

Networking Europe

Erik van der Vleuten and Arne Kaijser

The paper explores processes of transnational network building in Europe in the 19th and 20th centuries. The first section reviews several relevant literatures. It concludes that historiographies of Europe often recognize the pivotal importance of transnational network building, but fail to analyse network developments as well as their entanglement with wider historical processes. Specialized infrastructure studies exist in economic and technological history, but have a distinct (sub)national focus. The networking of Europe has not been investigated. The second section presents a preliminary narrative of transnational network building in the 19th and 20th century. It highlights the relationship between network building and political events in different eras, as well as different types of ambiguities or tensions. The conclusion suggests a number of topics for further research.

Keywords: European History; European Integration; Infrastructures; Large Technical Systems; Network Society

Prologue

In 1986 two of the most colourful and strong-willed politicians in post-war Europe, Margaret Thatcher and François Mitterand, signed a bilateral treaty about the construction of a tunnel under the English Channel. In 1994 the 50-km long connection was formally inaugurated and train traffic under the Channel began. Britain was tied directly to Europe for the first time since the end of the last glaciation. John Neerhout Jr, chief executive of the project, proudly portrayed the tunnel in a prestigious Gould distinguished lecture on ‘Technology and the quality of life’ as ‘one of the great technological accomplishments and civilization milestones of this era’ that also stands as a ‘symbol of European unity.’¹ The European Commission (EC), the executive body of the European Union (EU), contends that the Channel Tunnel sends out ‘signals to the citizens of the European Union that European integration is progressing’ and illustrates how trans-European networks constitute ‘a key instrument for

Erik van der Vleuten is Assistant Professor at the Department for History, Philosophy and Technology Studies (HPTS), Technische Universiteit Eindhoven, The Netherlands. Email: e.b.a.v.d.vleuten@tm.tue.nl. Arne Kaijser is Professor of History of Technology at the Royal Institute of Technology in Stockholm, Sweden. Email: arnek@kth.se

economic, social and territorial cohesion.² The EU's obligation to promote trans-European networks for these purposes is formulated in the EU's founding document, the Maastricht Treaty (1992).³

However, from a European point of view, there are other, less triumphant sides to the Channel Tunnel story. Neerhout reminds us that the tunnel had 'one of the longest gestation periods in history.' Reformulated, the Channel tunnel was a failure, a missing link or 'non-link' in Europe for more than a century. To contemporaries the non-link between the world's leading commercial powers, only 30 kilometres apart but practically separated by sea, seemed an anachronism in the progress of civilization. Opposition to integration blocked a number of initiatives. The first tunnel proposal dates from 1750, and joint Anglo-French preparations in the early 1800s fell victim to the Napoleonic wars. In the early 1880s drilling had started on both sides of the Channel when flooding problems and British military protests halted the project. General Wolseley expressed the military concern: 'no matter what fortifications and defences ... there would always be the peril of some Continental enemy seizing the tunnel exit by surprise, and all the commercial advantage ... could not outweigh such a risk.'⁴ A more recent attempt in the mid 1970s was opposed not by the military but by British trade unions, arguing that the project primarily benefited the well to do. Labour Prime Minister Harold Wilson needed unions for a new economic policy and sacrificed the tunnel project.

When the missing link in the European transport network was finally built a decade later, the stakes were not primarily 'European.' Both Thatcher and Mitterand used the tunnel project to reverse economic decline that marked England and North-western France in the mid 1980s. Still today it is unclear what its European character entails. While the EC appropriates it to legitimize a policy of promoting trans-European networks for transport, energy, and telecommunications, Eurosceptics rather disconnect the tunnel from the emerging EU: 'if one were to judge by the Commission's report ... cross-border transport and free movement of goods in Europe could not exist without the EU. Needless to say, governments are capable of freely cooperating ... without needing to surrender their powers to an unelected, supranational authority.'⁵

To guarantee free flows of people and goods, the governments involved have a legal obligation to keep the tunnel open. However, the new link also created a new vulnerability. French mass transit workers on strike blocked the tunnel in 1995. So did French dockers in 1998, protesting against job losses following abolishment of duty-free sales. Two years later anti-riot police were in place when French farmers tried to block the tunnel, but blocking the Paris-Calais motorway proved just as effective.

In addition, the tunnel produced some unexpected flows. In March 2001 nine Romanian gipsies, including a 3-year old girl and two pregnant women, risked their lives hiding under a Eurostar train freight compartment. In February that year, an Iraqi refugee died and another broke both legs after jumping 20 feet from a bridge onto a moving train heading for Britain. Between November 2001 and November 2002 no less than 1733 asylum seekers were taken off trains at the British side. British government and EC pressures on France and the Eurotunnel company resulted in double skin fences, over a hundred guards, heartbeat-monitoring equipment inside the tunnel and

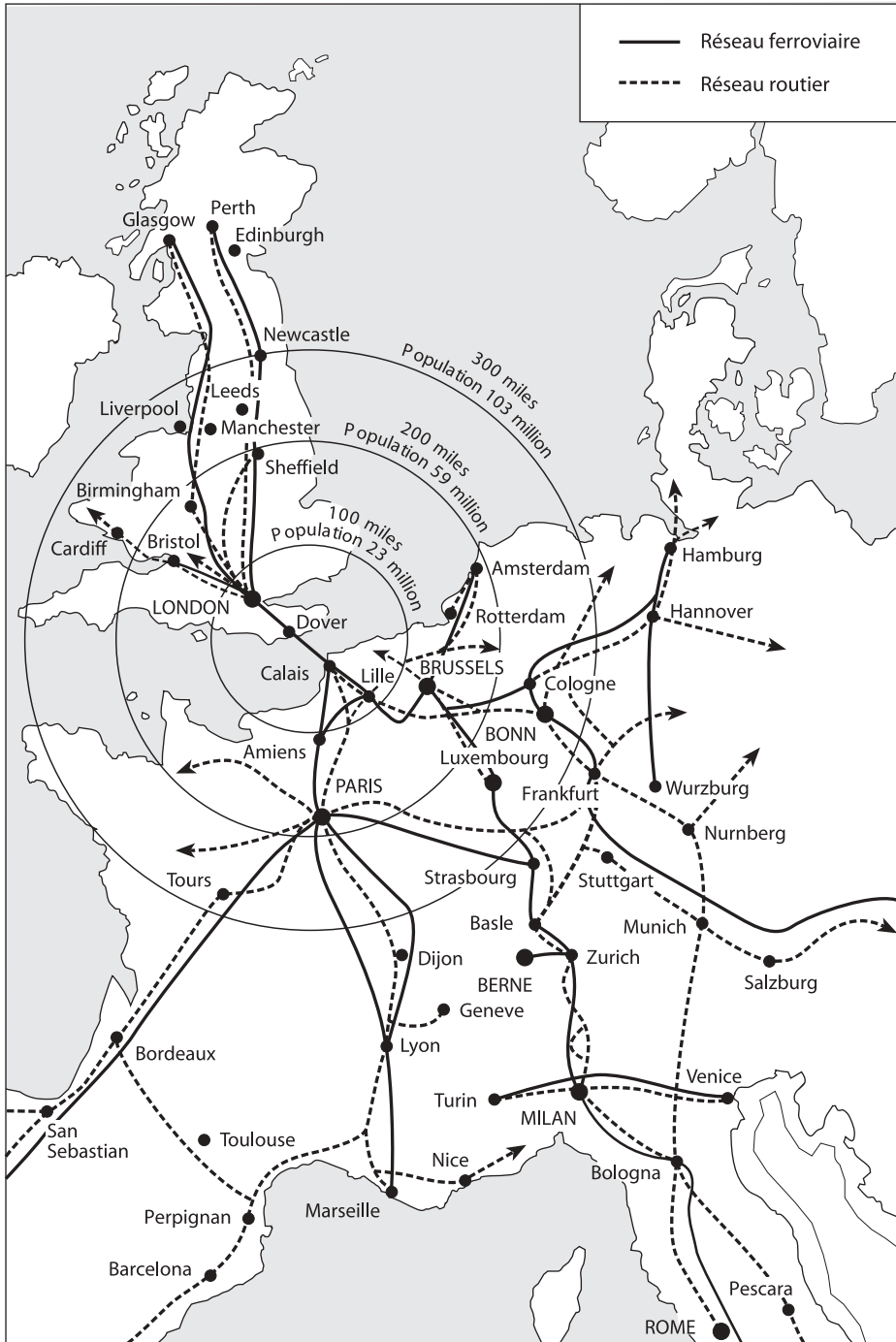


Figure 1 The Channel Tunnel between France and Great Britain portrayed as a central node in Europe's rail and road networks. The European Commission prefers to see the Channel Tunnel as an element of progressive European integration, while Eurosceptics see it as a bilateral project.

Source: Redrawn from G. van Iterson. 'Internationale conferentie over de Kanaaltunnel,' *De Ingenieur* 101, no. 12 (1989): 31-34.

the closing of a Red Cross asylum camp on the French side. Notably, the EC interpreted the French failure to stop refugee flows as a breach in European rules concerning the free movement of goods, as it led to the slowdown and cancelling of freight services.⁶ In the name of Europe some kinds of trans-border flows are supported at high cost, while others are vigorously prevented.

Introduction

The story of the Channel Tunnel illustrates two important observations. First, transnational linkages and networks have been priorities for policymakers for centuries. Ever since the Enlightenment politicians, philosophers and engineers have broadly discussed the potential of linking people and societies across natural or political borders by means of network technologies.⁷ Leading politicians in the Ottoman and Soviet empires, the Third Reich, as well as individual nation states actively used network technologies to build and strengthen their economies and societies. Preceding the EU, political bodies such as the League of Nations and the United Nations Economic Committee for Europe (UNECE) stressed the role of transnational network building for creating a peaceful and prosperous Europe. It is due time, then, to include network technologies in the historical narratives of the shaping of Europe. Within the research programme *Tensions of Europe: Technology and the Making of Europe*, one of the research teams called ‘Networking Europe’ has been investigating the forging of transnational linkages in the 19th and 20th centuries. This article reports its preliminary findings.

