

## **Transport as a causal factor in history**

### **A case study in new philosophy of history**

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#### **1 Transportation**

Innovations in transportation have had massive consequences in history. The development of a railroad network linking the western and eastern parts of North America created Chicago as a metropolis; mechanized warfare gave Germany decisive advantages in the early years of World War II; and the coming of steamboats to the Yangtze River pushed the process of economic integration in late imperial China. What can we learn about large-scale historical causation from study of transportation? This paper examines several important cases of historical change involving new transportation systems. It then considers several important questions: Do transportation systems have specific causal properties that are robust across a variety of social settings? What are the mechanisms that underlie these causal properties? Can the study of transportation shed light on important large-scale historical events or processes? It will be argued that transportation systems stand in an intermediate position within a scheme of “microfoundations” for causal explanations in history: reference to the specifics of the transportation system can serve as a microfoundation for a higher-level causal claim, and it is also desirable to provide a more refined microfoundational account of various of the system characteristics of a given implementation of a transportation technology.

## **2 What is the “new” philosophy of history?**

This paper, like the several upon which it builds, falls within what I would like to call a “new philosophy of history.” Why do we need a new philosophy of history? Because the subject is intellectually important, and because philosophy has made very little progress in this field in decades. The approach that I am taking in this body of work asks abstract questions about historical processes and historical knowledge, but it does not derive from the research traditions of the traditional philosophy of history. Instead, it takes its inspiration from the philosophy of science. I take the view that historians are attempting to provide rationally justified knowledge about the past. They are interested in identifying “significant” historical events or outcomes (e.g. the French Revolution, the outbreak of the American Civil War, the collapse of the Qing Empire); giving realistic descriptions of these events; and answering questions about the causes and effects of these events. The task of the philosophy of history as I will pursue it is to analyze and assess the practice of outstanding historians in order to uncover the assumptions they make about the goals of historical inquiry, the ways in which evidence, theory, and inference can lead to discoveries within historical disciplines; and to identify some of the conceptual and methodological difficulties that arise in the practice of historical investigation.

My guiding intuition is that historians implicitly define the rationality and objectivity of the discipline of historical knowledge; and philosophers can elucidate (and criticize) that ensemble of assumptions about historical inquiry and knowledge in a way that illuminates both the nature of historical knowledge and the ways in which current approaches may be flawed or partial. In other words, the philosophy of history can

function as a conceptual enhancement for working historians, and it can function as a source of rational criticism of specific methods or approaches within contemporary historiography. So we can learn a great deal about the conceptual and epistemic features of good historical explanation by giving close attention to these powerful innovative examples of current historiography.

### **3 Conjunctural contingent meso-history**

There is a body of work in history and historical sociology in which it is possible to identify the strands of a new paradigm of historical inquiry—what might be called “meso-history.” This work provides examples of strong, innovative macro-explanations that give more compelling and nuanced expression to this approach to historiography than past macro-history. I characterize this paradigm as “conjunctural contingent meso-history” (CCM), and I argue that this approach allows for a middle way between grand theory and excessively particularistic narrative (Little 2000). The paradigm recognizes historical contingency—at any given juncture there are multiple outcomes that might have occurred. It recognizes the role of agency—leaders, inventors, engineers, activists, and philosophers are able to influence the course of development in particular historical contexts. It recognizes the multiplicity of causes that are at work in almost all historical settings—thereby avoiding the mono-causal assumptions of much previous macro-history. And it recognizes, finally, that there are discernible structures, processes, and constraints that recur in various historical settings and that play a causal role in the direction and pace of change. It is therefore an important part of the historian’s task to identify these structures and trace out the ways in which they constrain and motivate individuals in particular settings, leading to outcomes that can be explained as contingent results of conjunctural historical settings. This approach

recognizes an important role for social theory within the historian's practice, while at the same time emphasizing that the notion of historical inquiry as no more than applied social theory is one that trivializes the problems of explanation and interpretation that confront the working historian.

