



MAKING EUROPE



# EUROPE'S INFRASTRUCTURE TRANSITION

Economy, War, Nature



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# Introduction: Chevalier's Dream

## *Manifesto for a New Europe*

Eradicating poverty. Achieving independence from nature. Creating lasting peace.

These were key aspirations embraced by Michel Chevalier and other engineers of his time. It was July 1830, the start of the Second French Revolution, and the future of Europe worried the 24-year-old Chevalier. As a graduate of the engineering schools *École Polytechnique* and *École des Mines* in Paris, he had been steeped in ideology: modernization was paramount—but not at the cost of peace. And so Chevalier felt deeply conflicted about the revolution. Like many in his circle, he fervently supported the revolutionaries' "modern" liberal, democratic agenda. But, as an emerging pacifist, he abhorred the violence and suffering of war.

To resolve his inner conflict, Chevalier joined the pacifist reform movement, becoming a so-called Saint Simonian. The movement's leader, Barthélemy Enfantin, enlisted the spirited Chevalier as editor-in-chief of the new Saint Simonian newspaper *Le Globe*. During the next two years, Chevalier elaborated his vision on the pages of *Le Globe*. Europe, he contended, was mired in



violence—and had been for millennia. Neither the military efforts to settle conflict nor the peace conferences of the time (such as the Congress of Vienna, after the Napoleonic Wars) could establish lasting peace. Peace, all agreed, depended on harmony between nations and accord between social classes. But, to Chevalier's dismay, the revolutionaries of 1830 proclaimed that peace could only be won through war. Woefully, Chevalier observed that the progress of humanity had "its passport written on a cannonball."<sup>1</sup> From Paris to Brussels to St. Petersburg, Europe's revolutionaries embraced violent means—and aristocratic rulers responded in kind; the cycle of violence continued.

Chevalier proposed an alternative. His idols, *Enfantin* and the late Count Claude Henri de Saint Simon, saw "bathing Europe in fire and blood" as no solution.<sup>2</sup> Chevalier and his mentors advocated instead a process of joining people in a "universal association," building businesses and industries together, as equals. Chevalier argued that warmongering royalists and republicans failed to acknowledge the signs of this emerging association. Increasingly, "the continuous exchange of sentiments, ideas, and material goods" connected Europeans across class lines as well as local, national, and continental borders.<sup>3</sup> At the same time, powerful new networks promised to inspire cooperation and enable economic progress for all countries, all social classes, and all individuals like never before. These new "material networks"—primarily railroads and steam-ship lines—and "intangible networks" like credit would promote peace, progress, and liberty more efficiently than peace treaties and political constitutions. For Chevalier, it was these tangible networks—now known as infrastructure—and intangible networks that would forever change the human condition. One of his translators even published a book of Chevalier's collected newspaper articles entitled *The Railroads, Constituting the Primary Material Means of Creating Peace in Europe and Happiness for Humanity*.<sup>4</sup> In a later piece, Chevalier stated that "railways have more in common with the religious spirit than we think; never before has an instrument so powerful existed to connect scattered peoples."<sup>5</sup> Chevalier called his vision the circulation society; today we speak of the network society.

An impressive plan for a transcontinental railroad and steamship system underpinned Chevalier's vision. Railroads would help connect the Mediterranean, the Black Sea, and the Caspian Sea

from Cadiz and Tangiers to Constantinople (Istanbul) and Teheran. Northbound lines would link these eastbound axes to the North and Baltic Seas, while another ambitious eastbound railroad would connect Flanders at the North Sea via Warsaw, Vilnius, Riga, and St. Petersburg to the Russian Pacific. In all, Chevalier envisioned 60,000 kilometers of interconnected, double-track railroad as the basis for Europe's "universal association." Simultaneously, thousands of steamships would traverse the seas. In true pacifist style, he argued that the necessary funding of 4.5 billion francs was feasible; after all, the sum did not exceed the total French military loans of the previous forty years.