Second, the tunnel example reveals multiple tensions. It suggests that network building could be highly contested and that political negotiations can fail—the tunnel was a non-link for more than two centuries. There were alternatives, such as improving ferry services or building a bridge. When the tunnel was finally constructed it involved skilful political manoeuvring and multiple agendas of the EC as well as national and regional/local players. After its completion, there have been tensions regarding the flows through the tunnel and the very interpretation of the tunnel as a ‘European’ or bilateral project. The ideology of free movement of goods, people, and information contrasts with a policy of enabling some flows while preventing others. The Channel Tunnel also proves that transnational connections were created before the EU started pushing for such links in the early 1990s.

These tensions are not surprising. Historians of technology have amply demonstrated that sociotechnical change is not a straightforward, rational process, but a messy, negotiated, and often contested process that is affected by many contextual factors. It is indeed ‘full of contradictions, laden with human folly, saved by occasional benign deeds, and rich with unintended consequences,’ as Thomas P. Hughes formulates it. Others speak of ‘ambiguities’ or ‘tensions.’⁸ To be sensitive to such tensions is the historian of technology’s trade; they should be included in any narrative on the networking of Europe.

This article contains three parts. First, we search for points of departure in the existing literature on network technology developments in Europe in the 19th and 20th centuries. Second, we will suggest a preliminary narrative of the networking of Europe,

situating the case studies conducted in the *Networking Europe* project in a broader context. We shall take particular notice of dominant tendencies as well as types of tensions within those tendencies. Third, we shall propose directions for further research.

Delineations

The work is narrowed down in several ways. First, we focus upon *transnational* linking and delinking processes, that is, network building in Europe that interconnect states or have a supranational meaning. Having worked earlier with the development of network technologies or Large Technical Systems (LTS) on a national level (including cross-national comparisons) we perceived the study of transnational networks—so important to politicians—as a ‘white spot’ in our discipline. We know of only one other programme that seriously tried to place the history of transnational networks on the research agenda. It was set up by economic historians, produced conference proceedings, and concluded that the subject is of eminent importance yet largely forgotten. Much more research is needed.⁹

Second, we define transnational *network technologies* as geographically expanded, materially integrated structures that cross national boundaries. They include transport, energy, and communication systems. As historians of technology know, it can be profitable to study such networks as LTS, that is, as systems of interrelated components of technical and non-technical nature including elements that are often labelled as organizational, institutional, managerial, legal, etc., manipulated and juxtaposed by privileged actors called system (or network) builders.¹⁰ Some ‘LTS’ historians even define their research subject in sociotechnical terms, but there is no consensus on doing so. We see approaches fostered in the LTS field of research as privileged entries into the study of network technologies.¹¹

Third, we assume that the complex shaping of European societies was recorded in material infrastructures, which, because of their obduracy and life span, continued to structure European society building with all its contradictions. ‘Networking Europe’ thus refers to a simultaneous transnational network and society building in Europe. However, while the current state of research allows us to profitably investigate such interactions for nation states,¹² it is too early to address this interaction to a satisfactory degree for the European case. Presently we focus upon processes of transnational network building and their context of major political developments.

Finally, the term ‘Europe’ itself is unstable and contested. It has different meanings for different historical and present actors in different nations and academic disciplines. Even the facts of geography do not offer a way out. The choice of delineating natural borders may be unclear (particularly to the East) and politically conditioned,¹³ and besides, network technologies may be designed exactly to penetrate and overcome such borders. Moreover, economic geographers may see yet a different Europe—equated with Western Europe, or including parts of Russia east of the Urals, while excluding scarcely populated zones in northern Scandinavia.¹⁴ We shall employ the concept of Europe in a flexible and practical manner. In the literature review we

include publications that explicitly address ‘Europe.’ In the narrative presented afterwards, we follow the networks described by historical actors as well as researchers participating in the Networking Europe project.

Europe and Infrastructures: A Review

Our topic, transnational infrastructure building in relation to transnational society building in Europe in the 19th and 20th centuries, led us to search the existing literature in two main directions. We searched the historiography of Europe for references to transnational infrastructure building. In addition, we searched for infrastructure studies in specialized fields of enquiry, most prominently economic and technological history. The sheer amount of literature warrants a disclaimer. Even publications on infrastructure history, the field in which we both worked for a number of years, are too numerous for a complete review. No surprise, the amount of publications (and languages) addressing the 20th century history of Europe forces us to give up any illusion of a representative review. Our observations are based upon selected readings, but we have tried to include canonical publications in different fields.

Historiographies of Europe

According to a recent review, the historiography of Europe has at least three overall forms.¹⁵ A first form, dominant particularly before the First World War but still encountered today, portrays the history of Europe as the history of European nation states, and is of less importance to this review. A second form termed ‘European History’ conceives of Europe as something more than the sum of European states, but remains difficult to define. For A. J. P. Taylor ‘European History is whatever the historian wants it to be’ as long as it relates to the area ‘we call Europe,’ the extent of which is, however, unclear. Norman Davies concludes ‘it is the same with European history as with a camel. The practical approach is not to try and define it, but to describe it.’¹⁶

Compared to the prominence and social implications of transnational infrastructures for politicians and citizens throughout Europe, European history handbooks and journals pay little attention to the development of transnational infrastructures. Online indexes of the *European History Quarterly* (Sage, 1970–), *Contemporary European History* (Cambridge University Press, 1991–) and the *European Review of History* (Routledge, 1994–) reveal hardly any articles on infrastructures, although some deal with technology. Incidentally, the majority of articles address nation states within Europe rather than transnational issues.

European history handbooks at least note the importance of infrastructure changes for the history of Europe. Davies’ above-mentioned monumental history of Europe (1996) is illustrative of defying a monodisciplinary approach and addressing politics, cultural movements, and socio-economic trends. Among the latter the paramount importance of network technologies like roads, railroads, electric power, and communication systems is repeatedly noted. Inland communications were crucial to the industrial revolution, while locomotives, gasworks, and dynamos were symbols of expanding

European power in the 19th century. Post-war North Sea oil and gas discoveries reduced dependence on foreign imports, while high-speed trains, autobahns, Alpine and Channel tunnels, and large bridges closed ‘missing links in a unified network.’ Yet, in contrast with their asserted importance, these events receive only a few paragraphs in a work of more than 1,300 pages. Main inventions and dates are mentioned, but there is no analysis.¹⁷

The same applies to other books in this genre such as Eugen Weber’s modern history of Europe (1971). In a later book, *Peasants into Frenchmen* (1976) Weber described the pivotal role of roads in French nation building. In his European history handbook Weber suggests a similar thesis: ‘the transport revolution played a major part not only in the economic but in the political history of Europe,’ affecting the standardization of time and the demise of regional cultures and local markets. However, this intriguing observation is not backed by analysis, and a beautiful map of expanding European railroads is used only for illustration.¹⁸ There are exceptions, of course; in his *magnum opus* on Europe around 1900, the Dutch champion of ‘integral historiography’ Jan Romein narrated the geopolitical turmoil following German expansionism through the lens of the Berlin–Baghdad railway and telegraph projects.¹⁹ Still, the narratives generally do not systematically include (transnational) infrastructure building.

A third form, European integration history, devotes scant attention to transnational networks. Again, there is not consensus upon the definition of the field, although the main subject seems to be the EU and its predecessors.²⁰ The *Journal of European Integration History* (Nomos, 1995–) publishes studies on ‘all aspects of European integration,’ although political institutions and cultural issues, such as identity formation, dominate. Furthermore, books addressing cultural integration may not refer to network technologies at all.²¹ Canonical works on European institution building always mention politicians’ interests in transnational network building, but rarely expand on the topic in any detail.²² In some cases, they may explicitly note the importance of networks but exclude them from their domain of study. Richard Griffiths, editor of a number of books on European integration, finds ‘solid grounds for pointing out that “integration” is not a set of treaties or organisational frameworks but the degree to which politics, economies and societies of nation states were enmeshed, or integrated, at a more fundamental level.’²³ Griffiths mentions transport infrastructures as an example, but they remain excluded from the narrative.

A fourth field worth noting here may be called globalization studies, which are multidisciplinary in scope. Again, the importance of infrastructures is often stated but seldom investigated. Immanuel Wallerstein’s famous work on the expanding ‘world system’ (1974–1989), that is, an expanding *European* system, observes that the size of the world economy is primarily a function of transport and communications.²⁴ Yet he takes infrastructural change largely for granted and does not analyse it. The pivotal role of network technologies shaping transnational societies is clear in the work of Manuel Castells, who coined the term ‘Network Society’ to stress that ICT networks and the global restructuring of production, work, financing, and crime went hand in hand.²⁵ But again, the development and role of infrastructures in these processes is only briefly sketched. Calling for explicit emphasis on the spatial dimension of globalization, the

work of David Held *et al.* seems more promising.²⁶ The work includes infrastructures as one of four dimensions to map the organizational profile of globalization, yet infrastructural technologies still seem to fall from the skies; their development and entanglement with social processes is not analysed. Finally, the *Journal of World History* (University of Hawaii Press, 1990–) includes issues as cross-cultural technology transfer and world trade, but so far does not address network technology developments.

However, we should mention two notable exceptions. The geographer Peter Hugill has devoted two books (1993, 1999) to describing the infrastructural logic of the progress of capitalism and the changing world system in the last 500 years. We also want to highlight the Belgian sociologist Mattelart (1994, 1996, 2000), who traced an idea–history of what we would call the co-construction of societies and infrastructures, from nascent ideas of political economy in the late 17th century, via the network ideologies of Saint Simonians in the 19th century, to current debates on globalization and infrastructures.

Economic and Technological History

The development of infrastructures merits more investigation in economic history and, of course, in the history of technology. Both fields inspired initiatives to study transnational networks in the 1990s (see below). In this section we shall discuss the scholarship dealing with network technologies prior to those projects.

