# The Development of an Industry

**The Rise of the American Electrochemicals Industry, 1880–1910**. Studies in the American Technological Environment. MARTHA MOORE TRESCOTT. Greenwood, Westport, Conn., 1981. xxxviii, 394 pp. $45. Contributions in Economics and Economic History, no. 38.

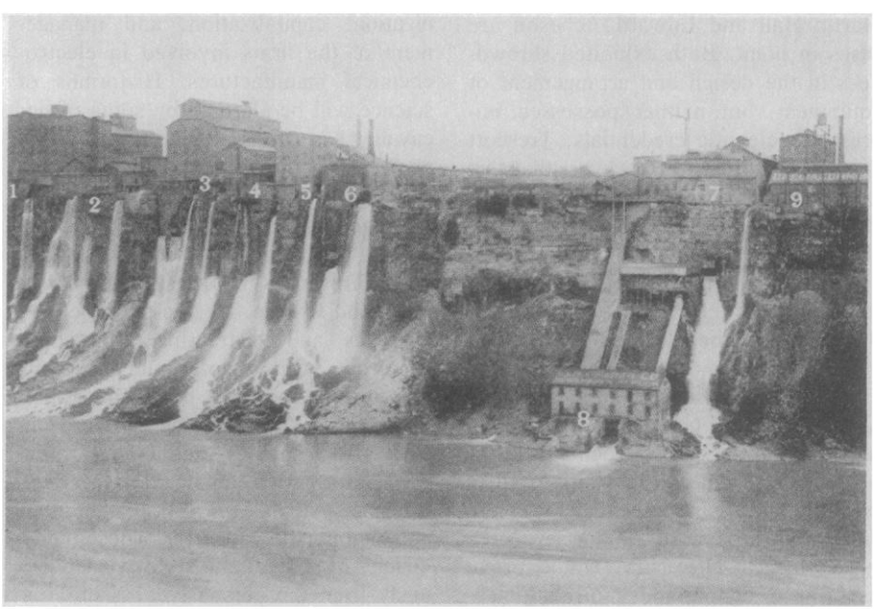
In 1902 the Bunsen Gesellschaft, an organization of German industrial chemists, sent Fritz Haber on a tour of the United States. His mission was twofold: to evaluate the equipment and processes used by American manufacturers of electrochemicals and to survey American methods of teaching electrochemistry. He was impressed by much of what he saw. At Niagara Falls he found a burgeoning colony of industrial firms using electricity to produce a wide array of products: abrasives, aluminum, calcium carbide, sodium, and alkalies. Their processes were not always very elegant or efficient, but the companies were thriving. And, although American technical schools and universities were generally not as sophisticated as those of Germany, Haber was struck by the scale of the foundations being laid in America for research and training in the applied sciences, especially electrochemistry. After returning to Germany, Haber reported that the United States was already a force to be reckoned with in the electrochemicals industry. German firms could not afford to ignore their American counterparts; indeed, they had much to learn from them.

Haber was not the only observer to testify to the vitality of the American electrochemicals industry at the turn of the century. The industrial complex at Niagara Falls was as powerful a lure for scientists and engineers as the waterfall was for honeymooners, and visitors usually came away convinced that the expansion of electrochemical production would constitute an important chapter in American industrial and technological development. Time has confirmed their judgment. The industry was a site of technical innovation, and it stimulated changes in scientific and engineering education. From it there sprang diversified chemical companies whose products won markets at home and abroad; and some of these firms, such as Union Carbide, were leaders in industrial research. It is little exaggeration to say that the electrochemicals industry was to the United States what the organic dyestuffs industry was to Germany.

The growth of this industry therefore is a rich and important story. It raises issues that should interest historians of science and technology as well as specialists in business and economic history. How did the industry evolve and why did it become a leading sector in the development of chemical manufactures in the United States? Did electrochemical theory as taught in universities affect industrial practice? And how does the history of this enterprise fit into the larger story of American technology and business? These are among the questions that Martha Moore Trescott discusses in this volume. Her answers are both imaginative and provocative.

It is sometimes said, for example, that cheap electricity was the key to the success of the makers of electrochemicals in the United States; hydropower attracted energy-intensive industries to upstate New York and gave them an insurmountable advantage over their competitors. Trescott argues that this is a simplification. The beginnings of the American electrochemicals industry predated the Niagara Falls power project. Moreover, the intensive exploitation of the power available at Niagara Falls and the growth there of an electrochemicals complex were symbiotic developments. Cheap power helped make American electrochemicals competitive, but the electrochemicals plants that opened near Niagara Falls themselves constituted an essential market for the producers of electricity. Rather than attributing the prosperity of one industry to the presence of the other, Trescott maintains that they should be seen as products of a common and distinctively American industrial environment. American inventors and entrepreneurs were oriented toward the production of inexpensive machines and goods for the mass market. They stressed speed and quantity of production, and they paid close attention to the design of, and organization of work within, industrial plants. It was this orientation, Trescott suggests, that fostered both the Niagara power project and the electrochemicals plants that grew up around it.

