalworkers. Because the Edison lightbulb was not so much a single invention as a bricolage of small improvements, the diversity of the team turned out to be an essential advantage for Edison. Solving the problem of the filament, for instance, required a scientific understanding of electrical resistance and oxidation that Upton provided, complementing Edison’s more untutored, intuitive style; and it was Batchelor’s mechanical improvisations that enabled them to test so many different candidates for the filament itself. Menlo Park marked the beginning of an organizational form that would come to prominence in the twentieth century: the cross-disciplinary research-and-development lab. In this sense, the transformative ideas and technologies that came out of places such as Bell Labs and Xerox-PARC have their roots in Edison’s workshop. Edison didn’t just invent

technology; he invented an entire system for inventing, a system that would come to dominate twentieth-century industry.

Edison also helped inaugurate another tradition that would become vital to contemporary high-tech innovation: paying his employees in equity rather than just cash. In 1879, in the middle of the most frenetic research into the lightbulb, Edison offered Francis Upton stock worth 5 percent of the Edison Electric Light Company—though Upton would have to forswear his salary of $600 a year. Upton struggled over the decision, but ultimately decided to take the stock grant, over the objections of his more fiscally conservative father. By the end of the year, the ballooning value of Edison stock meant that his holdings were already worth $10,000, more than a million dollars in today's currency. Not entirely graciously, Upton wrote to his father, "I cannot help laughing when I think how timid you were at home."

By any measure, Edison was a true genius, a towering figure in nineteenth-century innovation. But as the story of the lightbulb makes clear, we have historically misunderstood that genius. His greatest achievement may have been the way he figured out how to make teams creative: assembling diverse skills in a work environment that valued experimentation and accepted failure, incentivizing the group with financial rewards that were aligned with the overall success of the organization, and building on ideas that originated elsewhere. "I am not overly impressed by the great names and reputations of those who might be trying to beat me to an invention. It's their 'ideas' that appeal to me," Edison famously said. "I am quite correctly described as 'more of a sponge than an inventor.'"

The lightbulb was the product of networked innovation, and so it is probably fitting that the reality of electric light ultimately turned out to be more of a network or system than a single entity. The true victory lap for Edison didn't come with that bamboo filament glowing in a vacuum; it came with the lighting of the Pearl Street district two years later. To make that happen, you needed to invent lightbulbs, yes, but you also needed a reliable source of electric current, a system for distributing that current through a neighborhood, a mechanism for connecting individual lightbulbs to the grid, and a meter to gauge how much electricity each household was using. A lightbulb on its own is a curiosity piece, something to dazzle reporters with. What Edison and the muckers created was much bigger than that: a network of multiple innovations, all linked together to make the magic of electric light safe and affordable.

Why should we care whether Edison invented the lightbulb as a lone genius or as part of a wider network? For starters, if the invention of the lightbulb is going to be a canonical story of how new technologies come into being, we might as well tell an accurate story. But it's more than just a matter of getting the facts right, because there are social and political implications to these kinds of stories. We know that one key driver of progress and standards of living is technological innovation. We know that we want to encourage the trends that took us from ten minutes of artificial light on one hour's wage to three hundred days. If we think that innovation comes from a lone genius inventing a new technology from scratch, that model naturally steers us toward certain policy decisions, like stronger patent protection. But if we think that innovation comes out of collaborative networks, then we want to support different policies and organizational forms: less rigid patent laws, open standards, employee participation in stock plans, cross-disciplinary connections. The lightbulb shines light on more than just our bedside reading; it helps us see more clearly the way new ideas come into being, and how to cultivate them as a society.