

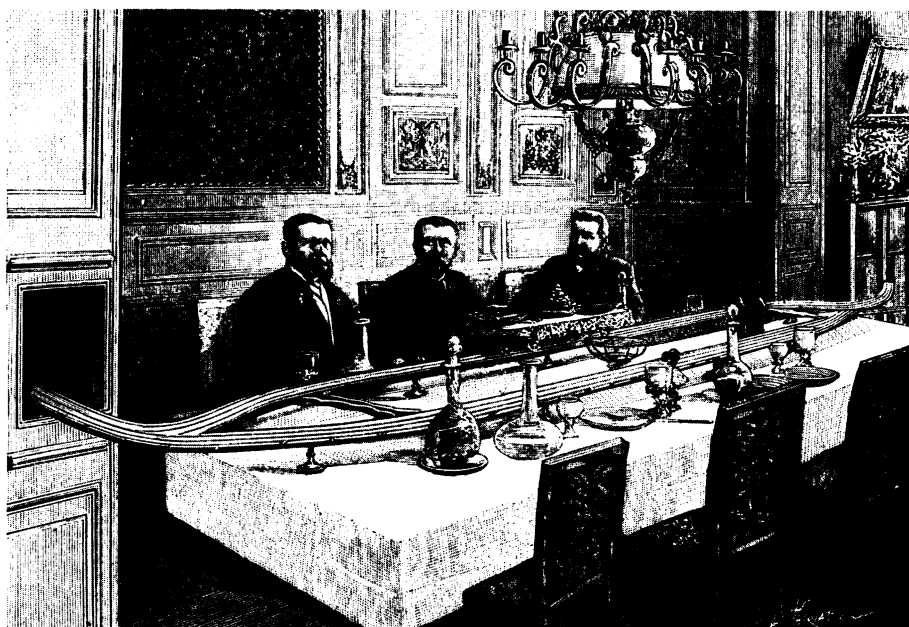
inroads in education and to prevent German ascendancy over French culture. The authors do not say so explicitly, but science popularization also served the commercial interests of writers, illustrators, publishers, and booksellers in an explosive period of growth in the printing and publishing industry.

The title of the volume is the title of one of the 19th-century popular science periodicals, *La Science pour tous*, founded in 1856. Typical of scientific writers and entrepreneurs for such periodicals was Edouard Charton, a former Saint-Simonien, who founded two popular science reviews, then became director of the science and technology collection *Bibliothèque des merveilles* and the periodical *Le Tour du monde* for the Hachette publishing house. When a member of the National Assembly in 1848, Charton argued that only citizens who can read and write should have the right to vote. His aim, he said, was to destroy the ignorance that is at the origin of inequality, disorder, and evil in the world. Science was the key.

Among popular science writers, some of the most important were the Jesuit François Moigno, who founded the Catholic-oriented periodical *Cosmos* in 1852; Louis Figuier, science columnist for *La Presse*, who founded *L'Année scientifique et industrielle* in 1856; Gaston Tissandier, the founder of *La Nature* (the predecessor of *La Recherche*) in 1873 and author of numerous *Récréations scientifiques* for the young and general reader; and Camille Flammarion, author of *L'Astronomie populaire*, which sold 100,000 copies between 1880 and 1900. Camille Flammarion was the older brother of Ernest Flammarion, who established the Librairie Flammarion in the late 1870s.

Among publishing houses, early leaders in scientific popularization were Hachette and Hetzel, the latter the publisher of books like Flammarion's early *Histoire du ciel* (1872) as well as of "scientific novels" by Jules Verne and children's scientific books by Jean Macé. Some publishers specialized in "haute vulgarisation," rather than in science for the masses, and prices ranged from 30 francs for a volume like Amédée Guillemin's handsome *Le Ciel* to 10 centimes for one of the 363 issues of Figuier's *Merveilles de l'industrie*. Prestigious collections included Reinwald's *Bibliothèque des sciences contemporaines* (which published books by Darwin, Vogt, and Haeckel) and Germer-Baillière/Alcan's *Bibliothèque scientifique internationale* (which published volumes written by leading French and foreign scientists chosen by a committee of scientists).

