## Charles Proteus Steinmetz: History and Science

Both during his life and after his death, Charles Proteus Steinmetz was often referred to as the “Wizard of Schenectady.” However, when I looked into his life, most of his famous contributions occurred between when he arrived in America, penniless, with no English or practical engineering skills in June of 1889 (he was a political refugee from Germany due to his socialist beliefs), and when he was transferred to Schenectady in February of 1894. Nevertheless, I believe that his moniker of “Wizard of Schenectady” was justified, just not in the way that most people think. For in Schenectady, Steinmetz used his influence to create the first industrial cooperative research institute ever, the first consulting department ever, the first electrical engineering department that was part of a liberal college in the United States (and was influential towards promoting a rounded EE departments in colleges everywhere), and was so influential towards the survival of GE that he was allowed to do whatever he wanted. In a world that compelled conformity, Steinmetz played by his own rules and had a fantastic time doing it. Ready to learn about one of the most quirky, delightful and I argue influential engineers of all time? Let’s go!

Steinmetz’s career at GE arguably began when Edison was fired from Edison’s General Electric in April of 1892 and, by December of 1892, 27 year old Steinmetz was hired by the now Edison free General Electric where he taught them how to use AC. 14 months later Steinmetz and almost all the GE employees were transferred from the GE labs in New York City to 165 miles away in Schenectady. In 1911, Steinmetz recalled that, “Schenectady had a reputation at that time of being very similar to a cemetery. I was very agreeably disappointed to find that reputation underserved… and do not intend to live anywhere else.”[1]

Steinmetz soon moved into a rented house with his assistant, Ernst Berg where they were often joined by Ernst’s brother Eskil visiting from Sweden. By January, 1895, Eskil was back in Europe and Steinmetz wrote to him to “come over at once, without wasting any more time in Europe,” and that, “you will have to work here, and a good deal of it, but there is plenty of time left to have a good time, thus come over at once.”[3] Soon Eskil was living with them and part of the “family” pictures. (Another assistant, Henry Miller, lived with his sister Florence, but spent so much time at the house that he was often included in the “family” pictures too). Soon Ernst started adding strange pets, pets that Steinmetz formed a particular attachment to and soon they had “a small-sized menagerie of queer pets,” including, “racoons, supposedly tame; an alligator or two, the special pets of Steinmetz; owls, squirrels, monkeys, and a pair of crows, with which Steinmetz…professed to be able to converse with.”[4] Steinmetz was particularly close to the crows, named Mary and John, and was heartbroken when a pet raccoon got free and ate them.

It is hard not to look at these old photographs, and Steinmetz loved taking photos, including trick photos, without seeing how Steinmetz was always the center of a party. Rock climbing, skiing, boating, picnics, bicycle rides, they even tried to fly with what they called the “Mohawk River Aërial Navigation” Club, which was America’s first glider club. However, they couldn’t really get any of their prototypes off the ground, Steinmetz said that they made a few jumps but nothing they produced, “could be dignified with the term ‘flight’.”[5] Amusingly, Steinmetz managed to make it look like they flew with trick photography.

This wasn’t as much as an all-boys club as you might think as there were several women and many children that would visit regularly, including the Ernst and Eskil Berg’s sister Julia, Miller’s sister Florence, a neighbor named Mrs. Krueger who was basically the den mother of this whole mad group and Steinmetz’s half-sister Clara who would often stay for long periods until the craziness of the situation became too much, when she would escape to her own devices in New York.[6]

Then, in 1900, the club started to break up as the Berg brothers moved away to work at other jobs or to live less-bohemian lives on their own. Still, Steinmetz continued to have a steady stream of visitors both engineers and local families. It was around this time that the now president of GE, Edwin Rice agreed to Steinmetz’s idea that they should start a research group at GE, which they did at Steinmetz’s stable that he was using as a home laboratory. I am going to show you a small clip from a documentary made by the Edison Tech club about it, which is why they have so many images of Edison even though Edison never worked at GE nor had anything to do with GEs decisions:

