Thus, in hamlets deprived of
The abundant, civilizing waters running all around them,
Does poverty, ignorance, and envy reign.
The iron arteries of the beneficent network
Over every piece of soil affected and crossed,
Carry life through the social body.
Every city is becoming a vast reservoir
From which come great flows of wealth and knowledge.¹
Lachembeaudie, 1855

A poem hailing the civilizing effects of railways was but one of myriad expressions celebrating the benefits of the railway age. Such enthusiasm—quaint perhaps to modern ears—takes us back to the heroic phase of steam locomotion and iron roads, to the marvel of steam and speed. To better appreciate that era, historians need to revisit not only the archives but the territory of historical geography also. For French historians, this means returning to the methods of Marc Bloch and Fernand Braudel that combined history and geography in comparative perspective.² The call to “return” is apt, for while social scientists are pursuing questions of spatiality, historians continue to move in other directions.³ Consequently, geographic aspects of the past have all but disappeared from the historian’s agenda, as a review of articles in leading historical journals shows clearly.⁴ True, allusions to “space” and “sites” are common today, but these terms typically are either metaphors or indefinite locations for the study of cultural practice.⁵ Over the past decade, neither "geography" or "spatial" have appeared in The American Historical Review’s topical indexes. As Duke historian Martin Lewis Duke recently put it: "Few historians pay explicit attention to geography, and few geographers give more than a token nod to history. Yet some of us would stubbornly concur . . . that historical processes can only be understood as they take place geographically, and that geographical patterns can only be explained through historical analysis."⁶ Meanwhile, on the other side of the disciplinary divide, Rhys Jones laments the lack of historical depth in human geography, which in turn reifies postmodern claims concerning the historically disconnected and self-referential present.⁷ To “bridge the divide,” writes historical geographer Alan Baker, we need to "deepen the historical awareness of geographers and to widen the geographical consciousness of historians."⁸ We agree. The time for spatial history has come.
To illustrate this, we draw on our larger investigations into the study of railways in Britain and France to exemplify the blending of historical research with geographical thinking and new methods of spatial analysis. With our sights on Britain and France, we use comparisons to identify similar and differing patterns of change and interconnectivity. In so doing, we apply new tools that deserve a place in the historian’s kit, namely the digital technology of geographic information systems (GIS) and spatial statistical analysis. Thus equipped, we examine railway expansion and its effects on rural society in new ways. In contrast to studies of railway policy and economic change that focus on the nation as a whole, we study national patterns in relation to regional and local differences, the better to describe uneven economic, demographic, and cultural change across time and geographic space. At the national scale of comparison we identify broad contours of uneven geographic development, the role of railways in restructuring rural economies, shifts in regional economic inequalities, and geographic patterns of population change. Developments at the international scale also enter the analysis: the decline in transport costs and the productivity of American agriculture intensified competition, generating an intense phase of globalization in foodstuffs and the consequent agrarian crisis that struck British and French farmers in the last quarter of the nineteenth century (ca. 1873-1896). Finally, whereas previous studies tend to concentrate one or another aspect of the story, be it railways, demography, agriculture, or economic developments, the aim here is to bring these aspects together and to illuminate the interconnections among them.

At the regional and local scale, we question a commonly held view that the coincidence of railway expansion into the countryside and increasing rural out migration is evidence that railways accelerated rural depopulation and hastened the decline of rural communities. Not so persuaded, we pursue another hypothesis, one that a few scholars have mentioned but none have pursued. Rather than hollow out the village economy, the transforming effects of rail transportation arguably gave rural communities a second chance at stability or limited growth while opening new cultural horizons as well. Accessible rail transport stimulated commerce and created new economic opportunities for marketing of agricultural production and for finding employment in retail commerce, extractive industries, logging for railway timbers and ties, or in service trades such as the horse-drawn carriage of goods to and from rail stations. Consequently, rural communities with ready access to rail service might enjoy a period of revitalization, an economic stimulus
that slowed the pace of rural depopulation. And when the agrarian depression struck in the later 1870s, the economic benefits of rail service likely slowed rural out migration, at least in certain areas.

Impermanent as revitalization was, cultural effects would endure because new economic opportunities made literacy and schooling appear to rural inhabitants more advantageous than before. In addition, the increased circulation of newspapers and mail made rural inhabitants aware of events and jobs beyond the sound of the village bell. Indeed, however modest the impact of railways was on the performance of the economy or the agrarian sector as a whole, their effects on rural communities and farmers appear quite significant when the problem is studied not in the aggregate but in terms of varied spatial patterns of uneven geographic development that shifted over time.12

Uneven Development. The incidence of rural decline and rural revitalization are aspects of what social scientists term uneven development. Geographer Neil Smith has equated this unevenness with the shifting geography of modern capitalism, a process through which “space” is produced through economic change.13 Rather than a fixed and neutral container for human activities, “space,” argues Smith, refers to clusters of natural resources and sites of production that are integrated into the capitalist system. Neither static or neutral, these “spaces” are continually in flux—developing, declining, expanding, and contracting in step with the amount of capital investment and level of production in a specific territory at a given time.