During his lifetime Chevalier worked diligently toward this dream. A two-year stay in the United States confirmed his belief in the power of infrastructure to build nations. Once back in France, Chevalier successfully promoted domestic railroads, the transalpine Simplon tunnel, and the Suez and Panama canals. He was well positioned as a professor of political economy and later as a member of Napoleon III's Council of State and Imperial Senate. Contemporaries knew him as the French signatory of the Cobden–Chevalier Treaty, the Anglo-French free-trade agreement of 1860 that prompted many others, boosting world trade.<sup>6</sup>

After his death, Chevalier's name faded from public memory, but his dream—of European prosperity and peace through infrastructure—endured. In the spirit of Chevalier, many since have dreamed of and built ambitious infrastructure projects. Everything from Europe's system of waterways to its energy and digital networks has promised prosperity and peace. Just as Chevalier campaigned for railroads in the nineteenth century, today's social-media marketers promise to "give people the power to share and make the world more open and connected," as Facebook's mission statement reads. The dream lives on; historians now see Chevalier's 1830s vision as a manifesto for our current Network Age.<sup>7</sup>

We see that Chevalier's dream was shared by many others. But did that dream deliver on the promise of prosperity and peace for all? This question drives the three main parts of this book.

In Part I, we explore this claim of equality and ask what came of Chevalier's vision for integrating Europe via infrastructure rather than through political treaties. We examine different kinds of infrastructure, from transport, to communications, to energy. In Part I and throughout the book, our analysis of building Europe through

infrastructure transcends the European Union—because infrastructure itself transcends physical and political boundaries. We contrast the dream of a uniformly connected, harmonious Europe with the reality of a Europe with an uneven infrastructure in which some inhabitants are hyper-connected, others marginalized. In short, Part I of this book investigates how Europe's infrastructure space developed and what it came to look like. Who was connected to whom; who was left out, and why?

In Part II, we ask what came of Chevalier's hopes for economic progress and peace for humankind. For Chevalier, it was not about building infrastructure for its own sake. Infrastructure was to foster prosperity for all nations and individuals on a poverty-ridden continent; economic cooperation would create peace between rival nations and between competing social classes. After all, why attack one's own collaborators? In this section, we outline the ways in which Europe's economy has indeed been built on infrastructure. It is this infrastructure-based economy that achieved spectacular gains in living standards, although inequalities persisted, as did war. Contrary to Chevalier's expectations, the twentieth century became Europe's bloodiest and most destructive ever. We show that the same railroads used to distribute food and improve health also helped Europe's military forces to wage war on an ever-larger scale. Ironically, infrastructure connected people and places for the purposes of peace as well as war, producing prosperity as well as previously-unimagined violence.<sup>8</sup>

In Part III, we consider Chevalier's belief that infrastructure would liberate Europeans from their restrictive dependence on nature. Steamships would turn seas that divide into arteries that connect. Railroads would traverse mountains and "liberate" isolated territories such as Russia, whose inhabitants Chevalier referred to as "a paralyzed people locked in by snow."<sup>9</sup> In Part III we demonstrate how infrastructure of all kinds helped tame the natural environment and use it for human purposes. Many today note that our hard-won freedom from nature comes at a price: they *blame* transport and energy infrastructure for a host of environmental problems, from pollution and resource depletion to climate change and loss of biodiversity. To activists, infrastructure connected Europeans—and indeed the world—to create a shared catastrophe: the ecological crisis. Part III asks how infrastructure affected Europe's natural environment, particularly its land, water, and air, for better or for worse.

Infrastructure played a far more complex role in the making of modern Europe than Chevalier had ever imagined. This is the essence of Europe's modern infrastructure transition: Europe's infrastructure, its overlapping economies, its wars, and its natural environments interacted in an unpredictable, exceptionally dynamic process of historical change.<sup>10</sup> This book traces the making of this complex web of connections, and the ruptures within, that transformed Europe beyond recognition.