What that movie didn’t say is that the reason that Whitney created an independent laboratory for the GE research is because an accident burned down part of the stable that Steinmetz and the research group were using for a laboratory in January of 1901.[7] GE research laboratory was the source of many important discoveries over the years and was an inspiration for other research labs, like Bell labs that was created in 1925.[8]

Meanwhile, Steinmetz then decided to build his own house, factory and conservatory, which were described as a “Den of incomprehensible perplexity.”[9] Steinmetz also bought a little shack on the side of a river as a vacation spot. Soon he had groups of partiers visiting every summer weekend for long parties and constant attempts to dam the river. (He famously checked the stability of the shack by hosting a large party and putting the band and the punch bowl at the weak end. When it survived the night, Steinmetz figured it was stable enough to live in).

By this time, Steinmetz’s reputation was exploding, at least with engineers. In 1901, Steinmetz was elected president of the American Institute of Electrical Engineers, in 1902, he was awarded an honorary degree from Harvard in 1902. The president of Harvard declared, in an American-centered way, that Steinmetz was, “the foremost expert in applied electricity of this country, and therefore the world.”[10] The following year, a liberal college in Schenectady called Union College gave Steinmetz an honorary doctorate and hired him as a professor of electrical engineering. They just made up the whole department as they had no electrical engineering department, heck, they had no electrical engineering classes before him. Steinmetz was excited about the job, and decided to do it for free.[11] Here is a small clip from Union College about this.[12]

It was around this time that the press started to get interested in Steinmetz. It started in March of 1903, when *Success* magazine ran a big article about Steinmetz where they said, “he is known and recognized by engineers everywhere as the man who probably knows more about the practical application of electricity than any other man in this country.”[13] Soon the newspapers were full of articles about Steinmetz, which was pushed by GE and Union College. GE in particular was happy to have a flamboyant face to humanize their company especially as it was awkward to promote Edison as he had been fired just 10 years earlier.

Meanwhile, Steinmetz, who always liked to live communally, became particularly close to a shy young engineer named Joseph LeRoy “Roy” Hayden. When Roy Hayden married a woman named Corrine in 1903, Steinmetz invited the newly married couple to live with him. In his old photographs with the Berg brothers, Steinmetz labeled them as his family, however, with the Haydens this was finally true and in 1905, Steinmetz formally adopted Roy Hayden. The three people (which quickly grew to six with the arrival of Hayden’s three children, Joe, Midge and Billy) lived in bohemian happiness for the rest of Steinmetz’s life. One can see the delight and love Steinmetz had for his grandchildren from his photographs of them and their remembrances of their doting grand-daddy.

Steinmetz then decided that as he was so often called to look at special problems, that GE should form a special consulting department that was composed of the best specialist engineers so that they could swoop down and deal with any emergency. In 1910, GE created that department and made Steinmetz the head.[14] Now, of course, every tech company has such departments.

At the same time, Steinmetz’s work with Union college inspired him to promote the idea that an electrical engineering education should have a broad framework specifically in the classics (at this time almost all electrical engineering departments treated education as a trade where the students learned about EE only). Steinmetz, on the other hand, felt that a full liberal education not only would help with knowing the origin of terms but also because, “the vocation of the engineer is especially liable to make the man one-sided. Since he deals exclusively with empirical science and its applications, the engineer forgets, or never realizes, that there are other branches of human thought equally important as factors of a broad education and intellectual development.”[15] Soon most electrical engineering departments required a rounded education for their students, a practice that continues to this day. If you got a degree in electrical engineering at a college and enjoyed getting a well-rounded education you can thank Steinmetz. If you did and hated having to take English, History and Languages you can blame Steinmetz too, I guess.