Another helpful perspective can be found in the work of Doreen Massey who opened up the determinist approach to spatial political economy developed by Lefebvre, Harvey, and Smith. In her classic study of Britain in the late twentieth century, *Spatial Divisions of Labour: Social Structures and the Geography of Production* (1984, 1995), and in subsequent articles and her most recent book, *For Space* (2005), Massey defines “geography” as the study of social relations stretched over space and through time. Incorporating culture, gender, race, and open historicity in her recent studies, she argues that “places” are not static but active and historically conditioned localities. Formed by layers of past investment and the spatial division of labor that such investment produced places—be they industrial, agrarian, or administrative in historical character—continue to shape and constrain their own diverse paths of development. These structural determinants, however, need not be decisive. Political actions, she adds, can
intervene to modify historically-conditioned spatial relations. Space and place have contingent trajectories and are always undergoing material reconstruction and cultural representation.

**The Big Picture: National Patterns of Railway Expansion.** Uneven economic development in nineteenth-century Europe, France, and Britain leaps out from maps of the era showing the expansion of the steam-powered railway system. As fixed capital of unparalleled cost and as construction projects of unprecedented size and complexity, railway systems propelled a second phase of industrialization and transformed social and physical landscapes. As a system of transport that altered economic relations and cultural perceptions, railways helped determine the livelihoods of urban and rural inhabitants. Time itself was transformed in the sense that railway scheduling brought about the standardization of time over regions and nations. Perceptions of time changed also as time came to be measured out in minutes and seconds; even a minute late was enough to miss the train. Space, too, changed as high-speed rail transport served to shrink geographic space, connected remote areas to a central network, and transformed rural and urban landscapes through the construction of rail lines and stations, the intensification of market forces, and consequent changes in the use of land. As for speed alone, in the early nineteenth century, fast horse-drawn coaches were thought remarkable to reach Edinburgh from London in 69 hours. By the 1880s the same voyage by train took only 10 hours.

**The Growth of Railway Systems over Time.** In Britain and France the timing and pace of railway expansion followed different but converging paths, marking the ways that differing political economies modernized. In Britain, the early, explosive growth of the rail system in the 1840s and early 1850s was followed by a second round of brisk expansion in the 1860s and a more gradual pace of growth thereafter. In France, steady advance in railway construction was the rule. Turning upward in the mid-1840s, the pace of expansion picked up and sustained itself from the 1850s to the early 1880s, with the noticeable break during the Franco-Prussian War. Thereafter, growth subsided during the industrial and agrarian contractions of the 1880s and early 1890s. By the end of the century, the two rail systems were converging in terms of the length of their main lines in operation. By then, it appeared, the French tortoise was closing on the British hare.

**Figure 1. Kilometers of Railways per 100,000 people.** (about here.)
The growth of rail networks in England and Wales bore witness to the conquest of space by private enterprise during the industrial era. True, parliamentary authority was needed to permit companies to construct lines, and at times rail company proposals that appeared inadequately planned and financed failed to win approval. Parliament also rejected other schemes that met with successful opposition, as when the plan to extend a line in the scenic Lake District was defeated by preservationists in 1887. Parliament also exercised regulatory authority over all lines, authority it tightened beginning in the 1870s. Nonetheless, all British railways were constructed and owned by privately owned joint-stock companies. Their first and foremost interest was profit, so the securing of money-making routes was of utmost importance.

The competitive search for profitable routes is captured by a series of maps showing the growing extent of the rail network from 1844 to 1914. (See Map 1.) The geography of the system in 1845 and 1854 shows an emerging network that linked major cities, ports (Liverpool and Bristol), areas rich in coal and iron (Newcastle & Cardiff), and the centers of manufacturing such as Manchester, Birmingham, and Leeds. The rise in construction during the 1860s and early 1870s considerably enlarged the network and reached increasingly into hitherto neglected rural areas. A company’s development of rural branch lines—many, if not most, deemed unprofitable—was an effort to capture additional traffic for lucrative trunk lines and to limit or prevent rival companies making inroads to their territorial domains.

For small communities, branch lines that brought rail service near to hand were benefits much sought. A remote town newly endowed with a station was well poised to become a thriving market center in which farmers would find growing opportunities to sell their produce and to which village job seekers would likely turn first to find work. This was not a pipe-dream. By 1876 in England and Wales, there were some 4,190 rail stations in operation, and relatively few rural districts lacked a rail connection of some sort.

Map 1. The Growth of Railways in England and Wales, 1845-1914. (about here.)

Another feature of a second round of expansion in the 1860s was the successful conquest of rugged terrain. Thanks to the increasing power of locomotives, the replacement of iron rails by steel, improved coupling and braking systems, and other technological improvements, rail companies were able to push
farther into the countryside and upward, over the hills and mountains into remote areas, opening new lines that incorporated additional resources and populations into the expanding rail network and national markets.

**Map 2. Mean Slopes of Terrain Crossed by Rail Lines, 1830-1855 and 1856-1876** (expressed as the average percentage change over a rail segment). (about here.)

Prominent in this respect were the upland regions in the Northwest comprising the Lake District and mining areas near the border with Scotland. In the Southwest, new lines negotiated steeper terrain in Devon and Cornwall. Even more striking developments were underway in Wales. Whereas the rugged, interior terrain of Wales was all but untouched by rail up to the 1850s, thereafter a major program of railway construction was devoted to conquering its hills and mountains. Not surprisingly, the slate mines in northern Wales and the great coal mines in the southern valleys near Cardiff were the first areas to be well served by rail transport. To a lesser degree, the agrarian regions of Central Wales were drawn into the expanding rail network as well, beginning in the 1860s.

