

## Writing Technology into History

EDA KRANAKIS

---

*Making Europe: Technology and Transformations, 1850–2000*, a book series edited by Johan Schot and Phil Scranton, crowns a research effort of two decades. Building on the work of hundreds of scholars in the Tensions of Europe network, this innovative, six-volume synthesis offers “brand-new perspectives on the history, formation, and culture of Europe.”<sup>1</sup> It seeks to revise understanding of the history of European integration by charting paths of transnational sociotechnical change, revealing a “hidden integration” of Europe that originated a century before the first steps toward political unification were taken after World War II. This hidden integration was rooted in infrastructure, information, and mobility systems that multiplied and stretched ever further across European borders, transporting people, goods, energy, information, and culture. The systems were “hidden” in that the burgeoning array of experts and system builders who developed and regulated them worked behind the scenes. The public used the systems on a growing scale, but “the machinery behind that integration remained largely invisible.”<sup>2</sup> The series revises European history also by linking it

Eda Kranakis is full professor in the Department of History at the University of Ottawa, Canada. Her recent work looks at oil depletion, aviation in relation to European integration, and patents in relation to globalization, modernity, and postmodernity. She thanks Cyrus Mody, Dick Van Lente, and Ruth Oldenziel for helpful comments. She owes a big debt of gratitude to van Lente, Oldenziel, and Hermione Giffard for their help in getting the text ready for publication.

©2021 by the Society for the History of Technology. All rights reserved.

0040-165X/21/6201-0009/212–40

Citation: Kranakis, Eda. “Writing Technology into History.” *Technology and Culture* 62, no. 1 (2021): 212–40.

1. “An online European History Experience unlike any you know,” accessed July 14, 2020, <https://pro.europeana.eu/post/an-online-european-history-experience-unlike-any-you-know>. The volumes of the series are Oldenziel and Hård, *Consumers, Tinkers, Rebels*; Kohlrausch and Trischler, *Building Europe on Expertise*; Høgselius, Kaijser, and Van der Vleuten, *Europe’s Infrastructure Transition*; Kaiser and Schot, *Writing the Rules for Europe*; Fickers and Griset, *Communicating Europe*; Diogo and Van Laak, *Europeans Globalizing*.

2. Kaiser and Schot, *Writing the Rules for Europe*, 10. The concept “hidden integration” was presented in Misa and Schot, “Introduction.”

more closely with globalization. It aims to show that the circulation of people, goods, technology, and ideas between Europe and the rest of the world has shaped Europe's history, from high politics to the modalities and trends of everyday life.

Each volume contributes a crucial element. *Consumers, Tinkerers, Rebels: The People Who Shaped Europe*, by Ruth Oldenziel and Mikael Hård, looks at the users of sewing machines, household and recycling technologies, railways, bicycles, and computers. This volume shows how users challenged systems that did not meet their needs and applied technologies in innovative and unexpected ways, setting new trends that crisscrossed Europe. *Building Europe on Expertise: Innovators, Organizers, Networkers*, by Martin Kohlrausch and Helmuth Trischler, centers on the experts—implementers of the knowledge society—who developed new systems, codified and diffused knowledge, and coordinated the embedding of technology into the fabric of collective life, either to enhance democratic possibilities or achieve authoritarian control. *Europe's Infrastructure Transition: Economy, War, Nature*, by Per Høgselius, Erik van der Vleuten, and Arne Kaijser, studies the technological and energy infrastructures that transformed commerce, finance, and warfare; altered spatial and temporal relationships; and intersected with environmental concerns. *Writing the Rules for Europe: Experts, Cartels, and International Organizations*, by Wolfram Kaiser and Johan Schot, details efforts going back to the nineteenth century to coordinate cross-border systems such as railways and steel production. They argue that these cooperative, techno-regulatory endeavors, which enabled the systems to operate internationally, were the true roots of European economic and political integration. They fostered a pattern of “technocratic internationalism,” establishing institutions and principles now associated with the European Union.<sup>3</sup> *Communicating Europe: Technologies, Information, Events*, by Andreas Fickers and Pascal Griset, concentrates on telecommunications, information processing, and mass media infrastructures (radio and TV), which play a crucial role in governance, business, identity formation, and everyday life. The authors detail the evolution of these infrastructures amid rivalry and cooperation among European states and their contribution to the expansion of a new mobility culture. Finally, *Europeans Globalizing: Mapping, Exploiting, Exchanging*, by Maria Paula Diogo and Dirk van Laak, discusses flows and linkages between Europe and the rest of the world since 1850. The book focuses especially on Europe's history of imperialism, colonialism, and the way technology bolstered these hegemonic pursuits. It also highlights Europeans' embrace of science and technology as a badge of civilizational superiority.

As each volume of *Making Europe* has been reviewed in *Technology and Culture* or elsewhere, this essay focuses on the series' organizational,

REVIEW

ESSAY

3. Schot and Lagendijk first presented this concept in “Technocratic Internationalism.”

conceptual, and historiographical contexts. First, it shows how *Making Europe* drew on two earlier history of technology series—TIN-19 and TIN-20.<sup>4</sup> It then contrasts *Making Europe* with three multivolume surveys of the history of technology published between the 1950s and the 1970s, led by Charles Singer in Britain, Maurice Daumas in France, and Melvin Kranzberg and Carroll Pursell in the United States. These comparisons also serve as a vehicle to highlight the expansion of contextualist approaches in the history of technology up to the 1990s. The essay then discusses *Making Europe*'s unique contribution to current historiographical trends. The concluding section considers aspects of European and global history since 1850 that require further investigation, focusing on energy humanities as a new tool to meet the contextual challenge of writing technology into history.

### From *TIN* to *Making Europe*

Schot proposed the idea for *Making Europe* in 1998–99 as a research project under the auspices of the Foundation for the History of Technology (SHT), modeled upon the TIN-19 and TIN-20 book series that SHT was supporting.<sup>5</sup> Initiated by Harry Lintsen, the “father” of the history of technology in the Netherlands, TIN-19 and TIN-20 were mammoth projects. TIN-19, “History of Technology in the Netherlands: The Emergence of a Modern Society, 1800–1890,” published between 1992 and 1995 under Lintsen, comprised six volumes (around 2,000 pages) and listed thirty authors, six of them on the editorial team.<sup>6</sup> TIN-20, “Technology in the Netherlands in the Twentieth Century,” was published between 1998 and 2003 under a large editorial team led by Schot, Lintsen, Arie Rip, and Adri Albert de la Bruhèze.<sup>7</sup> It had seventy authors, covering fourteen sectors or sites of technological change from 1890 to 1970.

*Making Europe* probably would not have seen the light of day without the experience and organizational techniques acquired through TIN-19 and TIN-20, or SHT's coordinating expertise. For TIN-19, Harry Lintsen built up a powerful organizational system with two key elements that later guided TIN-20 and *Making Europe*. One element was the SHT, an independent foundation that Lintsen established in 1988 in collaboration with the Royal Netherlands Society of Engineers (KIVI). It became a vehicle for

4. TIN is the acronym for Techniek in Nederland (Technology in the Netherlands) in, respectively, the nineteenth (19) and twentieth (20) century.

5. Stichting Historie der Techniek (SHT), 1998 Annual Report (April 1999), 5; 1999 Annual Report (May 2000), 3, 6, available at: [www.histech.nl/www/about/jaarverslagen](http://www.histech.nl/www/about/jaarverslagen). See also Deutsches Museum, 2000 Annual Report, 106, [www.deutsches-museum.de/wir-ueber-uns/jahresbericht/](http://www.deutsches-museum.de/wir-ueber-uns/jahresbericht/).

6. Schot et al., *Techniek in Nederland*. The summarizing volume in English is *Technology and the Making of the Netherlands*. On Lintsen's role, see Schot, “Confronting the Second Deep Transition,” 452.

7. Lintsen, ed., *Geschiedenis van de techniek in Nederland*.

both fundraising and the administration and intellectual governance of large, collaborative projects. The second element was a collaborative research system involving formal support from multiple universities; participation of scholars around the country; group discussions to agree on overarching project themes; detailed research plans and work schedules for each segment; funding doctoral and postdoctoral students to pursue topics contributing to the larger project; conferences and workshops to provide feedback on research results, maintain intellectual coherence, and keep all the project components on point and on track; spinoff publications as the work progressed to the final book series; and significant fundraising to make everything else possible.<sup>8</sup>

REVIEW  
ESSAY

TIN-20 applied this model on a large scale, with every Dutch university and around 100 researchers participating. Exploratory meetings in 1992 and 1993 determined the major themes, and over the next three years, detailed research plans were established for each topic, and major fundraising efforts were launched. The editorial committee led the project, joined by fifteen editors who served as project leaders for the various themes, and contributed as authors. As the project progressed, scholars from abroad were invited to the workshops and conferences, including Arne Kaijser and Mikael Hård, who later participated in *Making Europe*. TIN-20 also produced numerous spinoff publications. The SHT coordinated the twelve-year project, costing about 10 million U.S. dollars.<sup>9</sup>

Like TIN-20, *Making Europe* was collaborative, yet tightly coordinated. Costing more than five million euros, it drew on work by hundreds of scholars from Europe and North America, through the Tensions of Europe transnational network, which Schot inaugurated. He and his close collaborators steered *Making Europe* through three phases between 1999 and 2015, each with well-defined aims and significant funding initiatives. The first phase from 1999 to 2005 used a large grant from the European Science Foundation (ESF) to establish Tensions of Europe as a “Network of Excellence,” which proved crucial for developing knowledge required for the book project. The project topics were also determined in this phase, and initial literature reviews undertaken.<sup>10</sup> Additionally, Schot won a large grant from the NWO (Netherlands Organization for Scientific Research) in 2002 for an affiliated project, “Transnational Infrastructures and the Rise of Contemporary Europe” (TIE), which funded new doctoral and postdoctoral students who pursued projects relevant to the book series.<sup>11</sup>

