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Engineering Invention: Frank J. Sprague and the U.S. Electrical Industry. By Frederick Dalzell. (Cambridge, Mass.: MIT Press, 2009. xii + 287 p., ill., notes, index. ISBN 978-0-262-04256-7 $30 US)

Janis Langins

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gnetic devices. The electric motor and the telegraph form much of Schiffer's focus, as he takes the reader through the conception, developmental, and acceptance stages of each technology. Throughout the entire process, negotiations take place with key groups of people, and it is through these debates that we see an elevation in the social power of the scientific community, especially through the Royal Institution in Great Britain, and the Patent Office in the United States, which acted as a gatekeeper in technological development.

Using case studies allowed Schiffer to remain focussed on his initial goal of examining technological change. His study is a great volume for anyone seeking to learn the early history of electricity, or early debates about technological acceptance, but anyone seeking new information may be disappointed. Much of his information comes from secondary sources, and in some cases entire chapters are almost entirely paraphrased from other authors. For example, chapter nine, which details Samuel Morse's early history and experiences with the telegraph is borrowed heavily from Kenneth Silvernamn's, *Lightning Man: The Accursed Life of Samuel F.B. Morse* (Knopf, 2003). Schiffer's originality lies in his methodological approach; historians of technology could be well served by incorporating a more archaeological viewpoint in their own work. Schiffer omitted a conclusion and chose instead to dedicate his last chapter to Edison. While useful for bringing the reader back to his starting point, a chapter summarizing the main points and reinforcing his thesis would have been more helpful in tying up the book.

In the end, Schiffer reminds us that "practicality" is not an inherent property of technology, but rather something that is socially and personally defined. In doing so, he touches upon the analytical styling of the social construction of technology, while at the same time drawing from his archaeological training to explain human choices. Anyone with an interest in the history of technology as a discipline or the history of electricity as a subject will find *Power Struggles* both informative and easy-to-read.

DOROTEA GUCCIARDO
University of Western Ontario

***Engineering Invention: Frank J. Sprague and the U.S. Electrical Industry*. By Frederick Dalzell.** (Cambridge, Mass.: MIT Press, 2009. xii + 287 p., ill., notes, index. ISBN 978-0-262-04256-7 $30 US).

The title "Engineering Invention" indicates the main theme of this book. Frank Julian Sprague (1857-1934) is known mostly as the first person to build a commercially viable streetcar system in Richmond, Virginia in 1888. Dalzell sees him as someone who stands just behind the first rank of

inventors the world hears about today (Edison, Tesla, etc.) yet whose accomplishments were not inferior to theirs. In fact, the electric streetcar had as big if not more of an impact both on the electrical industry and on society as did the incandescent lamp. In a brief (1884-1902) and intense period of activity Sprague lived through and felt the impact on his own life and work of the transition from the heroic inventor-entrepreneur to the large modern high-tech corporation. It was Sprague who was one of the people whom the corporations were attempting to "tame" as stability and control over innovation became a more important aim for them than innovation itself.

Historians today see the growth of systems as the primary framework to see the history of technology in this period and no longer believe in the myth of the heroic inventor-entrepreneur. Dalzell argues, however, that there is something to the myth and it was a myth that was accepted and often motivated and inspired the public and inventors like Sprague in their own time. Indeed, the vitality of the phenomenon of the heroic inventor was both a cause of the technical advance and one of the main challenges to the corporate giants. Ultimately, the corporate giants won over the inventors, including Sprague, but he was one of the last inventors who not only invented but attempted to bring into practice and commercialize his invention by corralling capital, ironing out the bugs that emerged in implementing the invention, publicizing it, and attempting to create an industrial offshoot of the invention. In addition to the basic design of electrical streetcars that is essentially unchanged to this day, Sprague worked on electrical elevators and the multiple unit (MU) system of control for streetcars; rather than being pulled by a single locomotive, each has a source of traction that can be centrally controlled. The latter may have even been even more important than the streetcar itself in laying the groundwork for mass transit with numerous high-speed trains making multiple stops. Dalzell looks at these three episodes in his life and also at the period when he took on the role of elder statesman and constructor of his own heroic myth as well as working on the electrification of the New York suburban mass transit system and the Grand Central station. The book has an epilogue by Sprague's grandson, whose papers were apparently put at the disposal of Dalzell, who also consulted Sprague's papers in the New York Public Library.

A graduate of the US Naval Academy at Annapolis, Maryland, Sprague obtained a good engineering education as well as experience of the large technical systems that were fundamental to modern navies. It was also in the navy that he encountered inventors like Moses Farmer, another major electrical pioneer who designed dynamos, electric locomotives, and was involved with the Navy Torpedo Station at Newport, Rhode Island. Sprague soon felt that his inventive drive, which manifested itself in numerous

designs of electrical devices while serving at sea, was being cramped and he left the Navy to work for Edison, who put him to work constructing central stations. Again Sprague was not happy working in construction rather than inventing new technologies but the experience he picked up was valuable for engineering complex systems of which electrical devices were parts. Leaving Edison he set himself up in business on his own and built the universally admired electrical street railway in Richmond that signalled the rapid demise of horse powered tramcars in a remarkably short time.

Dalzell is a business historian and he sees Sprague as striking case study of the problems of launching and stabilizing a new invention in a context of overall turbulence in the commercial life of the time. In a very brief period —Sprague's period of inventive activity nicely falls within it—advanced technology businesses grew explosively and attracted the interest and discipline of financiers who alone were able to advance the enormous amounts of capital required to make them viable. At the beginning of his career Sprague functioned in a period where the field was still populated by a multiplicity of entrepreneurs and inventors and entry costs, while high, were still not beyond the reach of an energetic and persuasive inventor. At the end, he was confronting large horizontally integrated companies determined to avoid the risks of technological upsets and the turbulence injected by inventors like Sprague. To survive, the latter had to engineer innovation, not merely invent, and the former had to assimilate and develop such innovations for their own benefit. Sprague was more successful than many other inventors partly because of the time in which he worked and partly because of his skill in "engineering innovation." In Dalzell's words, he chose a "platform" (a significant and highly visible technological challenge) on which he "staged" his invention—playing out a heroic and stark drama wherein the inventor took an idea, put it into practice by perfecting technical details and making subsidiary inventions at the same time as constructing his system—before an audience of potentially interested financiers and the public. Concordant with his own vision of himself as heroic inventor entrepreneur, Sprague attempted to do all of this himself at a time when this was becoming a specialized process requiring not just inventors, but research and development labs as well as large sources of capital and production facilities.

To a remarkable extent he succeeded yet ultimately had to give way and sell out to his corporate competitors and his financiers. The book raises the interesting question well worth further study of whether heroes only actually appear at the dawn of new technologies or whether they are merely visible at that time.

JANIS LANGINS
University of Toronto