#### **4 Why transportation?**

This essay is a case study. It is an effort to get traction on the question—what is the role of large-scale factors in historical change? A large-scale factor is a factor that is pervasive, that recurs across historical settings, and that arguably exerts strong influence on historical processes. Examples include such things as climate, population, technology, natural resources, or disease. All these are plainly of interest in explaining large historical events or outcomes. They exercise their influence in ways that are sometimes perfectly visible and sometimes hidden. And it is important for historians to have a reasonably clear understanding of the ways in which such factors come into historical accounts, and the ways in which we can treat them rigorously.<sup>1</sup>

This research constitutes a case study, because I proceed by singling out a single interesting candidate as a “large historical factor”—the factor of transportation—and then examine some specific historical explanations where this factor is invoked as an important part of the explanation of an outcome. The factor then becomes part of the answer to the question, to what extent is there historical necessity at work in certain historical developments? So study of transportation as a large historical factor can illuminate the logic of reference to such factors more generally. It can also alert us to

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<sup>1</sup> For example, how would we answer the questions, was there a “little ice age” at the end of the middle ages, and how did this period of climate change affect historical developments in Europe following this period (Fagan 2000)?

some of the conceptual difficulties and challenges that arise when we use large historical factors as a ground for historical explanation. And it can challenge us to attempt to supply greater rigor in constructing explanations that invoke such factors. (Thus the formal modeling provided in economic geography and central place theory is analogous to the effort to introduce the tools of neo-classical economics into economic history.)

The CCM theory (described above) emphasizes the structuring role of intermediate factors (of which transport is a good example) and the importance of contingency—e.g. policy choices made at a specific point in time that structure future developments. Transportation technology and systems appear to offer important examples of both points: that transportation represents a causal factor that influences social developments in very similar ways across many social and historical settings; and that there are crucial contingencies that influence the unfolding of a given transport system (Chicago rather than St. Louis, steam traction rather than electric motors, a rail network designed for military needs for mobilization rather than efficient economic activity throughout the country). Finally, transportation represents a factor, unlike climate, in which there is an internal process of development that can be studied using the methods of the history of technology, the history of business organization, and the tools of the new institutionalism. Transportation has its own internal history that can be analyzed and theorized with profit. And careful study will demonstrate that there are important structural and institutional differences in the way in which transportation technologies are implemented that themselves have important historical consequences across contexts. (For example, consider Perrow's discussion of the differences in the

state and regulatory contexts in France, England, and the US in the early implementation of railways; (Perrow 2002).)

Transportation stands intermediate between the highest level constructs—”technology”—and more local constructs—”water mills in the ancient world”. Transportation has much to do with technology; but it also has much to do with social purposes, economic processes, and the interests of powerful agents in society. We can explore the imperatives that lead to innovation in transportation technology, as well as the down-stream effects that important innovations have.

The idea to be tested is something like this: the system of transportation available at a given time creates a framework of opportunities and constraints that have deep causal consequences for historical development. It creates opportunities for individuals within the context of a specific but evolving set of economic arrangements and institutions. It creates the pathways through which people, goods, and ideas flow within and across societies—and these movements themselves have consequences. The system of transportation facilitates a certain kind and intensity of military power. It creates the feasibility of a certain kind and intensity of state-society relations (e.g. fiscal and police powers). It is possible to provide an abstract framework in terms of which to analyze transportation systems. And the implications that come along with this abstract framework may facilitate our understanding of phenomena that seem distant from transportation. (For example, the travel of revolutionary ideas and the pattern of mobilization in the Canton Delta; (Hsieh 1974).)

A detailed examination of the role of transportation in history can thus help us towards greater clarity on the topic of the role of large factors in history more generally.

How can we analyze such factors? In what senses do they recur across historical settings? Can we offer predictive theories, grounded in the social sciences, that can be applied to cases? Does the factor of transportation shed light as well on the nature of differentiation that we find among broadly similar processes?