### *Europe's Infrastructure Transition*

How do we locate Europe's infrastructure transition in time and space? By the 1830s, when Chevalier developed his vision, significant threads in Europe's infrastructure fabric had already been woven. For example, in the previous centuries, long-distance trade routes by land and sea had already come to cover vast territories; shipping networks spanned the globe. In fact, seventeenth- and eighteenth-century observers praised England and the Low Countries, in particular, for their advanced maritime and inland canal infrastructure. Historians have also shown that seventeenth- and eighteenth-century Europeans were much more mobile than previously believed. These centuries saw occasional mass migrations and the expansion of mega-cities such as London, Paris, and Amsterdam, which drew primarily on imported labor, food, and energy.<sup>11</sup>

These developments, in the context of their times, were indeed impressive; yet the present-day traveller would have found Europe's pre-nineteenth-century infrastructure to be terribly slow, dangerous, and cumbersome, not to mention sparse. For example, the prevailing forms of transportation and communication were pedestrian, animal (horses and oxen, for example), and wind (sailing ships). The great Roman roads had long fallen into decay; roads were local and unpaved. Natural formations, from mountain ranges to lakes, and even heaths and moors, constituted huge barriers to mobility. Often, states chose these natural formations as political boundaries and military defense lines; conveniently, these physical barriers necessitated only a limited number of man-made

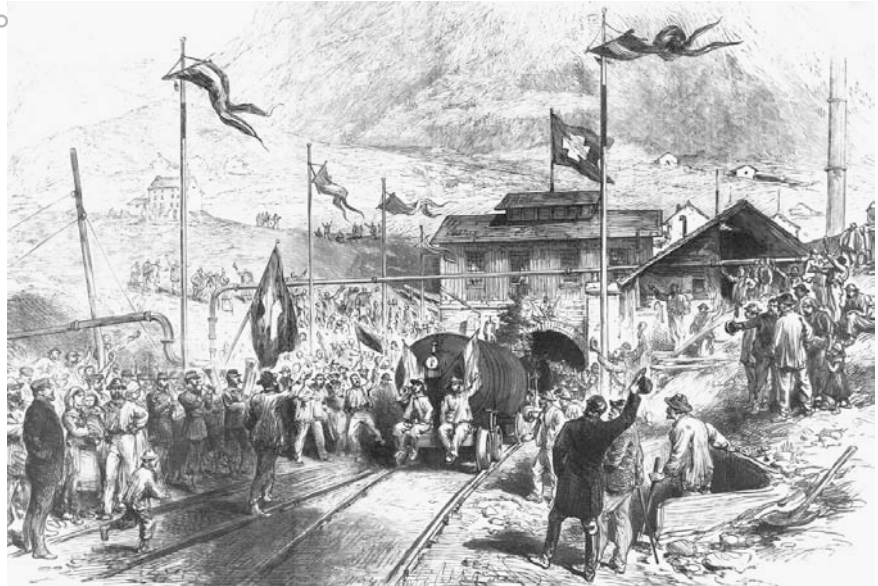
fortified passage points. Weather conditions, from drought to rain, storms to icy waters, transformed travel from a slow process into an ordeal. For this reason, travel was mostly the province of aristocrats, sailors, soldiers, merchants, wandering artisans, rural emigrants, and seasonal workers. At this time—the first half of the nineteenth century—the average number of migrations undertaken by these groups languished at roughly one million per year—in a European population of roughly 180 million!<sup>12</sup> For the great majority of people, peacetime contacts with other communities were limited to neighboring villages. For the average European, local energy, food, information, and security shaped daily life. Present-day travellers would be shocked by their early-nineteenth-century counterparts' poor diets, harsh living standards, and average life expectancy of well below 40 years of age.