8. SHT Annual Reports, 1988–95. The author thanks Ruth Oldenziel for additional information.

9. SHT Annual Reports, 1991–2004.

10. SHT Annual Reports, 2000–4.

11. NWO Projectendatabank, [www.nwo.nl/projecten/277-53-001-0](http://www.nwo.nl/projecten/277-53-001-0). Schot’s summary of the project plan, “Transnational Infrastructures and the Rise of Contemporary Europe,” January 2003, [www.yumpu.com/en/document/read/34449000/transnational-infrastructures-and-the-rise-of-contemporary-europe](http://www.yumpu.com/en/document/read/34449000/transnational-infrastructures-and-the-rise-of-contemporary-europe). Within the TIE project, Alec

The second phase, from 2005 to 2010, involved a large ESF EUROCORES theme grant (“Inventing Europe: Technology and the Making of Europe, 1850 to the Present”) and national agency funding for research programs, workshops, conferences, and summer schools. The book series was a promised outcome of the EUROCORES grant.<sup>12</sup> In the third phase (2010 to 2015), funding from the Dutch Institute for Advanced Studies (NIAS) enabled the *Making Europe* authors to collaborate at the institute in 2010 and 2011 and synthesize the results that enabled the writing of the book series.<sup>13</sup> As with TIN-19 and 20, the SHT coordinated the entire process and signed a formal contract with every author.<sup>14</sup> In line with Lintsen’s system for TIN-19, the research program generated spinoff publications, doctoral dissertations, etc.<sup>15</sup>

*Making Europe* also drew on the TIN-19 and TIN-20 conceptual models. Initially, the TIN projects were influenced by analyses of industrialization and the economic history approach that compared “leading” and “lagging” nations.<sup>16</sup> How did country A industrialize so quickly? What made country B lag behind? Why did country C’s growth decline? In this conceptual world, industrialization and growth equaled progress, which was ultimately about money and power. A classic text of the genre was David Landes’s *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present*. First published in 1969 and reprinted fourteen times, it was considered important enough for a “Classics Revisited” retrospective in *Technology and Culture* in 2005. The book’s conclusion summed up the approach:

Economic history has always been in part the story of international competition for wealth. . . . The Industrial Revolution gave this com-

---

Badenoch carried out postdoctoral research and Vincent Langendijk, Frank Schipper, Irene Anastasiadou, and Suzanne Lommers completed doctoral dissertations on European electricity networks, highways, railways, and radio. Several volumes in *Making Europe* drew upon their work.

12. Not all the supported EUROCORES research projects fed directly into *Making Europe*. The original proposal for “Inventing Europe,” September 2005, is at <http://archives.esf.org/coordinating-research/eurocores/programmes/inventing-europe/background.html>. The final report, February 2011, is at [http://archives.esf.org/fileadmin/Public\\_documents/Publications/InventingEurope\\_01.pdf](http://archives.esf.org/fileadmin/Public_documents/Publications/InventingEurope_01.pdf)

13. SHT, 2009–10 Report, July 2011, 4.

14. Schot and Scranton, “Making Europe: Technologies and Transformations, 1850–2000: Proposal for a Six-volume Series,” July 2009, 3–4, [www.slideshare.net/making-europe/ie-making-europe-series-proposal-final-5744115](http://www.slideshare.net/making-europe/ie-making-europe-series-proposal-final-5744115).

15. Van der Vleuten and Kaijser, eds., *Networking Europe*; Oldenziel and Zachmann, eds., *Cold War Kitchen*; Badenoch and Fickers, eds., *Materializing Europe*; Disco and Kranakis, eds., *Cosmopolitan Commons*. Partial list at [www.tensionsofeurope.eu/projects-and-publications/publication/](http://www.tensionsofeurope.eu/projects-and-publications/publication/), accessed December 10, 2020. The EUROCORES final report includes dissertations and postdoc projects affiliated with *Making Europe*.

16. SHT, 1988 Annual Report, June 1989, 3.

petition a new focus—wealth through industrialization—and turned it into a chase. There was one leader, Britain, and all the rest were pursuers. The lead has since changed hands, but the pursuit goes on in what has become a race without a finishing line. . . . The laggards have good reason to be concerned: the race is getting faster all the time, and the rich get richer while the poor have children. . . . The historical experience of western and central Europe provides us with some of our best insights into the nature of this race after wealth and the power that goes with it: into the sources and dynamics of industrial development; stimulants and deterrents; the implications of precedence and backwardness; the effect of non-economic values and institutions on economic performance.<sup>17</sup>

REVIEW  
ESSAY

This approach saw production technology as the foundation of industrialization. It avoided topics like tourism or consumption that did not fit easily into production and economic efficiency debates. Indeed, as late as 1991, economic historian Patrick O'Brien felt it necessary to justify viewing "new goods and services [intended] for sale directly to consumer" as technical progress, framing his justification around economic growth: "Novelties' are indeed an integral component of technical progress because markets can be saturated and economic growth (particularly in this century) has depended more and more upon persuading customers to buy unfamiliar products and services."<sup>18</sup> Comparative industrialization studies ignored users and did not consider how technology and industrialization shaped political struggles, lifestyles, and cultural practices.

TIN-19 could hardly avoid the influence of comparative economic history, especially because two studies in 1976 and 1979 had analyzed the Netherlands as an example of "industrial retardation."<sup>19</sup> Partly in response, TIN-19 charted a new direction, shifting focus from industrialization to the broader sociological concept of "modernization" and drawing on the contextual and social constructivist approaches emerging within the history of technology. TIN-19 conceptualized technological change in the Netherlands as "a social process," not simply a quest for efficiency, profit, and economic growth.<sup>20</sup>

The change in TIN-19 became a full paradigm shift in TIN-20.<sup>21</sup> Proclaiming technology's "paramount importance in history" and viewing

17. Landes, *Unbound Prometheus*, 538.

18. O'Brien, "Mainsprings of Technological Progress," 7.

19. Mokyr, *Industrialization in the Low Countries*; Griffiths, *Industrial Retardation*.

20. Van Lente et al., "Techniek en Modernisering," 24. To emphasize technical development as a social process, the TIN-19 team cited Thomas P. Hughes, David Noble, and Wiebe Bijker, see Van Lente, "Technology in Dutch Society." See also Van Royen et al., "Techniek en modernisering"; and Homburg, "Techniekgeschiedenis in Nederland."

21. The shift with TIN-19 was nevertheless significant enough for reviewers to take note. See Davids, "Historici, ingenieurs en techniek," 205.

historians of technology as “privileged chroniclers of the modern era,” TIN-20 pursued a new kind of “integral history” to show “how a history of technology in the Netherlands can be a history of the Netherlands.”<sup>22</sup> TIN-20 examined the infrastructures that spawned the “material unification” of the Netherlands. It explored crucial sites where technologies intersected with social practices, such as the home or the hospital, and it documented how the “lifeworld” changed in response to new technology.<sup>23</sup> Particularly through the efforts of Ruth Oldenziel, who had not participated in TIN-19, TIN-20 also incorporated a well-developed gender dimension and focused much more on technological consumer culture and the role of users.<sup>24</sup> Finally, TIN-20 depicted technological change as a conflictual process that encompassed choices and debates about which technologies to promote or oppose and how to design and use them. As one review explained, TIN-20 was packed with examples of “alternatives . . . different development paths . . . undercurrents and counter-movements.”<sup>25</sup> “Contested modernization” became the central theme of TIN-20.<sup>26</sup>

Given TIN-20’s scope, conceptual importance, and practical success—and the continuities in editorship and authorship between the two series—*Making Europe* unsurprisingly echoes several features of the earlier series.<sup>27</sup> Like TIN-20 (but scaled up to European level), *Making Europe* offers not just a history of technology in Europe, but a history of Europe itself since 1850, “viewed through the lens of technology.”<sup>28</sup> An accompanying podcast series tells listeners that it might change their “outlook on modern European history and how the European Union came to be.”<sup>29</sup> Like TIN-20, *Making Europe* conceptualizes technological change as a conflictual process. It emphasizes the “material unification” of space and society through infrastructure networks, incorporates a gender dimension, and focuses on users. Furthermore, *Making Europe* continues to explore how technologies

22. Schot et al., “Betwiste modernisering,” 48–49; Schot and Rip, “Techniek en de geschiedenis van Nederland,” 15.

23. Van der Vleuten, “De materiële eenwording van Nederland”; Schot et al., “Techniek in ontwikkeling,” 17, 40.

24. In English, see the spinoff publication, Albert de la Bruhèze and Oldenziel, eds., *Manufacturing Technology, Manufacturing Consumers*.

25. Davids, “Keuzes en patronen,” 51.

26. Contested modernization, introduced in the first volume of the series, was developed further in the final synthesizing volume and its English version (Schot et al., eds., *Technology and the Making of the Netherlands*).

27. Schot took a leading role in directing and editing both TIN-20 and *Making Europe*, and he directed the large grants that made the latter series possible. In addition, Schot, Oldenziel, and Van der Vleuten, who all wrote important sections of TIN-20, were also co-authors of volumes in *Making Europe*. Schot and Oldenziel co-chaired the Tensions of Europe Coordination Committee, guiding its research themes, which fed into *Making Europe* (SHT Annual Reports 2000–4).

28. Schot and Scranton, “Making Europe,” ix.

29. Podcasts at: [www.makingeurope.eu/podcasts](http://www.makingeurope.eu/podcasts) (last accessed in 2020).

have been embedded in sites, practices, and institutions of collective life across Europe. It also looks at two other themes of TIN-20 in greater depth and breadth: technology in colonial settings and the rise of a knowledge society dependent on technical experts.