This investigation is by no means fated for success. It would be possible for us to conclude, for example, that transportation is of course an important historical factor; but it is a trivial factor, in that we can easily summarize the mechanisms through which transportation filters or constrains historical developments. Or we might conclude that the category of transportation is too broad to provide analytical bite, in that it ranges from human load-carriers to jumbo jets. But I will maintain that many of the discoveries we can reach by considering transportation and transportation systems are non-obvious and non-trivial. The study of transportation therefore provides a very concrete instance of a kind of social explanation that is, according to me, ubiquitous: the establishment of a set of opportunities and constraints that shape the choices that actors take, leading to outcomes that would otherwise not have occurred. Moreover, by examining transportation systems and their evolution carefully, we can discern the role that powerful agents (e.g. the state) play in the adoption of new transport technologies and the infrastructures that they require (for example, the grain trade in Imperial China and the water infrastructure of pre-modern China, or the extension of the rail system in 19<sup>th</sup> century United States).

*Large questions to answer*

My thesis is that transport is a general and cross-setting historical factor; it has a characteristic logic that can be rigorously investigated; that it creates specific and

important constraints and opportunities for social actors; and that it leads to predictable and sometimes surprising historical outcomes.

Here are some of the questions that I find interesting about transportation:

- How does the development of transport affect history—political power, state intensity and pervasiveness, settlement and urbanization, economic integration?
- Does consideration of the logic of transport and innovation provide a theoretical or analytical basis for predicting outcomes as a result of a given type of transport system or a given kind of innovation?
- What drives the development of transport systems?
- What is the importance of the “**system**” side of the issue? Are there interesting system properties that have historical consequences/effects?
- Are there useful generalizations about transport in history (analogous to “hunger in history”, population, war, environment, technology)?
- Are there useful differentiations to make in different settings—where transport has had significantly different pattern of development or different effects (e.g. Skinner on cities, or Hughes on different technological “styles”)?
- How did innovations in transport affect specific moments in history?
- What implications did uneven adoption have—e.g. in economic and urban development?

## **5 Cases**

Let us consider several examples that give a preliminary idea of how transport can function as a broad historical factor. Many examples appear relevant; for example,



blitzkrieg warfare in WWII, the social and geographical implications of the Roman road system, the economics of horse hauling in early modern Europe (Langdon 1984), the impact of telegraphy on diplomacy in the 19<sup>th</sup> century (Nickles 1999). I will focus on four examples from the past two centuries.

*Rail and war: the Franco-Prussian War*

Michael Howard (Howard 1961) argues that the development of railroads created a powerful new form of military advantage in Europe in the mid-nineteenth century. A rail system gave a military power a great advantage in speed of concentration of forces—an advantage that was particularly significant for German states in the nineteenth century. Troops would arrive at the battlefield in better condition than their marching competitors. And, most significantly, the vast challenge of supplying an army in the field was greatly facilitated by the presence of an effective and well-administered rail system. However, a rail system is not simply a collection of track, locomotives, and rail cars; it is an organized social system with intricate logistics, infrastructure, and planning. Howard takes the view that an important determinant of the outcome of the Franco-Prussian War was the administrative superiority of the Prussians over the French in the management, planning, and deployment of their rail resources. The French rail system was forced into sudden disarray by the attempt to rapidly mobilize a large civilian army. Troops and their equipment were separated, often forever. Mountains of matériel were to accumulate in depots without adequate logistical planning for how to deliver these weapons, ammunition, uniforms, and food to the field. There were sufficient war materials to support an army of adequate size; instead, “it was the chaos of the French mobilisation” that led to the disastrous failure of 1870 (Howard 1961: 66). On Howard’s account, then,

the failure of the rail system is a very important cause of the shocking collapse of the French military during the Franco-Prussian war.