It was only at the time of Chevalier's coming-of-age—around 1830—that changes in Europe's infrastructure began to accelerate in earnest. Over the following two centuries, Europe has become interconnected by colossal networks from steel rails to asphalt roads, from copper wire to electromagnetic waves to fiber optic cable.<sup>13</sup> These physical networks and systems enabled the far-reaching circulation of people, of food and water, of goods and credit, of news and entertainment, as well as the circulation of energy and pollution. Today, virtually all Europeans commute or travel on a daily, weekly, monthly, or at least yearly basis; Europeans rely on resources—from food to information—that are produced outside their local communities. Europe's physical infrastructure, and the economies it fostered, has transformed life radically. Indeed, food and energy have become abundant and cheap, while life expectancies have doubled.

At the same time as it has improved standards of living, Europe's elaborate physical infrastructure has increased the risk of harm. As we discuss in Parts II and III, this vast web contributed to escalating the scale of war as well as the scale of environmental damage. Thus, *Europe's Infrastructure Transition* focuses on the period from the mid-nineteenth century or so to the present, the time in which an intricate web of connections was formed. These were the connections that changed Europe—for better and for worse.

When it comes to locating Europe's infrastructure transition in physical space, our inquiry transcends the boundaries defined by either states or by continents, by natural boundaries like

**Fig. 0.1 Piercing the Alps:** During Europe's infrastructure transition new transport, communication, and energy connections pierced major natural obstacles. In May 1882, some six hundred guests from all over Europe celebrated the opening of the railroad tunnel through the St. Gotthard massif in Switzerland. Financed by the Swiss federal and canton governments, the Kingdom of Italy, and Imperial Germany, the line symbolized the connection between Europe's North and South. In the course of the next few decades, telegraph, telephone, and electric power lines also penetrated the Gotthard massive. The first road tunnel came in 1980.



mountains, or by the politics of the European Union. Instead, we use infrastructure itself—with its associated economic, military, and environmental systems—as the framework for defining boundaries. After all, infrastructure crossed conventional political and natural boundaries, time and time again. In the 1830s, Chevalier chose railroads and steamships precisely because of their ability to reach beyond borders. Less than a century later, new connections indeed challenged traditional definitions of Europe. “The railway ... is a lesson in the futility of artificial restrictions on progress,” noted an anonymous reporter at the International Railway Congress in 1910: “The passenger boards his train at Calais and frontiers are wiped out between the English Channel and Brindisi; or he sets out on his journey from St. Petersburg and his destination is the distant port of Vladivostok in the Far East. For him the artificial distinction that calls this ‘Europe’ and that ‘Asia’ is wiped out.”<sup>14</sup>

Accordingly, the authors of this book do not set out to study Europe's infrastructure transition within a predefined spatial container called “Europe”; instead, we examine how the infrastructure transition changed the very shape of that container.<sup>15</sup> We trace the making of modern Europe as a web of global connections, from Siberian gas fields to Colombian coal mines; Senegalese

groundnut plantations to Australian cattle farms; the New York Stock Exchange to the battlefields of Vietnam, the cables of the ocean floor to the pollutants in Earth's stratosphere.

Infrastructure has proven both its power to connect and its power to divide. For this reason, we analyze Europe's global connections as well as its hierarchies and ruptures. One example is Britain's famously-extensive telegraph network that runs beneath the ocean floor. This network, which was in place by 1900, was designed specifically to bypass land-based telegraph systems in territories beyond British control. Infrastructure could create new borders or reify existing ones: new canals, railroads, and highways actually cut local neighborhoods in two. When the Soviet Union incorporated the Baltic States after the Second World War, Baltic telephone connections to the West were cut, and all telephone calls were rerouted through Moscow. The Iron Curtain was a massive attempt at de-linking infrastructure and building borders. Twin electric power lines on either side of the French–German border duplicated that boundary rather than eliminating it. This also held true for national road networks in Bulgaria and Romania: even in 2011, only one structure, formerly known as the Friendship Bridge, crossed their 470-kilometer border along the Danube River. In Hungary, by contrast, nine bridges crossed the Danube in the capital city of Budapest alone.

