Creating the Twentieth Century: Technical Innovations of 1867–1914 and Their Lasting Impact. By Vaclav Smil. New York: Oxford University Press, 2005. Pp. vi, 350. $35.

Those economists who survived five years of Latin grammar in high school might recall Alfred Marshall's proclamation that *natura non facit saltum* (nature does not make leaps). Vaclav Smil does not agree with this sort of craven marginalism, and instead argues that nature has made spectacular leaps at least twice in the past 10,000 years: during the Han dynasty; and in the era from 1867 through 1914 when "the greatest technical discontinuity in history took place" (p. 4). The latter period is commonly known as the Second Industrial Revolution, but Smil prefers "the Age of Synergy," to be distinguished from Mumford Jones's Age of Energy (1865–1915).

The introductory chapter argues that modern civilization is based on the "unprecedented saltation" of the Second Industrial Revolution/Age of Synergy, which was characterized by the unique visionary boldness of the breakthroughs of the time. The first harbingers in 1867 encompassed the discovery of the second law of thermodynamics, the improvement of the typewriter, Alfred Nobel's production of dynamite, and the publication of *Das Kapital*. Another noteworthy element of the age was the rise of the United States as the leading industrial power. Its conclusion was marked by the patenting of the tungsten filament for the light bulb, the Ford assembly line, and Niels Bohr's work on the atom. As a way of demonstrating the discontinuity of this critical era, it is proposed that Antoine Lavoisier (1743–1794) would have been befuddled by the world of 1913; whereas Thomas Edison, a pivotal participant in the Age of Synergy, would have a keen understanding of the world of 2005, because the innovations that surround us today were derived from Edison's own work and those of his contemporaries.

The introduction is followed by four chapters, each of which is dedicated to descriptions of the evolution of a key category of technical innovation. These include electricity and electrical inventions; internal combustion engines; high performance materials involving the large-scale output of iron, steel, aluminum, nickel, more effective explosives, and synthetic chemicals; and communications and information technology such as the delivery of parcels by mail, typewriters, cameras, moving pictures, phonographs, telephones, and wireless telegraphy. These advances occurred "at a frenzied pace," their diffusion and impact were "almost instantaneous," and they were "indispensable for creating the 20th century."

The author describes chapter 6 as an "exercise in restraint," merely covering as it does: the development of data processing; a description of some of the personal details of several great inventors ("Alfred Nobel did not commit suicide and did not die a mysterious death" p. 269); product cycles; the annual time series of U.S. patents granted; a medley of economic statistics; a disquisition on energy consumption; as well as an outline of mechanization and mass production. Chapter 7 concludes by briefly addressing contemporary perceptions of this "astonishing concatenation of epochal innovations."

The book traces the development of these key technologies on both sides of the Atlantic. For instance the chapter on electricity begins in various European capitals in the eighteenth century, deviates to New York and New Jersey towards the end of the nineteenth century, and by World War I encompasses crucial contributions in both Europe and the United States. The origins of the internal combustion engine lay in the explosive power of cannons that was recognized in the eighteenth century as a potential motive force, but significant productivity gains awaited the later nineteenth century, when

German inventors Nicolaus Otto, Eugen Langen, Gottlieb Daimler, and Karl Benz improved on the efforts of more than a dozen international inventors from the first half of the century. Throughout, the exposition is enlivened by illustrations, cartoons, personal observations, and an array of quotations from diverse sources, ranging from *Scientific American* to *The Wind in the Willows*.

We all have our favorite great invention, but the author's constitutes a refreshingly original choice: among all of these international discoveries, synthetic ammonia may be "the most far-reaching of all modern technical innovations" (p. 7). The synthesis of ammonia from its elements by the German chemists Fritz Haber and Carl Bosch is "inexplicably little appreciated," even though it allowed for the mass production of synthetic fertilizers. Smil contends that, in the absence of this innovation, the world could only sustain a population of 3.5 billion. As for most favored time period, he does not hesitate to rank the 1880s as the "most inventive decade of the century."

It is extremely useful to have all of these details collated in one volume, although no valid information is presented that will be new to a specialist in this area. The book is strongest on description, but the analysis and conclusions will likely provoke much debate among skeptics. Economic historians in particular will raise an eyebrow at the variant of the axiom of indispensability that is promoted here. Fabian Socialists believed in the "inevitability of gradualism," and much of the evidence that Smil himself presents is inconsistent with the notion of discrete leaps in technical innovation. The spread of many of the innovations that are singled out here was neither rapid (much less "instantaneous") nor uniform. In 1910 only 10 percent of American homes had access to electricity; whereas there still remains a marked lack of standardization in frequencies, amperage, and electrical inputs such as plugs and sockets in this country and (more so) elsewhere. As for the author's pet invention of chemical fertilizers, global production was minimal until just before 1950 (p. 193). It would have been useful to examine the determinants of this variation in diffusion, such as pricing, the presence or absence of complementary innovations that might facilitate use, and institutional impediments.

Finally, the expectant reader will be disappointed to ultimately find that scant attention is actually paid to measuring or even reciting the "lasting impact" of these great inventions that the title promises. However, perhaps that tale will actually unfold in the planned sequel to the current volume.

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The Irony of State Intervention: American Industrial Relations Policy in Comparative Perspective, 1914–1939. By Larry G. Gerber. Dekalb: Northern Illinois University Press, 2005. Pp. viii, 212. $40.

The puzzle that sets the agenda for this book is the divergent paths taken in the United States and Britain with regard to the role of the state in industrial relations. Despite a common heritage of limited government and an ideological aversion to an interventionist state, the United States responded to the depression of the 1930s with the construction of the now familiar system of state regulated and sanctioned trade union recognition and collective bargaining, a system in which the state became intimately involved in the relations between labor and capital. In Britain, on the other hand, the state played a more muted role in industrial relations leading to the creation of what became known as "collective laissez faire," in which unions and employers' organiza-