TIN-20 incorporated much original, scholarly research yet promoted accessibility with a readable style, numerous illustrations, and by avoiding abstract theoretical discussions (which occurred extensively behind the scenes). *Making Europe* echoes these techniques and similarly targets a public audience beyond academia. Taking advantage of recent internet culture, *Making Europe* has a dedicated website with a free podcast series containing interviews with authors of the volumes. In addition, Alec Badenoch established a European Digital Museum for Science and Technology, offering six exhibitions corresponding to the volumes of *Making Europe* and additional “tours” by guest curators around Europe.<sup>30</sup>

Most *Making Europe* authors were not directly affiliated with TIN-20 and did not simply follow its lead; rather, their own research had been moving in similar directions. These authors were already discussing the history of infrastructures in political, economic, social, and cultural contexts.<sup>31</sup> Several were discussing technology in relation to modernity and modernization processes or were conducting fine-grained, contextual studies of technologies and their users.<sup>32</sup> Years before the first volume of TIN-20 appeared, Hård was already advocating the need for “a social conflict approach” that analyzes technology as “the outcome of conflicting interests and ideas.”<sup>33</sup> Such parallels were by-products of the new intellectual currents transforming the history of technology from the 1960s to the 1990s. The authors of *Making Europe* were all participating in these intellectual shifts.

### Contextualism Interrupted

Major historiographic transitions are *medium-durée* phenomena that involve the work of many scholars over decades. To enhance understanding of the collective changes that transformed the history of technology in

30. The digital representation of the project at: [www.inventingeurope.eu](http://www.inventingeurope.eu) (last accessed in 2020).

31. Griset, “L’Évolution des télécommunications”; Griset, *Entreprise, technologie et souveraineté*; Griset and Headrick, “Submarine telegraph cables”; Kaijser, *I fädrens spar*; Kaijser and Hedin, eds., *Nordic Energy Systems*; Kaijser, “Trans-border Integration”; Van Laak, “Der Begriff ‘Infrastruktur,’” “Infrastrukturgeschichte”; Van Laak, *Imperiale Infrastruktur*; Carneiro et al., “Portuguese Engineering and the Colonial Project;” Diemel and Trischler, *Geschichte der Zukunft des Verkehrs*; Lyth and Trischler, *Wiring Prometheus*; Fickers, “‘Politique de la grandeur’ versus ‘Made in Germany.’”

32. Characteristic examples are Hård and Jamison, *Intellectual Appropriation of Technology*; Van Laak, *Weißer Elefant*; Trischler, “Die neue Räumlichkeit des Krieges”; Fickers, *Der Transistor*; Hård and Jamison, “Alternative Cars.”

33. Hård, “Beyond Harmony and Consensus.”

REVIEW

ESSAY

the decades preceding *Making Europe*, it is helpful to begin by drawing comparisons with two earlier book series that are in some sense analogues of *Making Europe*: a seven-volume series published between 1954 and 1978—*A History of Technology*—edited by Charles Singer, E.J. Holmyard, A.R. Hall, and Trevor I. Williams; and a five-volume series published between 1962 and 1979—*Histoire générale des techniques*—edited by Maurice Daumas.<sup>34</sup> They both gave substantial attention to Europe and were heralded as major achievements that helped to define and establish the history of technology as a discipline. *Technology and Culture* editor Melvin Kranzberg devoted an entire issue to critically analyzing the first five Singer volumes, asserting that they had “become the criterion” by which all other efforts in the field were measured.<sup>35</sup> Lynn White stated that the Singer series “established the history of technology as an intellectual enterprise,” but he saw the Daumas series as an equally important undertaking that marked “an advance over Singer’s work.”<sup>36</sup> The following year, Daumas was awarded the Society for the History of Technology’s Leonardo Da Vinci Medal, partly for his work on that series.<sup>37</sup>

What is most striking today about these series is their aggressively internalist approach, which effaced earlier efforts to develop a contextual understanding of technological change. The Singer series editors “felt justified in concentrating upon . . . a history of how things have been done or made.”<sup>38</sup> Editor Hall reflected in *Technology and Culture* in 1960, “When we were planning our History it seemed to us (and I still think that this view was correct) that . . . it was not incumbent upon us to traverse the work of the economic, social, or scientific historian beyond what was strictly necessary.”<sup>39</sup> The Daumas series similarly asserted that “the political, social, or economic context of technical progress is mentioned only to the extent that it is indispensable to do so.”<sup>40</sup>

Singer and Daumas sidelined earlier efforts to develop a contextual history of technology. Daumas claimed to follow Lucien Febvre, a leading historian of the contextualist Annales School, but his approach was the opposite. Febvre had argued that the history of technology must combine three elements: a “technical history of technology,” meaning an archaeology and anthropology of technical activity and its products; an assessment of the roles of practical and scientific knowledge in technological change; and

34. The first three Daumas volumes were published as a series in English: Daumas, *A History of Technology and Invention*. The Singer series initially had five volumes covering the period from ancient times to 1900. Two more volumes were added later, covering 1900–50, edited by Trevor I. Williams.

35. Kranzberg, “Introductory: Charles Singer,” 301.

36. White, “Review of *Histoire générale des techniques*,” 228.

37. “The Leonardo Da Vinci Medal,” 206–8.

38. Singer et al., *A History of Technology*, 1:v.

39. Hall, “A History of Technology,” 315.

40. Daumas, *Histoire générale des techniques*, 1:xiv.

analysis of the ways that technology was “influenced by what may be termed general history—and, at the same time, acts upon this history.” Febvre emphasized that *bringing together* these three aspects—which he viewed as “inseparable,” formed the history of technology.<sup>41</sup> Daumas deliberately set aside the third element, however.<sup>42</sup> He also denigrated Lewis Mumford’s contextual classic, *Technics and Civilization*, saying that it did not qualify as history and was only a “jumble of commonplaces” that should “sink into ridicule.”<sup>43</sup>

REVIEW  
ESSAY

Charles Singer, lead editor of the first five volumes of *A History of Technology*, opposed what he regarded as Marxists’ politicization of the history of science and technology. At the Second International Congress of the History of Science in 1931, Singer deliberately sidelined the Soviet delegation, craftily making it impossible for them to deliver their papers.<sup>44</sup> In the Singer series, he suppressed a powerful, human-centered historiography of the British Industrial Revolution. The 700-page volume did not cite Mumford or the classic studies by Arnold Toynbee, Paul Mantoux, and John and Barbara Hammond, which sought to integrate the technological history of the Industrial Revolution with social history; nor did it discuss the rise of the factory system or social changes connected with industrialization. Sociologist Francis R. Allen’s survey article on technology and social change in the inaugural issue of *Technology and Culture* concluded that the Singer series was “really outside the scope of these works” because it provided “little treatment of social effects.”<sup>45</sup>

Daumas and Singer’s internalist stance impoverished historical understanding by ignoring technology’s connections to major historical events and trends. The Daumas series made no mention of imperialism, colonies, or the Suez Canal (despite its technical significance and historical importance for Europe). It ignored the world wars, depression, rise of fascism, the Cold War, and decolonization. There is no hint that technology was directed toward violence and terror on an unprecedented scale in the 1900s. On the contrary, as if to blot out this lived history, Daumas insisted that technology included “only those activities of mankind that have the aim of gathering, adapting, and transforming natural materials in order to improve the conditions of his existence.” He contended that technology “followed a continuous ascending curve.”<sup>46</sup> The Singer series used the term “imperialism” only once in the volumes covering the period after 1850 and gave limited attention to major historical events. One chapter surveyed

41. Febvre, “Réflexions sur l’histoire des techniques,” 532–33.

42. Daumas, *Histoire générale des techniques*, 4:vii–xi; Daumas, “L’histoire des techniques,” 5–19.

43. Daumas, “Technology,” 415; Daumas, “L’histoire des techniques,” 13; Mumford, *Technics and Civilization*.

44. Chilvers, “Five Tourniquets and a Ship’s Bell.”

45. Allen, “Technology and Social Change,” 50.

46. Daumas, *Histoire générale des techniques*, 1:viii, 1:xiv.

major twentieth-century events, but only as an introductory backdrop, which isolated them from the technological chapters.

The gulf separating the Singer and Daumas series from *Making Europe* could hardly be wider. First, the big historical trends and events mentioned above, and their connections with technology, are discussed extensively in *Making Europe*. Second, there are major differences in approach and conceptual framing. The Singer and Daumas series lack user and gender perspectives and do not utilize the concept of a knowledge society or discuss the rise of a consumer society, all of which figure centrally in *Making Europe*. The Daumas series says nothing about household technology, and only mentions the sewing machine in a chapter on industrial electricity. The Singer series devotes a chapter to household technology, but it is marred by class and gender bias. It comments that servants asked to use vacuum cleaners were “frightened at having to control such a novel machine; it must be remembered that this invention was almost the first machine to be put into the hands of simple, uneducated people.”<sup>47</sup> Third, the Singer and Daumas series lack the concept of infrastructure. *The Oxford English Dictionary* suggests that “infrastructure” was a new term in the early 1950s, referring to installations such as airbases that supported military needs. The term embeds the idea of a technological system that supports either other systems or structures of collective life. It has moreover become an umbrella concept, giving rise to a systems approach that considers interactions between systems. The Daumas and Singer volumes lack this perspective. Their unit of analysis is the individual component, machine, or invention. Finally, they lack the ideas that technological systems and networks alter time-space relations and integrate space, fostering new patterns of mobility and governance. *Making Europe* explores these ideas in depth, showing how they contributed to a popular culture of mobility and to processes of European cultural integration and transnational governance.<sup>48</sup>

### Reinvigorating Contextualism

Despite the prominence of the Daumas and Singer series, the historians of technology collectively rejected internalism and brought contextualism back to the fore. This shift was greatly assisted by the founding of The Society for the History of Technology in 1958; *Technology and Culture* in 1959, with Melvin Kranzberg as editor; and by the 1967 survey, *Technology in Western Civilization*, edited by Melvin Kranzberg and Carroll Pursell.