Infrastructure connections alone did not guarantee mobility: checkpoints and tariffs restricted the circulation of everything from people to money to products. Consider Europe's Channel Tunnel that connects France and Britain. Since 1994, this iconic cross-border link has enabled the free circulation of businesspeople, tourists, and cargo. At the same time, high-security fencing; extensive monitoring equipment; and more than one hundred armed guards have prevented access by tens of thousands of migrants and asylum seekers who also tried to enter Britain via the tunnel. In practice, universal connectivity has proven to be elusive, despite the promises offered by everyone from Chevalier to the founders of Facebook. In the landscape of infrastructure linkages, some have become "more equal" than others.<sup>16</sup> Accordingly, this history of Europe's infrastructure transition traces far-reaching connections as well as connectivity hierarchies, boundaries, and asymmetries.

## *Building Systems, Making Europe*

In the making of modern Europe, the infrastructure transition was fundamental because it transformed—unpredictably yet powerfully—Europe's physical connections, its economies, its wars, as well as its natural environments. How can we understand the dynamics of this transition? How do we trace its tightly-woven fabric of connections?

We emphasize that this fabric did not emerge as a result of impersonal forces such as technological advance, globalization, and Europeanization. To the contrary, the web resulted from the concrete preferences and choices of its makers. Many contributed to building Europe's modern infrastructure, its economic and military systems. Among them were individuals, companies, and governments; engineering communities, international organizations, and others. These were Europe's system-builders; it is they who spun its web of connections and decided, implicitly and explicitly, whom to connect and whom to bypass; how to use infrastructure for economic and military purposes; and how to treat the natural environment. This book documents the visions, priorities, and choices of Europe's system-builders as they constructed or blocked connections in infrastructure, the economy, the military, and the environment.<sup>17</sup>

Who, exactly, built which parts of modern Europe? Europe's infrastructure transition involved many kinds of system-builders who constructed connections and borders within and between infrastructure, economic, military, and environmental systems. Part I (chapters 1 and 2), titled *Connecting Europe*, focuses on system-builders who connected Europe through transport, communications, and energy infrastructure. Some worked toward what they perceived as the betterment of Europe. For example, around 1930, walking in the footsteps of Chevalier, visionary engineers Oskar Oliven, Georges Valensi, Piero Puricelli, and Hugo Junkers proposed unity via pan-European electrical networks, telephony, highways, and airline networks, respectively. Historically, many different organizations strove to integrate European infrastructure. These groups included: the International Railway Union (1922), the International Broadcasting Union (1925), the United Nations (The Economic Commission for Europe, 1948), and the European



Conference of Post and Telecommunication Administrations (1959). And, since the 1990s, it has been the European Union that champions the construction of so-called Trans-European Networks (TENs) in an effort to create a coherent European economy and society.

All these system-builders, from Chevalier to the current EU commissioners, shared the goal of integrating Europe's infrastructure. But each expressed distinctly divergent views on *how* to integrate Europe's infrastructure, embracing, as they did, different visions of Europe—some inclusive, others exclusive. For example, Gunnar Myrdal—Secretary General of the United Nations Economic Commission for Europe (1948) and a Nobel Prize winner in economics—advocated an inclusive agenda. Myrdal promoted the so-called E-road plan and other infrastructure as “all-European” connections that should integrate the socialist East and capitalist West. His aim was to prevent a third world war, no less. He heavily criticized infrastructure projects limited to a few countries, such as efforts by the European Economic Community (a forerunner to the European Union) at infrastructure integration for its six member states only. Myrdal condemned use of the term “Europe” in such “sub-regional” initiatives as “intensely inimical” to his own organization's work.<sup>18</sup>