To start with, handbooks on the economic history of Europe normally recognize the importance of network technologies. ‘Of all the industries developed by Europeans in the century before 1914, none had a more dramatic, yet lasting effect on the growth of a world economy than European improvements in transport and communications,’ notes the *Fontana Economic History of Europe*. However, ‘information on land transport has to be sought in the histories of individual countries.’²⁷ Indeed economic histories of Europe resemble the first type of historiography of Europe mentioned above—a historiography of European nations. They typically offer a chapter on transport infrastructures, mention major inventions (steel steamships, locomotives) in leading countries (Great Britain in particular), and systematically juxtapose transport network developments by country.²⁸ We learn little about transnational connections and disconnections, although accompanying maps may in fact illustrate the development of pan-European networks. The majestic *Cambridge Economic History of Europe*, published in eight volumes (1963–1978), contains a large chapter on transport with a section on ‘the era of transcontinentals.’ This section, however, is disappointing—it notes the ‘piercing of the Alps’ by railways in half a page and devotes more attention to the American transcontinentals and the Trans-Siberian railway (1891–1903).²⁹

Closely tied to economic history is the field of transport history. Ville (1990) distinguishes between an ‘antiquarian’ school, producing numerous case studies, and an ‘econometric’ school.³⁰ Mergér *et al.* (1995) provide a brief historiographical survey of the latter.³¹ After the Second World War, development economists posited strategic investment in infrastructures as a pathway to economic growth. Their writings ignited a long debate with quantitative studies on social savings, social returns on investment,

forward and backward linkages of infrastructural developments, and so on. According to Mergér *et al.* this 'first cliometric wave' of network studies had several biases. It focused nearly exclusively on railways (and occasionally on ocean and inland navigation) at the expense of other networks, and was concerned with investment effects without developing an understanding of network development. Moreover, measuring contributions to nation states' GDP it normally chose a national framework of analysis. A list of obstacles to transnational analysis includes perceptions of networks as tools for nation building, national sources and languages, the predominance of national funding, and the lack of historiographies of international organisations involved in transnational linking.

The latter point may be partly true; some international actors deliberately downplayed their role because—as for instance the first UNECE Executive Secretary, Gunnar Myrdal, argued—they did 'practical and effective' work in a time when working for East–West linkages was considered 'almost subversive'.³² Still, there are a few publications on international network building organizations, but these have so far not been picked up by economic (and technological) historians.³³

A third approach to (mainly transport-) networks emerged in the 1990s and took the perspective of institutional economics. Underlining that the expanding economies in Europe and the USA are 'hard to imagine without ... transport and communications' and that 'transport history in a wide sense is cardinal in economic history research,' their studies on regulation and governance still seem to privilege the national framework of analysis and railway networks.³⁴

All these approaches privilege the national framework of analysis. This applies also to a few monographs on the economic history of transport in Europe that have appeared in the 1990s,³⁵ and is confirmed by recent reviews on the historiography of specific networks.³⁶ Furthermore, looking back at 50 years of the *Journal of Transport History* (1953–), which developed from British transport history and by and large followed the trends in economic history, Mom observes a similar predominance of the (sub)national framework of analysis dominated by British cases. Only recently did the journal express its aim to embrace a wider array of approaches and topics that originated and developed in another field, the history of technology.³⁷

There are no handbooks on European technological history—the existing handbooks either deal with 'Western' or global technological history, but network technologies have attracted plenty of attention in the history of technology. Still, in the early 1980s Thomas P. Hughes and others criticised the history of technology for a focus upon artefacts (the machine, the light bulb, the car, the locomotive, the telephone, the computer) at the expense of the larger 'systems' of which these are part.³⁸ Indeed, the sections on network technologies in standard reference works centre around the invention and improvements of vehicles, locomotives, rail building, signalling equipment, power generators, etc. rather than network development.³⁹ The so-called 'large technical systems' research field was set up with systems, not artefacts, as its unit of analysis; their societal importance and sociotechnical character warrant specialised academic scrutiny.⁴⁰ Although the LTS field is not institutionalized as much as some imagine, it inspired a large and still growing number of studies on network technologies, and

became the most important reference point for network studies within the history of technology.⁴¹

Methodologically, this and related fields (sometimes jointly referred to as sociohistorical technology studies) developed a vocabulary aiming at analysing the simultaneous shaping of network technologies and societies in their complexities; it avoids universalistic categories as ‘technology’ and ‘society’ that may obscure how many actors, ideas, negotiations and conflicts helped shape sociotechnical systems. LTS studies, notes the economic historian Louis Galambos, ‘humanized’ infrastructure studies as carried out in economic history.⁴² As noted above, we maintain such a sensitivity for network technologies’ societal importance as well as their ambiguous and contested character in the narrative of 20th century Europe.

However, with regard to their geographical focus, the main body of LTS literature suffers from a similar (sub)national bias as economic history studies on network technologies.⁴³ Rich countries such as the USA, Britain, France, Germany, the Netherlands, and the Nordic countries are clearly over-represented. Although there are a number of cross-national comparisons,⁴⁴ the study of transnational infrastructures in Europe is largely unexplored. Inspired by recent political developments in Nordic and European integration, a few recent articles may help open up the issue.⁴⁵

New Points of Departure

Acknowledging the limited scope of this survey, we conclude that historiographies of Europe often state the importance of network technologies but fail to analyse their shaping or entanglement with broader historical developments. Specialized infrastructure studies within economic and technological history suffer from a (sub)national bias.⁴⁶ There is a gap to fill: it is high time that *transnational* network building is integrated into narratives of the shaping of economies, spaces, and societies in 20th century Europe. We will come back to this issue in the final section where we suggest directions for further research. Here we want to shortly present three initiatives set up in the 1990s aiming to address this gap and place transnational network building in 19th and 20th century Europe on the research agendas of economic and technological historians.

The International Economic History Association’s 10th International Congress (1990) dealt prominently with national network technologies.⁴⁷ In the next congress (1994) a research group explored the history of transnational networks in Europe. Conference proceedings, edited by Merger, Carreras, and Giuntini, were published (mainly in French) in 1994 and 1995 and include interesting case studies and a few general observations.⁴⁸ For instance, researchers observed that network building followed the political context as well as technical constraints (including technical standards). Yet there was no attempt to develop a coherent narrative and, according to at least one commentator, there was a lack of sensitivity to tensions.⁴⁹

More recently some of these economic historians were involved in the European research programme COST 340 ‘Towards a European Intermodal Transport Network: Lessons from History’ (2000–2004). It aims to study the two major factors in the

integration of transport networks within Europe: trans European connections and intermodal transportation.⁵⁰ The programme addresses only transport networks, and judging from the available proceedings, the main focus is on multimodality rather than transnational linking—although again there are interesting case studies on transnational links.⁵¹ Remarkably, a (most valuable) bibliographic publication juxtaposing national bibliographies seems to reinforce the national approach to transport history.⁵²

Finally, since 1999 historians of technologies have explored possibilities to write a European history of technology, of which this special issue bears witness. The programme ‘Tensions of Europe’ focuses on transnational linkages and circulation.⁵³ Its ‘Networking Europe’ sub-theme explored the development of transnational infrastructures, and its participants contributed various case studies exposing ambiguities in transnational network building. In the next section we shall draw on these and other case studies to develop a preliminary narrative of transnational network building in 19th and 20th century Europe.

Narrative: Europe’s Network Builders

In the history of network technologies, the 19th and 20th centuries are characterized by enormous expansion. Around 1800 road and water transport still constituted the main arteries for trans-border exchanges of people, goods, energy, and information. Communication and energy supply had not yet separated from transport (except for optical telegraphy, used largely in wartime situations). In the 19th and 20th centuries, however, networks not only expanded greatly in scale and density but also multiplied: entirely new networks were built and they reached continental or even global dimensions. These included new transport networks (railroads, air transport, automobile-only roads) as well as new separate networks for communications (telegraphy, telephony, radio, television) and energy supply (electricity, gas networks).⁵⁴

We shall construct our narrative primarily with reference to those network technologies in focus in contemporary society: railways and electromagnetic telecommunications in the 19th century, and electricity and automobility in much of the 20th. They had charged symbolic value during the periods under investigation something like ICT networks have today. Also, we shall pay special attention to privileged actors that were centrally positioned in transnational network building: Europe’s system- or network builders. This allows us to describe transnational network building as a human process rather than a necessity feature of progressive European integration or technical development, foregrounding how networks were conceived, built, negotiated, and contested. Moreover, these actors often related to broader societal questions (the Nazis used *Grossraumtechnik* to construct their *Neuropa*, the EU sees *Trans European Networks* as tools for economic and social cohesion). Therefore this approach allows us to explore relations between transnational network and society building in 20th century Europe. Notably, we do not argue that these network builders were solely responsible for top-down building transnational networks. Rather, to study these actors is a methodological move to access the complex game of transnational network and society building.

States and 19th Century Transnational Network Building

By the turn of the 20th century two infrastructures unknown by 1800 had reached continental and global dimensions. Railroads and electric telegraph networks captured the imaginations of contemporaries. They stood out as symbols of modernity and progress. Simultaneously, contemporaries might be highly disturbed by the ‘annihilation of time and space.’⁵⁵ Moreover, these network technologies were hailed as tools to integrate societies in the service of progress and world peace. ‘Railways have more relation to the religious spirit than we think. Never has there existed an instrument of such power to link together scattered peoples,’ concluded Michel Chevalier in the 1830s, the Saint-Simonian and future French Senator.⁵⁶ As vehicle of hope, railways had replaced waterways. Saint Simon himself—on the occasion of the Vienna congress (1814)—had seen the linking up of Europe by artificial waterways as a task of his envisioned ‘European Parliament’, a new institution that should put an end to war as Europe’s ‘normal condition’.⁵⁷

This European parliament did not materialize. Instead, 19th century transnational network building was often carried out by states or private companies allied with states. Also new international organizations like the International Telegraph Union (ITU, founded 1865) contributed to shaping international systems. Perhaps they even foreshadowed post-Second World War European cooperation initiatives.⁵⁸ Their role has to be further investigated, but judging from the studies available so far it seems that states became the primary network builders. International organizations like the ITU seem responses to coordination problems that emerged subsequently.

From the existing literature we know about the British endeavours to construct global shipping and telegraphy networks, and how other powerful states like the USA, France, and Germany engaged in network building to challenge British economic and military hegemony. Next to shipping and telegraph lines, railways played an increasing role, as the Baghdad and Siberian railway projects indicate.⁵⁹ States moulded domestic as well as international relations through network building.

