A Companion to Economic Geography

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Chapter 8

The Geography of Production

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The heart of every economy is industrial production, and the heart of economic geography lies in the spatial patterns and physical landscapes industry creates. Industry location may seem a limited provenance, at first. One starts off comfortably enough with the localization of different factories and sectors, such as steel mills and automobile plants, but all too quickly the division of labor outruns traditional notions of what constitutes an "industry" and the spatial division of labor disperses into a thousand pieces cast hither and yon – tire factories here, engine plants there, electronic ignitions and engineering plants somewhere else. These all have to be knit together into discrete units called factories, offices, or design houses, and into much looser connections called firms, sectors, or networks. To make matters worse, these webs of production overlap and interconnect in surprising ways that can never be entirely untangled, and they stretch far and wide across boundaries and to the far reaches of the global economy. The modestly ambitious industrial geographer must pull on seven-league boots as we try to mark off the immense tapestry of localization and globalization woven by contemporary production and trade.

This immense geography of production is in constant motion, rendering moot all fixed ideas about industry location patterns. Industrialization drives sectors and places along divergent paths of growth, and disrupts all established geographic habits. That divergence and instability is essential to the uneven development of the industrialized world. But movement alone does not capture the creative (and destructive) powers of modern industry. Successive industrial revolutions have built up the great cities, transport systems, and landscapes of production that surround us; industry does not locate in a known world so much as it produces the places it inhabits. This jagged process of industrial development repeatedly outruns prediction and liquidates the geographies of the past, generating the endless novelty that makes economic geography such a lively and challenging area of inquiry.

What is Industrial Production?

Production is making something. That something may be as rock solid as a car, as passing as a meal, or as shadowy as a program flickering on a TV screen. As the

/orld moves toward more information-rich forms of production and products, like omputer software and video games, there are more products that come in small ackages, like CDs, and fewer bulky objects like steel girders. But production is, in ll cases, an act of human labor; it involves work, plain and simple. In one case there ; a definite product, something you can kick with your foot, a good like a television r a hamburger. In the other, there is only a change of condition, a labor-service such s a pierced ear, clean floor, or plane ride to Jamaica.

In traditional usage, "industrial location" referred to manufacture, or the making f goods. There is little reason for economic geographers to be so restrictive today, /hen manufacturing has dwindled down to one-fifth of employment, on average, in ıe advanced industrial economies. We have to come to grips with the larger ompass of modern industrial activity and its spatial distribution. Nonetheless, we ill inhabit an industrial economy with the production of goods at its core. There is good deal of confusion on this point because official censuses call almost every-ıing today a service.

A great many things called services are, in fact, work on goods. Some kinds of oods take unusual forms, like french fries to go, downtown skyscrapers, or the 'ater coming out the tap. Some come in modest physical carriers with lots of critical ıformation, like newpapers or software disks. Some very large goods are used by ıany people through lease and rental arrangements, as with hotels, airplanes, and anes. Long-lived goods require repeated maintenance and repair, which is why ıere are so many auto shops, janitors, and house-painters (Sayer and Walker, 1992).

Nor should one forget the important arenas of agriculture and resource extrac-on, which no longer take up much of the workforce in the advanced industrial ations but share most of the characteristics of modern industries (Hanink, this olume; Page, this volume). Then there are the crucial functions of distribution and ıle of all goods that involve extensive distribution networks of warehouses and ores. Together, all such labor involved in the production, distribution, and repro-ıction of goods of every kind more than doubles the usual estimates of manufac-ıring, bringing the total employment in basic industry up to well over half the ivate sector. Most of the remainder is taken up by three major labor-using tivities: health care, education, and personal service. Their output unquestionably kes the form of labor-services, not goods.

Whatever category these segments of goods and services production fall under, ost are organized today on a large-scale industrial basis – ask any Las Vegas maid she works in the "hotel industry" or Miami janitor if he works in the "cleaning dustry." All such industries play a role in shaping the landscape of modern cities ıd regions, whether the factory districts of Kuala Lumpur, the malls surrounding linneapolis, the hotels of Cancun, or the sea of warehouses around O'Hare Air-ort. They are all a part of modern economic geography, even if its heart remains anufacturing, from Manchester to Silicon Valley (Daniels, 1993).

In saying that production is an act of human labor, we mean that people are ntrally involved in organizing, orchestrating, and carrying out the tasks of modern dustry. This means that securing a labor force is a prime task of any industrial eration, and critical to its locational calculus. Firms must recruit labor either by cating near to where the workers live or by attracting them from long distances; is matching of labor demand and supply is a base point for economic geography.