Meanwhile, Steinmetz continued to be an active socialist, if not a particularly radical one. He felt that America, “has given me everything I wanted… the only criticism which I can make is that I would far more enjoy my advantages if I knew that everybody else could enjoy the same.[16]” Steinmetz was therefore delighted when in 1911, Schenectady actually elected a socialist mayor named George Lunn. Steinmetz immediately offered his services and was nominated to be on the board of Education which elected him president. Steinmetz learned that the town had quadrupled in size but the schools had not increased enough in size and there were over 3,000 students who were unable to get an education. Within two years, Steinmetz had built three new schools and enlarged 2 more and built numerous playgrounds, set up a system of school meals, and set up systems of school doctors and created an epidemic plan (which was good timing as the pandemic of 1918 was just about to arrive). However, he was stymied by the board of apportionment which never seemed to be willing to pay for all of this. Therefore, in 1913, Steinmetz ran to be on the board in charge of finance. Unfortunately, both Steinmetz and the mayor Lunn lost. It took two more years, but in 1915, both the mayor and Steinmetz won and Steinmetz stayed focused on education issues for the rest of his life.[17]

You might wonder how his political feelings meshed with working for a giant energy conglomerate like GE. However, to Steinmetz, working at GE was part of his socialist and environmental beliefs. Steinmetz tried to warn us that, “We have been a wasteful nation because of our great natural wealth…we have been destroying our forests to get lumber in the most extravagant way. We have taken out crops year after year and never put anything back in the earth. There has been no such thing as conservation. It has been destruction.”[18] But how to fix that without rejecting technologic advances? In 1913, Steinmetz felt he was working on the answer: “Electricity, my friend!...Electricity will take the place of coal, and will do the work a thousand fold better. The time is not far.”[19] Not only that, but Steinmetz felt that we could reach a perfect society which was powered by electricity instead of by the oppression of the poor, as he explained in a radio address in 1922: “with one taking care of the disproportion and supplies of energy, the other of materials. With these, all requirements are complete to develop the most perfect civilization the world has ever seen. This civilization not for a minority depending on the labor of masses of slaves or serfs but a real civilization of benefit to all the members of the human race.”[20]

Steinmetz was also an early leader in electric cars! See, in January 1914, Steinmetz gave a talk with the title of “The Future of Automobiling Belongs to the Electic” as gas cars were very expensive and, unlike a horse an electric car “requires no attention.”[21] Edison immediately asked Steinmetz if he could add that the electric car requires no attention “if equipped with an *Edison* battery.”[22] Steinmetz agreed and even signed the ad and Edison used this and his image to promote the Edison battery. Then soon after that (or perhaps before) Steinmetz bought a 1914 Detroit Electric, a model 48 Duplex (and no, I don’t know enough about old cars to know what that means). However, these early cars were very difficult to operate especially for Steinmetz with his physical limitations, so he started to tinker with it and by March, 1920 declared that he had made a better system and actually formed his own company, the “Steinmetz Electric Motor Car Company.”[23] Some “Steinmetz trucks” were produced in 1922 and had very good press.[24]

Now I am going to talk about a really famous photograph of Albert Einstein that was edited to make it look like it was a private meeting and why. It all started in April of 1921 when Albert Einstein went on a tour of America to raise money for a Jewish college as he was starting to see “countless examples” of how Jewish students in Germany were being deprived of educational opportunities (not realizing that Germany was just getting started on that score).[25] This was just after the end of WW1, so the anti-German feeling was very strong, but Einstein was so famous that everyone flocked to see him and to use him to promote their cause or business. It was for that reason that the Radio Corporation of America had a big to do with Einstein. GE took the opportunity to invite their top stars like Irving Langmuir, Albert Hull, Steinmetz’s old friend Ernst Berg and, of course, Charles Proteus Steinmetz to the party. Note that this guy is not Nikola Tesla but instead the engineer John Carson who I mention in my video about the history of FM radio (he is the one who said that FM wouldn’t work to remove static and said, “static, like the poor will always be with us”)[26] Many years after the event GE claimed that Steinmetz and Einstein hung out for hours after this and talked about science, engineering and socialism.[27] Although Einstein was very busy so it seems unlikely that they spoke for hours, they did both speak German (and Einstein didn’t speak English at the time) so they probably talked a bit at least. Also, soon after the meeting, Steinmetz gave a series of lectures about Einstein’s theory of relativity for laymen to give people, “a general knowledge and understanding of the new ideas on time and space.”[28] Also, in February of 1922, Steinmetz wrote Vladimir Lenin, yep that Lenin, a letter offering his services to help out Russia with their electricity systems to which Lenin politely declined but sent a signed picture and publicized their letters. Steinmetz then put that portrait on the wall and insisted that every and all visitors had to admire it! GE was a little nervous about having Steinmetz doing this publicly, but he was just too famous for them to fire or reprimand.