**France.** A comparison with France brings out the particularities of a rail system forged by a mixture of state tutelage and private enterprise, government and private financing. From 1828 to 1841, the first few railways in France stemmed from local initiatives with minimal involvement of the central government.20 From 1842 on, however, it was the French state that shaped the national system. State engineers of the *Ponts et Chaussées* (Department of Bridges and Highways) designed a national network that imitated the improved highway system of the eighteenth and early nineteenth centuries. At the outset, all rail lines conceded to private companies were to lead to Paris, forming a radial network connecting the capital with major ports and economically important regions. Only in the 1870s did lateral lines with east-west linkages begin to appear. (See Map 3.) As first stipulated in the Law of 11 June 1842, financing rail construction was a joint affair, shared by the state and private companies. Beginning in 1859, the French state encouraged investment in private rail companies by guaranteeing an attractive rate of return, virtually eliminating risk for investors holding stock on lines authorized by the government.21 Then, at the end of the 1870s, after the defeat by Prussia (1870) and the bloody repression of the Paris Commune (1871), the liberal Third Republic committed itself to an enormous expansion of railways, which it saw as vital step toward modernizing its large but stagnating rural economy. In 1878, the Minister of Public Works, Charles Freycinet, initiated a
program of expansion for both the main system and a newer, secondary network consisting of “lines of local interest.”


By 1914 the primary system had grown by some 8,000 kilometers. Meanwhile the secondary network gradually came into operation. After a slow start in the 1880s and 1890s, it grew rapidly from 1900 to the Great War, after which it peaked at 20,291 kilometers in 1928. (See Figure 2.) It was understood from the outset that local lines were apt to run continual deficits that would have to covered by subsides from the state and localities. Indeed, the political calculus behind this expansion are worth emphasizing. The government, prompted by pressure from regional and local interests where rail service was scant or non-existent, recognized that the main network then in service had aggravated disparities among various regions of France, favoring the North and northeast over the Midi (South) in particular. Implementing the Freycinet program, including the secondary network of small branch lines, was thus an act of joined political will from above and below. In the democratizing Third Republic, no region was to be left behind. By 1920, much of that pledge had been fulfilled. (See Map 3.)

Figure 2. The Growth of the French Secondary Rail Network. (about here.)

In 1890, eighty to ninety percent of the French rail system was in place. The recognized disparities of rail service and associated economic benefits were being reduced, a process that would culminate in the 1920s. (See Map 3.) The disparities remaining in 1890 stand out when a geo-statistical technique is used to identify clusters of two kinds: cantons that enjoyed little or no proximate access to rail service and those with uncommonly high levels of service. Map 4 shows that under-served areas (in blue) were prominent in central Brittany and more generally through regions south of a line running from Saint Mâlo to Geneva, the line commonly used to demarcate the developed North from the less developed South.

Map 4. Geographic Clustering of Rail Transport in 1890. (about here.)

Favored regions (in red) stand out, too. As a port and entrepôt for the wine trade, Bordeaux joined the Montpellier-Marseilles area as urban centers in the Midi that were exceptionally well served by rail. A hub for the trade in mass-market wines with large port facilities within arm’s length, the Montpellier-Marseilles area connected world and regional markets to Lyon and the North via a regional junction of lines at Chalons-
sur-Saône. In additional to the Paris region, Tours and the textile center of Evreux were well-endowed with rail service, as was the agglomeration of industry and highly productive agriculture running from Paris to Lille and Calais.

**Map 5. The French Rail System in 1890 and the Challenge of Topography.** (about here.)

While some regions were “left behind” because they lost out in the fierce competition for rail transport, other regions in the disadvantaged south were victims of challenging topography and an associated history of poor communications and sparse capital investment. The effect of these disadvantages is reflected in Map 5 where the rail lines existing in 1890 are overlaid on a digital terrain model. Before the 1860s, when technological improvements such as steel rails, more powerful locomotives, and effective coupling systems took hold, the hilly and mountainous regions of the Massif Central, Pyrenees, and Alps were deemed all but inaccessible to steam-powered locomotion. In the southern Alps, things began to change in 1875 with the opening of a line from Marseille to Gap. In the northwest, Brittany saw its first rail service to the cities of Rennes and Nantes in the late 1850s, with lines along the perimeters of the peninsula opening in the 1860s and connections to some parts of the interior in the 1870s and 1880s. In the Indre, the Black Valley immortalized in George Sands’ rustic novels entered the railway age in 1882 when a branch line from Châteauroux was opened to La Châtre. Hence in 1890, clusters of upland cantons in the South and in the Alps still lagged well behind the developing north and northeast in the transport revolution. This was the geography of uneven capital development that the Freycinet program was just beginning to reduce. (See Map 6.)