Different kinds of work demand different kinds of capacities from workers and provide varying levels of wages and other rewards, and here lies an elemental force for spatial differentiation of industrial activities, or spatial divisions of labor (Peck, this volume).

Workers and capitalists actively shape each other in the process of production. They do so in the workplace through labor training, managerial adjustment, and conflict – from everyday jostling for autonomy and control in the office or on the shopfloor, to full-blown strikes, lockouts, or violent confrontations. They do so outside the workplace in the way workers settle into residential communities with their own ways of life, and the way industrialists try to influence local development patterns and politics. And they do so by the way institutions and expectations evolve around well-established employment centers and communities, giving a strong element of inertia to industrial and worker location (Hanson and Pratt, 1995).

Human effort is augmented in three vital ways, however. The first is by tools and machines, from the simplest axe to the most complicated computer. The second is by nature and natural processes, such as bacteria turning milk into yogurt, chemical reactions in a steel furnace, or the electrons racing along a microcircuit. Workers initiate, guide, and oversee such gifts of nature, and we all benefit from them. Third, every worker benefits from accumulated knowledge, passed along from other people and embodied in plans, blueprints, books, machinery, and software. Technology is frequently imagined to be the prime mover of modern industry in commentaries on "computerization," "high tech," or "the information age," but production is basically a labor process to which machines and technical wonders are allied. The contemporary fascination with technology too often overshadows the central place of ordinary work and workers in economic geography (Herod, 1998).

Spatial Divisions of Labor: The Geography of Industries

Today's market economies produce millions of different commodities for sale, and employ hundreds of millions of people. They are immensely complex systems of production, made up of an extraordinarily large number of pieces. Those bits and pieces constitute "the division of labor," and are the basic building blocks of the industrial system and of economic geography. Without a division of labor, there would be no differentiation of economic activities, no factories to site, no localization of industries. The pied and dappled geography of modern economies comes about precisely because of the wide variety of work being done at different places. Yet, the division of labor is not infinite: individualized work, where the person labors alone on a project like making a pair of shoes, is rare in advanced economies. Work today is mostly collective labor, where each person is responsible for a part of the whole. These collectivities range from small groups, such as fabric cutters, to whole garment factories, to entire commodity chains. A basic concept for the study of industrial geography is, therefore, the social division of labor.

The term industrial location was largely replaced by spatial divisions of labor in the lexicon of economic geographers during the 1980s. The former had come to mean the optimal siting of production units according to their specific needs for inputs, in the tradition of Alfred Weber (1909), or the optimal spatial allocation of sellers according to a highly abstract calculus of access to customers, in Walter

hristaller's (1935) and August Lösch's (1944) central place theory. Industry was ssumed to conform to pre-existing patterns of people and resources on the land. oreen Massey (1984) turned this around. For her, spatial divisions of labor sig- ified a view of industrial patterns that recognized powerful forces for spatial ifferentiation coming out of industry itself and projected onto the landscape.

To speak of "industries" and their locations is to carve out specific arenas of social bor. Yet there are many ways of slicing up the industrial economy into observable nits (Sayer and Walker, 1992). The most common definition of industries is on the asis of the product division of labor, or the distinction among types of output, such s the toy or shoe industry. Similarly, the most basic meaning of industrial location is ie distribution of such sectors across places, as in case of the automobile industry of etroit, the steel complex of Pyongyang, or the old cutlery district of Sheffield.

A difficulty immediately arises in that these sectors are really clusters of products, id can be further differentiated. The garment industry, for example, can be broken own into segments such as men's suits, sporting outfits, or blue jeans. These are kely to have surprisingly different locational patterns, as illustrated by the sports irments district of Los Angeles, the fashion industry of Paris, and the blue jean belt ong the US–Mexico border. Conversely, one can lump industries into larger group- gs, such as consumer goods and producer goods. Instead, studies of industry have one in the other direction, paying closer attention to the fine grain of the social vision of labor and its spatial manifestations.

Almost all products today are sufficiently complex that they require many parts, id several stages of production, before they are complete. This is rarely done under ie roof. Whole hosts of intermediate inputs arrive at the typical factory to be sembled into a car or airplane (or at separate factories for car bodies or engines or des before final assembly). A different sort of production occurs where the same aterial requires several stages of processing, as in the making of thread into cloth refining of crude oil into petrochemicals. Here, too, the products are likely to ove between factories before they are finished and ready for sale.