Kranzberg’s introductory editorial for *Technology and Culture* was a call for more contextualism. He criticized Singer’s definition of technology as “how things are commonly done or made” and “what things are done

47. Wilson, “Domestic Appliances,” 7:1131.

48. A chapter in Daumas covering 1450–1650 discusses technological organization of space, but the idea does not appear later. See Gille, “Les techniques d’organisation de l’espace.”

and made” because it suggested that technology was “insulated from the rest of society.” Kranzberg instead wanted to know:

Why are things done and made as they are? What effects have these methods and things upon other areas of human activity? How have other elements in society and culture affected how, what, and why things are done or made? The five volumes of *A History of Technology* . . . do not answer these further questions.

REVIEW

ESSAY

To chart a new path, Kranzberg announced that the journal would publish “general articles dealing with the relations of technology with society and culture,” interpreting ‘culture’ in “a broad anthropological sense.”<sup>49</sup>

Kranzberg and Pursell’s preface for *Technology in Western Civilization* further criticized the internalist approach. They insisted that the history of technology should be seen as “a branch of social history” and “an important part of intellectual, economic, political, art, military, and even religious history.” They presented their volumes as “the first faltering attempts” by the contributors and editors to understand the history of technology “in terms of the total social and cultural picture.”<sup>50</sup> They did not provide an integrated historical narrative like *Making Europe*; the approach was encyclopedic, particularly volume two on the twentieth century. Yet the volumes were highly readable, carefully edited for clarity and succinctness, and widely used for teaching up to the 1980s.

*Making Europe* is heir to this series more than to Singer and Daumas. Conceptually, *Technology in Western Civilization* is a milestone, a determined, imaginative effort to implement a new vision for a contextual history of technology. Its vision is apparent in chapters devoted to social, cultural, military, and political topics, and in thoughtful bibliographical essays. Unlike Singer and Daumas, the authors discuss the Suez Canal and cite Toynbee, Mantoux, the Hammonds, and Mumford. The volumes recognize the need for a “systems approach” and prefigure several important concepts. Although they do not use the term “infrastructure,” its underlying ideas emerge in topics like urbanization and transportation. They do not refer to “consumer society,” but include a chapter on the “Crisis of Abundance” and discussions of mass production, mass consumption, and the evolution of marketing through mail-order houses, chain stores, supermarkets, and consumer credit. Inevitably, some chapters have not stood the test of time, such as one that severely underrates the importance of technology in the era of “high imperialism.” Additionally, themes such as gender and the environment appear only in embryo. But the series displays excellent instincts about what inquiries to pursue and creates frameworks suggesting new directions for contextual research.<sup>51</sup>

49. Kranzberg, “At the Start,” 1, 8–9.

50. Kranzberg and Pursell, *Technology in Western Civilization*, 1:viii, 1:vi.

51. The Kranzberg and Pursell series featured in a *Technology and Culture* retrospective review. Ceruzzi, “A Large Canvas.”

Despite Kranzberg's and Pursell's pleas for more contextualism, however, internalist studies remained widespread throughout the 1970s. For example, although the Singer and Daumas volumes that covered the twentieth century were published in the late 1970s, they still paid little heed to contextualism. More importantly, John Staudenmaier, classifying *Technology and Culture* articles published from 1959 to 1980, noted that few addressed "the relation of technological design and human culture," and elements of contextual analysis were "an inchoate mass of detail" with no coherent perspective. He found "little sign of emerging consensus" about what to include in contextual studies.<sup>52</sup>

Part of the problem was that it took time to find fruitful techniques for contextual analysis and ways to conceptualize the intermeshing of technology, society, and nature. This occurred through a vast collective effort, a kind of self-organizing megaproject in which new approaches, themes, and topics were introduced and discussed over time, with many conflicting and incompatible threads. We should not lose sight of the fact that the path from TIN-19 and TIN-20 to *Making Europe* was embedded within this larger terrain, forged at first sporadically in the 1960s and more widely after the 1970s.

The 1980s were a turning point. A range of new studies and approaches appeared, aided by the rise of social history, rapid expansion of the history (and sociology) of technology in university programs, and new international societies such as the Society for Social Studies of Science (4S, founded 1975), the European Association for the Study of Science and Technology (EASST, founded 1981), and national organizations. Emerging research fronts fed into the TIN series and *Making Europe*: Thomas P. Hughes's systems approach; David Noble's analysis of conflictual technological politics; Ruth Cowan's attention to consumers, users, and gender; Bruno Latour, Michel Callon, and John Law's actor-network approach focusing on controversies, networks, and the inseparability of technology and society; Trevor Pinch and Wiebe Bijker's constructivist approach, emphasizing users and their influence on technological change; David Nye and Claude Fischer's focus on social and cultural contexts of infrastructure use; rising interest in technology, mass media, and popular culture associated with American Studies and Communication Studies, which also influenced research in the history of technology; and analysis of hegemonic uses of technology in warfare and colonial contexts by scholars like William H. McNeill, Daniel Headrick, and Michael Adas.<sup>53</sup>

52. Staudenmaier, "What SHOT Hath Wrought," 17; Staudenmaier, *Technology's Storytellers*, 122.

53. Examples of the pioneering studies: Hughes, *Networks of Power*; Noble, *Forces of Production*; Latour, *Science in Action*; Callon et al., eds., *Mapping the Dynamics of Science and Technology*; Cowan, *More Work for Mother*; Bijker et al., *Social Construction of Technological Systems*; Nye, *Electrifying America*; Fischer, *America Calling*; McNeill, *Pursuit of Power*; Headrick, *Tools of Empire*, and *Tentacles of Progress*; Adas, *Machines as the Measure of Men*.

The preceding examples offer glimpses of the new perspectives that have emerged since the 1970s. Overall, there was a seismic shift of focus toward technologies in use, how they were entangled in political, social, and cultural practices, and how groups and individuals interpreted and contested technological changes. New terms emerged that became code words for multifaceted concepts or broad systemic changes in society—like infrastructure, modernization, consumer society, and knowledge society. Such terms grew from the thinking of many researchers and multiple disciplines. They were products of collective thought and, once created, shaped further research and interpretation.<sup>54</sup> All of these shifts contributed to the patterns of similarity and difference that distinguish *Technology in Western Civilization* from TIN-19, TIN-20, and *Making Europe*.

REVIEW

ESSAY

### *Making Europe* and the Shift to Transnational History

The shift in geographic scale from TIN-20 to *Making Europe* demanded changes in conceptualization, methodology, and subject matter. *Making Europe* devoted much more attention to the two world wars and the Cold War. Thematically, it shifted to Europeanization, seen as a broad trend of European history, a facet of globalization, and as a political and regulatory process of European integration. Thus, whereas TIN-20 focused on “contested modernization” in one country, *Making Europe* is about contested Europeanization in a continental and global context.

Emphasizing Europeanization raised the question of how to define “Europe,” not merely geographically, but also in an ideological and historiographical sense. For example, Cold War ideology had made the two sides of the Iron Curtain seem like entirely separate worlds, and for decades, scholars neglected trying to understand how the two worlds and their inhabitants were connected. *Making Europe* addressed this by reframing European history as one of border making and border breaking, delineating technology’s role in these processes. The history of European imperialism and colonization further complicated the challenge of defining “Europe.” It has become clear that Europe’s history cannot be adequately understood without considering the enormous impact of imperialism and colonialism on European technology and infrastructure development, production, consumption, and ideologies. The series weaves this side of Europe’s past more fully into the fabric of European history, especially in the final volume, *Europeans Globalizing*, by Maria Paula Diogo and Dirk van Laak.

Defining “Europe” also intersects with the political process of European integration, which has fostered an inferred hierarchy of “European-ness.” Countries belonging to the European Community are viewed as more “European” than others. Those that join are deemed to be joining

54. See, e.g., Hornidge, “‘Knowledge Society’ as Academic Concept and Stage of Development.”

Europe. This perspective has become dominant since the establishment of the European Union in 1993, and the shift was not merely discursive. Applicant states are told, in detail, changes and laws they must implement to be admitted to the EU. *Making Europe* seeks to challenge this understanding of Europe and thereby “decenter the EU.”<sup>55</sup> It achieves this by taking a longer-term approach, showing that integration began at least a century before the post-1945 process of economic and political unification. *Making Europe* moreover unravels the connections between technology and forms of European integration and governance. The volumes reveal multiple, overlapping “Europes” linked to specific technologies and networks that in turn fostered new governance structures. The series editors explain that these technology-linked governance structures constituted “the foundation for the formal process of European integration that gained traction in the 1950s.”<sup>56</sup>

The change of scale between TIN-20 and *Making Europe* brought a fundamental shift away from “methodological nationalism,” the assumption that nation-states form the natural “container” of society and history.<sup>57</sup> Instead, *Making Europe* embraced the turn toward transnational history that has arisen since the mid-1990s.<sup>58</sup> Comparative economic history had viewed nation-states as the natural “containers” for industrialization but ranked them in a normative hierarchy of leaders and laggards. Rejecting this approach, TIN-19 and TIN-20 had highlighted the Netherlands’ unique technological experience, which suited local conditions. TIN-19 and TIN-20 thus adopted a form of methodological nationalism, but not unquestioningly. Discussing how infrastructures helped to unify the Netherlands, Erik van der Vleuten explained:

Infrastructure development is here intentionally interpreted in the historical context of nation-state building. This does not mean that the nation-state is taken for granted as the implicit, unproblematic, almost naturalized container for historic inquiry, which much infrastructure history unfortunately does. . . . It situates this development—if only briefly—against simultaneous and intertwining process of international and local infrastructure integration. To bring out contrast alongside connectedness, it repeatedly places

55. Kaiser and Schot, *Writing the Rules for Europe*, 1.

56. Schot and Scranton, “Making Europe: An Introduction to the Series,” x.

57. On methodological nationalism, see Beck and Sznaider, “Unpacking Cosmopolitanism”; Beck, “Cosmopolitan Condition”; Beck, “Toward a New Critical Theory”; Chernilo, “Social Theory’s Methodological Nationalism.”