Less well known is that small states, too, engaged in the game of trans-border infrastructure building as the material and political maps of Europe were redrawn. In northern Europe, Denmark became a node in international telegraphy as the Great Nordic Telegraph Company’s wires connected Britain, Scandinavia, and Russia, China and Japan independent of British cables. On the Iberian peninsula, Spain and Portugal were negotiating a position in the British-dominated telegraph network. At the Channel coast, the Belgian and Dutch states competed for trade flows by connecting their main ports (Antwerp and Amsterdam) by rail to Germany’s industrial Ruhr area in the 1840s. A few decades later, the Austrian, Swiss and French governments initiated infrastructural works to attract north–south traffic through the Alps, while Italy and Greece started competing for Suez canal traffic.⁶⁰

In the Networking Europe programme, we have analysed several of these cases.⁶¹ Angel Calvo and Ana Paula Da Silva examine Spanish and Portuguese involvements with British telegraph cable building.⁶² For instance, British telegraph companies were interested in a southern transatlantic route involving the Spanish Canary Islands and

Cuba. In the end negotiations failed as the Overseas Ministry in Madrid refused to allow a cable from Cuba to the US coast. Some decades later the same ministry tried hard to get a telegraphic connection directly with Cuba. However, the outbreak of the Cuban revolt and the 1898 war with the USA meant that Spain lost Cuba as a colony.

The Portuguese government, by contrast, successfully negotiated cooperation with Great Britain, perceived as a great strategic ally. The Portuguese aimed for a win-win scenario: British transatlantic telegraph companies could use Lisbon, the Azores, and Cape Verde as relay stations. Simultaneously, the Portuguese government would achieve communication links with its colonies, for which it lacked financial and technical resources of its own. However, the political relations were rather unequal; Portugal felt increasingly squeezed in subsequent negotiations on ownership, terms, and profits of cable use, but could not change its marginal position. The 'hosts' felt they had become 'hostage' of the British.

Likewise, Tympas and Anastasiadou and Schueler reveal several ambiguities in railway building.⁶³ In south-eastern Europe, Greek engineers and politicians foresaw Athens as a gateway to Europe after the Suez canal opened in 1869.⁶⁴ One tension relates to disagreement about the *routing*. An east-west line connecting Athens to the western Greek coast and by a short maritime passage to Italy was discussed since 1869. This line, later named the 'Iron Egnatia Road' (after the old Roman road connecting Greece to Rome), was never constructed. The development of steam shipping rendered the time gains of rail transport via Greece obsolete—ships would head for northern Italy directly. The other route ran from Athens to the northern border, where it would connect to the railroads of the Ottoman Empire.

The latter connection was built but ran into the tensions of politics. Negotiations on interconnection with the Ottomans failed. Only after a new Balkan War (1912–1913), the First World War, disintegration of the Ottoman Empire, and the Greek annexation of Thrace and Macedonia, was the south-north line connected to the lines inherited from the Ottomans and thus to Europe, via Serbia and Bulgaria.

A third tension concerned the perceived economic role of the railway network. For some Greeks, economic development would follow from the integration of as much Greek territory as possible by means of cheap, narrow gauge (meter-wide) rail lines. Others saw Greek economic growth dependent on connection to the European economy and railroad network and preferred a European standard gauge (1.44 m). The result was a hybrid network, combining a broad gauge south-north connection with narrow gauge secondary lines. Notably, their incompatibility would increase further as the south-north artery was updated to handle faster and heavier transport demands.

Analysing one of the most famous passages through the Alps, the Gotthard tunnel (opened in 1882), Judith Schueler adds a new set of tensions to the research domain. She emphasizes the multiple meanings of this vital node. The St. Gotthard became a vital transport junction connecting the countries of northern Europe to southern Europe, particularly the trade centres in northern Italy, with heavy involvement (and financing) of the German and Italian states. Simultaneously, Swiss politicians backed the tunnel because it attracted rail traffic in competition with the Mont Cenis tunnel between France and Italy and the Semmering railways in Austria. The tunnel was also

a hallmark of heroic engineering and dangerous work (199 labourers died during construction), a central point in collective Swiss identity, a crucial junction in the Swiss military defence system, and even a tourist site valuable to the local economy of the region.

These and other cases suggest that, already before 1900, Europe was increasingly linked up in telegraph and railroad networks. Geographical bottlenecks, like oceans and mountain ranges, were overcome. The context, however, was one of *nation states* supporting and negotiating transnational network building for their own benefit. While Europe was increasingly integrated, it was a game of winners and losers, of successful and failed projects, of cooperation, negotiations, and conflicts. In the end, some areas were much better integrated than others; some became political and economic centres, others remained on the periphery. These trans-European networks and related power structures remain to be systematically charted.

The Era of Electricity, Automobility, and European Dreams

States, large and small, are still key actors in building transnational networks today. However, new players and visions entered the field in the first half of the 20th century. The First World War triggered political visions of a United Europe, and again new and exciting network technologies were seen as possible carriers of this process. Electric power networks promising universal and abundant power supply, based on hydro-power and later nuclear power, and universal (auto)mobility became the new symbols of hope and progress. By the 1930s, ideas of a technological unification of Europe were gaining momentum. There was a wave of trans-continental power supply plans that would tie European nations together in pan-continental electricity networks fed by the hydropower sources of Norway, Switzerland and Austria, or dams to be built in the Straits of Gibraltar or across the English Channel. Simultaneously, the first plans of pan-European highway networks emerged.

One of these utopian projects, the so-called Atlantropa project envisioned the forging of Africa and Europe together in the new continent Atlantropa. Through a 35-km dam across the Straits of Gibraltar this project should produce new 'living space' in the Mediterranean basin, while supplying all of Europe with hydroelectricity distributed by a pan European high-voltage network. The projected capacity of the Gibraltar power plant (50,000 MW) equalled that of all European power plants combined in 1930.

Alexander Gall identifies three streams of thinking that merged in the visions of the Atlantropa project.⁶⁵ First, it connected to nascent ideas of European political integration as a means to counter threats to the Old World's global dominance. Atlantropa's founding father, Hermann Sörgel, was much inspired by Coudenhove-Kalergi's Paneuropa Union (1923), which strove to politically unite the continent to counter the perceived economic threat from an emerging USA and a military threat from a politically united Soviet Union. Second, the Atlantropa project also drew on the burgeoning technocracy movements that were sceptical about politician's abilities to forge a peaceful world. Sörgel and others saw the material integration of Europe as an alternative

route to the unrealistic route of political integration: material integration would avoid nationalisms, promise profits and thereby motivate entrepreneurs, and create prosperity and the mutual dependency of nations in the long run. Finally, plans like Atlantropa in a strange way benefited from the world crisis—Gall speaks of a ‘Utopia of crisis.’ It was at times presented as a gigantic employment relief project, and Sörgel promised prosperity and an end to unemployment for the entire continent.

One irony is that such plans fell far short of being executed. Another is that this way of thinking was picked up in Nazi Germany. Helmut Maier shows how new scientific domains as large-area economy—*Grossraumwirtschaft*—and large-territory technology—*Grossraumtechnik*—ideologically connected transnational infrastructure building to the building of a New Europe, *Neuropa*.⁶⁶ During the Second World War, several transborder power, highway, and broad-gauge railway systems were built. Yet rather than forging a new society or Reich, they served to extract energy and raw materials from the annexed countries destined for the German war economy. Moreover, analysing the industrial complex of Auschwitz, Maier shows that the war industry was



Figure 2 Oskar Oliven’s plan for a pan-European electric power grid was one of several schemes for electrical integration published around 1930. Oliven saw a major role for the abundant hydropower resources of Scandinavia. Norwegians, however, were reluctant to export their electric power. After the Second World War, similar visions of electrical integration were developed based on the promises of atomic power.

Source: Oskar Oliven. ‘Europas Großkraftlinien: Vorschlag eines europäischen Höchstspannungsnetzes,’ *Zeitschrift des Vereines Deutscher Ingenieure* 74, no. 25 (June 1930): 875–879.

intimately tied to transborder electricity supply (using electricity produced in Kaprun, Austria) and the lager system (providing the necessary labour).

Post-War Reconstruction and the Cold War

After the Second World War, a new group of network builders entered the scene, again embracing transnational network building as a means to forge transnational societies. One major tension in network building related to the new East–West division in Europe.

The United Nations established an Economic Committee for Europe (UNECE, 1947) explicitly to forge ties between *all* countries of Europe. In the words of the first UNECE executive secretary, Gunnar Myrdal, the stake was ‘strengthening the links between countries on both sides of the divide, which must be preserved and strengthened if we want to build a sounder Europe and a peaceful world.’⁶⁷ Pär Blomkvist describes the UNECE policy of promoting transnational motor roads, railway, and electricity systems.⁶⁸ Not unlike Sörgel 20 years earlier, Myrdal preferred to bypass complicated political processes. Instead, the UNECE aimed at tying Europe together by material networks. It preferred to work with non-political partners such as the International Telecommunications Union (ITU) and the International Road Federation (IRF). This provided a route for corporate lobbies to affect transnational nation building through the UNECE. For instance, the IRF managed to get the famous E-road plan for a network of motorways connecting Europe on the UNECE agenda in 1950. The IRF was created by oil, rubber and car industries in the USA in 1948 and had a commercial stake in connecting road building to increased well-being and individual freedom, captured in the slogan ‘Better roads for better living’ (closely echoing the Dupont company’s slogan, ‘Better things for better living through chemistry’). In Europe, Shell and other European oil and car companies gained influence through national IRF branches established to affect national politics, and a European IRF office lobbying for UN policies, a lobby which fitted well with the UNECE’s desire for non-political expert partners.