How influential and well read were these books and periodicals? Subscriptions to *La Nature* increased from 2000 in 1873 to 15,000 in 1885. *La Science et la vie*, estab-



"Vue d'ensemble du petit chemin de fer électrique du table de M. Gaston Menier." [Reproduced in *La Science pour tous* from *La Nature*, 1880]

lished in 1913 in a small format, with short articles, lots of photographs, and a full-color cover, sold 100,000 subscription copies in its first year. Who was reading these works? In 1862, lecture courses at the Conservatoire des Arts et Métiers, aimed at workers, foremen, young people, engineers, and the interested public, were said to attract 1500 to 1800 auditors each evening and a total of 180,000 "present" during the year. France was a country of roughly 40 million people at the end of the century. In 1889, the Paris Exposition Universelle attracted 32 million

entrants in six months, many of them there to see Edison's phonograph, spectacular displays of electric lighting, and the "panorama du pétrole." The intended public for *vulgarisation* in science and technology was drawn from these people. This volume of essays provides an excellent introduction to the means, if not the achievement, of "la science pour tous."

MARY JO NYE

Department of the History of Science,
University of Oklahoma,
Norman, OK 73019

A Modern Necessity

Electrifying America. Social Meanings of a New Technology, 1880–1940. DAVID E. NYE. MIT Press, Cambridge, MA, 1991. xvi, 479 pp., illus. \$29.95.

Man-made electricity permeates our lives. It illuminates our way, powers our machines, carries our messages. It is a necessity of modern life. Historian David E. Nye's *Electrifying America* describes how Americans first encountered, experienced, and employed electrification between 1880 and 1940. Nye's story is wide-ranging, as is the realm of electricity.

Books on technology usually fall into two camps: heavily researched monographs on

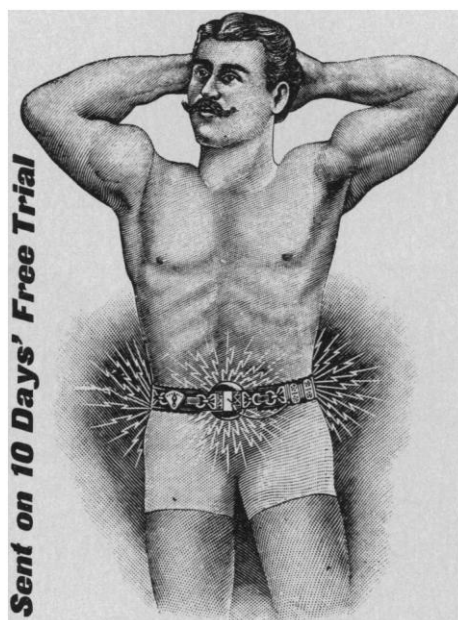
how developers created and diffused a new system, or speculative essays, even polemics, on what the human meaning of it all is. *Electrifying America* is a rarer and valuable effort. It is a heavily researched study of the human meanings, an examination of how Americans came to live with a major new technology.

Others have told the technical and the business histories of electrification. Nye's focus instead is on "the human experience of making electricity part of city, factory, home, and farm" (p. xi). Using the particular case of Muncie, Indiana—"Middletown" of sociological fame—as a frequent grounding, Nye explores several large topics,

among them the lighting for public streets and public spectacles like world fairs; the rise and decline of the electric streetcar; public debates about electricity and electric metaphors in public debates; the application of electric power to factories, especially to the assembly line; women's use of new appliances to do housework; and the political struggle to bring electric power to rural households. Nye wants to show, in these disparate domains, how the electric industry introduced its product, how consumers used it, and how Americans understood it symbolically.

Nye also wants to correct any impression that these uses and social consequences were simply determined by the technical features of electric power. He argues that electricity's role was socially conditioned. At a few points, he suggests that certain changes—for example, factory piecework and suburban sprawl—were not the results of electrification but were the “American results” of electrification. Most dramatically, in the 1920s more than two-thirds of northern European farmers had electric power, but only 10 percent of American farmers did (p. 287), a testimony to how political systems shaped technological development.