58. Some useful overviews of transnational history are Geyer and Bright, “World History in a Global Age”; Clavin, “Defining Transnationalism”; Bayly et al., “AHR Conversation”; Werner and Zimmermann, “Beyond Comparison”; Saunier, “Learning by Doing”; Van der Vleuten, “Toward a Transnational History of Technology”; Rüger, “OXO.”

the Dutch networked nation developments in comparative international perspective.<sup>59</sup>

Nevertheless, the overriding goal of TIN-19 and TIN-20 was to explain patterns of development in one country.

By embracing transnational history, which methodically decenters the nation-state, *Making Europe* moved away from TIN-19 and TIN-20. The series emphasizes shared goals, systems, and circumstances that transcended national borders, affecting the lives and outlook of millions of people around Europe. Each volume details important facets of the collective changes that restructured governance and everyday life experiences similarly around Europe. Oldenziel and Hård, for example, analyze the differences between first-class and third-class international rail travel. These differences generated class-based commonalities across borders, while underscoring class divisions within nations.<sup>60</sup> Kohlrausch and Trischler detail another cross-border connection: the rise to prominence of a new class of technical experts, with common scientific outlooks, who collaborated across borders, creating “a shared European experience, a true European history.”<sup>61</sup> They emphasize that this process was full of contradictions and ambiguities. European experts gained influence in international governance and worked to build a universal system of knowledge, yet they also bolstered systems of aggressive nationalism, imperialism, and authoritarianism. Many lauded a utopian vision of human progress through science and technology, but others designed the war machines that tore the continent apart, creating a shared experience of trauma, suffering, and death that diminished the clout and legitimacy of European nation-states.

Transnational history highlights the inherent provisionality of nation-states. Efforts to achieve “sovereignty” and social and cultural unity were never fully realized, often undermined in practice, and structurally altered or diminished by technological change. All the *Making Europe* volumes present technologies and infrastructures that disrupted sovereignty and national unity, and sometimes protected them, albeit less successfully. Radio waves cannot be stopped at borders, so states engaged in jamming and cross-border propaganda, but also, ultimately, in cooperative, international regulation. Air pollution could no longer be addressed through national policies alone. Infrastructures propelled urbanization and connected cities around Europe, enhancing their cultural commonalities while simultaneously sharpening urban-rural divides within nation-states. Likewise, the growth and professionalization of expert communities created new elites with political influence, thereby widening intellectual divides and creating new political divisions within states. With the rise of transnational

REVIEW  
ESSAY

59. Van der Vleuten, “Networked Nation,” 49.

60. Oldenziel and Hård, *Consumers, Tinkerers, Rebels*, 83–122.

61. Kohlrausch and Trischler, *Building Europe on Expertise*, 301.

transport and communication infrastructures, European nation-states also became more dependent on outside resources and more vulnerable to the spread of financial and economic instability. *Making Europe* presents these and many other examples, all linked with technological change. Together they show that European nation-states are historically contingent constructions: they have had to contend endlessly with interacting technological, cultural, economic, and environmental changes that transformed the conditions of their sovereignty. *Making Europe* does not propose that nation-states are irrelevant or impotent, but reading the series makes nation-states no longer seem like natural containers of society and history, as in the heyday of methodological nationalism.

*Making Europe's* transnational orientation also overcame a conceptual problem that had haunted both the Singer and Daumas as well as the Kranzberg and Pursell series. The problem was a misleading technological universalism. The earlier series did not analyze the contextual specificities of nations in relation to technological change. They depicted paths of change as a universal—but actually “Western”—norm. In Kranzberg and Pursell, this characteristic is evident in chapter titles such as “Man Harnesses the Atom” or “Technology and Labor in the Twentieth Century.” The latter projected U.S. developments as a universal norm, thus negating their specificity. It asserted, “The United States is the classic environment for the first two thirds of the twentieth century in the unfolding of technology and its consequences for the working classes.”<sup>62</sup> Paradoxically, the transnational history approach in *Making Europe*, despite decentering the nation-state, had to take the specificity of nations into account, without arranging them in a normative hierarchy as in comparative economic history. It looked at nations in an interactive and evolutionary way in relation to technological change. This approach provincializes all nation-states and thereby avoids being caught up in a mythic Western universalism.

*Making Europe* is an iconic landmark in the long, collective effort to write technology into history. Importantly, it provides wide-ranging yet in-depth analyses of how technological infrastructures and artifacts like cars, bicycles, and transistor radios shape collective life. It explores how users experienced and shaped those technologies, and how technologies and infrastructures figured in international commerce, mobility, cultural diffusion, transnational systems of governance, and in building, transcending, and breaking down geographical and other borders. The series marks the culmination of a long-term, transnational research program, but it also stands as an invitation to further inquiry.

One area that needs much more attention is globalization, many aspects of which are mediated by technology, like resource extraction, offshoring, outsourcing, military interventions, environmental protection,

62. Barbash, “Technology and Labor,” 64.

espionage, terrorism, financialization, intellectual property issues, and the exercise of new forms of “soft power.” Technology also figures in the development of global governance regimes. Research on all of these issues has been undergoing rapid conceptual and historiographic change, a path that looks set to continue. It is already easy to envision not just a further volume but a book series that would tackle the challenge of making sense of Europe’s changing place and role in the world since the Victorian era. At present we still lack adequately developed conceptual frameworks to tie these phenomena together in a meaningful way.

REVIEW

ESSAY

### Technology, Infrastructures, and the Rise of Energy Humanities

Beyond the need for a more comprehensive analysis of globalization, writing technology into European history demands a more robust energy perspective. The development of “energy transitions” research and “energy humanities” make this goal more easily attainable. Energy transitions research emerged over the past three decades, focused on the shifts from biomass energy based on fuelwood and fodder, to fossil fuels. More recently, it has become part of the blossoming domain of “energy humanities,” which views energy regimes as drivers of historical change.<sup>63</sup> One recent survey asserted, “we can no longer fully understand developments in culture, society, politics, and economics without paying attention to the role played by energy in each domain.”<sup>64</sup> Frederick Buell, examining “the nineteenth and twentieth-century shift from coal capitalism to oil–electric capitalism,” similarly reminds us that energy systems are “constituted by sociocultural, economic, environmental, and technological relationships.”<sup>65</sup>

*Making Europe* does not ignore energy. Høgselius, Kaijser, and Van der Vleuten’s volume acknowledges the shift to fossil fuels and the energy

63. The energy transitions perspective has deep roots, emerging from work by experts concerned about fossil fuel depletion (economist William S. Jevons in the 1860s), from the study of industrialization, e.g., Wrigley, “Supply of Raw Materials,” and from scholars interested in the role of energy in social change, such as the pioneering study by Cottrell, *Energy and Society*. Recent studies include Smil, *Energy in World History, Energy Transitions*, and *Energy and Civilization*; Haberl, “Energetic Metabolism of Societies”; Fouquet and Pearson, “A Thousand Years of Energy Use”; Fouquet, *Heat, Power, and Light*; Siefertle, *Subterranean Forest*; Podobnik, *Global Energy Shifts*; Malanima, *Energy Consumption in Italy*; Warde, *Energy Consumption in England and Wales*; Kander et al., *Power to the People*.

64. Dominic Boyer and Imre Szeman, “Breaking the Impasse: The Rise of Energy Humanities,” *University Affairs*, February 12, 2014, [www.universityaffairs.ca/opinion/in-my-opinion/the-rise-of-energy-humanities/](http://www.universityaffairs.ca/opinion/in-my-opinion/the-rise-of-energy-humanities/). Studies now classified as energy humanities: Yergin, *Prize*; Nye, *Consuming Power*; Freese, *Coal*; Engdahl, “Oil and the Origins of the Great War”; Mitchell, “Carbon Democracy”; Huber, “Use of Gasoline,” “Energizing Historical Materialism,” and *Lifeblood*; Smil, *Prime Movers of Globalization*; Malm, *Fossil Capital*; Wilson et al., eds., *Petrocultures*; Johnson, *Mineral Rites*.

65. Buell, “A Short History of Oil Cultures.” 273.

infrastructures that moved coal, oil, and natural gas.<sup>66</sup> These and other authors have a background in energy issues, yet this was not brought fully to bear in the current series. Doing so would further link the history of technology to the main threads of European history.

The energy transitions approach is essential to understand European history since 1850 “through the lens of technology,” because that is when the shift from biomass energy to a fossil fuel economy occurred. In 1850, more than 70 percent of Germany’s total energy use came from biomass, but by 1914, more than 80 percent came from fossil fuels, specifically coal. Per capita energy consumption in Germany increased nearly five-fold over the same period. Throughout the twentieth century, the proportion of German energy consumption derived from fossil fuels never fell below 80 percent. All continental European states made the transition to a predominantly fossil fuel economy after 1850, although not all with the same timeline or fuel. Only Britain made the transition prior to 1850.<sup>67</sup>

The energy transitions approach is also fundamental to understanding European history since 1850 because energy sources and technologies have a symbiotic, synergistic relationship: they shape paths of historical change together. Europe’s infrastructure transition occurred in tandem with the rise of a fossil fuel economy. The latter made it possible to burn vast amounts of biomass energy formed millions of years ago, either through prime movers or directly in industrial processes. This unparalleled expansion of power made it possible to produce the iron, steel, and copper needed to build infrastructure networks; to operate electricity networks powered by fossil fuels; to build and operate the trains, ships, trucks, and planes that moved people and products around the world; to supply the armies that fought imperial and world wars; and to run the industries and machinery producing the goods to be traded and consumed. Analyzing the shift to fossil fuels is essential to understand the insistent quest for infrastructures, the material possibility of creating them, and how they were used.