Soon, however, the Cold War produced its own system builders. The UNECE, again in the words of Myrdal, deeply regretted being ‘bypassed’ by highly successful ‘subregional organizations.’⁶⁹ While the envisioned pan-European integration did not materialize—quite to the contrary, many existing links across the Iron Curtain were closed down, or ‘delinked’—these subregional organizations built transnational networks on opposite sides of the Iron Curtain. Thus, network building intertwined with the emergence of a ‘Western’ and ‘Eastern’ European space.⁷⁰

Looking at this process in more detail, Per Högselius analyses how the Baltic states were integrated politically, economically, and technically into the Soviet empire.⁷¹ Railway and telegraph lines had already been designed to tie together the Tsarist empire and needed little adaptation. Transnational telephone lines, built in the 1930s to connect the Baltic countries westward and to Finland, were cut and replaced by new connections to Moscow, which remained an obligatory passage point for Baltic international calls until the 1980s. In the 1950s and 1960s the Baltic region was electrically tied into the Soviet empire via the so-called ‘North-western Ring’. Immense new power

stations, such as the infamous Ignalina nuclear power plant (1983) in Lithuania and several shale-oil power plants in Estonia (1959, 1969) formed part of a large system (involving also the Kaliningrad enclave and Belorussia) to provide a major part of the electricity consumed in the north-western part of the Soviet Union. Simultaneously, the COMECON set up the Central Dispatching Organization of the Interconnected Power System (1962) to facilitate Soviet electricity exports to COMECON member states.

Meanwhile, 'Western' Europe was also increasingly linked up. Geert Verbong describes how the construction of a transnational power grid was coordinated by the Union for Coordination of Production and Transport of Electricity (UCPTE, 1951) set up by the new Organisation for European Economic Cooperation (OEEC, 1948) administering the Marshall Plan funds.⁷² The UCPTE strove to guarantee electricity supply 'as if there were no borders'.⁷³ In the early 1960s Scandinavian electrical integration was negotiated within the Nordic organization Nordel, established in 1963.⁷⁴ The UCPTE and Nordel coordinated the construction of a power grid that by 1965 stretched from northern Scandinavia to southern Italy. Verbong shows that this integration was not achieved by top-down network building; instead, these rather weak organisations mediated between state-owned and private electricity companies that were responsible for constructing and maintaining different parts of the grid. This perhaps explains a first irony—the new transnational power grid was hardly used before the era of liberalization. Each power company prioritized self-sufficiency in its own territory and bilateral exchange contracts with other companies covered only supplementary supply. National or even provincial electricity flows remained dominant.

A second irony pertains to the increased transnational power flows following the liberalization of electricity markets in the 1990s. In the 1970s and 1980s several countries had rejected nuclear power, after intense societal debates and the Chernobyl catastrophe. Yet the availability of a transnational power grid combined with new deregulation policies sometimes resulted in massive imports of Belgian or French nuclear power. This happened in the Netherlands, which despite rejecting atomic power silently became a nuclear society after all.

We should observe that this division of Europe into two networked transnational blocks included a set of breaches in the Iron Curtain, such as the Hungarian–Austrian power exchange or the Czechoslovakian–German trade on the Danube River. More controversial was the construction of gas pipelines from the Soviet Union to Western Europe in the 1970s. The large-scale import of Soviet gas to Western Europe caused considerable tensions within NATO. The US government was very critical of these gas contracts and pointed to the dependency that was created and the risk that the Soviet Union could close the gas taps to put pressure on importing countries.

1989

Finally, the political and economic reorientation of the former Eastern European countries after 1989 also played out in the field of network building. For instance, the EU

increasingly prioritised East–West links in the 1990s, and the current EU enlargement process is accompanied by discussions on extending Trans-European Networks to link up the new EU countries in what is today called Central Eastern Europe. These programmes are also contested—for instance, East–West integration is prioritized at the expense of integrating Central Eastern European countries mutually, which some consider much more urgent.⁷⁵

The above-mentioned study by Högselius of electricity systems in the Baltic states further analyses some of the tensions, contradictory concerns, and multiple stakes in processes of political and material relinking. The Baltic independence movement of the late 1980s chose electrical independence from Russia and connection to the West as one of its primary arenas. Environmentalism, especially opposition to nuclear power and to dirty shale oil plants, was part of this rhetoric. However, when the Baltic states had achieved independence, new nationalistic considerations took over. The big power plants represented an important economic value not easily discarded. Much to the surprise of Western politicians and officials, the previous Baltic interests in ‘clean Western power’ vanished. Environmentalism turned out to be little more than a tool for political independence.

Equally interesting, projects to interconnect the Baltic to the Western power grids remained in the planning phase. In contrast, many other former ‘Eastern European’ countries actually disconnected from the Russian grid and synchronized with the West-European (UCPTE, now UCTE) grid. The Baltic states with large power plants found exports to Russia an asset too valuable to lose, and the plans for delinking from Russia and relinking to Sweden, Poland, and Finland proved politically and economically difficult to realize. For the time being, Baltic power stations supply their own populations and have a modest export to Russia.

Suggestions for Future Research

At present politicians, officials, and businessmen all over the continent see the ‘networking of Europe’ as a major challenge. The EU enlargement of 2004 has spurred lots of plans and projects to increase the capacity and standards of transnational infrastructures. We showed above that this focus on networks is not new. In the past two centuries many individuals and institutions worked hard to promote transnational infrastructures. The building and use of these networks created material and institutional links between European states that greatly affected many political, economical, social and cultural processes, which in turn have strongly influenced the construction of infrastructures.

With this article we argue that the networking of Europe should therefore be seen as a major challenge by historians as well. Our review of the existing literature indicates that many historians acknowledge the pivotal role of infrastructures in the shaping of Europe, but have failed to actually study European network development and its entanglement with broader societal changes. This task is long overdue. Recent exploratory projects in the context of the 11th international economic history conference, the COST 340 programme, and the Tensions of Europe programme ought to be followed

up by a more systematic research effort. In this concluding section we will suggest some topics for future research.

One major challenge is to further specify and investigate the intertwining of network building and wider societal changes in Europe. This very ambitious and difficult issue relates to the role of technology in European history at large and requires a wide-ranging dialogue between the history of technology and European integration history disciplines, one that would transcend the (reductionist) question of the primacy of technology or, say, politics.

For instance, the preliminary narrative presented above fuses two periodizations: in the history of network technologies, roads, and waterways were in focus in the 18th century, while rail and telegraphy occupied centre stage in the 19th century. Electric power and automobile networks attracted imagination and investments in much of the 20th century, which ends with a fascination for information and communication technologies by the turn of the 21st century. A periodization following European political history, on the other hand, may include an era of nation-state building and nationalism, which is often believed to have culminated in two World Wars. As the Napoleonic Wars inspired Saint Simon to plea for a European Parliament, the two world wars revived visions of a European polity. After the Second World War, Europe was increasingly integrated albeit in two competing blocks divided by the Iron Curtain. After the events of 1989, the EU became the main proponent of European integration and expanded into Central and Eastern Europe.

Neither periodization dominated; the ‘material basis’ of network technologies set the stage for wider socio-economic and political events, while political developments affected the shaping of transnational networks. We hope to investigate the multiple ways in which these periodizations connect. In the narrative above we spotlighted actors that were involved in politics as well as network building, and followed their simultaneous engagements in the construction of both spheres. Much more work is needed to develop our understanding of the interactions between network building and wider political and cultural changes in 19th and 20th century Europe.

We now specify these general concerns by proposing more concrete research issues that fit the portfolio of historians of technology. To begin, *visions for transnational networks* are a promising research site. Above we briefly introduced Hermann Sörgel and Gunnar Myrdal, two very different visionaries of European networks. Many other Europeans have during the past two centuries formulated plans and visions for tunnels and bridges crossing natural boundaries of mountains or water, and for creating networks of cables, rails, or roads embracing many countries—only few of which have ever been realized. These visionaries and their visions are fascinating research topics. Under which circumstances and in what kind of intellectual and political milieus were such visions and plans formulated? How were they phrased: in engineering terms, as making infrastructural systems more rational and efficient; in economic terms, as enabling trade and prosperity; or in political terms, as bringing peace and stability? What was their geographic scope: a single link between two countries, or a network encompassing all of Europe or even its colonies, or somewhere in between? Which areas were included and—not less interesting—excluded?

The journey from visions and plans to material reality involves *transnational system building*, a second promising research entry. Often infrastructures were first constructed *within* countries, and each country developed its own institutional frameworks and perhaps also specific technical standards and designs. Transnational linking projects had to deal with these differences, either by developing interfaces⁷⁶ or by harmonizing and standardizing systems internationally.⁷⁷ A large number of international organisations have been established since the 19th century to provide arenas for handling such issues. These include formal institutions for government representatives (like the ITU) as well as informal lobby groups for industrialists and different engineering communities. Who created such organizations and why? How did they function and interact with national governments, multinational companies, and transnational bodies like the League of Nations, UN, NATO, COMECON or EU?

Moreover, transnational system building involves many *challenges on site*. Sometimes transnational link construction involved complicated engineering efforts, like the Channel tunnel, the Öresund bridge or submarine telegraph cables. Sometimes it involved the rather straightforward building of an ordinary stretch of road, rail or cable across a border, but ran into challenges of an institutional or political nature. How have different transnational links come about? Which kind of actors were involved and how were decisions made? Did the actual construction process lead to special problems due to the international character of the project? A new link is sometimes expected to have considerable regional consequences on both sides of the border, and local interest groups may support or oppose its construction. Under which circumstances did local resistance delay, halt, or change projects? And what happened after the completion of links—did fears or hopes come true?

This brings us to the *use of transnational linkages*. The study of usage constitutes a rich research area in the history of technology. Moreover, it has proven very productive for understanding how network development intertwined with wider societal changes at the national level of analysis.⁷⁸ Which uses of transnational networks or links were anticipated, and to what extent did these expectations come true? Such anticipated uses can vary considerably in kind. For example, a century ago railways in Europe were built not only for use in times of peace but also as a preparation for war. At the outbreak of World War I millions of soldiers were transported to the various fronts according to very elaborate Military Travel Plans. Another aspect of the use of transnational linkages has to do with unanticipated and unwanted flows. The refugees trying to use the Channel tunnel is a telling example. New links are often accompanied with custom stations entrusted to prevent the unwanted flows across borders. How did they fulfil their gate-keeping functions? Furthermore, one may study how individual and ‘institutional’ users⁷⁹ mobilized existing transnational networks for their own purposes.