### *The street car and the settlement of Boston*

The settlement patterns of suburban Boston in the early twentieth century depended crucially on the pace and geographical location of the extension of the street car system from downtown Boston into the less developed environs (Warner 1969). Prior to the extension of the trolley line into Roxbury, Newton, and other Boston suburbs, these areas were home to the affluent and powerful of Boston who could afford to maintain a horse and buggy for transportation. Once the trolley reached these areas, however, it was possible for working families to choose to live in these suburbs and travel to work in Boston by trolley. This created demand for a new kind of housing—smaller, cheaper, and more densely packed. This increase in population density in turn triggered the emergence of a new set of businesses in these areas—green grocers and other suppliers of daily necessities. Warner puts the point this way:

At any given time the arrangements of streets and buildings in a large city represents a temporary compromise among such diverse and often conflicting elements as aspirations for business and home life, the conditions of trade, the supply of labor, and the ability to remake what came before” (Warner 1962:15)

### *Chicago*

William Cronon’s work provides a fascinating analysis of the development of the metropolis of Chicago. The central causal mechanisms in this instance are the market demand created by rising population in the Northeastern United States (Boston and New York), and Chicago’s favorable location for rail and water transport to points east. Concentrated urban demand causes development of infrastructure and flow of timber and

grain. Residents in the urban eastern United States need food, so rising population creates rising demand for grain. Rising demand gives economic incentive to distant producers to increase production. And it gives economic incentives to commercial agents to organize infrastructure (warehouses, railyards, grain elevators, exchanges) that permit efficient and large-scale trade in grain. Goods need to be transported from the point of production to the point of consumption—thereby creating an economic incentive for transport providers to establish transportation infrastructure (railroads, terminals, rolling stock). Greater availability of goods transported by effective transportation, in turn, provides incentive to new residents and traders to choose Chicago over Peoria—leading in turn to rising population and consequent demand.

It is worth noting that the processes described here have, in turn, additional unintended and unexpected consequences. Dense population causes more frequent public health problems. Effective transportation systems create constituencies of working class people who can be mobilized to politics and union activity (e.g. the Pullman strike). More intensive inter-regional transportation can have the effect of spreading disease more rapidly. Effective communication systems cause the more rapid diffusion of ideas, innovations, and social movements—which in turn cause changes in technology, politics, and patterns of consumption.

In analyzing and viewing the development of great metropolitan regions—the restructuring of economic activity throughout the region (crops, forestry, manufacturing, the movement and circulation of people and goods, the proliferation of new and more diverse and specialized enterprises)—we see a great and powerful process. We see the invention of new inter-locking business institutions and practices; new patterns of

consumption; and new secondary technologies that fill the niches created by the new regional flows.

Transport plays a key role in these patterns of regional development. But is it an instigating cause; an important explanatory variable; or a predictable and obvious necessary condition (and therefore not of special explanatory interest)? We might say that it is the economic causes—population, demand, and markets—that elicit the innovations and adoptions of the new technology and that transport is simply an intervening variable. It seems clear from Cronon's account that rail transport played a somewhat autonomous causal role in the process. If the investments had not been made in Chicago's rail infrastructure; if siting decisions had been made differently crossing the mid-west; and if supporting innovations (futures grain markets, grain elevators) had not been forthcoming, then Chicago's economic and social development would have been very different.

We can also ask the question of contingency in the Chicago story. How much path-dependency do we find in this story? Was it the circumstances of the location of the terminus and the initial structure of the network that led to the development of the metropolis? Or were the circumstances of pre-existing water transport (Great Lakes), along with geography linking east and west, sufficient to select Chicago over other possible hubs?

### *Water transport in China*

Water transport was a crucial factor in China's economic and spatial development. Many parts of China were very richly provided with networks of rivers; these were supplemented by canals to provide low-cost transport throughout relatively

large spaces. And China's major rivers provided the possibility of long-distance commerce based on low-cost river transport. Water transport, according to G. William Skinner, set the structure within which "macro-regional" economies emerged; and the social transactions and behavior of people throughout China were very much structured by these economic networks. The role of transport in late Imperial China was thus of great importance for the development of the size and spatial distribution of population, the reach of the state, and the ability of the state to maintain social order. The grain trade provided for more intensive population development, the movement of troops helped to secure public order, and the movement of officials and messengers was essential to the imperial state's ability to impose its will on the periphery.