Part of the reason for this fame is that in March 1922, mere weeks before Lenin published their letter, GE held this big demonstration to show that Steinmetz had made the first artificial lightning bolt with power to Thomas Edison.[29]

Steinmetz had actually built the device in fall of 1921 after Steinmetz’s vacation cabin was struck by lightning two summers before. He had already used his mathematical calculations to determine that lightning was not useful for commercial purposes, noting that it may have immense power (he calculated around 600 million horsepower) but it only lasted for two millionths of a second. So, “the electricity in a cloud that can hurl a thousand lightning-bolts is worth just ten dollars!”[31] Steinmetz then decided it was time to use “modern” technology to recreate lightning, which he did with 200 of what were basically Leyden jars in the form of glass slabs which would produce around 120,000 volts. This was just a fraction of a real lightning bolt which Steinmetz estimated averaged between 50 to 100 million volts. Steinmetz knew that higher voltages had been made before, specifically by Elihu Thomson, Nikola Tesla and the GE lab. But according to Steinmetz, “mere high voltage is not lightning and has no similarity to lightning in its action and effects.”[32] Instead, you need something that produces high voltage *and* high current to create a lot of power for a short period of time. Steinmetz’s lightning produced over a million horsepower for a hundred-thousandth of a second. Steinmetz said that “a small tree, exposed to the discharge, is torn to pieces. A piece of wire struck by it vanishes in dust.”[33] But Steinmetz wasn’t just interested in a big flash. He was doing all this to actually test lightning arresters (the lightning protectors for electrical power lines) for the first time.

Now what was so influential about this demonstration was not just that artificial lightning was amazing and it is a good idea to test arrestors but that it caused a reunion between Edison and GE, a reunion that GE used to promote themselves. From then on GE used Edison’s image as their logo and spokesman and used Steinmetz’s image and story as their way to talk about AC without involving the people who were unrelated to GE like Micheal Dolivo-Dobrovolsky, Westinghouse, Stanley or Tesla. You can see how they did this in this clip from a 1976 GE promotional film.

According to Steinmetz, Steinmetz and Edison had met each other way back in August 1893, at an electrical meeting at the world’s fair in Chicago just after Steinmetz’s boss Eickemeyer sold out to GE. At the meeting Eickemeyer introduced Steinmetz to Edison and Edison turned to them and jokingly pointed at Steinmetz and said “pure theory,” pointed to Eickemeyer and said, “theory and practice” and then at himself and said “pure practice.”[34] Over the years Steinmetz and Edison met at various meetings and soon they began a correspondence. By 1914, as I said before, Steinmetz agreed to let Edison use his words and images to promote Edison’s battery. Then, in 1922, Edison decided to break his 30-year moratorium and officially visit GE to see Steinmetz’s lightning and get a tour of the facilities. I am not 100% sure what motivated Edison to do this but as far as I can tell it went down like this: a few years earlier, Henry Ford who was a GIANT Edison supporter decided to make a museum dedicated to “show industrial history” which eventually turned into the Henry Ford Museum of American Innovation.[35] Ford started envisioning recreating Edison’s Menlo Park’s lab at his museum with the long-range plan of hosting a big party on October 1929 to celebrate 50th anniversary of Edison’s manufacture of his first incandescent lamp. It is possible that Ford, who knew a lot about PR, convinced the reluctant Edison to return to Schenectady and convert General Electric back to Edison’s General Electric at least in spirit, and used Steinmetz’s amazing lightning experiments to give Edison a legitimate excuse for this action.