A fifth research entry we want to mention are *moments of radical political change*, which may have affected flows in dramatic ways or even led to the delinking or relinking of networks. It can be interesting to compare different infrastructures and their ability to respond to such events. For example, a journalist recently visiting Riga, Latvia, compared that city’s aviation and railway systems. The international airport serving Riga was recently enlarged and rebuilt and looks like modern airports anywhere

in the rich world. The departure board announces flights westward to foreign cities like Copenhagen, Frankfurt, Stockholm, Brussels, Warsaw and Prague. Riga's main railway station, by contrast, is firmly rooted in the past, even though it has been handsomely renovated. The few long-distance trains head for Moscow and St Petersburg in Russia, Odessa and Lviv in Ukraine, and Gomel in Belarus. No direct trains run from Riga to Tallinn or Vilnius, the capitals of the neighbouring Baltic countries. The Soviet legacy is clearly evident in the rigid railway system, while the flexible aviation system has been adapted quickly to new political and economic possibilities.⁸⁰

No doubt, many other research strategies and topics can be productive to investigate the networking of Europe. We believe that a multiplicity of approaches may help to avoid narratives that falsely portray this process as a linear, politically or technologically inevitable success story. Above all, we find the networking of Europe a topic far too important to be excluded from the European history canon.

Acknowledgements

This paper benefited greatly from discussions within the European Science Foundation network *Tensions of Europe* and the *Transnational Infrastructures in Europe* (TIE) programme at the Technische Universiteit Eindhoven, and from grants from the European Science Foundation, the Netherlands Organisation of Scientific Research, and the Bank of Sweden Tercentenary Fund. Johan Schot, Tom Misa, and two anonymous referees provided useful comments.

Notes

- [1] Neerhout, 'The Making of the Channel Tunnel.'
- [2] Commission of the European Communities, 'Proposal for a Decision', 5.
- [3] Articles 154, 155 and 156. Compare McGowan, 'Trans-European Networks.'
- [4] Hunt, *The Tunnel*, 45.
- [5] Jeffrey Titford (EDD), Debates of the European Parliament, May 30, 2002.
- [6] Various articles on news.bbc.co.uk and www.cnn.com.
- [7] For a history of this idea see Mattelart, *The Invention of Communication*; Mattelart, *Networking the World*.
- [8] Hughes, *Human-Built World*, 1. Compare Misa, 'The Compelling Tangle', 9; Staudenmaier, 'Henry Ford's Relation'; Hård, 'Beyond Harmony.'
- [9] The programme produced two largely overlapping conference proceedings and a collection of summaries. Merger *et al.*, *Les réseaux Européens*; Carreras *et al.*, *European Networks*; Carreras *et al.*, *European Networks—A Companion Volume*. Another programme, the COST 340 programme (2000–2004) headed by Merger, set out to research the history of transnational and intermodal transport, but seems to focus particularly on multimodality.
- [10] Hughes, *Networks of Power*; Hughes, 'The Evolution.'
- [11] Van der Vleuten, 'Infrastructures and Societal Change.'
- [12] Van der Vleuten and Verbong, *Networked Nation*.
- [13] Den Boer *et al.*, *The History*; Davies, *A Modern History of Europe*, 8. Malmberg and Stråth, 'Introduction' to *The Meaning of Europe*.
- [14] Dawson, *A Geography*, 2–3.
- [15] Woolf, 'Europe and its Historians.'

- [16] Davies, *Europe*, 45 and 46.
- [17] *Ibid.* 681–82, 759–68 and 1081.
- [18] Weber, *A Modern History*, 447–50; 709–15; 982–9. Compare Weber, *Peasants into Frenchmen*; Van Dijk, *De modernisering*; Knudsen and Ifversen, *Hjem til Europa*; Lutzen and Rosenbeck, *Den moderne tid*.
- [19] Romein, *The Watershed of Two Eras*.
- [20] Gillingham, *European Integration*.
- [21] Den Boer *et al.*, *The History*. Le Goff, *Das alte Europa*; Shore, *Building Europe*; Malmborg and Stråth, *The Meaning of Europe*. Peter Bugge mentions Stefan Zweig, who in 1943 related a European community spirit with technical developments that outdated borders. See Bugge's contribution to Den Boer *et al.*, *The Meaning*, 85.
- [22] Urwin, *The Community*. Gillingham, *European Integration*.
- [23] Griffiths, *The Netherlands and the Integration of Europe*, ix.
- [24] Wallerstein, *The Modern World System*, Vol. 1, 349.
- [25] Castells, *The Information Age*.
- [26] Held *et al.*, *Global Transformations*.
- [27] Woodruff, 'The Emergence', 688 and 735.
- [28] Heaton, *Economic History of Europe*; Birnie, *An Economic History of Europe*; Clough, *European Economic History*; Woodruff, 'The Emergence'; Ville, 'Transport and Communications.'
- [29] Girard, 'Transport'; Landes, 'Technological Change.'
- [30] Ville, *Transport*.
- [31] Merger, Carreras and Giuntini, 'Introduction' to Merger *et al.*, *Les réseaux européens*.
- [32] According to UNECE's first Secretary General Myrdal, 'Twenty Years', 621.
- [33] On transnational electricity lines see UCPTE, *UCPTE 1951–1971; UCPTE, 25 années*. On railroads see Armand, *Union Internationale*. On European broadcasting see Degenhardt and Strautz, *Auf der Suche*. Zeller, *Die EBU*. These organisations will be studied in the Transnational Infrastructures in Europe (TIE) project at the Technische Universiteit Eindhoven (2003–2007).
- [34] Cited from Andersson-Skog and Kranz, 'Preface' to *Institutions in the transport and communications industries*.
- [35] Grübler, *The Rise and Fall*; Ville, *Transport*; Kunz & Armstrong, *Inland Navigation*.
- [36] Anastasiadou, 'Building'; Schipper, 'Free Mobility.'
- [37] Mom, 'What Kind of Transport History.'
- [38] Hughes, *Networks of Power*.
- [39] Williams, *A History of Technology*; Dumas, *A History of Technology*.
- [40] For a review see Van der Vleuten, 'Infrastructures and Societal Change.'
- [41] Which is not to say that there are no network studies outside its framework of reference. See for instance the work of Headrick on imperialism; Fischer, *America Calling*; Nye, *Electrifying America*.
- [42] Galambos, 'A View', 177.
- [43] Hughes, *American Genesis; Rescuing Prometheus*; Hughes and Hughes, *Systems*; Mayntz and Hughes, *The Development*; La Porte, *Social Responses*; Summerton, *Changing Large Technical Systems*; Coutard, *The Governance of Large Technical Systems*; Gras, *Grandeur et dépendance*; Braun and Joerges, *Technik ohne Grenzen*; Kaijser, *I fädrens spår*; Blomkvist and Kaijser, *Den konstruerade världen*; Jonsson, *Infrasystemens dynamik*; Van der Vleuten and Verbong, *Networked Nation*.
- [44] Hughes, *Networks of Power*; Kaijser and Hedin, *Nordic Energy Systems*; Nielsen, *New Energy Systems*. Rinde, *Kontingens*.
- [45] Kaijser, 'Trans-Border Integration'; Summerton, 'Power Plays'; McGowan, 'The Internationalisation'; Griset, 'Technological Systems.'
- [46] This might also apply to infrastructure studies in historical geography and business history. Pounds' *An Historical Geography of Europe* addresses transport networks but

follows the 'Europe of nation states' format. Dawson's *A Geography of European Integration*, 4–12 confirms this format's dominance in geographies of Europe, claiming to be the first book to address all of Europe. Dawson, however, pays little attention to infrastructural changes. In business history, Chandler's *The Visible Hand* is famous for asserting the importance of rail and telegraphy in the growth of large US companies, which has spurred much debate. Compare Davids, 'The Fabric of Production.' The field has been much inspired by economic history and is currently interested in network industries.

- [47] Caron, 'Introduction'; Caron, 'L'évolution.' Compare the 'List of Papers Submitted', 111–2.
- [48] Merger *et al.*, *Les réseaux Européens*; Carreras *et al.*, *European Networks*; Carreras *et al.*, *European Networks—A Companion Volume*.
- [49] Headrick, 'Réseaux et pouvoir', 412.
- [50] Merger, introduction to *Towards a European Intermodal Transport Network*, xvi–xix; <http://www.cordis.lu/cost-transport/src/cost-340.htm>.
- [51] Merger and Polina, *Towards a European Transport System*. Merger and Mata, *Towards a European Transport System*. Dienel, *Unconnected Transport Networks*.
- [52] Only the Italian and Spanish contributions contain sections on transnational networks. Giuntini and Pavese, 'Bibliography', 115–6; Carreras, 'National Bibliography', 179–81.
- [53] Instead of comparing national experiences as was suggested in the early 1990s. Christensen, *European Historiography*; Bruland, 'Comparative Studies.'
- [54] Compare Verbong and Van der Vleuten, 'Under Construction.'
- [55] Schivelbush, *Geschichte*; Gras, *Les macro-systèmes*.
- [56] Mattelart, *The Invention*, 103.
- [57] St. Simon, 'The Reorganisation of the European Community.'
- [58] Thus argues Van der Hertten, *België onder stoom*, 102.
- [59] Hugill, *World Trade*. Hugill, *Global Communications*. Headrick, *The Invisible Weapon*.
- [60] Thestrup and Johansen, 'Le Danemark'; Arcarons, 'L'Espagne et les liaisons.'
- [61] These papers will be published in a forthcoming book.
- [62] Calvo, 'Out of Spain'; Silva, 'From Host to Hostage.'
- [63] Tympas and Anastasiadou, 'Gateway to Europe?'; Schueler, 'Penetrating the Alps.'
- [64] See also Anastasiadou, 'National and International Considerations.'
- [65] Gall, 'Atlantropa: A Technological Vision.'
- [66] Maier, 'Nazi System Building.'
- [67] Myrdal, 'Twenty Years', 619, 628.
- [68] Blomkvist, 'Roads for Peace!'
- [69] *Ibid.*
- [70] Rey, 'Borders', 21.
- [71] Högselius, 'Ambiguous Reconfiguration.'
- [72] Verbong, 'Dutch Power Relations.'
- [73] Bauer *et al.*, *UCPTE*, 161.
- [74] Kaijser, 'Trans-Border Integration.'
- [75] Fleischer, 'Infrastructure Networks.'
- [76] Hughes, in *Networks of Power*, speaks of 'couplers.' David and Bunn, in 'The Economics', speak of 'gateway technologies.' An example is the connection of two electricity systems by a High Voltage Direct Current Link. Such links can be made between systems with different standards, and disturbances in one of the systems is not transferred to the other.
- [77] Kaijser, *I fädrens spår*.
- [78] E.g. Nye, *Electrifying America*; Fischer, *America Calling*; Van der Vleuten and Verbong, *Networked Nation*.
- [79] Van der Vleuten, 'Infrastructures and Societal Change' and 'In Search of the Networked Nation.'
- [80] 'Europe's Building Site', *The Economist* 22 November 2003.

