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Creating the Twentieth Century: Technical Innovations of 1867-1914 and Their Lasting Impact.

By Vaclav Smil. New York: Oxford University Press, 2005.

Interdisciplinary scholar Vaclav Smil, whose previous books have examined global energy, food production, economics, and public policy, and energy and environment in China, has turned his attention to the history of invention and innovation in the late nineteenth and early twentieth centuries. *Creating the Twentieth Century: Technical Innovations of 1867-1914 and Their Lasting Impact* argues that the two generations preceding World War I marked an unprecedented scientific and technical discontinuity that laid the groundwork for the technical advances and globalized economy of the twentieth century. The late nineteenth century made the twentieth, in Smil's estimation, and as such, this book is his "homage to the creators of a new world." Writing against a historiographical tradition that has emphasized the global effects of twentieth-century technological development, Smil locates in the late nineteenth century the origins of an "Age of Synergy," an age defined by the rise of electrical systems, the diffusion of internal combustion engines, a robust science of chemicals and materials, and the emergence of new modes of communication.

Creating the Twentieth Century is a retrospective assessment of a remarkable era of scientific and technical innovation, primarily in North America and Europe. It is not, Smil points out, a world history, an economic history, a history of engineering, or a triumphalist tale of technological determinism. Smil pointedly avoids using the word technology throughout his book - presumably to avoid anachronism - but his book is largely an internalist history of technology (i.e., focused on the creation of technological artifacts) that celebrates the twentieth-century legacy of nineteenth-century innovators and their achievements. It is a remarkably wide-ranging synthetic account of four distinct facets of technical innovation, rich in technical detail and replete with illustrations of patent drawings and inventors' portraits, as well as illustrations from popular periodicals. Smil draws upon a broad array of secondary sources from the history of science and technology, economic history, and professional scientific and engineering institutions, as well as upon primary sources that illuminate the creation and reception of numerous technical innovations.

The core of the book consists of four chapters on different sectors of the Age of Synergy. "The Age of Electricity" chronicles the history of electrification, with particular attention to the technical and organizational innovations of large-scale electrical systems (also illuminated in Thomas Hughes's 1983 *Networks of Power: Electrification in Western Society, 1880-1930*). "Internal Combustion Engines" traces the design, commercialization, and diffusion of the combustion engine, and "New Materials and New Syntheses" covers the design and use of steel as well as the development of chemical syntheses. "Communication and Information" features new media technologies devoted to printing, the visual arts, and telecommunications, and a brief concluding chapter, "Contemporary Perceptions," offers an abbreviated tour of the social and cultural dimensions of Smil's Age of Synergy by examining whether those living in such an age were aware of its import.

Creating the Twentieth Century covers an impressively broad range of topics, from automobility to the alu-

Digital Object Identifier 10.1109/MTS.2007.906669

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minum reduction process to Hertzian waves, which are always described with great technical specificity (not to mention authority and admiration). Readers interested in the underlying scientific principles and internal workings of electrical transformers, the Diesel engine, the Haber-Bosch ammonia synthesis, halftone printing, and the like will be richly rewarded by this volume. Those interested in the history of invention and patent controversies will appreciate Smil's attention to, among others, the Nicolaus Otto-Beau de Rochas legal dispute over patent rights to the four-stroke engine, and telephony patent applications by Alexander Graham Bell and Elisha Gray. In general, this book will serve as a valuable reference for anyone interested in science and technology in the late nineteenth century.

However, readers interested in the broader historical context of the late nineteenth century, this reviewer included, will likely want more from Smil's internalist history and its explanations for historical change. Smil's focus on the world inside the lab and the workshop leads him to divide a bit too neatly technical and social change and to suggest that technical change leads - in a linear fashion - to social change. In his sixth chapter, "A New Civilization," Smil mentions "mobility…mass consumption, democratization, opportunity, equality, emancipation, rise of the middle class, recreation and leisure" as "attendant socioeconomic impacts" (p. 260). The influential work of Wiebe Bijker (whose work on Bakelite Smil cites) and others on the sociotechnical lives of artifacts has persuasively argued that technical artifacts are indeed political and social, that technical and social change is a messy, complex, mutually constitutive process in which social change shapes technical change and vice-versa [1]. To take just one example, Smil ends the book with a brief mention of the 1892 Homestead steel strike as one example of "everyday realities [that] were hardly uplifting" — in his formulation, the technical and thus economic imperatives of the booming steel industry produced a social impact: steelworkers' wages were dramatically reduced by Carnegie, and a violent strike erupted (p. 311). But a different way of understanding the relationship between the technical and the social reveals a more complex and interesting story. Thomas J. Misa's path-breaking history of the steel industry, *A Nation of Steel: The Making of Modern America, 1865-1925*, shares Smil's general argument about the fundamental importance of late-nineteenth-century technical developments, but demonstrates quite convincingly an opposite point: technological change often does not cause but rather results from institutional, economic, and social change [2 pp. xv-xix.]. Misa's analysis reveals that the steel industry's treatment of labor was a "social choice," not a solely technical or economic one, and his assertion that the intricate relationship between producers and consumers ultimately accounts for technological and social change is a compelling point that might have inspired broader parameters and a different model of causation for *Creating the Twentieth Century* [2, p. 270]. At the outset, Smil declares that his aim is "to tell a story of amazing changes of the greatest discontinuity in history, and to do so from a multitude of perspectives in order to bring out the uniqueness of the period." Smil succeeds, but such a story could be, historically speaking, more complex and complete.

References

[1] W.E. Bijker, *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change*. Cambridge, MA: M.I.T. Press, 1995.

[2] T.J. Misa, *A Nation of Steel: The Making of Modern America, 1865-1925*. Baltimore, MD: Johns Hopkins Univ. Press, 1995.

New Professional Ethics Resource at IIT

The Illinois Institute of Technology's Center for the Study of Ethics in the Professions is pleased to announce a new resource for scholars of practical and professional ethics. The IEEE-CS/ACM Software Engineering Code of Ethics Archive includes emails, faxes, and other documents concerned with the drafting, debate, and final adoption of the joint IEEE Computer Society /ACM Software Engineering Code of Ethics and Standards of Practice. The archive may be seen as providing a rich record of how software engineering developed from an occupation to a profession. The online archive is the final product of two projects funded by the National Science Foundation, 9523650, and 0117471. The archive can be found at http://hum.iit.edu:8080/aire/mainindex.html

Correction

In the Summer 2007 issue of *IEEE Technology and Society Magazine*, typographical errors appeared in the article "Importance of Gender Homophily in the Computer Science Classroom," by Roli Varma and Marcella LaFever. In several instances on page 46 of the article, the symbol "χ^2" is shown incorrectly as "<<2". This occurs twice in the text (left column) on the page, and also occurs in the column headings of Table II on the same page. *IEEE T&S Magazine* apologizes for this error.