**Map 1. Increase in Rail Accessibility, 1890 to 1910.** (about here.)

**Railways and Rural Economic Change.** The arrival and growth of rail service in the countryside and remote districts reinforced or diminished economic disparities among regions and localities in complex patterns of change and inertia. In well served areas, rail transport tended to stimulate commerce, extractive industries, and agriculture, depending upon the mix of endowments an area possessed. In regions where service was remote or non-existent, inertia and decline were apt to worsen, dramatized by rising rates of out migration and de-population, as happened in the Lodève region of Languedoc. There, de-industrialization
and the rise of viticulture and the attendant risks of monoculture comprised but one of many variants in the shifting spatial political economy associated with railway expansion.29

Besides the accessibility of rail transport, changing patterns of uneven development were conditioned by other circumstances affecting regions and localities, among which prevailing market conditions were usually predominate. In agriculture, the transport revolution increased competition at the international level, especially in wheat. The consequences of globalizing markets in foodstuffs flowed downward through markets at the national and regional scales to arrive at the farm gate. Beginning in the 1870s, the arrival in European markets of vast quantities of cheaper wheat from the United States saw prices tumble. With farm costs remaining stable or rising, and with a series of poor harvests striking English and French cereal farmers, agriculture fell into a long depression (ca.1876-1896). British and French farmers struggled through a first crisis of globalization, and those who survived began to breathe easier only at the turn of the century. In this sense, what railways—and steamships—gave with one hand, they often took away some years later with the other, forcing even favored communities to adapt to changing market conditions.30

In Britain, the shifts toward concentration and specialization in extractive industries and agriculture began to take hold in the 1860s. Rail transport that reached into remote areas opened a variety of new economic opportunities.31 Coal and other natural resources in previously inaccessible areas were now be brought into production. The stone quarries of Leicestershire, the slate quarries of northern Wales, and the lead mines of Shropshire and Central Wales are all examples. In the eastern Midlands, railways revitalized the mining of iron ore and led to the establishment of smaller centers of iron production in rural Northampton as the larger and older sites in Staffordshire and Derbyshire faced the exhaustion of local ores.32

In agrarian regions, railways revitalized local agriculture by opening up distant markets and stimulating local production. By the 1870s, thanks to the speed and lowered cost of rail transport, the trade in perishable food was rapidly expanding into more distant regions to meet the rising demand in growing cities. Fresh vegetables such as peas from Essex and strawberries from Hampshire found their way to eager London tables, as did meat from as far away as Scotland. Railways benefited stock raising by making improved animal feed readily available, and farming, by bringing fertilizing night soil from large cities to
farms beyond the range of horse-drawn carting. In addition, railways fostered viable alternatives to grain production in livestock and dairy farming when the fall in grain prices in the 1870s ended Western Europe’s golden age of wheat farming and a prolonged agrarian depression set in.

The depression worsened in the 1880s, and a recovery in wheat farming—the sector most affected—made little headway until the first years of the twentieth century. Meanwhile, the growth in stock raising and the fresh-meat trade marked the successful adaptation to new market conditions by some farmers, while others shifted to dairy farming in response to the rising urban demand for butter and especially fresh milk. By the late 1870s, a decade or so before modern refrigeration came into general use, fresh milk from as far as Dorset, Wiltshire, and Somerset helped supply the booming London market, a trade further augmented in the 1880s and 90s by the increasing numbers of dairy farms in the West Country (Dorset, Devon, and Gloucestershire) and in western Wales. Similarly in the North, railways enabled Yorkshire farmers to sell their milk in Leeds, Newcastle, and Liverpool. (See Map 7.)

**Rural Patterns of Change in France.** In agriculture at mid-century, family farming committed to polyculture remained typical in most of France, and the production of cereal crops—with wheat increasingly predominant over rye and other lesser grains—was considered the base of agrarian production in nearly every region. Beyond family farming, the production of cereals favored an increase of large farming units that utilized both hired, as compared to family, labor and greater capital. In the second half of the century, however, family or peasant farming expanded, and large farming declined as the growth of stock raising outpaced the growth of cereals in response to rising demand for meat and dairy products and the declining prices of wheat. More intense in some regions than in others, this general transformation entailed a major change in land use: by 1929, 66 percent of agricultural land was devoted to pasture and animal husbandry; 34 percent, to wheat and other crops—the reverse of the proportions extant in 1862 and much more extensive than the shift from arable to grassland in England and Wales. Meanwhile and more significantly, the pronounced gap in 1840 between the rich North and the poor South had diminished. Indeed, by 1900 the growing productivity of southern agriculture surpassed the northern rate, bringing about a convergence in yields and total agrarian output per worker.
In this convergence, expanding rail transport facilitated the further development of regional specialization geared to provisioning distant urban markets. The vegetable and fruit gardens established in Marseilles and Perpignon before the 1840s were greatly expanded after the arrival of railways. In 1861, for example, the Paris-Lyon-Mediterranean Rail Company opened with considerable success a high-speed express service to transport fresh produce from the Midi to Paris. In plateaus of the southeast, rail transport prompted the creation of entirely new farming areas to produce perishable fruits and vegetables. In regions of the north, the center, and central east, dairy farming and the fresh-meat trade expanded. Areas bringing fresh milk and meat to Paris, for example, extended into Lower Normandy, the Loire Atlantique, the Limousin, the Nièvre, the Allier, and even further afield, thanks to the increasing speed and diminished cost of rail transport. In the late 1860s, François Jacquim wrote of the astonishing growth in Paris markets, with unprecedented quantities of wine, metallurgical products, and live animals arriving by train. In the cattle trade, the geography of increasing regional specialization was captured by the statistical service of the French government in a map showing the density of cows by department in relation to the national average in 1882. In regions of the west and the center of France, a notable expansion and intensification had occurred since the advent of rail transport.