Most infrastructure system-builders, however, did not aim primarily at European integration. Private companies, imperial governments, and bilateral projects dominated the international scene with infrastructure visions and objectives of their own. In this arena, even such apparently powerful international organizations as the European Union find their influence on Europe's infrastructure development to be severely restricted.<sup>19</sup> Moreover, domestic infrastructure building was much larger than any international initiatives—whether or not they were aimed at building an integrated Europe. Over the last two centuries, national and municipal governments have accumulated unprecedented power, budgets, and manpower. National and local infrastructure projects have followed suit, while national and urban spaces have emerged as magnets in Europe's infrastructure geography. Any transnational history of Europe's infrastructure transition must acknowledge that the age of European integration and globalization was also the age of the nation state and the municipality.<sup>20</sup>

Finally, we note that infrastructure builders, at times, deployed the ‘European integration’ mission strategically. For example,

hydraulic engineers Antonin Smrček, Jaroslav Kubec, and others promoted the Danube–Oder–Elbe canal as the missing link in Europe's inland navigation system. For more than a century, engineers worked to construct this canal that would connect the North Sea, the Baltic Sea, and the Black Sea. What kept their partly-built project alive was the ability to adapt their designs and visions to competing and successive political agendas, including Czech nationalism, Moravian regionalism, Central European integration efforts, Nazi *Neuroropa*-building, postwar Pan-Europeanism, and socialist integration. When the European Union gained importance, engineers lobbied to make the canal a priority project of the Trans European Network program.<sup>21</sup>

As for system-builders creating ruptures in Europe, examples also abound. Consider the disintegration wrought by Cold War infrastructure: everything from border crossings to barbed-wire fences to the entire constellation of technologies that constituted the Iron Curtain. Contemporary versions of these ruptures also abound: the European Union agency for external frontiers management, Frontex, is a controversial and telling example of a border builder today. In the name of European solidarity and migrant safety, EU member states supply Frontex with aircraft, ground-patrol units, and equipment to intercept migrants who try to cross the EU's Greek-Turkish, Mediterranean, and Atlantic borders. Individuals and families are imprisoned in detention centers which, by Council of Europe standards, qualify as "inhumane." Whenever possible, would-be migrants are returned to their countries of origin. And, while EU ministers praised the democratic revolutions of the 2011 Arab Spring in Northern Africa and the Middle East, they also accelerated development of Frontex's European External Border Surveillance System (EUROSUR) to guard against the anticipated surge in illegal immigration from these territories. An unprecedentedly-advanced infrastructure, EUROSUR consists of coastal radar, satellite tracking systems, drones, and autonomous targeting systems. The goal is to detect small vessels as they approach EU territory and to transform the edges of the EU into so-called "smart borders."<sup>22</sup> Today's European Union functions like the infrastructure system-builders have historically: the EU envisions and builds connections as well as borders.

Part II of this book (chapters 3, 4, and 5), *Economy and War*, addresses the role of infrastructure in the making of peace and war.

In Chevalier's pacifist vision, "material" railroad and shipping networks and "immaterial" credit networks would unite Europe in a common economy and reduce the risk of war. He wrote: "Industry is eminently peaceful. Instinctively it rejects war; that which creates does not combine with that which kills."<sup>23</sup> Many since Chevalier have reiterated this argument. In order to unravel how peoples and places became connected (and divided) through wars and economics, we study the historical makers of these connections.

In chapters 3 and 4, we investigate how various actors—individuals and companies, governments and international organizations—mobilized infrastructure to build Chevalier's so-called networks of peace, now known as Europe's network economy. These actors served as veritable "economic system-builders": using infrastructure links, they connected farms, factories, stores, and consumers into economic systems for the production and allocation of scarce goods and services.<sup>24</sup> For example, starting in the late nineteenth century, William and Edmund Vestey expanded their Liverpool-based family butchery to cattle farms, meat processing plants, and cold stores in Argentina, Uruguay, Venezuela, and Australia. The Vesteyes built—or corralled others into building—railroads that connected their inland cattle farms to harborside meat processing plants, stores, and docks. They set up their own Blue Star Line shipping company to connect these overseas facilities to their new cold stores at the London docks. From here, existing inland transport networks facilitated further distribution to shops in London. The Vesteyes had built an intercontinental food chain, and British meat consumption rose steeply as retail prices dropped.