Researchers in the energy humanities have begun exploring the synergistic relationships between specific forms of energy, prime movers, infrastructures and the economics, politics, culture, and lifestyles associated with particular energy regimes. They are also investigating the relationships between energy transitions, environmental change, and sustainability issues. This work reminds us that the sustainability crises we face today are deeply rooted in the transition to fossil fuels in the nineteenth century. In 1850, the amount of coal used annually in Britain already provided the energy equivalent of burning forests covering twice the size of the entire country. By 1900, that figure had quadrupled.<sup>68</sup>

66. Høgselius, Kaijser, and Van der Vleuten, *Europe’s Infrastructure Transition*, 167.

67. Data from Harvard University and University of Cambridge, accessed October 28, 2020, <https://sites.fas.harvard.edu/~histecon/energyhistory/energydata.html>.

68. Mitchell, “Carbon Democracy,” 402, with data based on calculations by Sieferle, *The Subterranean Forest*, 102–4.

Europe's changing "energetic metabolism" shaped many facets of its history and development.<sup>69</sup> The energy perspective helps to explain how democratization and Europeanization within Europe were structurally linked to militant and exploitative patterns of imperialism and colonization.<sup>70</sup> It also deepens understanding of the two world wars, the origins of European integration (such as founding the European Coal and Steel Community), and the dynamics of European imperialism, colonialism, neo-colonialism, and European consumer society. Schot and Scranton state in *Making Europe* that "technology became a reference point for European superiority."<sup>71</sup> Yet after the 1850s, Europeans increasingly also saw fossil fuel energy as a currency of military and economic power within Europe and beyond, although they worried because it was not uniformly accessible. Sources were geographically concentrated, and would eventually be depleted, factors which created international tensions.<sup>72</sup> Politician, technocrat, and energy expert Jean Maroger, for example, saw Germany's rise to power after 1850 as a by-product of its shift to a coal economy, and he believed that a system for sharing this crucial resource was the essential prerequisite for European integration.<sup>73</sup>

REVIEW

ESSAY

The quantitative and qualitative methodologies of energy humanities and energy transitions research are valuable additions to the toolkit for doing contextual history of technology. They make it possible to identify and track energy transitions. They help uncover links between energy regimes and forms of culture, such as consumer culture and mobility culture. Energy mediates between human desires for freedom and abundance, technological choices, and sustainability. Energy perspectives reveal and clarify the trade-offs that always accompany technological choices, thereby tempering progress ideology. Of course, energy does not explain everything, but it is everywhere. It is a substructure beneath the infrastructures, undergirding all human activity, sitting at the intersections between nature, environment, technology, society, politics, economy, and culture. Energy humanities helps to unravel these interconnections and make sense of them, which is a necessary step toward writing technology more fully into history.

69. From Haberl, "The Energetic Metabolism of Societies," and Fischer-Kowalski, "Society's Metabolism."

70. Mitchell, "Carbon Democracy," 402.

71. Schot and Scranton, "Making Europe: An Introduction to the Series," x.

72. "Mr. Gladstone on the Reduction of the National Debt—Budget Speech, May 3," *Globe*, May 19, 1866, 1; Eastman, "La grosse industrie allemande et charbon"; Gales and Smits, "Delfstoffenwinning in Nederland," 19.

73. Jean Maroger, "Les grands problèmes de l'Europe unie: La mise en commun de ses ressources est une condition essentielle de la réussite," *Le Monde*, May 4, 1948.

## Bibliography

*Published Sources*

- Adas, Michael. *Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance*. Ithaca: Cornell University Press, 1989.
- JANUARY  
2021  
VOL. 62
- Albert de la Bruhèze, Adri A., and Ruth Oldenziel. *Manufacturing Technology, Manufacturing Consumers: The Making of Dutch Consumer Society*. Technology and European History Series. Amsterdam: Aksant, 2009.
- Allen, Francis R. "Technology and Social Change: Current Status and Outlook." *Technology and Culture* 1, no. 1 (1959): 48–59.
- Badenoch, Alexander, and Andreas Fickers. *Materializing Europe: Transnational Infrastructures and the Project of Europe*. Basingstoke: Palgrave Macmillan, 2010.
- Barbash, Jack. "Technology and Labor in the Twentieth Century." In *Technology in Western Civilization*, edited by Melvin Kranzberg and Carroll Pursell, 64–76. New York: Oxford University Press, 1967.
- Bayly, C. A., Sven Beckert, Matthew Connelly, Isabel Hofmeyr, Wendy Kozol, and Patricia Seed. "AHR Conversation: On Transnational History." *American Historical Review* 111, no. 5 (2006): 1441–64.
- Beck, Ulrich. "The Cosmopolitan Condition: Why Methodological Nationalism Fails." *Theory, Culture and Society* 24, nos. 7–8 (2007): 286–90.
- Beck, Ulrich. "Toward a New Critical Theory with a Cosmopolitan Intent." *Constellations* 10, no. 4 (2003): 453–68.
- Beck, Ulrich, and Natan Sznaider. "Unpacking Cosmopolitanism for the Social Sciences: A Research Agenda." *British Journal of Sociology* 57, no. 1 (2006): 1–23.
- Bijker, Wiebe E., Thomas Parke Hughes, and Trevor J. Pinch, eds. *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge, MA: MIT Press, 1990.
- Bloch, Marc. "Avènement et conquêtes du moulin à eau." *Annales d'histoire économique et sociale* 7, no. 36 (1935): 538–63.
- Buell, Frederick. "A Short History of Oil Cultures: Or, the Marriage of Catastrophe and Exuberance." *Journal of American Studies* 46, no. 2 (2012): 273–93.
- Callon, Michel, John Law, and Arie Rip, eds. *Mapping the Dynamics of Science and Technology: Sociology of Science in the Real World*. Basingstoke: Macmillan, 1986.
- Carneiro, Ana, Maria Paula Diogo, Ana Simões, and Manuel Troca. "Portuguese Engineering and the Colonial Project in the Nineteenth Century." *Icon* 6 (2000): 160–75.
- Ceruzzi, Paul E. "'A Large Canvas': Melvin Kranzberg and Carroll W. Pursell Jr., eds. *Technology in Western Civilization*." *Technology and Culture* 50, no. 3 (2009): 658–68.

- Chernilo, Daniel. "Social Theory's Methodological Nationalism: Myth and Reality." *European Journal of Social Theory* 9, no. 1 (2006): 5–22.
- Chilvers, Christopher. "Five Tourniquets and a Ship's Bell: The Special Session at the 1931 Congress." *Centaurus* 57, no. 2 (2015): 61–95.
- Clavin, Patricia. "Defining Transnationalism." *Contemporary European History* 14, no. 4 (2005): 421–39.
- Cottrell, Fred. *Energy and Society: The Relation between Energy, Social Change, and Economic Development*. New York: McGraw-Hill, 1955.
- Cowan, Ruth Schwartz. *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave*. New York: Basic Books, 1983.
- Daumas, Maurice, ed. *Histoire générale des techniques*. 5 vols. Paris: Presses Universitaires de France, 1962–78.
- Daumas, Maurice, ed. *A History of Technology and Invention: Progress through the Ages*. Translated by Eileen B. Hennessy. 3 vols. New York: Crown Publishers, 1969–79.
- Daumas, Maurice. "L'histoire des techniques: Son objet, ses limites, ses méthodes." *Revue d'histoire des sciences et de leurs applications* 22, no. 1 (1969): 5–32.
- Daumas, Maurice. "Technology: The Continental Approach. L'histoire des techniques." *Technology and Culture* 1, no. 4 (1960): 415–18.
- Dauids, Karel. "Historici, ingenieurs en techniek: Over de relatie tussen techniekgeschiedenis en algemene Geschiedenis." *BMGN—Low Countries Historical Review* 113, no. 2 (1998): 202–7.
- Dauids, Karel. "Keuzes en patronen in de techniekgeschiedenis van Nederland in de twintigste eeuw." *BMGN—Low Countries Historical Review* 120, no. 1 (2005): 51–59.
- Dienel, Hans-Liudger, and Helmuth Trischler, eds. *Geschichte der Zukunft des Verkehrs: Verkehrskonzepte von der frühen Neuzeit bis zum 21. Jahrhundert*. Frankfurt: Campus Verlag, 1997.
- Diogo, Maria Paula, and Dirk Van Laak. *Europeans Globalizing: Mapping, Exploiting, Exchanging*. Making Europe: Technology and Transformations, 1850–2000, edited by Johan Schot and Phil Scranton, vol. 6. New York: Palgrave Macmillan, 2018.
- Disco, Nil, and Eda Kranakis. *Cosmopolitan Commons: Sharing Resources and Risks across Borders*. Cambridge, MA: MIT Press, 2013.
- Eastman, Mack. "Mr Maurice Baumont, la grosse industrie allemande et charbon." *Annales d'histoire économique et sociale* 1, no. 4 (1929): 596–602.
- Engdahl, F. William. "Oil and the Origins of the Great War." *History Compass* 5, no. 6 (2007): 2041–60.
- Febvre, Lucien. "Réflexions sur l'histoire des techniques." *Annales d'histoire économique et sociale* 7, no. 36 (1935): 531–35.
- Fickers, Andreas. *Der Transistor als technisches und kulturelles Phänomen: Die Transistorisierung der Radio- und Fernsehempfänger in der Deut-*