References

- Anastasiadou, Irene. 'National and International Considerations in the Building of the Greek Railroads.' In *Proceedings of the First International Conference on the History of Transport, Traffic and Mobility T2M*. Eindhoven: ECMD, 2003.
- . 'Building Europe on the Rails: Ph.D. Research Design.' Unpublished Report, Eindhoven, 2004.
- Andersson-Skog, Lena and Olle Kranz, eds. *Institutions in the Transport and Communication Industries*. Canton: Science History Publications, 1999.
- Arcarons, Melchior. 'L'Espagne et les liaisons télégraphiques transatlantiques.' In *Les Réseaux Européens transnationaux*, edited by M. Merger *et al.* Nantes: Ouest, 1995.
- Armand, Louis *et al.* *Union Internationale des Chemins de Fer*. Nantes: Berger-Levrault, 1964.
- Bauer, L., G. A. L. van Hoek, and M. Vibert, eds. *UCPTE 1951–1976: 25 années UCPTE*. Arnhem: UCPTE, 1996.
- Birnie, Arthur. *An Economic History of Europe 1760–1939*. London: Methuen, 1962.
- Blomkvist, Pär. 'Roads for Peace! Lobbying for a European Highway System.' In *Networking Europe*, edited by E. van der Vleuten and A. Kaijser, forthcoming.
- Blomkvist, Pär, and Arne Kaijser, eds. *Den konstruerade världen: Tekniska system i historiskt perspektiv*. Stockholm: Brutus Ostlings, 1998.
- Braun, Ingo and Bernward Joerges, eds. *Technik ohne Grenzen*. Frankfurt: Suhrkamp, 1994.
- Bruland, Kristine. 'Comparative Studies in European History of Technology.' In *European Historiography of Technology*, edited by Dan Christensen. Odense: Odense University Press, 1993: 226–234.
- Calvo, Angel. 'Out of Spain: The Role of Business and Politics in Trans-Border Crossings.' In *Networking Europe*, edited by E. van der Vleuten and A. Kaijser. Canton: Science History Publications, forthcoming.
- Caron, François. 'Introduction.' In *Debates and Controversies in Economic History: Proceedings of the 10th International Economic History Congress*, edited by Erik Aerts. Leuven: Leuven University Press, 1990: 83–4.
- . 'L'évolution des transports terrestres en Europe (1800–1940).' In *Debates and Controversies in Economic History: A-Sessions: Proceedings of the 10th International Economic History Congress*, edited by Erik Aerts. Leuven: Leuven University Press, 1990: 85–94.
- Carreras, Albert. 'National Bibliography and Literature Survey on Spanish Transport History.' In *Towards a European Intermodal Transport Network*, edited by M. Merger and M.-N. Polino. Paris: AHICF, 2004: 146–81.
- Carreras, Albert, Andrea Giuntini, and Michèle Merger, eds. *European Networks, 19th–20th centuries: New Approaches to the Formation of a Transnational Transport and Communications System*. Proceedings 11th International Economic History Congress, Milan, 1994.
- . eds. *European Networks/Réseaux européens: A Companion Volume*. EUI working papers HEC 95/1. Florence: EUI, 1995.
- Castells, Manuel. *The Information Age: Economy, Society, Culture*. 3 vols. Oxford: Blackwell, 1996–1998.
- Chandler, Alfred. *The Visible Hand: The Managerial Revolution in American Business*. Cambridge: Belknap Press, 1977.
- Christensen, Dan, ed. *European Historiography of Technology*. Odense: Odense University Press, 1993.
- Clough, Shepard. *European Economic History: The Economic Development of Western Civilization*. 2nd ed. New York: McGraw-Hill, 1968.
- Commission of the European Communities. 'Proposal for a Decision of the European Parliament and of the Council Amending Decision No. 1692/96/EC' (2001/0229 (COD) Brussels 2001).
- Coutard, Olivier, ed. *The Governance of Large Technical Systems*. London: Routledge, 1999.
- Daumas, Maurice, ed. *A History of Technology and Invention: Progress Through the Ages*. Vol. III, 1725–1860. New York: Crown, 1969.

- David, Paul, and Julie Ann Bunn, 'The Economics of Gateway Technologies and Network Evolution: Lessons from Electricity Supply History.' *Information Economics and Policy* 3 (1988): 165–202.
- Dauids, Mila. 'The Fabric of Production: The Philips Industrial Network.' *History and Technology* 20, no. 3 (2004): 271–90.
- Davies, Norman. *A Modern History of Europe*. London: Pimlico, 1997.
- Dawson, Andrew. *A Geography of European Integration*. London: Belhaven, 1993.
- Degenhardt, Wolfgang, and Elisabeth Strautz. *Auf der Suche nach dem Europäische Program: Die Eurovision 1954–1970*. Baden-Baden: Nomos, 1999.
- Den Boer, Pim, et al. *The History of the Idea of Europe*. 2nd ed. London: Routledge, 1995.
- Dienel, Hans-Liudger, ed. *Unconnected Transport Networks: European Intermodal Traffic Junctions 1800–2000*. Frankfurt: Campus, 2004.
- Fischer, Claude. *America Calling: A Social History of the Telephone to 1940*. Berkeley: University of California Press, 1992.
- Fleischer, Tamas. 'Infrastructure Networks in Central Europe and EU enlargement.' Institute of World Economics Working Paper no. 139. Budapest: Hungarian Academy of Sciences, 2003.
- Galambos, Louis. 'A View from Economic History.' In *Social Responses to Large Technical Systems*, edited by Todd R. La Porte. Dordrecht: Kluwer, 1991: 177–81.
- Gall, Alexander, 'Atlantropa: A Technological Vision of a United Europe.' In *Networking Europe*, edited by E. van der Vleuten and A. Kaijser. Canton: Science History Publications, forthcoming.
- Gillingham, John. *European Integration, 1950–2003: Superstate or New Market Economy?* Cambridge: Cambridge University Press, 2003.
- Girard, L. 'Transport.' In *The Cambridge Economic History of Europe*. Vol. 6, *The Industrial Revolution and After*, edited by H. J. Habbakuk and M. Postan. Cambridge: Cambridge University Press, 1965: 212–73.
- Giuntini, Andrea, and Claudio Pavese 'Bibliography on the History of Italian Transport Systems.' In *Towards a European Intermodal Transport Network*, edited by M. Merger and M.-N. Polino. CDROM, 2004: 100–16.
- Gras, Alain. *Grandeur et dépendance: Sociologie des macro-systèmes techniques*. Paris: PUF, 1993.
- . *Les macro-systèmes techniques*. Paris: PUF, 1993.
- Griset, Pascal. 'Technical Systems and Strategy: Intercontinental Telecommunications in the First Quarter of the 20th Century.' In Olivier Coutard, ed. *The Governance of Large Technical Systems*. London: Routledge, 1999: 58–72.
- Grübler, Arnulf. *The Rise and Fall of Infrastructures: Dynamics of Evolution and Technological Change in Transport*. Laxenburg, Austria: IIASA, 1999.
- Griffiths, R. T., ed. *The Netherlands and the Integration of Europe 1945–1957*. Amsterdam: NEHA, 1990.
- Headrick, Daniel R. *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century*. Oxford: Oxford University Press, 1981.
- . *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850–1940*. Oxford: Oxford University Press, 1988.
- . *The Invisible Weapon: Telecommunications and International Politics, 1851–1945*. Oxford: Oxford University Press, 1991.
- . 'Réseaux et pouvoir.' In *Les réseaux Européens transnationaux*, edited by M. Merger, A. Carreras, and A. Giuntini. Nantes: Ouest, 1995: 409–12.
- . *When Information Came of Age: Technologies of Knowledge in the Age of Reason and Revolution, 1700–1850*. Oxford: Oxford University Press, 2002.
- Heaton, Herbert. *Economic History of Europe*. New York: Harper International, 1948.
- Held, David et al. *Global Transformations: Politics, Economic, and Culture*. Cambridge, UK: Polity Press, 1999.
- Hughes, Thomas. *Networks of Power: Electrification in Western Society 1880–1930*. Baltimore: Johns Hopkins, 1983.