Trescott recognizes that an orientation toward mass production is not sufficient




"Factories of the lower milling district on the 'high bank' served by the hydraulic canal [at Niagara Falls] were (1) Central Milling Company; (2) Niagara Wood Paper Company; (3) Schoellkopf & Mathews Flour Mill; (4) Pettebone Pulp Mill; (5) Charles B. Gaskill Flouring Mill; (6) Niagara Falls City Water Works; (7) Cliff Paper Company (first use of water, 75 ft. head); (8) Cliff Paper Company, Lower Mill (second use of water, 125 ft. head); and (9) Oneida Community Mill." [Reprinted in *The Rise of the American Electrochemicals Industry, 1880–1910* from E. D. Adams, *Niagara Power* (Niagara Falls Power Co., 1927)]

to explain the genesis and prosperity of the American electrochemicals industry. Other factors also played a role, in particular the mechanical and metallurgical experience of American engineers and inventors. Metals are the final product of many electrochemical processes, and the processes themselves take place in cells and furnaces, the design of which requires skill in mechanical engineering. The entrepreneurs and inventors who migrated to Niagara Falls in the 1890's were experienced both in the extraction of metals and in machine design. Many began their careers in an effort to discover ways of producing aluminum inexpensively. The experience and knowledge they gained in this search for cheap aluminum—the silver in clay—could be and was applied to the making of many products. Their electrolytic cells and electrical furnaces could yield alkalies, Carborundum, calcium carbide, graphite, sodium, and ferroalloys. And some of these products in turn were used in the manufacture of others. Calcium carbide, for instance, is a starting point in the production of acetylene, from which a multitude of organic chemicals may be derived. Like the organic chemists employed by German dye firms, the inventors and entrepreneurs at Niagara Falls could turn their knowledge to many purposes.

Unlike the organic chemists of Germany, however, the first American electrochemists typically lacked formal and prolonged indoctrination in scientific theory or research techniques. Charles Martin Hall and Edward Acheson are cases in point. Both exhibited shrewdness in the design and arrangement of equipment, but neither possessed impressive scientific credentials. Trescott is quick to point out, however, that this does not mean that science had no bearing on the rise of the American electrochemicals industry. Although these pioneers were unprepared to contribute to the edifice of electrochemical theory, they often did benefit from their exposure, however meager, to physics and chemistry in school. And soon after plants began to open at Niagara Falls a new generation of electrochemists appeared who, while no less interested in profits than their predecessors, were convinced that formal training, especially in physical chemistry, would prove useful in designing and improving electrochemical processes. Out of the efforts of industrial scientists like F. M. Becket, research laboratories emerged where reaction processes were studied under controlled conditions and interpreted with the help of chemical thermodynamics. Nor did benefits flow only in one direction, from science to technology. Trescott argues, for example, that the growing electrochemicals industry was an important stimulus toward the development of programs in chemical engineering in universities and technical schools.

Trescott is hardly the first historian to credit Americans with a proclivity (some would call it genius) for mass production. Nor is she the first to call attention to the importance of machine design and the extractive industries in the history of American technology. Nevertheless, her use of these themes is novel and intriguing. By stressing the importance of "the American technological environment," she at one stroke suggests how the growth of the electrochemicals enterprise was of a piece with contemporary developments in other sectors of American industry, such as automobile production, and contributes toward explaining why both the chemical industries and the profession of chemical engineering evolved along different paths in America and Germany. There was a powerful and pervasive logic underlying the development of American technology and industry.

Trescott's imaginative and suggestive book, however, is not without serious shortcomings. Economic historians will be disappointed by her perfunctory treatment of factors such as pricing policies, labor costs, tariffs, and production statistics. Business historians will find that she has all but ignored the internal organization, capitalization, and management of the firms involved in electrochemical manufactures. Historians of science will be alarmed by some of her cavalier assertions about the history of physical chemistry and electrochemistry, and historians of technology will be dismayed by her vague accounts of machines, processes, and products. Moreover, Trescott's book is poorly organized and written. Needlessly repetitive passages and distracting cross-references mar every chapter, and Trescott's prose is littered with jargon and other infelicities. What meaning can a reader derive from phrases such as "a nonrandom information amalgam" (p. 245), "people systems" (p. 314), or "an interpersonal person" (p. 321)? These inadequacies of content and style detract seriously from the persuasiveness of Trescott's arguments. This is a misfortune, for her thesis merits notice.

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## Science Publishing Indicators

**Scientific Journals in the United States.** Their Production, Use, and Economics. DONALD W. KING, DENNIS D. MCDONALD, and NANCY K. RODERER, with contributions by Patricia M. Dowd, Charles G. Schueller, Barbara L. Wood, and Mary K. Yates. Hutchinson Ross, Stroudsburg, Pa., 1981 (distributor, Academic Press, New York). xvi, 320 pp., illus. $34. Publications in the Information Sciences.

In 1976 and 1977 Donald W. King and associates published a wealth of statistics on scientific and technical communication (*1*). The present work updates their earlier research and analyzes the flow of information through the journal system, showing the interdependence of authors, publishers, libraries, and readers.

The book addresses two continuing concerns, the state of scholarly communication generally and the development of indicators of social change.

Humanists, social scientists, and librarians—troubled several years ago by rising costs, cutbacks in library budgets, and the adjustment to rapidly changing technology—wrestled with the first problem in the report of the National Enquiry into Scholarly Communication (*2*). At that time the scientific community seemed better off, but that may no longer be true, judging from Philip Abelson's recent editorial on the plight of scientific communication in Britain (*Science*, 23 October).

Interest in social indicators burgeoned in the 1960's and led to the publication by the federal government of *Science Indicators 1972* and *Social Indicators 1973* (and their successor volumes). King's research, financed by a grant from the National Science Foundation, can be viewed as an extension of that line of inquiry.

The statistics presented in *Scientific Journals* range from direct counts (the number of scientific and technical journals in various disciplines, for example) to global estimates (such as the total annual cost of scientific information in the United States, including reading time and the imputed wages of academic editors who donate their services). Data from several surveys are also presented, including a sample survey of journal users.

Two questions come quickly to mind: How good are the data and what do they mean?

The answer to the first question can only be guessed at. King and associates tell very little about the assumptions and methods underlying their data-gathering and presentation. Yet we know from the