Honors Physics Presentation on Charles Steinmetz, February 2004

THE PRESENTATION

Biographical Information

Which resident of Schenectady, New York, was considered the greatest electrical engineer of his time and could picture third-degree equations in his head?

Charles Proteus Steinmetz, who was actually born in 1865 in Breslau, Germany, now part of Poland. Although he initially had difficulty in math, he became one of the school's best students by age ten. After graduating from the gymnasium, he entered the University of Breslau in 1883, where he memorized logarithmic tables in order to perform problems in his head in a matter of seconds. He was attracted to socialism as a means of redistributing wealth to the poor, but the antipathy of German Chancellor Otto von Bismarck toward socialists forced Steinmetz to flee to Switzerland and then, in 1889, to the United States. There, he found employment with the Osterheld and Eickenmeyer Company in Yonkers. He later moved to Massachusetts and then to Schenectady, New York, to work as an advisor for General Electric, where his problem-solving ability earned him the reputation of being the "supreme court" of answering questions. In 1902, Steinmetz became president of the American Institute of Electrical Engineers. Between 1902 and 1913, he led Union College's School of Electrical Engineering and continued to teach there until his death in 1923.

Accomplishments

Soon after his arrival in America, Steinmetz—working for Rudolph Eickemeyer—designed a more powerful motor for Otis's elevators.

After Thorburn Reid presented a paper entitled "The Armature Reaction of Alternators," Steinmetz was critical of Reid's failure to discuss third harmonics. Steinmetz later presented his own paper to the American Institute of Electrical Engineers explaining his theory of third harmonics. Reid and Steinmetz subsequently became great friends.

While endeavoring to discover how to prevent trolley car motors from overheating when alternating current was used in the place of direct current, Steinmetz arrived at a mathematical solution called the "Law of Hysteresis" or "Steinmetz's Law." When the forces, especially the magnetic forces, affecting a body are changed, the delay in the reaction of the body to that change is called "hysteresis."

He also developed the Theory of Electrical Transients, and his work with electrical transients led to a greater understanding of how lightning impacted AC systems, which in turn led to better lightning arrestors.

Steinmetz invented an AC rectifier that allowed AC systems to incorporate magnetic arc lamps which ran on DC. The rectifier also proved useful in using AC to charge storage batteries. For their breakthroughs on the magnetic arc lamp, Steinmetz and his associates were given the Franklin Institute's certificate of merit in 1908.

In addition, Steinmetz devised practical formulas for alternating current. The previous ideas concerning AC had been so complex that scientists had been forced to resort to observation and graphs to approximate values. Because of his experience with complex numbers, however, Steinmetz was able to develop a series of simple calculations for AC that removed the function of time and made the algebra as simple as that for DC. The discovery was explained in three papers and a later textbook, "Alternating Current Phenomena," as well as in his lectures at Union College. It was these advancements in AC that allowed the generation and distribution of

electric power to overcome the obstacles posed by the previous empirical and graphical methods of analysis, which allowed for the expansion of electric power in the US.

Steinmetz once said that “absolutely all the success I have had has been due to my thorough study of mathematics.”