Skinner's insights have generated a very fertile program of research for the China field. His own analysis of the marketing hierarchies of pre-modern China sets the social context for much of the subsequent study that scholars have provided for subjects as diverse as urbanization, religion, and rebellion.

Winston Hsieh (Hsieh 1974) provides an interesting example of how these factors come together in explanation of an important historical episode—the rapid and patterned diffusion of rebellion in the Canton Delta in 1911. His narrative depends on transport in several important ways. The population density of the lower Canton Delta was made possible by the availability of low cost bulk transport through the water network of the delta. This permitted farmers to specialize in export rice; commercialization proceeded intensely, and the population density of the region rose sharply (Hsieh 1974: 130).

Another important effect occurred in the small city of Shih-Ch'i; its western districts grew rapidly in urban intensity in the final decades of the 19<sup>th</sup> century, while the other

parts of the city declined. Hsieh attributes this pattern of growth to the importance of ferry and steam shipping on the Shih-ch'i Sea (129). But the income created by low-cost transport was challenged by another transportation innovation—the establishment of the Canton-Kowloon railroad in 1906, which allowed rice merchants to bring Thai rice directly into competition with the rice harvest of the lower Canton delta.

Hsieh argues that transport and marketing hierarchies provide critical explanatory variables for the timing and pattern of mobilization of Republican rebellion in the Canton Delta in 1911. Transport constituted a longstanding structural variable that created population density and population interests that were vulnerable to crisis—and therefore provided a population ready to be mobilized when crisis hit. And the marketing routes that had been established through local markets also provided the networks through which agents of mobilization—sectarians, martial arts instructors, millenarianists—would travel and mobilize.

## **6 Transportation and social change**

These cases illustrate some plausible and complex instances where the features of the transport system have given rise to causal processes that exert large influence on subsequent historical developments. I take the position that transport is a relatively autonomous factor in large historical change. At one level this is a truism, and the effects and mechanisms of the role of transport are almost too obvious to comment on. But at another level, a more refined analysis of transport systems and the interlocking institutions they require provides non-trivial insight into historical processes and events. Transportation has deep effects on social development, including the pattern and pace of the extension of settlement, the course of economic development (by enlarging regional

and national markets and lowering costs of delivery), and facilitating the flow of ideas, bodies of knowledge, and innovations. Let us turn, then, to some of the factors and mechanisms through which transport influences history.

### *Important social effects of transport*

We can attempt to categorize the effects of transport by exploring likely effects flowing from the transport of **goods**, **people**, and **ideas**.

The flow of goods that is effected by a transport system leads to market expansion (increasing availability of goods over a larger region), market integration (price correlations across space), greater commercialization (more production for the market as a result of broader and more predictable markets for goods), broader patterns of consumption, and diffusion of technology (as new potential users are exposed to new products, tools, and processes).

Easier movement of people creates equally important and equally visible effects. Long distance migration depends on transportation; symmetrically, an increase in transport efficiency and convenience will predictably increase the volume of migration. At the more local scale (inter-village, inter-city) improved transport increases the ability of people to seek employment, goods, and services at greater distance—thereby creating the possibility of ring settlements around higher-level places. Improved efficiency of the movement of people has important effects on the state and other dispersed organizations. if it takes the representative of the Emperor 14 days to travel from Beijing to Hankow, the ability of the Emperor to control events is clearly limited. When rail travel shortens this trip to 2 days, the administrative grasp of the state is enhanced. And if it takes a

week to move reliable troops into position in defense against rebels, clearly the state's ability to control rebellion is weak.

The movement of ideas that is facilitated by more effective transport is equally important. The movement of ideas depends on the movement of people and goods, but the effects are important and independent. The circuits of White Lotus teachers and martial arts instructors brought heterodox ideas to many parts of rural Shandong in the late Qing—with dramatic effects in the production of millenarian rebellion. The distribution of newspapers in the west by rail allowed for a form of national unity that would otherwise have been impossible. The diffusion of new farm machinery and the cultivation techniques that accompanied depended profoundly on the network of railroads that crossed the west.