As with cattle, so with wine, the arrival of rail transport stimulated a remarkable rise in production in more distant regions. Production in the Beaujolais, for instance, shot up after rail transport arrived in 1855. Even more striking was the vast increase in the old province of Languedoc. Astonished, Jacquim described the much expanded wine industry as “the foundation for unparalleled wealth . . . . There is perhaps no other region in Europe for which the railway had occasioned more affluence and prosperity than in the Department of the old Languedoc.”

The Agrarian Depression, ca. 1876 to 1896. As international transport costs fell, vast amounts of cheaper grain—especially wheat—from the American heartland landed in European markets, joined eventually by growing quantities from Canada, Australia, and Russia. Accordingly, prices fell lower and lower. Farmers who had adapted themselves to intensifying domestic competition now faced the greater challenge of relentless competition from abroad. In response to falling prices in cereals and steady or rising prices for fresh meat, French farmers in northern Burgundy and Normandy, and English farmers in Wiltshire, Dorset,
and Derbyshire, to name some prominent examples, increasingly shifted to stock raising or dairy farming, converting arable fields into pasture and lowering their wage bill since cattle farming and dairying required fewer hands than cereal farming.

In response to the crisis and pressure from agrarian interests, the governments of Britain and France adopted different policies. In Britain, the government held to its policy of free trade, leaving landlords and farmers to adapt to market conditions and intense international competition as best they could. In France, a long history of state intervention prevailed in the form of protective tariffs and a vast program of railway expansion.

**Rail Service and Net Migration in England and Wales.** Although agrarian distress accelerated rural depopulation as a rule, the rate of rural depopulation was apt to differ depending upon regional and local conditions in agriculture. Indeed, the gains and losses due to net migration from the 1860s to the 1890s varied considerably across England and Wales. (See Map 8) In rural areas, the highest levels of out migration were located in the agrarian zones of southern England and central Wales. The affected districts lay within a band running from the tip of Cornwall in the southwest to East Anglia and Lincolnshire in the East, with Central Wales and Gloucestershire forming an isthmus. Generally, out migration in these areas peaked in the 1870s and then subsided in the following decade. There were notable exceptions, however: in central Wales and some scattered clusters in East Anglia and Lincolnshire, high rates of out migration continued into the 1880s.

**Map 8. Patterns of Net Migration 1861-1891. (about here.)**

To the extent that rail service bolstered the economies of rural communities, accessible service was apt to stem migration from rural areas. In the case of out migration (“negative net migration)” the positive relationship is thus: *as railway accessibility increases, out migration (negative values) tends to diminish.* To test the proposition, we turn to geographically weighted regression (GWR).

The model under study posits that variations in net migration results in part from the interactive effect of three variables: 1) rail density (an indicator of accessible service); 2) distance from an urban population center; and 3) the relative ruggedness of the terrain. The lack of a statistically significant fit for the 1861-71 decade, together with the statistically significant fit for the two following decades, suggest that
the influence of rail transport on migration took hold some ten years after rail lines first began to reach the majority of rural districts. The results for the 1870s and 1880s suggest that rates of rural out migration during those decades were reduced in rural districts where higher levels of rail transport were available. Mapping coefficients for rail density makes this more specific.

Table 1. GWR Regression results

Percentage population change due to net migration = density of rail lines (kilometers of rail per square kilometer of district area) + rurality (distance to the closest city with 300 or more persons per square kilometer) + the ruggedness of terrain (standard deviation of a district’s mean elevation)

<table>
<thead>
<tr>
<th>Period</th>
<th>Statistical significance of rail density (p&lt;=.05)</th>
<th>R-square statistic for the regression</th>
<th>No. of districts.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1861-91</td>
<td>Not significant</td>
<td>.24</td>
<td>595</td>
</tr>
<tr>
<td>1871-81</td>
<td>Significant</td>
<td>.42</td>
<td>606</td>
</tr>
<tr>
<td>1881-91</td>
<td>Significant</td>
<td>.39</td>
<td>616</td>
</tr>
</tbody>
</table>

(See also Table 2 in the appendix.)

Map 9. The Effect of Rail Density on Net Migration 1871-1881. (about here.)

As displayed in Map 9, the positive relationship between rail transport and net migration appears to have been greatest in the areas shaded in dark blue: in the rural districts from Bristol to Penzance in the southwest, those in a band to the north and west of London, others in the far northwest, and still others in a Welsh triangle covering parts of the central region and all of the south. In sum, during the 1870s (and 1880s), in rural regions that were already loosing population, rail transport tended to diminish the rate of rural depopulation and to a degree that varied geographically, being greater in parts of central and southern Wales, the Southwest, and the far Northwest. Given the agrarian depression during these decades, the commercial benefits of accessible rail service in rural communities arguably reduced the pace of rural depopulation to a greater or lesser degree.

Rail Service and Population Change in France. For France, where data on net migration is unavailable, a comparable analysis can be undertaken by estimating the effect of rail service on population change from 1861 to 1892. As with Britain, the effects of rugged topography and distance from a center of urban population are combined with measures of accessible rail service. But for France rail service is defined by two variables: the density of rail stations in a canton –the equivalent of an English registration district—and
the shortest distance from the center of a rural *canton* to an urban *canton* with a population density of more than 120 persons per square kilometer.