- . ‘The Evolution of Large Technical Systems.’ In *The Social Construction of Technological Systems*, edited by Wiebe Bijker, Thomas Hughes, and Trevor Pinch. Cambridge: MIT, 1987.
- . *American Genesis: A Century of Invention and Technological Enthusiasm*. New York: Penguin, 1989.
- . *Rescuing Prometheus*. New York: Pantheon, 1998.
- . *Human-Built World*. Chicago: University of Chicago Press, 2004.
- Hughes, Agatha, and Thomas Hughes, eds. *Systems, Experts, and Computers: The Systems Approach in Management and Engineering, World War II and After*. Cambridge: MIT, 2000.
- Hugill, Peter. *World Trade Since 1431: Geography, Technology, Capitalism*. Baltimore: Johns Hopkins, 1993.
- . *Global Communications Since 1844: Geopolitics and Technology*. Baltimore: Johns Hopkins, 1999.
- Hunt, Donald. *The Tunnel: The Story of the Channel Tunnel 1802–1994*. Upton-upon-Severn, UK: Images Publishing, 1994.
- Högselius, Per. ‘Ambiguous Reconfiguration: Electricity and Politics in the Baltic Region.’ In *Networking Europe*, edited by E. van der Vleuten and A. Kaijser. Canton: Science History Publications, forthcoming.
- Hård, Mikael. ‘Beyond Harmony and Consensus: A Social Conflict Approach to Technology.’ *Science, Technology & Human Values* 18 (1993): 408–31.
- Jonsson, Daniel et al. *Infrasystemens dynamik—om sociotekniska förändringsprocesser och hållbar utveckling*. Stockholm: FRN, 2000.
- Kaijser, Arne. *I fädrens spår: Den svenske infrastrukturens historiska utveckling och framtida utmaningar*. Stockholm: Carlssons, 1994.
- . ‘Trans-Border Integration of Electricity and Gas in the Nordic Countries, 1915–1992.’ *Polhem* 15 (1997): 4–43.
- , and Marika Hedin, eds. *Nordic Energy Systems: Historical Perspectives and Current Issues*. Canton, MA: Science History Publications, 1995.
- Knudsen, Anne, and Jan Ifversen. *Hjem til Europa: Det Europæiske hus*. Vol. 6. Copenhagen: Gyldendal, 1992.
- Kunz, Andreas, and John Armstrong. *Inland Navigation and Economic Development in Nineteenth-Century Europe*. Mainz: Philip von Zabern, 1995.
- Landes, David. ‘Technological Change and Development in Western Europe 1750–1914.’ In *The Cambridge Economic History of Europe*. Vol. 6, *The Industrial Revolution and After*, edited by H. J. Habakkuk and M. Postan. Cambridge: Cambridge University Press, 1965: 274–603.
- La Porte, Todd, ed. *Social Responses to Large Technical Systems: Control or Anticipation*. Dordrecht: Kluwer, 1991.
- Le Goff, Jacques. *Das alte Europa und die Welt der Moderne*. München: Beck, 1994.
- Lutzen, Karin, and Bente Rosenbeck. *Den moderne tid: Det Europæiske hus*. Vol 5. Copenhagen: Gyldendal, 1991.
- Maier, Helmut. ‘Nazi System Building: Auschwitz as a Critical Node in the War Economy.’ In *Networking Europe*, edited by E. van der Vleuten and A. Kaijser. Canton: Science History Publications, forthcoming.
- Malmborg, Mikael af, and Bo Stråth, eds. *The Meaning of Europe*. Oxford: Berg, 2002.
- Mattelart, Armand. *Mapping World Communication: War, Progress, Culture*. Minneapolis: University of Minnesota Press, 1994.
- . *The Invention of Communication*. Minneapolis: University of Minnesota Press, 1996.
- . *Networking the World 1784–2000*. Minneapolis: University of Minnesota Press, 2000.
- Mayntz, Renate, and Thomas Hughes, eds. *The Development of Large Technical Systems*. Frankfurt: Campus, 1988.
- McGowan, Francis. ‘Trans-European Networks: Utilities as Infrastructures. Editor’s Introduction,’ *Utilities Policy* 3, no. 3 (1993): 179–86.
- . ‘The Internationalisation of Large Technical Systems.’ In Olivier Coutard, ed. *The Governance of Large Technical Systems*. London: Routledge, 1999: 130–48.

- Merger, Michèle, Albert Carreras, and Andrea Giuntini, eds. *Les réseaux européens transnationaux: XIXe et XXe siècles: Quels enjeux?* Nantes: Ouest, 1995.
- Merger, Michèle, and Marie-Noëlle Polino, eds. *Towards a European Intermodal Transport Network: Lessons from History: A Critical Bibliography*. Paris: AHICF, 2004.
- Merger, Michèle, and Maria Eugenia Mata, eds. *Towards a European Transport system: Proceedings 1st COST conference, Lisbon, 23–25 May 2002*. CD-ROM. Paris: AHICF, 2004.
- Misa, Thomas. 'The Compelling Tangle of Modernity and Technology.' In *Modernity and Technology*, edited by Thomas Misa *et al.* Cambridge: MIT, 2003.
- Mom, Gijs. 'What Kind of Transport History Did We Get? Half a Century of *JTH* and the Future of the Field.' *Journal of Transport History*, 3rd ser., 24, no. 2 (2003): 121–38.
- Myrdal, Gunnar. 'Twenty Years of the United Nations Economic Commission for Europe.' *International Organization* 22, no. 3 (1968): 617–28.
- Neerhout, John Jr. 'The Making of the Channel Tunnel: A Modern Day Wonder.' Gould distinguished lecture on Technology and the Quality of Life 1995. www.lib.utah.edu/gould/1995/lecture95.html.
- Nielsen, Henry, ed. *New Energy Systems in Scandinavia and the Netherlands*. Special issue of *Centaurus* 41, nos. 1–2 (1990).
- Nye, David. *Electrifying America: Social Meanings of a New Technology*. Cambridge: MIT, 1990.
- Pounds, Norman J. *An Historical Geography of Europe 1800–1914*. Cambridge: Cambridge University Press, 1985.
- Rey, Violette. 'Borders vs. Networks in Eastern Central Europe.' *Flux* 3 (1991): 21–28.
- Rinde, Harald. 'Kontingens og kontinuitet: Framveksten av stivhengige organisasjonsmonstre i skandinavisk telefoni'. Ph.D. diss., Oslo University, 2004.
- Romein, Jan. *The Watershed of Two Eras: Europe in 1900*. Middletown: Wesleyan University Press, 1978.
- Schipper, Frank. 'Free Mobility and the European Dream. Ph.D. Research Design.' Eindhoven: Unpublished report, 2004.
- Schivelbusch, Wolfgang. *Geschichte der Eisenbahnreise: Zur Industrialisierung von Raum und Zeit im 19. Jahrhundert*. München: Carl Hanser, 1977.
- Schueler, Judith, 'Penetrating the Alps: Multiple Identities of the Gotthardt Rail Tunnel.' In *Networking Europe*, edited by E. van der Vleuten and A. Kaijser. Canton: Science History Publications, forthcoming.
- Shore, Cris. *Building Europe: The Cultural Politics of European Integration*. London: Routledge, 2000.
- Silva, Ana Paula, 'From Host to Hostage: Portugal, Britain and Atlantic Networks.' In *Networking Europe*, edited by E. van der Vleuten and A. Kaijser. Canton: Science History Publications, forthcoming.
- St. Simon and A. Thierry, 'The Reorganisation of the European Community or the Necessity and the Means of Uniting the Peoples of Europe in a Single Body Politic while Preserving for Each their National Independence.' In *Henri Comte de Saint-Simon, 1760-1825: Selected Writings*, edited by F. M. H. Markham. London: Hyperion Press, 1991: 28–68. Original publication in 1814.
- Staudenmaier, John. 'Henry Ford's Relationship to 'Fordism': Ambiguity as a Modality for Technological Resistance.' In *Resistance to New Technology*, edited by Martin Bauer. Cambridge: Cambridge University Press, 1995: 147–164.
- Summerton, Jane, ed. *Changing Large Technical Systems*. Boulder: Westview Press, 1994.
- . 'Power Plays: The Politics of Interlinking Systems.' In *The Governance of Large Technical Systems*, edited by Olivier Coutard. London: Routledge, 1999: 93–111.
- Thestrup, Paul, and Hans Chr. Johansen. 'Le Danemark, un point nodal du réseau télégraphique international dans les années 1870.' In *Les Réseaux Européens Transnationaux*, edited by M. Merger *et al.* Nantes: Ouest, 1995.
- Tympas, Aristotle, and Irene Anastasiadou, 'Gateway to Europe? Piraeus and the European Railway System.' In *Networking Europe*, edited by E. van der Vleuten and A. Kaijser. Canton: Science History Publications, forthcoming.

- UCPTE. *UCPTE 1951–1971. 20 ans d'activité*. Rome: UCPTE, 1971.
- Urwin, Derek. *The Community of Europe: A History of European Integration Since 1945*. London: Longman 1991.
- Van der Hertten, Bart. *België onder stoom: Transport en communicatie tijdens de 19e eeuw*. Leuven: Universitaire Pers Leuven, 2004.
- Van der Vleuten, Erik. 'Infrastructures and Societal Change.' *Technology Analysis and Strategic Management* 16, no. 3 (2004): 395–414.
- . 'In Search of the Networked Nation: Transforming Technology, Society and Nature in the Netherlands in the 20th Century.' *European Review of History* 10 (2003): 59–78.
- . and Geert Verbong, eds. *Networked Nation: Technology, Society, and Nature in the Netherlands in the 20th Century*. Special issue of *History and Technology* 20, no. 3 (2004).
- Van Dijk, Henk. *De modernisering van Europa: Twee eeuwen maatschappijgeschiedenis*. Utrecht, 1994.
- Verbong, Geert, 'Dutch Power Relations: From German Occupation to the French Connection.' In *Networking Europe*, edited by E. van der Vleuten and A. Kaijser. Canton: Science History Publications, forthcoming.
- . and Erik van der Vleuten. 'Under Construction: Material Integration of the Netherlands 1800–2000.' *History and Technology* 20, no. 3 (2004): 205–26.
- Ville, Simon P. *Transport and the Development of the European Economy 1750–1918*. Basingstroke: MacMillan, 1990.
- . 'Transport and Communications'. In *The European Economy 1750–1914: A Thematic Approach*, edited by Derek Aldcroft and Simon Ville. Manchester: Manchester University Press, 1994.
- Wallerstein, Immanuel. *The Modern World System*. 3 vols. New York: Academic Press, 1974, 1980, 1989.
- Weber, Eugen. *A Modern History of Europe*. New York: W.W. Norton, 1971.
- . *Peasants into Frenchmen: The Modernization of Rural France*. Stanford: Stanford University Press, 1976.
- Williams, Trevor, ed. *A History of Technology*. Vol. VII, 1900–1950, Part II. Oxford: Clarendon Press, 1978.
- Woodruff, William. 'The Emergence of an International Economy 1700–1914.' In *The Fontana Economic History of Europe*, edited by Carlo Cipolla. London: Fontana/Collins, 1973: 656–737.
- Woolf, Stuart. 'Europe and Its Historians.' *Contemporary European History* 12, no. 3 (2003): 323–337.
- Zeller, Rüdiger. *Die EBU: Internationaler Rundfunkkooperation im Wandel*. Baden-Baden: Nomos, 1999.