What are the obvious implications of new transport capabilities? Some of the direct and predictable consequences of innovation in transportation include: patterns of settlement; extension and integration of markets; the enhancement of military power and mobilization, diffusion of people and ideas through a transport network; and the pattern and nodes of immigration.

Are there unanticipated and perverse consequences that can emerge as a result of enhancement of service? Some traffic specialists have maintained that the third harbor tunnel in Boston will increase congestion, by giving the public the impression that it will be more convenient to drive to the airport. Speeding up the velocity of travel on the tributary roads may lead to staggering traffic jams on the trunk road—with greater lost time overall. (The Albuquerque traffic simulation.) New transportation options may



enhance the spread of crime (the letter from Bonny and Clyde to Mr. Henry Ford complementing him on the reliable transportation he provided them!).

### *Characteristics of transport systems*

Let us look briefly at some of the structural features of transport systems. Transportation systems require traction, vehicles, and networks. Traction may be animal (horse, ox, human), or it may be mechanical (steam, internal combustion, jet). Networks include roads, railways, ports, and airports—the infrastructure that is necessary to permit vehicles to move from point to point in space. Transportation systems also require organization, finance, and communication (see, for example, (Pope 2001)). Trains need to be scheduled, employees need to be trained and supervised, tracks need to be maintained, and emergencies need to be handled.

A transport system can be measured in several dimensions: coverage, velocity, capacity, price, and predictability. The technology of transport can affect each of these variables; and significant change in the variables can in turn have major social or economic effects. Likewise, the organization and communication systems that underlie the transport system can have major effects on the central variables (e.g. predictability).

Different modes of transport have significantly different system properties. Rail creates a powerful locational momentum around its nodes and termini, because of the large capital cost associated with establishing the rail network and hubs. Air transport is more flexible, since planes can be re-routed anywhere. But the economics of airports are likewise spatial; demand density determines location and profitability.

Note the importance of appropriate surrounding institutions—financial, banking, letters of credit, futures contracts, grain evaluation and storage (Cronon's point about

grain elevators, futures contracts, management systems). It is now a well studied insight in the history of technology that technologies are not assemblages of **machines and tools**; rather, they are **systems** that include workers' and leaders' knowledge, organizations (internal and external), consumers, users, ... This point is equally valid in application to transportation systems; and the social context and social content (i.e. the social institutions within which transport functions, the political institutions, and the internal managerial and organizational systems) make a pronounced difference in the workings, development, and social consequences of transport systems.

Improvement of transport is in part an area of technological change. But, like any complex technology system, a transport network is unavoidably institutional, managerial, and organizational. Innovations in management, information processing, and finance are as important as “pure” technology innovations. This is a place where the seminal insights of Thomas Hughes can be effectively deployed; his advocacy for looking at technological systems as wholes, his emphasis on the inter-relatedness of social, managerial, financial, and technical factors; and his important concepts of technological momentum and “reverse salients” all shed important light on transportation.

Here, then, are some of the dimensions of transportation systems that may have major and interesting historical consequences. First, there are the material and economic variables associated with the system--speed, reliability, volume, cost, and coverage. Changes in any of these variables can have major consequences for population density, commercialization, or military power. Second, there are a suite of technological factors associated with the development of transportation as a technology system—for example, the pace and nature of innovation, the cadres of experts who are created. Third, there are

important system factors—the character and layout of the transport network, the logistics of freight and passenger management. Fourth, there are important managerial factors—the organizations and systems of training through which operations are managed, the financial systems that are needed, the systems through which system safety is assured. And finally, there are social factors—for example, the ways in which the transport system affects consumers’ preferences and expectations.