Such production systems are frequently called "commodity chains" (Gareffi and orzeniewicz, 1994), but only some look like chains; most spread out like tree roots. conomic geographers find the linkages binding such production systems to be more gnificant than the bits and pieces considered separately (a car engine is a marvelous oduct, but who cares apart from the final automobile?). The geography of com- odity chains may be regional, as in the case of Toyota's amazing subcontracting twork in the Nagoya area (Tabb, 1995). Or their geography may be global, as is mously the case for Nike's network of subcontractors for sports shoes (Dongahu id Barff, 1991). Your personal computer, for example, may be assembled in Texas om a casing made in Taiwan, a liquid-crystal screen made in Japan, a disk drive put gether in Silicon Valley, a CPU chip fabricated in Phoenix, and memory chips ade in Malaysia (Dedrick and Kramer, 1998).

The definition of an industry and its geography is clouded by the way commodity ains branch into other commodity chains, becoming a thicket of connections. The rmal name for this is "input–output systems." If we map out where every product es and every part, piece, and machine comes from, we get a network of product ows criss-crossing almost every sector. Ponder the complexity of national input– tput accounts and one is likely to despair of isolating finite industries at all. Yet

businesses and financiers speak of the biotechnology or wood-products sector all the time, and most corporations know very well which sectors they operate in.

On closer inspection, then, every economy has practical ways of drawing boundaries around industries, even if those lines are fuzzy at the edges. For the economic geographer, this implies that the boundaries of industries are social conventions. These often have a strong national or regional character, and are rooted in past business practices as much as in the technical logic of production (Tabb, 1995; Herrigel, 1996). This is why seed companies in Germany are part of the chemical industry, whereas in the United States they have traditionally been independent – although they are now being transforming into biotech companies, some of which are attached to the chemicals industry and some to agribusiness companies. Similarly, computer production in Japan grew out of the domain of consumer electronics under expansive companies such as NEC and Hitachi, whereas in the United States it developed out of business machines (IBM, NCR) and new firms (Apple, Sun) (Henderson, 1989). Research into the location of biotech or electronics must be aware of national differences and changing sectoral boundaries.

Spatial Divisions of Labor: Geographies of Skill and Management

A quite different way of slicing up social labor is by occupations, or what individual workers do in their jobs. An occupational division of labor can be found within any workplace and every industrial sector, regardless of the final output, and it can be aggregated across sectors. The number of occupations certainly runs into the tens of thousands, with some highly specific to their sector, like cinematographers or meat-cutters. But the same general occupations can be found across widely different product industries: engineers, computer operators, machinists, secretaries, managers, and so on. These can, in turn, be lumped into highly aggregated categories such as "skilled," "semi-skilled," or "unskilled," the definition of which is both technical and social, and forever open to question.

Within any industry there are different workplaces with different locational patterns. Economic geographers have become keenly aware of two divisions of labor of vital importance for the functioning of all production (Sayer and Walker, 1992). The first is the expanding provenance of management, or the administration of industry. Managers fill up a substantial proportion of the occupational positions in what can be called a "hierarchical division of labor," accompanied by armies of accessory workers in clerical and personal assistance, computing and communications, billing and accounting, copyrights and litigation.

A second area of expanding industrial division of labor has been lateral – extending production in time. This includes several critical types of work, mostly of an intellectual and creative sort, that necessarily take place before a new product or process is introduced. One is research and development on new technologies. Big corporations have long set aside divisions for R&D, often far from manufacturing facilities: a good example was the Bell Labs of AT&T (now spun off as Lucent Technologies). Another is product design, as in the contrasting fortunes of Apple's fashionable iMac computers and its failed "Newton" think pad. All automobile corporations have design teams who come up with new makes and models every year.

While management, research, and design used to be part of the internal division of labor within the large firm, these functions have spilled out into the open market. This has led to rapid growth in enterprises and employment in the "business services" sector. Corporations have long sought outside help, of course; advertising has traditionally been an independent sector centered on New York's Madison Avenue. But all this has vastly expanded. Today, managerial functions are commonly turned over to consultants such as McKinsey & Company, engineering firms such as Bechtel provide technical design input, telemarketing companies handle phone sales, billing companies take care of consumer accounts, leasing companies supply office furniture, and food service firms staff the lunchrooms (on "financial services," see Leyshon, this volume).

Headquarters, R&D, and business services each have their own geographical calculus, and these have become a staple of economic geography (Daniels, 1993). Corporate managers and their high-level advisors cluster in prestigious locales, traditionally in major urban centers like New York. More recently, many have decamped to salubrious suburban estates not too far from the airports on the edge of big cities. But they are likely to consign their accessory workers to back offices in distant suburbs or cities, like the billing offices of Chevron in the outer reaches of the San Francisco Bay Area.