As I said before, GE was delighted and decided to use this meeting to promote the company and worked overtime to promote the Steinmetz-Edison connection and the story of Steinmetz, which is why they photoshopped that picture of Einstein and Steinmetz so it looked like it was just the two of them. Here is a clip from the first video that GE made about this meeting:

Now we get to a famous story about Steinmetz and Henry Ford. I could find two sources for this, one from a letter to the editor in 1965 stating that his father told him the story, and another from a radio show at GEs WGY from 1972 on the 50th anniversary of their first show.[36] Now considering how much people liked to exaggerate Steinmetz stories you can take this one with a grain of salt. Or you can decide to believe, cause why not? Although some of the details are subtly different, the punchline was the same. I will let Kolin Hagar, one of the first radio broadcasters from WGY, set the scene: Then, according to these sources at Ford’s factory Steinmetz refused all help and after two days of observing the giant machine, made a mark on the generator with some chalk and told the engineers that they needed to remove sixteen windings from the field coil at that point. When the engineers complied, the generator was fixed! Ford was delighted until he got a bill for $10,000, at which point he demanded an itemized bill. Steinmetz responded with a note that simply said, “Making chalk marks on generator $1, Knowing where to make mark $9,999, Total due $10,000.”[36]

In fall of 1923, Steinmetz was invited to give a talk at the American Institute of Electrical Engineers in Del Monte, California. Steinmetz was excited as he had never been to the West coast. The whole family went together and in Hollywood, Steinmetz was given a tour of the set by non-other than the famous movie star Douglas Fairbanks. Steinmetz loved the trip but found it a bit tiresome and declared that their next one would be to the Mediterranean. When he woke up in the morning, he said he still felt a bit tired. His son, Hayden, offered to get him breakfast in bed, and by the time Steinmetz’s grandson came up with the tray, Charles Proteus Steinmetz had died. He was 58 years old. Soon after his death, his car company folded. GE and Union college continued to use his image to promote themselves so that he was commonly known in the general public up until the 1960s. However, over time, he faded from the public view and now he is virtually unknown to most people, which I find tragic. Luckily, the people at Union college have collected and preserved many of his original documents, old car, and photographs, and the Ford museum has a lot of old devices and pictures and actually moved his vacation shack to his museum. There are also a few books that cover his amazing story. I will link my favorite two below.

Now usually this is where I say how some concept of this video leads to the subject of my next video, but this time I am going to do something slightly different. As I was working on this video, I was given the opportunity to get a personalized behind the scene tour of the amazing Spark Museum in Bellingham, Washington. On the part open to the public, I got to see a real live original Pixii generator! I got to play with an accurate recreation of the first Cooke-Wheatstone telegraph and the first Morse telegraph and John Jenkins, the cofounder of the museum, pointed out some things about the two telegraph systems and how they worked that just blew me away. On top of that John let me see and even hold original books from Gilbert, Guericke, Franklin, Galvani, Volta, Faraday, Maxwell, Hertz and more. Plus, I got to do this… I had so much fun – it was my Disneyland. My reaction to the Spark Museum in detail is next time on the lightning tamers. If you want a sneak peak, my friend Jeff Parisse (who actually built the Tesla coil used in that video) made a little video about our trip and I will link below.

I am so glad I got a chance to introduce you all to Steinmetz. If you want to see the script for this video with lots of footnotes, just join my free email list (link below) or, if you are feeling generous, you could join my Patreon (thanks Patrons). Either way, you also will be the first to know when my new book “The Lightning Tamers: True Stories of the Dreamers and Schemers who Harnessed Electricity and Transformed Our World” is available (which is coming up, Spring/Summer of 2022). If you are from the future, I will put a link below. Stay safe and curious.

[1] Charles Steinmetz “The Vitality of Schenectady” (April 7, 1911) *Schenectady Board of Trade*

[2] Hammond, *Charles Proteus Steinmetz: A Biography*, 221.

[3] Charles Steinmetz to Eskil Berg (Jan 9, 1895) *Steinmetz Digital Collection of Schenectady* #473868 <https://nyheritage.contentdm.oclc.org/digital/collection/schmuse/id/119/rec/5>

[4] “Charles Proteus Steinmetz,” *The Mentor-World Traveler* 13 (May 1925), 14.