Map 10 shows that high rates of de-population (-32 to -13 percent) were clustered in the peripheries of the country: in Normandy, mountainous and upland regions in the south, southeast, and the Ardennes, the Aube, Côte d’Or, Haute-Saône, and the Jura; and in inland cantons northeast of Bordeaux (the Charente). Modest to high levels of population increase occurred in the Center, in the coastal and inland cantons of southern Brittany, the Bordeaux area, and in the Mediterranean basin; in uplands of the Vosges; in the industrial areas in the Northeast (the Pas-de-Calais and the Nord), and in the Paris agglomeration.

**Map10. Percentage Population Change in Cantons from 1861 to 1892 (about here)**

The GWR regression analysis captures important aspects of this geography of widely varying population loss and increase. Overall, it accounts for about 40 percent of the variation in population change. More specifically, it attests to the differing spatial relationships among demographic change, rail accessibility, terrain, and rurality—i.e., remoteness from urban areas. (See Table 3 in the Appendix.) Mapping the local \( R^2 \) values shows that the statistical fit between the model and the actual data varies from poor to moderately good, depending upon region. It was poor in Normandy, the Pyrenees, Langedoc, the Alps and the southern Jura; and relatively good in the Northeast (including Paris); in Brittany, the West and Southwest; in the Lyon area Burgundy; and in the Vosges. (See Map 11.)

**Map 11. Percent Population Change, 1861 to 1892: distribution of local \( R^2 \) values (about here)**

As for the effect of rail accessibility, the high positive values of the parameter estimates for station density include large clusters of *cantons* below the Saint Målo – Geneva line. (See Map 12.) Apparently, the state’s effort to make rail service more accessible to the traditionally disadvantaged South was beginning to have an impact.

**Map 12. Percent Population Change, 1861 to 1892: distribution of regression coefficients of the variable distance to closest rail station in kilometers (about here)**

**Conclusion.** The benefits—and costs—of the Railway Age clearly affected the lived experiences of people in French and British rural communities. Communities with little or no access to rail transport likely found themselves passing through stages of stagnation, de-population, and decline to a greater degree than...
communities favored by being within a half-day’s walk or closer to a rail station. In agrarian villages thus favored, improved capacities for marketing local foodstuffs to meet growing demand in cities stimulated production, especially in livestock and perishables such as fresh milk and butter, vegetables, and fruits. Meanwhile, as employment in the contracting sector of cereal farming declined, new jobs in carting, logging, blacksmithing, or other artisanal and service trades helped stem out migration, as did mining in rural areas where coal or other minerals could be more fully exploited once rail service was established. Although railways and the transport revolution it helped to power engendered intensified domestic and international competition, farmers benefiting from proximate rail service had better options to adjust to new market conditions in various ways.

In these and other ways, rail transport helped shape patterns of change and persistence in uneven development, agricultural, and rural population from the 1850s to the eve of the Great War. Although much remains to be done, this progress report, we think, substantially enhances the understanding of the Railway Age. It also demonstrates that a spatial history which blends history and geography serves well to illuminate new, additional complexities of historical change.
Acknowledgements

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Appendix. Figures and Maps (see separate file)

1 From the poem “La Vapeur,” in Fables et Poésies de Lachambeaudie (Paris, 1855), 202, translation by Schwartz. The poet was taking up the Saint-Simonian enthusiasm for railways and their economic and cultural benefits. On the Saint-Simonian influence on Lachambeaudie and other poets, see Lodewijk de


4 With three or four notable exceptions, articles published since 1980 show a remarkable lack of geographical analysis or even geographical interest. An internet search in these journals produces a mere handful of articles, as well as a special issue of the *The Journal of Interdisciplinary History* in 2002 on space in medieval and early modern Europe. However, the articles use “space” in the sense of a cultural site or undifferentiated “public space.” The search terms were “geography” and “space;” and the journals reviewed were *The American Historical Review, The Journal of Interdisciplinary History, The Journal of Social History, The Journal of American History, The Journal of Modern History, Past and Present.*


10 By and large, this view is based more on assertion than on systematic analysis of local communities and spatial variations over time. In this respect they share the perspective of economic historians who focus on *the national aggregate*, on the effects of railways on economic growth, modernization, and agriculture overall, with little or no attention to the temporal geography of regional and local variations.


12 In studies of railways and their consequences, considerable debate arose in response to Robert Fogel’s argument that the contribution of railroads to economic growth in the United States was a good deal more modest than generally thought. Since then scholars have tested his claim in different European countries with varying results. A point of agreement in the field is that in densely settled regions such as the American East and Western Europe rail transport simulated commercial expansion and tended to reinforce existing


16 Ambleside Railway hearings, March 15–21, 1887, House of Lords Library, *House of Commons Evidence*, 1887, vol. 1. A committee usually made up of members from the Lords and the Commons, heard evidence from the company proposing railway construction and from interested third parties; then it made a determination as to whether the proposed scheme should be set aside or be forwarded to the House for passage of an authorizing bill. The successful opposition to the Ambleside proposal was led by a group determined to preserve the scenic Lakes from further degradation by railway tourism. Though not its leader, John Ruskin, the eminent art and literary critic, was a member of the group. A severe opponent of “railway vandalism,” he lived in Brantwood, a residence with a spectacular view on nearby Coniston Water. Ambleside itself was within walking distance of the former homes of William Wordsworth in Grasmere Village and Rydal Water—treasured sites among the era’s romantic ecologists, characterized derisively by the proponents of the scheme as self-interested “sentimental gentlemen.” For good accounts of the roles of Parliament and the British state with regard to railways, see Frederick S. Williams, *Our Iron Roads: Their History, Construction and Administration* [1884] (London, 1968) and Jack Simmons, *The Railway in England and Wales, 1830-1914*, vol. 1. *The System and Its Working* (Leicester, 1978).