Nye recounts examples of American entrepreneurs and consumers turning electric power to particular ends. Commercial signs rather than public lampposts brightened the streets of American cities in the early years, for merchants were better able to buy electricity than were city councils. Many streetcar companies used their spare power to illuminate the amusement parks they built to attract weekend riders. Women increasingly



“\$18.00 Giant Power Heidelberg Electric Belt.” Equipped with a battery made of a “secret, highly excitable, metal alloy,” a casing of “very fine selected satin,” and electrodes up to five inches across, the belt was advertised as a cure “for disorders of the nerves, stomach, liver and kidneys, for weakness, diseased or debilitated condition of the sexual organs.” [From *Electrifying America*; Sears, Roebuck catalog, 1901]

took factory jobs once electrification eased the requirements for physical strength on the shop floor. And American writers eagerly applied electric imagery: effective people were “dynamos,” thrills gave one “a charge,” and the modern personality, some asserted, was “overloaded” and “burnt out.”

Nye's interpretations of the historical ac-

count are refreshingly modest and sensible. The reader need not suffer through obscure, deconstructionist-style meditations on meanings or through single-note, political muckraking—both common in recent essays on technology. The users of electricity in this book are not “cultural dopes,” manipulated into using the technology against their best interests. They are prudent consumers, sometimes thrilled by electricity, sometimes shy of it, usually eager to put it to work. Occasionally, these uses might have paradoxical consequences. Nye, following others, argues, for example, that by adopting household appliances like vacuum cleaners and electric washing machines homemakers ended up accepting higher standards of housework rather than reducing the hours they worked. The social consequences of electrification were, for Nye, extensive and also complex.

The main virtue of this engaging book for the general reader, its wide range, has some drawbacks for the specialist. While Nye takes us in all sorts of directions—to the art of managing lines at amusement parks, novels about political corruption, and the rise of industrial psychology, for example—he explores few topics in depth. Nye's account of the streetcar's demise does not mention the lively debate among historians about whether this was fated or was the result of a scheme by General Motors. The discussion of how utilities marketed electrical appliances does not refer to detailed studies on the topic by scholars such as Mark Rose and Ruth Schwartz Cowan. Though these and similar omissions will not bother most readers, they make Nye's specific arguments less than conclusive.

Similarly, to support his avowal that electrification had great effects, Nye often relies on evidence that is largely impressionistic—claims by utility propagandists, contemporary journalists, or artists. To understand what meanings electricity had to Americans, Nye interprets contemporary novels, paintings, and photography. We do not know, however, whether average folk saw electrification at all in the same way these selected artists did.

Nye's broad scope also leads him to make many assertions about the role of electrification—for example, that it enforced factory discipline, brought the end of boarding-houses, and helped undermine the American family. Nye will have to wrestle the historians of the automobile, steam power, and the mass media, among others, for the rights to such all-pervasive implications. And, of course, the cause-and-effect connection is awfully hard to prove, especially when spanning so many domains of life.

Electrifying America is a tour of an America



“Two thousand flat irons taken in exchange for electric flat irons, c. 1912.” [From *Electrifying America*; General Electric Company]

made anew by electric technology. Like many a whirlwind tour, it can only hit the highlights and cannot dwell at any particular site. But it is worth the journey.

CLAUDE S. FISCHER
Department of Sociology,
University of California,
Berkeley, CA 94720

Elusive Exactitude

Keeping Watch. A History of American Time. MICHAEL O'MALLEY. Viking, New York, 1990. xvi, 384 pp., illus. \$19.95.

Keeping Watch traces a fascinating, century-long shift in the way Americans have thought about the measurement of time. In the 1820s, clock-watching Americans noticed that the sun was not a true authority for measuring the passage of time. Michael O'Malley traces the acceptance of sidereal time, based on astronomical observations, and then proceeds to the more familiar story of standardized time zones pioneered by the railroads in the 1880s. Subsequent chapters explore the production and marketing of clocks and watches, factory punchclocks, and stopwatches; the alteration in time sense brought by the movies; and the introduction and repeal of Daylight Savings Time in the era of World War I. This is no celebratory history of scientific achievement or of progressive movement toward precision. Each chapter of the book is rich with absorbing stories that illustrate how new ways of thinking about time frequently led to wrenching political, social, and even legal disputes. The theme running through all the disputes was: Who has the authority to say what time it really is?