Many other economic system-builders, both local and international, built and deployed infrastructure to forge Europe's food connections. Together, they created one of Europe's most fundamental economic transitions ever, a transition from widespread hunger and monotonous diets to abundant food and varied diets. Similarly, industrial entrepreneurs used transport, communications, and energy links—from trains transporting coal to gas pipelines—to set up Europe's heavy industry; financial traders used telecommunications to build Europe's financial market connections, which fueled economic expansion as well as financial crises.

Unfortunately, Europe's transnational economic systems did not eradicate the possibility of war, as Chevalier discovered in 1870.

**Fig. 0.2 Rails of**

**War:** *The development of war trains illustrates the entanglement of infrastructure systems and military systems. The Polish army captured the Śmiały (Polish for “bold”) war train from Austria-Hungary in 1918. In 1918–21 it successfully used the Śmiały and other armored trains in the Greater Poland Uprising, the Polish-Ukrainian war, and the Polish-Soviet war. In 1939 the Śmiały both destroyed German tanks and fought the Soviet invaders, before it surrendered to the Red Army. In 1941 the Germans captured it from the Soviets, then used it on the Eastern front.*



He was the only member of Napoleons III's Imperial Senate to vote against war with Prussia. The Franco-Prussian War came as a shock to the French military, though it eventually opened their eyes to the destructive power of infrastructure. Pre-1870, in processes akin to economic system-building, the Prussian army had learned to mobilize railroads and communications systems

for military purposes. Military system-builders such as Helmut von Moltke the Elder, Chief of the Prussian General Staff as of 1857, had developed elaborate mobilization plans. In the Austro-Prussian War of 1866, for example, the Prussian army had used railroads to transport nearly 200,000 men and 55,000 horses. Given their ability to rapidly concentrate troops and ammunition in decisive battles, the Prussians were able to outmaneuver the Austrian armies. This marked Prussia's military intervention with railroad construction. New lines were designed for military peak demand, which greatly exceeded day-to-day civilian demand. In 1870, within eighteen days of the declaration of war, von Moltke's staff directed approximately 400,000 troops to predetermined border positions. Outmaneuvering the French, they captured Emperor Napoleon and his army a month later. Chapter 5 investigates how, in response to these Prussian victories, other European military powers used infrastructure to build powerful logistics systems for warfare by land, air, and sea. The chapter also looks at the ways in which military infrastructure—NATO, for example—has aimed to integrate Europe.

In Part III of this volume (chapters 6, 7, and 8), *Networking Nature*, we examine how Europe's infrastructure transition created entanglements with the natural environment—water, air, and land. In order to trace the role of infrastructure in the construction and fragmentation of environmental connections, we again follow the makers of such connections. For example, system-builders manipulated nature to make their systems work. They modified natural waterways in order to “fit” them into networks of many different descriptions: drainage, navigation, water-supply, and hydroelectric power, to name just a few. Other system-builders claimed and redefined airspace for aviation, transmission of radio waves, and the disposal of emission gasses from power plants, factories, and vehicles. Still others manipulated mountains, forests, and moors for infrastructure purposes serving human needs. Knowingly or unwittingly, these professionals generated new environmental connections and ruptures, for better or worse.