### *Development of transport systems*

Consider some of the broad characteristics that can be discerned in the development of a transport technology and the system in which it is embedded. There are large breakthroughs that fundamentally transform the dimensions of the transport system—e.g. steam power replacing wind in maritime transport or rail over road and animal traction. There are large economic and financial factors that drive and limit the development of the technology. There is opportunistic refinement over a long time, as the devices, power systems, and control systems are refined. (In other words, each large transport technology has its own history of technology within a social and economic setting.) There are the regional or national variations that can be discerned, even within the development of a single transport scheme (the railroad, for example; (Perrow 2002)). These differences parallel those identified by Hughes in his account of electric power systems. There are important examples of path dependence, stalled development, and blind alleys: developments that acquire their own momentum but that block the emergence of other and perhaps better systems.

The development of transportation is relatively contingent because its emergence and the particular features of its underlying assemblages of technologies and institutions

themselves emerge through contingent processes. So the development of a particular system of transport is a contingent process of innovation and refinement, and the consequences of the establishment of the transport system are sometimes unexpected and radical.

It is useful to speak of a push and pull of transport development. The pull is the financial incentives created for investors and entrepreneurs by a new technology. The push is the community of engineers and innovators who have conceived of the new transport system possibilities.

How do circumstances—market forces, military considerations, policy choices—affect and channel the development of the transport technology? Factors that induce development within a system of transport include especially government policy, market demand, and investor interests. Governments can do much to push transport development faster, or in different directions. And market demand can provide strong incentives towards either incremental or step-wise growth—more river boats providing greater grain transport capacity, or significant increase in rail coverage providing new access to regions and markets.

It is important to take note of the fact that transportation often requires that large investment decisions must be made; these are contested; and they make a large difference in the course of future development. These decisions create institutional momentum for one system or technology over another. Sometimes the state and its agencies are critical in these decisions, and sometimes large private players are able to influence or determine policy outcomes. (Note Slotten's valuable treatment of satellite communication decisions in the 1960s (Slotten 2002).)

### *Mechanisms of influence*

Let us consider the question of causal influence of transport in historical settings. How does the transport system influence social action? Transportation is particularly important in the view that I offer of social explanation under the rubric of an “**institutional logic**” (Little 1998). Individuals make choices, large and small, within the context of the space of opportunities and powers that are available to them. And transportation constitutes one particularly fundamental such source of opportunities and powers. Transportation is a factor that creates an institutional logic for the individuals, organizations, and structures within a society at a specific moment in time, imposing constraints and creating opportunities for them to achieve their goals. Traders exploit the opportunity to push further up a river when motorized boats become available, and people choose to settle in more remote places. Fishermen push further out into deep ocean when more seaworthy ships become available (Sverrisson 2002). Smugglers take advantage of the wheel wells of aircraft. And so forth. Using the framework of an institutional logic, we can understand the historical dynamics of a social setting that are created by the transport network along these lines:

Individuals have a set of purposes; movement of people and goods influences their ability to achieve these purposes; individuals will adapt opportunistically to the opportunities and constraints created by the transport system; and large social patterns (e.g. patterns of settlement, market integration) emerge as the consequence of the large number of independent actions and choices made by individuals in the population.

How does the transport system affect historical events? It does so as an institutional logic. It presents actors with a specific set of opportunities and constraints as they pursue their plans and purposes. To the extent that the new option permits the actor to better achieve his goal, his behavior and choices will change accordingly. This is especially true with regard to residence, employment, and business activity. But it also extends in the direction of technology change. We can expect some actors to look for ways of taking advantage of the new technology—of refining, perfecting, or extending it. So we can expect entrepreneurial activity to take place around the implementation of the system. Likewise, we can expect agents of the state to seize opportunities of interest in and around the transport system—e.g. as a powerful tool for military mobilization. The transport system is thus a locus for individual agency.

These effects all derive from the purposeful choices of individuals. Equally interesting are the unintended consequences of a particular direction of transport technology—the creation of isolated suburban communities, the transport of criminal activity, the social inertia behind the automobile, the values and lifestyle choices that emerge as a result of suburbia.

The cost of transport is one critical variable in determining the effects of a new transport option. Another is the spatial organization of the transport system itself. Which destinations are accessible? Where are the nodes at which connections can be made to other routes or modalities?