17 Simmons, *The Railway in England and Wales*, chapters 3 & 4, and 166-178. The profit motivation of privately held railways in Britain is also treated in Frank Dobbin’s excellent comparative study of railway policy, *Forging Industrial Policy. The United States, Britain, and France in the Railway Age* (Cambridge:Cambridge University Press, 1994).


20 A common function was the carriage of coal or other raw materials to sites of manufacturing, the first example being the line transporting coal from mines at Andrézieux to metalworking firms in Saint Étienne. François and Maguy Palau, *Le rail en France: Les 80 premières lignes, 1828-1851*. (Paris, 1995): 18, 20-21.


22 This paragraph draws on Schwartz’s forthcoming article “Rail Transport, Agrarian Crisis, and the Restructuring of Agriculture: France and Great Britain Confront Globalization, 1860-1900”, *Social Science History* 34:2 (June 2010).


The map displays clusters of spatially-autocorrelated levels of rail density across some 1,950 cantons of France in 1890. Mapping the spatial statistic called Local Index of Spatial Autocorrelation (LISA) highlights regional disparities between contiguous areas where rail service was uncommonly dense (shaded red) and those where it was virtually non-existent (regions in dark blue).

This geography of disadvantage corresponds somewhat with the geography of share-cropping that was so prevalent in parts of the West and Southwest. See Jonathan Liebowitz, “Tenants, Sharecroppers, and the French Agricultural Depression of the Late Nineteenth Century,” Journal of Interdisciplinary History, 19 (1989): 432-34.

Bernard Cima, Histoire Chronologique des Chemins de Fer Français. (Menton, n.d.), in his atlas on CD-ROM, provides an extremely useful year-by-year chronology of the openings (and closings) of main lines and stations, the length of lines so affected, and accompanying maps from 1827 to 200. Despite the opening of lines in Brittany in the 1860s and 1870s, Caron, chemins de fer 1750-1883, 554-5, suggests that reliable service in many parts of the peninsula was well established only in the 1880s.

The interesting debate over the extent to which diversities were altered or modified is a problem that we are working to clarify. The sharpest differences are those between Roger Price and François Caron. Price, Modernization, p. 6, concludes that railways, even after the Freycinet plan came into being, diminished rural isolation but aggravated pre-existing economic inequalities among rural regions. Caron argues that the old disparities between the rich Northeast and the poor South were attenuated, and that some of the poorest regions caught up: chemins de fer, 1750-1883, p. 572.

There the flourishing textile center of Lodève, already facing decline in the 1850s, placed its hopes for revival on the Company of the Midi’s plan to establish a new route linking Montpellier to Paris and making Lodève a hub for traffic going north and south. When the Ministry of Public Works rejected the plan in 1862, the city’s industrial future was foreclosed. Christopher H. Johnson, The Life and Death of Industrial Languedoc, 1700-1920 (New York, 1995): chapter 7.

The “Great Agricultural Depression” portrayed by Rowland E. Prothero (Lord Ernle) in his English Farming Past and Present (1912) no longer seems as generalized and stark in the light of later research, beginning with T. W. Fletcher’s “The Great Depression in English Agriculture 1873-96,” Economic History Review, 2nd series 13 (1961): 417-32, which moderated the depth of the depression and re-defined its nature by differentiating declining crop production from stable or rising stock raising. More recent research has moved further in that direction to suggest, for example, that the incomes of landlords and farmers suffered more than laborers, while recognizing the need to explore regional variability in farmers’ responses to declining cereal prices. See Michael Turner, “Agricultural Output, Income and Productivity,” in E. J. T. Collins, ed., The Agrarian History of England and Wales. Vol. VII, 1850-1914, 2 vols. (Cambridge, 2000), I, Chapter 3 for the state of the question; and Bethanie Afton, “The Great Agricultural Depression in the English Chalklands: The Hampshire Experience,” Agricultural History Review 44 (1996): 191-205 for a regional study showing one variant of farmer response to declining cereal prices—a shift to grain production for animal feed instead of human consumption.


Toutain, ibid, 342-3; in England and Wales, the percentage of agricultural land under plow in 1875 was 57%; 41.1% in 1914. Calculated from Table 1, p. 2142 in E. J. T. Collins, "Conclusion," *The Agrarian History of England and Wales* Vol. 7, 1850-1914, *ibid*.


In his comparative study, *Forging Industrial Policy*, sociologist Frank Dobbin makes a strong case for this contrast with respect to British and French railway policy but does not pursue the question of actual implementation. Investigating the results of implementation at national, regional, and local scales is the primary object of our research.

This analysis was carried out with *GWR 3*, a copyrighted program by Martin Charlton, Stewart Fotheringham, Chris Brundson, and M. E. Charlton, Department of Geography, University of Newcastle, Newcastle upon Tyne. See their *Geographically Weighted Regression: The analysis of spatially varying relationships* (Chichester, 2002). Researchers interested in obtaining a license should contact Fotheringham, who has since moved to the National Centre for Geocomputation at the National University of Ireland at Maynooth (*stewart.fotheringham@nuim.ie*). Bandwidth is the number of contiguous aerial units (“nearest neighbors”) used to calculate the local regression estimates. The area units in this analysis are Census Registration Districts. The GWR program uses an iterative algorithm to determine the optimal number of units or cases.
Appendix. Tables, Figures and Maps.