To spotlight infrastructure's role in changing Europe's ecological systems, we also track the intermediaries who spoke on behalf of nature. As we will see, scientific organizations such as the International Meteorological Organization and the European Geodetic Association built systems to understand nature: they

**Fig. 0.3 Gray-Green Junctions:** *Europe's infrastructure transition fundamentally changed landscapes. First, railroads, canals, pipelines, and especially motorways caused habitat fragmentation for Europe's wild plants and animals, threatening biodiversity. Then, nature conservationists started building their own infrastructure: ecological networks reconnecting isolated patches of nature on regional, national, and pancontinental scales. “Wildlife crossings” or “ecoducts,” first built in France in the 1950s, are key nodes in such networks. The photo shows the ecoduct “het groene woud” (2003), allowing red deer, foxes, badgers and other species to cross the A2 motorway in the Netherlands. Local youth, to the dismay of conservationists, use it as a motocross passage.*



used telecommunications to connect observation posts that dotted the Continent and the skies, creating pan-European knowledge systems. These systems have yielded a more integrated understanding of Europe's lands, its bodies of water, and its air. For example, geographers, map-makers, and the like "integrated" Europe on paper via finely-detailed coordinate grids and models that defined Europe's landscapes and its skies.<sup>25</sup>

In addition, from the late nineteenth century to the present, nature conservationists have asserted the detrimental effects of the relationship between infrastructure and ecological habitats. "One of the most important issues is fragmentation of landscapes by human activities and infrastructure—a major cause of the alarming decrease in many European wildlife populations," noted European Environment Agency director Jacqueline McGlade and her Swiss colleague Bruno Oberle in a 2011 report.<sup>26</sup> Historically, conservationists have responded to these assertions by protecting and restoring nature in the form of nature reserves and ecological

connections. For example, they built fish ladders to bypass hydro-power dams; ecological corridors to traverse cultivated fields; and ecoducts (animal viaducts) to enable wildlife to cross highways. Indeed, the construction of national ecological networks began in the 1970s. And, in the 1990s, work commenced on a pan-European ecological network for the transcontinental circulation of plants and animals. Increasingly, ecological system-builders talked about these networks in terms of constructing “green infrastructure.”<sup>27</sup> In Part III, we investigate how system-builders tried to valorize, understand, and build their natural environments—and how this changed Europe's land, water, and air.

## *The Grid of History*

On the surface, our modern world of technology appears smooth and ever accelerating, propelled as it is by promises of connectivity and universal access. Our purpose in this book is to delve beneath this surface of technology—technology that is almost mythically complete, modern, and irrefragable. After all, the infrastructure of the modern world—indeed, infrastructure throughout history—usually remains invisible. Often, only a critical event—an electricity blackout or gas crisis, a food emergency or an ecological upset—reveals the infrastructure that makes it all work. These events expose asymmetries and dependencies, ruptures within our otherwise “connected” lives. In this book, we aim to make visible the hidden infrastructure dynamics of our modern world, to examine how these dynamics came into being.<sup>28</sup>

Indeed, our book portrays Europe's infrastructure transition as embracing several interrelated processes: the building of infrastructure, the construction of economic and military systems, and the manipulation of Europe's natural environment. In charting the making of modern Europe, most historical studies focus on one of these processes only: either physical infrastructure or economic systems, military systems or the environment. Juxtaposing these processes allows us to examine the interactions between them, in all their complexity and unpredictability. These interactions, we claim, also produced the vigorous infrastructure dynamic of Europe's remarkable evolution and, at times, its devolution.

Interweaving these four processes takes us into many different fields. For example, our history traces railroad projects all the way from Chevalier's early-nineteenth-century visions to Operation Barbarossa, the Nazis' failed invasion of Russia. We chart telecommunications from Napoleon's optical telegraphs to the dotcom crash of 2001. We look at developments in energy from early logging networks in Scandinavia to the construction of Europe's organic-chemical industries along its transcontinental and overseas oil networks. We analyze food chains from ice-cooled butter transports on the Trans-Siberian Railway to the Aboriginals' walk-out at a Vestey company meat farm in Northern Australia. We look at changes in Europe's natural environments, from satellite imaging of land uses to acid rain in Scandinavia.

It is by presenting these diverse yet interrelated processes, system-builders, and events that our history of Europe takes shape. To paraphrase historian Norman Davies: we use the history of the grid to reinterpret the grid of European history.<sup>29</sup>



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CONNECTING EUROPE