[5] Tom D. Crouch *A Dream of Wings* (W. W. Norton, 2002), 172.

[6] Hammond, *Charles Proteus Steinmetz*, 239

[7] George Wise *Willis R. Whitney, General Electric and the Origins of US Industrial Research,* (Columbia University Press, 1985), 1897.

[8] Guy Bartlett. "The General Electric Research Laboratory. What It Is and What It Has Accomplished." *Journal of Chemical Education*. 6. 10 (1929), 1619.

[9] Hammond, *Charles Proteus Steinmetz*, 400.

[10] According to *Western Electrician* (July 12, 1902), vol. 31. 22.

[11] Hammond, *Charles Proteus Steinmetz: A Biography*, 283-4.

[12] Joseph Laub (director) *Phasors Steinmetz and Union* (2014) <https://www.youtube.com/watch?v=8ddmM3EAzwY>

[13] Herbert Wallace “A Man Who Knows” *Success Magazine* vol. 6 (March 1903), 145.

[14] Hammond, *Charles Proteus Steinmetz: A Biography*, 296.

[15] Charles Steinmetz “On the Value of the Classics in Engineering Education” *The Classical Weekly* vol. 3 No 21 (April 2, 1910), 175.

[16] Charles Steinmetz *America and the New Epoch* (Harper & Brothers, 1916) ix.

[17] Hammond, *Charles Proteus Steinmetz*, 314-9.

[18] Sender Garlin *Charles P. Steinmetz, scientist and socialist* (American Institute for Marxist Studies, 1977), 12.

[19] Steinmetz quoted by H. Bedford-Jones “The Wonder-Work of the Mohawk Valley” *Popular Electricity* vol. 5, No. 10 (Feb 1913), 1020.

[20] “Steinmetz speaks on WGY radio” miSci - Museum of Innovation and Science, https://nyheritage.contentdm.oclc.org/digital/collection/schmuse/id/269/rec/167

[21] Charles Steinmetz “The Future of Automobiling Belongs to the Electric” delivered Jan 28, 1914, found in *Automobile Topics* (Feb 7, 1914), 1091.

[22] For example *The Automobile* (Feb 26, 1914), 532.

[23] “The New Steinmetz Electric” *The Central Station* (March, 1920), 302-3.

[24] “Steinmetz Electric Truck Called Marvel by Experts” *The American Monthly* vol. 14 (1922), 26.

[25] Einstein to Fritz Haber, (March 9, 1921) Siegfried Grundmann *The Einstein Dossiers* (Physica-Verlag, 2006), 123.

[26] “Einstein visits high power radio” *RCA News, Vol. 2* (1921), 6.

[27] Siegfried Grundmann *The Einstein Dossiers* (Physica-Verlag, 2006), 125.

[28] Charles Steinmetz *Four Lectures on Relativity and Space* (McGraw-Hill, 1923), v.

[29] “Man-Made Lightning Under Control” *Schenectady Works,* vol. 6 (March 3, 1922), 1-3

[30] “Modern Jove Hurls Lightning at Will,” the *New York Times*, March 3, 1922.

[31] Steinmetz quoted in “Still Greater Developments” *The Mining Congress Journal,* vol. 8-9, (June 1923), 207.

[32] “Tamed Lightning” *Scientific American* vol. 127 (July, 1922), 26.

[33] Ibid.

[34] Charles P. Steinmetz quoted in “1879 Edison Day – Oct 21, 1914” *The Saturday Evening Post* (Oct 17, 1914), 1.

[35] Gerry Boehme, *Henry Ford: Assembly Line and Automobile Pioneer* (New York: Cavendish Square Publishing, 2019), 89.

[36] Audio clip Kolin Hagar being interviewed by Larry Hart, 1972 found at https://edisontechcenter.org/CharlesProteusSteinmetz.html

[36] *Life*,May 14, 1965, 27.

[37] https://plunkettlakepress.com/ses.html