REVIEW

ESSAY

- schen Rundfunkindustrie 1955 bis 1965*. Bassum: Verlag für Geschichte der Naturwissenschaften und der Technik, 1998.
- Fickers, Andreas. "Politique de la grandeur" versus "Made in Germany": *Politische Kulturgeschichte der Technik am Beispiel der PAL-SECAM-Kontroverse*. Pariser Historische Studien, vol. 78. Munich: R. Oldenbourg Verlag, 2007.
- Fickers, Andreas, and Pascal Griset. *Communicating Europe: Technologies, Information, Events*. Making Europe: Technology and Transformations, 1850–2000, edited by Johan Schot and Phil Scranton, vol. 5. New York: Palgrave Macmillan, 2018.
- Fischer, Claude S. *America Calling: A Social History of the Telephone to 1940*. Berkeley: University of California Press, 1992.
- Fischer-Kowalski, Marina. "Society's Metabolism: The Intellectual History of Materials Flow Analysis, Part I, 1860–1970." *Journal of Industrial Ecology* 2, no. 1 (1998): 61–78.
- Fouquet, Roger. *Heat, Power, and Light: Revolutions in Energy Services*. Cheltenham: Edward Elgar, 2008.
- Fouquet, Roger, and Peter J. G. Pearson. "A Thousand Years of Energy Use in the United Kingdom." *The Energy Journal* 19, no. 4 (1998): 1–41.
- Freese, Barbara. *Coal: A Human History*. New York: Basic Books, 2003.
- Gales, B. P. A., and J. P. Smits. "Delfstoffenwinning in Nederland gedurende de twintigste eeuw." In *Techniek in Nederland in de Twintigste Eeuw*, edited by Johan Schot, Harry Lintsen, Arie Rip, and Adri Albert de la Bruhèze, 2: 17–27. Zutphen: Walberg Pers, 1998–2003.
- Geyer, Michael, and Charles Bright. "World History in a Global Age." *American Historical Review* 100, no. 4 (1995): 1034–60.
- Gille, Bertrand. "Les techniques d'organisation de l'espace." In *Histoire générale des techniques*, edited by Maurice Daumas, 2: 103–24. Paris: Presses Universitaires de France, 1965.
- Griffiths, Richard. *Industrial Retardation in the Netherlands 1830–1850*. The Hague: Martinus Nijhoff, 1979.
- Griset, Pascal. *Entreprise, technologie et souveraineté: Les télécommunications transatlantiques de la France, XIX<sup>e</sup>-XX<sup>e</sup> siècles*. Paris: Rive Droite, 1996.
- Griset, Pascal. "L'Évolution des télécommunications intercontinentales au XXI<sup>ème</sup> siècle." *History and Technology* 8, nos. 3–4 (1992): 231–45.
- Griset, Pascal, and Daniel Headrick. "Submarine Telegraph Cables: Business and Politics, 1838–1939." *Business History Review* 75, no. 3 (2001): 543–78.
- Haberl, Helmut. "The Energetic Metabolism of Societies, Part I: Accounting Concepts." *Journal of Industrial Ecology* 5, no. 1 (2001): 11–33.
- Hall, A. Rupert. "'A History of Technology': Some Editorial Reflections." *Technology and Culture* 1, no. 4 (1960): 311–19.
- Hård, Mikael. "Beyond Harmony and Consensus: A Social Conflict Ap-

- proach to Technology.” *Science, Technology, & Human Values* 18, no. 4 (1993): 408–32.
- Hård, Mikael, and Andrew Jamison. “Alternative Cars: The Contrasting Stories of Steam and Diesel Automotive Engines.” *Technology in Society* 19, no. 2 (1997): 145–60.
- Hård, Mikael, and Andrew Jamison, eds. *The Intellectual Appropriation of Technology: Discourses on Modernity, 1900–1939*. Cambridge, MA: MIT Press, 1998.
- Headrick, Daniel R. *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850–1940*. New York: Oxford University Press, 1988.
- Headrick, Daniel R. *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century*. New York: Oxford University Press, 1981.
- Høgselius, Per, Arne Kaijser, and Erik van der Vleuten. *Europe’s Infrastructure Transition: Economy, War, Nature*. Making Europe: Technology and Transformations, 1850–2000, edited by Johan Schot and Phil Scranton, vol. 3. New York: Palgrave Macmillan, 2013.
- Homburg, Ernst. “Techniekgeschiedenis in Nederland (TIN): De (voor-)geschiedenis van een project.” *Gewina* 18 (1995): 287–95.
- Hornidge, Anna-Katharina. “‘Knowledge Society’ as Academic Concept and Stage of Development: A Conceptual and Historical Review.” In *Beyond the Knowledge Trap: Developing Asia’s Knowledge-Based Economies*, edited by T. Menkhoff, H. D. Evers, C. Y. Wah, and E. F. Pang, 87–129. Singapore: World Scientific Publications, 2011.
- Huber, Matthew T. “Energizing Historical Materialism: Fossil Fuels, Space and the Capitalist Mode of Production.” *Geoforum* 40, no. 1 (2009): 105–15.
- Huber, Matthew T. *Lifeblood: Oil, Freedom, and the Forces of Capital*. Minneapolis: University of Minnesota Press, 2013.
- Huber, Matthew T. “The Use of Gasoline: Value, Oil, and the ‘American Way of Life’.” *Antipode* 41, no. 3 (2009): 465–86.
- Hughes, Thomas Parke. *Networks of Power: Electrification in Western Society, 1880–1930*. Baltimore: Johns Hopkins University Press, 1983.
- Johnson, Bob. *Mineral Rites: An Archaeology of the Fossil Economy*. Baltimore: Johns Hopkins University Press, 2019.
- Kaijser, Arne. *I fädrens spår: Den svenska infrastrukturens historiska utveckling och framtida utmaningar*. Stockholm: Carlsson, 1994.
- Kaijser, Arne. “Trans-Border Integration of Electricity and Gas in the Nordic countries, 1915–1992.” *Polhem* 15 (1997): 4–43.
- Kaijser, Arne, and Marika Hedin, eds. *Nordic Energy Systems: Historical Perspectives and Current Issues*. Canton: Science History Publications, 1995.
- Kaiser, Wolfram, and Johan Schot. *Writing the Rules for Europe: Experts, Cartels and International Organizations*. Making Europe: Technology

REVIEW  
ESSAY

- and Transformations, 1850–2000, edited by Johan Schot and Phil Scranton, vol. 4. New York: Palgrave Macmillan, 2018.
- Kander, Astrid, Paolo Malanima, and Paul Warde. *Power to the People: Energy in Europe over the Last Five Centuries*. Princeton: Princeton University Press, 2013.
- JANUARY  
2021  
VOL. 62
- Kohlrausch, Martin, and Helmuth Trischler. *Building Europe on Expertise: Innovators, Organizers, Networkers. Making Europe: Technology and Transformations, 1850–2000*, edited by Johan Schot and Phil Scranton, vol. 2. New York: Palgrave Macmillan, 2018.
- Kranzberg, Melvin. “At the Start.” *Technology and Culture* 1, no. 1 (1959): 8–9.
- Kranzberg, Melvin, and Carroll W. Pursell, eds. *Technology in Western Civilization*. 2 vols. New York: Oxford University Press, 1967.
- Kranzberg, Melvin, and Charles Singer. “Charles Singer and ‘A History of Technology’.” *Technology and Culture* 1, no. 4 (1960): 299–302.
- Landes, David S. *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present*. Cambridge: University Press, 1969.
- Latour, Bruno. *Science in Action: How to Follow Scientists and Engineers through Society*. Cambridge, MA: Harvard University Press, 1987.
- “The Leonardo Da Vinci Medal.” *Technology and Culture* 7, no. 2 (1966): 206–8.
- Lintsen, Harry W., ed. *Geschiedenis van de techniek in Nederland: De wording van een moderne samenleving, 1800–1890*. 6 vols. Zutphen: Walberg Pers, 1992–1995.
- Lyth, Peter J., and Helmuth Trischler, eds. *Wiring Prometheus: Globalisation, History and Technology*. Aarhus Universitetsforlag, 2004.
- Malanima, Paolo. *Energy Consumption in Italy in the 19th and 20th Centuries: A Statistical Outline*. n.p.: Consiglio Nazionale delle Ricerche, Istituto di Studi sulle Società del Mediterraneo, 2006.
- Malm, Andreas. *Fossil Capital: The Rise of Steam-Power and the Roots of Global Warming*. London: Verso, 2016.
- McNeill, William Hardy. *The Pursuit of Power: Technology, Armed Force, and Society since A.D. 1000*. Chicago: University of Chicago Press, 1982.
- Misa, Thomas J., and Johan Schot. “Introduction: Inventing Europe: Technology and the Hidden Integration of Europe.” *History and Technology* 21, no. 1 (2005): 1–19.
- Mitchell, Timothy. “Carbon Democracy.” *Economy and Society* 38, no. 3 (2009): 399–432.
- Mitchell, Timothy. *Carbon Democracy: Political Power in the Age of Oil*. London: Verso, 2011.
- Mokyr, Joel. *Industrialization in the Low Countries, 1795–1850*. New Haven: Yale University Press, 1976.