The system properties of a transport network are important to the consequences for activity. Once the nodes, route, and terminus of a transport network have been firmly

established, it is predictable that uncoordinated activity (settlement, merchandising, development of local resources) will begin to crystallize around these points of convenience. (The “Coming of the Road” and the destruction of traditional ways.) Seattle and Chicago became great metropolises; Port Townsend and Milwaukee did not. Places that are bypassed by transport (e.g. Worcester, Massachusetts) wither. Other system properties are significant as well. How does the system hold up when it is subject to stress (e.g. sharp jumps in demand, the need to transport men and materiel in time of military emergency)? how robust are the logistics of the system? is there adequate warehouse capacity in the system to handle surges? how robust is the scheduling of vehicles in face of unexpected delays? (Can a 10 minute delay in Chicago lead to a 5 hour delay in Los Angeles?)

## **7 concluding observations**

Several observations are justified at this point:

- Transportation is a plausible instance of a “portable” large factor.
- There is enough systematicity to transport to permit analysis and prediction.
- Transport provides a basis for some degree of generalization across historical contexts.
- Transport represents an instance of significant “contingent and conjunctural” variability across contexts.

Are there generalizations about the role of transportation in history? Yes, with appropriate *ceteris paribus* clauses.

Are there differentiating observations? Yes, and they are at least as interesting. Transportation and its effects are both conjunctural and contingent.

How do these various thoughts make a contribution to historical research? In several ways. First, they give a clue that there may be systemic properties in historical data that are simply never noticed until the question is posed, how has transport structured and constrained these data? Here the example of G. W. Skinner's analysis of the central places of Sichuan is deeply instructive. But of even greater interest to the historian—these insights can resolve anomalies. Hsieh's question is an interesting one—why was there a peculiar pattern to mobilization in the Canton Delta in 1911? And his answer draws upon Skinner's analysis of urban hierarchy; he points out that the rebels' activists followed the same routes as the merchants. Why is St. Louis noted for German beer and midwestern Hegelianism? Because it was the terminus to migration routes that were taken up by radicals fleeing repression following the failed revolutions of 1848.



## References

- Fagan, Brian M. 2000. *The Little Ice Age : how climate made history 1300-1850*. New York: Basic Books.
- Howard, Michael Eliot. 1961. *The Franco-Prussian war; the German invasion of France*. London,: R. Hart-Davis.
- Hsieh, Winston. 1974. Peasant Insurrection and the Marketing Hierarchy in the Canton Delta, 1911. In *The Chinese City Between Two Worlds*, edited by M. Elvin and G. W. Skinner.
- Langdon, John. 1984. Horse Hauling: A Revolution in Vehicle Transport in Twelfth- and Thirteenth- Century England? *Past & Present* 103.
- Little, Daniel. 1998. *Microfoundations, Method and Causation: On the Philosophy of the Social Sciences*. New Brunswick, New Jersey: Transaction Publishers.
- . 2000. Explaining Large-Scale Historical Change. *Philosophy of the Social Sciences* 30 (1):89-112.
- Nickles, David Paull. 1999. Telegraph diplomats: The United States' relations with France in 1948 and 1870. *Technology and Culture* 40 (1):1-25.
- Perrow, Charles. 2002. *Organizing America : wealth, power, and the origins of corporate capitalism*. Princeton, N.J.: Princeton University Press.
- Pope, Norris. 2001. Dickens's "The Signalman" and Information Problems in the Railway Age. *Technology and Culture* 42 (3):436-461.
- Slotten, Hugh. 2002. Satellite Communications, Globalization, and the Cold War. *Technology and Culture* 43 (2):315-350.
- Sverrisson, Árni. 2002. Small Boats and Large Ships: Social Continuity and Technical Change in the Icelandic Fisheries, 1800-1960. *Technology and Culture* 43 (2):227-254-3.
- Warner, Sam Bass. 1969. *Streetcar suburbs: the process of growth in Boston, 1870-1900*. [College ] ed, *Publications of the Joint Center for Urban Studies*. New York,: Atheneum.