Table 2. Geographically Weighted Regression: Britain, 1871-81
Percentage population change due to net migration in 1871-81 = rail density in 1876 (rail lines per square kilometer of registration district area) + rurality (distance to the closest urban district with 300 persons per square kilometer or greater in 1880 in meters) + ruggedness of terrain (standard deviation of mean terrain elevation in meters)

<table>
<thead>
<tr>
<th>Type of Multiple Regression Analysis</th>
<th>Ordinary least squares</th>
<th>Geographically weighted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases fit (N)</td>
<td>606</td>
<td>606</td>
</tr>
<tr>
<td>Adjusted r-square</td>
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<td>.42</td>
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<tr>
<td>Parameters</td>
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<td></td>
</tr>
<tr>
<td>Intercept</td>
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<td>.00</td>
</tr>
<tr>
<td>Rail density</td>
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<td>.05</td>
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<tr>
<td>Rurality</td>
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<td>.00</td>
</tr>
<tr>
<td>Terrain ruggedness</td>
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<td>.00</td>
</tr>
</tbody>
</table>

Parameters: Five Number Summaries of Regression Coefficients

<table>
<thead>
<tr>
<th>Parameter</th>
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<th>Lower Quartile</th>
<th>Median</th>
<th>Upper Quartile</th>
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<tr>
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</table>

Unlike ordinary least squares regression (OLS), geographically weighted regression (GWR) fits not one but a number of regression lines to the data, each line being the best linear fit for a spatial cluster of cases in the study area. To calculate the GWR results, a moving window proceeds across the study area, using an algorithm to determine the units that comprise each cluster cases to which a best-fitting regression line is fitted. The general aim of GWR is twofold: to determine whether there are spatially varying relationships of statistical significance among the specified variables for the study area; and, when such relationships exist, to provide a measure of the total variance explained by the independent variables (R²) and estimates of the coefficients for each term in the regression equation. The comparison between OLS and GWR results provides a good indication of the presence or absence of spatially varying relationships. The five-number summaries provide a range of the coefficient estimates. For study and interpretation, the mapping of GWR results complements the numerical summaries by offering a visual means of indentifying spatial patterns.

Table 3. Geographically Weighted Regression: France, Population Change, 1861 to 1892
Population change, 1861 to 1892 = rail station density (number of stations per square kilometer of cantonal area) + closest station distance + rurality (distance to the closest urban canton with population density greater than 120 persons per square kilometer) + ruggedness of terrain (standard deviation of the mean elevation of a canton)

<table>
<thead>
<tr>
<th>Type of Multiple Regression Analysis</th>
<th>Ordinary least squares</th>
<th>Geographically weighted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases to fit (N)</td>
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<td>Station density</td>
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<tr>
<td>Closest station distance</td>
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</table>
### Parameters: Five Number Summaries of Regression Coefficients

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Minimum</th>
<th>Lower Quartile</th>
<th>Median</th>
<th>Upper Quartile</th>
<th>Maximum</th>
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<tr>
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<tr>
<td>Closest station (in meters)</td>
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<tr>
<td>Rurality</td>
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<td>0.001034</td>
</tr>
<tr>
<td>Terrain ruggedness</td>
<td>-0.010577</td>
<td>-0.001694</td>
<td>-0.000219</td>
<td>0.001032</td>
<td>0.011019</td>
</tr>
</tbody>
</table>

### Figure 1. Kilometers of Railways per 100,000 people.

![Graph showing kilometers of railways per 100,000 people from 1827 to 1913](image)


Map 2. Mean Slopes of terrain crossed by rail Lines, 1830-1855 and 1856-1876.
(expressed as the average percentage change over a rail segment).

Figure 2. The Growth of the French Secondary Rail Network

Map 3. The Growth of the French Rail System, 1850 to 1920

Source: Rail lines digitized from Carte des chemins de fer française: SNCF, 1944, Bibliothèque National de France, Département des Cartes et Plans, Ge BB 368.
Map 4. Geographic Clustering of Rail Transport in 1890.
Map 5. The French Rail System in 1890 and the Challenge of Topography.

Map 6. Increase in Rail Accessibility, 1890 to 1910

Source: Rail lines digitized from Carte des chemins de fer française: SNCF, 1944.
Map 7. Railways and Rural Developments in England and Wales, ca. 1880

Effect on Net Migration of Rail Density (1876)

Rail Density Regression Coefficient

-0.24 - -0.04
-0.13 - 0.00
+0.01 - +0.13
+0.14 - +0.20
+0.23 - +0.74

Map showing the effect of rail density on net migration in England and Wales 1871-1881, with different colors indicating the regression coefficients.
Map 10. Percentage Population Change in Cantons from 1861 to 1892

Map 11. Percent Population Change, 1861 to 1892: distribution of local $R^2$ values from a GWR regression on station density, distance to closest station, distance to urban canton with population density of 120 inhabitants per square kilometer or more, and ruggedness of terrain (standard deviation of mean cantonal elevation)
Map 12. Percent Population Change, 1861 to 1892: distribution of regression coefficients of the variable distance to closest rail station in kilometers from the GWR regression described above.