- Mumford, Lewis. *Technics and Civilization*. New York: Harcourt, Brace, and Co., 1934.
- Noble, David F. *Forces of Production: A Social History of Industrial Automation*. New York: Knopf, 1984.
- Nye, David E. *Consuming Power: A Social History of American Energies*. Cambridge, MA: MIT Press, 1998.
- Nye, David E. *Electrifying America: Social Meanings of a New Technology, 1880–1940*. Cambridge, MA: MIT Press, 1992.
- O'Brien, Patrick. "The Mainsprings of Technological Progress in Western Europe, 1750–1850." In *Innovation and Technology in Europe from the Eighteenth Century to the Present Day*, edited by Peter Mathias and John A. Davis, 6–17. Oxford: Blackwell, 1991.
- Okonta, Ike, and Oronto Douglas. *Where Vultures Feast: Shell, Human Rights, and Oil in the Niger Delta*. London: Verso, 2003.
- Oldenziel, Ruth, and Karin Zachmann, eds. *Cold War Kitchen: Americanization, Technology, and European Users*. Cambridge, MA: MIT Press, 2009.
- Oldenziel, Ruth, and Mikael Hård. *Consumers, Tinkerers, Rebels: The People Who Shaped Europe. Making Europe: Technology and Transformations, 1850–2000*, edited by Johan Schot and Phil Scranton, vol. 1. New York: Palgrave Macmillan, 2013.
- Painter, David. "The Marshall Plan and Oil." *Cold War History* 9, no. 2 (2009): 159–75.
- Podobnik, Bruce. *Global Energy Shifts: Fostering Sustainability in a Turbulent Age*. Philadelphia: Temple University Press, 2006.
- Rüger, Jan. "OXO: Or, the Challenges of Transnational History." *European History Quarterly* 40, no. 4 (2010): 656–68.
- Saunier, Pierre-Yves. "Learning by Doing: Notes about the Making of the Palgrave Dictionary of Transnational History." *Journal of Modern European History* 6, no. 2 (2008): 159–80.
- Schot, Johan. "Confronting the Second Deep Transition through the Historical Imagination." *Technology and Culture* 57, no. 2 (2016): 445–56.
- Schot, Johan, and Arie Rip. "Techniek en de geschiedenis van Nederland in de twintigste eeuw." In *Techniek en Modernisering, Balans van de Twintigste Eeuw. Techniek in Nederland in de Twintigste Eeuw*, vol. 7, edited by Johan Schot, Arie Rip, and Harry Lintsen. Zutphen: Walberg Pers, 2003.
- Schot, Johan, Harry Lintsen, and Arie Rip, eds. *Technology and the Making of the Netherlands: The Age of Contested Modernization, 1890–1970*. Cambridge, MA: MIT Press, 2010.
- Schot, Johan, Harry Lintsen, and Arie Rip. "Techniek in ontwikkeling." In *Techniek in Ontwikkeling, Waterstaat, Kantoor en Informatietechnologie. Techniek in Nederland in de Twintigste Eeuw*, vol. 1, edited by Johan Schot, Arie Rip, and Harry Lintsen. Zutphen: Walberg Pers, 1998.

REVIEW

ESSAY

- Schot, Johan, Harry Lintsen, Arie Rip, and Adri Albert de la Bruhèze. "De betwiste modernisering van Nederland: Een introductie op de serie 'Techniek in Nederland in de twintigste eeuw'." *BMGN-Low Countries Historical Review* 120, no. 1 (2005): 48–50.
- Schot, Johan, Harry Lintsen, Arie Rip, and Adri Albert de la Bruhèze, eds. *Techniek in Nederland in de twintigste eeuw*. 7 vols. Zutphen: Walberg Pers, 1998–2003.
- Schot, Johan, and Phil Scranton, "Making Europe: An Introduction to the Series." In Ruth Oldenziel and Mikael Hård, *Consumers, Tinkerers, Rebels: The People Who Shaped Europe*, vols. 9–15. New York: Palgrave Macmillan, 2013.
- Schot, Johan, and Phil Scranton, eds. *Making Europe: Technology and Transformations, 1850–2000*. 6 vols. New York: Palgrave Macmillan, 2013–19.
- Schot, Johan, and Vincent Lagendijk, "Technocratic Internationalism in the Interwar Years: Building Europe on Motorways and Electricity Networks." *Journal of Modern European History* 6, no. 2 (2008): 196–217.
- Sieferle, Rolf Peter. *The Subterranean Forest Energy Systems and the Industrial Revolution*. Cambridge: The White Horse Press, 2001.
- Singer, Charles, E. J. Holmyard, A. R. Hall, and Trevor I. Williams. *A History of Technology*. 7 vols. New York and London: Oxford University Press, 1954–78.
- Smil, Vaclav. *Energy and Civilization: A History*. Cambridge, MA: MIT Press, 2017.
- Smil, Vaclav. *Energy in World History*. Boulder: Westview Press, 1994.
- Smil, Vaclav. *Energy Transitions: History, Requirements, Prospects*. Santa Barbara, CA: Praeger, 2010.
- Smil, Vaclav. *Prime Movers of Globalization: The History and Impact of Diesel Engines and Gas Turbines*. Cambridge, MA: MIT Press, 2010.
- Staudenmaier, John M. *Technology's Storytellers: Reweaving the Human Fabric*. Cambridge, MA: Society for the History of Technology and MIT Press, 1985.
- Staudenmaier, John M. "What SHOT Hath Wrought and What SHOT Hath Not: Reflections on Twenty-Five Years of the History of Technology." *Technology and Culture* 25, no. 4 (1984): 707–30.
- Szeman, Imre, Sheena Wilson, and Adam Carlson. *Petrocultures: Oil, Energy, and Culture*. Montreal: McGill-Queen's University Press, 2017.
- Trischler, Helmuth. "Die neue Räumlichkeit des Krieges: Wissenschaft und Technik im Ersten Weltkrieg." *Berichte zur Wissenschaftsgeschichte* 19, nos. 2–3 (1996): 95–103.
- Van der Vleuten, Erik. "De materiële eenwording van Nederland." In *Techniek en Modernisering, Balans van de Twintigste Eeuw. Techniek in Nederland in de Twintigste Eeuw*, vol. 7, edited by Johan Schot, Arie Rip, and Harry Lintsen. Zutphen: Walberg Pers, 2003.

- Van der Vleuten, Erik. "Toward a Transnational History of Technology: Meanings, Promises, Pitfalls." *Technology and Culture* 49, no. 4 (2008): 974–94.
- Van der Vleuten, Erik. "Networked Nation: Infrastructure Integration of the Netherlands." In *Technology and the Making of the Netherlands: The Age of Contested Modernization, 1890–1970*, edited by Schot, Lintsen, and Rip, 47–123. Cambridge, MA: MIT Press, 2010.
- Van der Vleuten, Erik, and Arne Kaijser. *Networking Europe: Transnational Infrastructures and the Shaping of Europe, 1850–2000*. Sagamore Beach: Science History Publications, 2006.
- Van Laak, Dirk. "Der Begriff 'Infrastruktur' und Was Er Vor Seiner Erfindung Besagte." *Archiv für Begriffsgeschichte* 41 (1999): 280–99.
- Van Laak, Dirk. *Imperiale Infrastruktur: Deutsche Planungen für eine Erschließung Afrikas 1880–1960*. Paderborn: Ferdinand Schöningh, 2004.
- Van Laak, Dirk. "Infra-strukturgeschichte." *Geschichte und Gesellschaft* 27, no. 3 (2001): 367–93.
- Van Laak, Dirk. *Weißer Elefant: Anspruch und Scheitern technischer Großprojekte im 20. Jahrhundert*. Stuttgart: Deutsche Verlags-Anstalt, 1999.
- Van Lente, Dick. "Technology in Dutch Society during the Nineteenth Century." *Tractrix* 2 (1990): 127–39.
- Van Lente, Dick, Harry W. Lintsen, Martijn Bakker, Ernst Homburg, Johan Schot, and Geert B. P. Verbong. "Techniek en Modernisering." In *Geschiedenis van de techniek in Nederland: De wording van een moderne samenleving, 1800–1890*, edited by Harry W. Lintsen, vol. 1. Zutphen: Walberg Pers, 1992.
- Van Royen, E., Dick van Lente, and Harry Lintsen. "Techniek en modernisering in negentiende-eeuws Nederland. Achtergronden en opzet van een mammoetproject." *Leidschrift: Historische Tijdschrift* 8, no. 3 (1992): 59–72.
- Warde, Paul. *Energy Consumption in England and Wales, 1560–2004*. Consiglio Nazionale delle Ricerche, Istituto di Studi sulle Società del Mediterraneo, 2007.
- Werner, Michael, and Bénédicte Zimmermann. "Beyond Comparison: Histoire Croisée and the Challenge of Reflexivity." *History and Theory* 45, no. 1 (2006): 30–50.
- White, Lynn. "Review of *Les origines de la civilisation technique*. Histoire générale des techniques. Tome I. Edited by Marcel Daumas." *Isis* 55, no. 2 (1964): 228–30.
- Wilson, G. B. L. "Domestic Appliances." In *A History of Technology*, edited by Trevor I. Williams, 7:1126–49. New York: Oxford University Press, 1978.
- Wilson, Sheena, Adam Carlson, and Imre Szeman, eds. *Petrocultures: Oil, Politics, Culture*. Montreal: McGill-Queen's University Press, 2017.

REVIEW

ESSAY

Winegard, Timothy C. *The First World Oil War*. Toronto: University of Toronto Press, 2016.

Wrigley, E. A. *Energy and the English Industrial Revolution*. Cambridge: Cambridge University Press, 2010.

Wrigley, E. A. "The Supply of Raw Materials in the Industrial Revolution." *The Economic History Review* 15, no. 1 (1962): 1–16.

JANUARY

2021

VOL. 62

Yergin, Daniel. *The Prize: The Epic Quest for Oil, Money, and Power*. New York: Simon & Schuster, 1991.