Up to the 1820s, time was conceived of as a natural phenomenon, pegged to the noon-ing of the sun, the moment when the sun was highest in the sky. By common agreement, the sun's noon translated to 12 on a clock and divided the duration of daylight into two equal parts; a sunrise at 5:52 meant that sunset was 6:08, as every almanac before the 1830s confirmed. But a sea change was at hand about 1830, brought about by a slow aggregation of distinct but related historical processes. The development of commerce, industry, transportation, and the social organization of factory and urban labor necessitated more accuracy and synchrony in daily timekeeping. Clockmakers obliged by developing cheap timepieces of wood or brass, and by the mid-1830s the market for clocks extended far and wide. But good mechanical clocks do not keep time with the sun, which raised a puzzling question: how could time be irregular?

Experts on time had known for several centuries about the discrepancy between clock time and sun time. Noon does not arrive precisely every 24 hours; the sun can run up to 15 minutes faster or 18 minutes slower than an accurate mechanical clock, depending on the time of year. This happens because the earth moves on an elliptical orbit with the sun at one focus; the earth's velocity hence is not constant. A second irregularity results from the tilt of the earth's axis; the sun thus moves across the sky on a great circle not parallel to the equator, and as it crosses each meridian line its speed appears to vary because the distance between meridian lines decreases toward the poles.

O'Malley does not linger long over the scientific explanations for solar and clock, or mean, time. He is at his best on the social and political implications of the challenge to timekeeping authority. If solar time is different from mean time (so-called because it represents an average of the varying solar days), who gets to determine when the factory bell rings, when contracts expire, or when the polls close in an election? Who is at fault if a millworker goes to work on sun time but the factory bell, set to mean time, has already rung? Who can verify that the factory bell is even accurate? Verifiable mean time was not possible until the late 1840s, when new astronomical observatories started measuring time by the stars and enterprising companies telegraphed time signals from observatories to paying subscribers. O'Malley calls this the first commodification

	SEARCH		INSPECT
	FIND		PRE-POSITION
	SELECT		RELEASE LOAD
	GRASP		TRANSPORT EMPTY
	TRANSPORT LOADED		REST FOR OVER COMING FATIGUE
	POSITION		UNAVOIDABLE DELAY
	ASSEMBLE		AVOIDABLE DELAY
	USE		PLAN
	DISASSEMBLE		

"Frank and Lillian Gilbreth's 'Therbligs.' The symbols could theoretically be written as hieroglyphic sentences, to describe any job as a sequence of standardized actions. 'Avoidable delay' is a sleeping worker, 'unavoidable delay' a broken worker, 'plan' a man scratching his head." [From *Keeping Watch*]

of correct time. By the 1870s, many cities featured Western Union time balls, familiar now only in that atavistic New Year's Eve symbol annually televised from Times Square.

The immediate stimulus for telegraphed time signals came from the railroads. In the mid-19th century, track mileage increased exponentially. Railroads moved people rapidly through space; they also moved them through time—but whose time? Even a short east-west trip required people to negotiate micro time zones varying by just minutes. If the confusion was great for passengers, whose main goal was not to miss a departure, it was even more serious for employees who had to synchronize the trains. O'Malley tells of inventive ways railroads tried to solve the problem. One company collected all employees' watches each night to set and redistribute them the next day. Some companies chose the local time of their business headquarters as the prevailing time for their whole rail system. The train station in Buffalo, New York, had three clocks—one for local time, the other two for the railroad companies that used the station. Some jewelers produced watches with two minute hands, to show both local and railroad time. All of these solutions seem simpler than a German practice, that of setting time posts along the roadbed that marked each ten-minute change in time, leading to frequent watch corrections.

The now-familiar solution to the railroad dilemma was the introduction of standard time zones; by railroad fiat, and not legislative policy, the innovation went into effect in November 1883. We have lived with this solution for a century now (although it took Congress until 1918 to approve it), so it is hard to imagine the opposition it engen-

Keep a Watch on EVERYBODY!



No need to keep a watch on me, Mr. Cop, for I already have the best watch in the world—THE WATERBURY.

Back cover of a pamphlet advertising the Waterbury Watch Company, 1887. [From *Keeping Watch*; National Museum of American History, Smithsonian Institution]