Sites of Production: Factories and Other Workplaces

In conjuring up an image of industrial production, most people think of the factory, which has been virtually synonymous with industrialization for most of the last two centuries. Factories are a highly visible and striking part of the landscape of industrialized countries, so shocking to early observers that they earned William Blake's epithet "dark satanic mills." But why do factories exist at all? We take them for granted, little considering that they are a way of coping with the division of labor and orchestrating industrial work.

Factories were a spectacularly successful innovation in business organization, crucial to the success of the industrial revolution and long pre-dating the modern corporation. The factory is a way of organizing social labor by bringing together many workers and tasks in one place, rationalizing the allocation of work and flow of materials over a limited space, allowing close oversight of workers by bosses, and driving machinery from a single power source (Nelson, 1995). Factories soon grew to embrace the work of hundreds or thousands of people. Some nineteenth-century New England textile mills were a mile long, Douglas's Long Beach aircraft plant once employed 100,000, and the steel mill complex at Tienshin, China, held over 200,000 workers.

Large factories include so much of the relevant social labor that they are more independent of linkages to other workplaces than smaller facilities. They have, therefore, tended to disperse toward the edges of cities or into rural sites where they dominate the landscape (Scott 1982). Pittsburgh's many steel mills spread out like stars in a spiral galaxy. Yet large factories often obscure the vital role of smaller workshops and plants in many industries, which have long clustered in industrial districts embedded in large and small cities (Scranton, 1997). Most such districts are rich combinations of large and small facilities, as in Silicon Valley today.

The most striking workplace of the twentieth century has been the office building, particularly the skyscraper. Offices are like factories in that they bring together large numbers of workers doing related tasks under direct supervision, with the provision of suitable equipment, from desks to photocopiers. But the occupations are different, "white collar" versus "blue collar," because the work is different: management, design, or marketing, not the hands-on labor of manufacturing. From humble beginnings off to the side of factories, they were set off on their own and driven ever skyward as they clustered together in the centers of big cities. The visual impact of the skyscraper at the turn of the twentieth century was as great as that of the satanic mills of a century before (Markus, 1993). But, like factories, many offices have shifted toward suburban office parks.

There are many kinds of workplaces besides factories and offices. Hotels, restaurants, airports, convention centers, and warehouses are common workplaces, and often as large as the biggest factories (Las Vegas hotels run to over 5,000 workers). Some workplaces are single open-air locales, like wheat fields, golf courses, and building sites. Others are extensive: cable networks, highway systems, or gas lines. Some workplaces are inside moving machines, such as ships and airplanes. Some workers move about from one designated site to another, as in theater or musical performance. And some roam freely, as in the case of truck-drivers or mail deliverers. Many sales representatives, designers, engineers, and repairers, not to mention gardeners and janitors, work in someone else's workplace instead that of their own employer.

The workplace is an essential building block in the organization of industrial production, and the invention of more effective workplaces is an important part of the evolution of business and management (Sayer and Walker, 1992). Workplace form has been neglected in contemporary industrial geography, which focuses on markets, firms, and networks. Yet it has been a key term (under such names as "plant" or "establishment") in the lexicon of economic geographers going back to Weber. Part of the logic of workplaces is dictated by technical considerations that give rise to economies of scale and scope in the shared use of machinery, bring together a set of tasks under one roof, or drive powerlines across hill and dale. But the social component in deciding workplace function, boundaries, scale, and location is sizeable. The early factory, with its high walls and clock tower, was a strict reminder of the new industrial order. Office towers and urban skylines are equally bold statements about the power of business. But the kind of megalomania entailed in Henry Ford's River Rouge plant, which did everything from make steel to assemble Model As, is rarer today. The importance of the large factory as a business strategy has been diminishing for the last half century, in favor of more dispersed, flexible, and externalized forms of organization (Noble, 1986; Nelson, 1995).

The Location of Firms and Corporate Geography

The other major "container" for production is the firm, and firms are key players in the geography of industry. We take the firm for granted, but the modern firm evolved in tandem with capitalism and the industrial revolution. The big advances in the nineteenth century were "limited liability" (which kept failed businessmen out of debtor's prison), joint stock holding (which made large investments by

outsiders easy), and unlimited charters (which freed business from special legislation and state monopolies). Impersonal, professional management arose alongside these, and became generalized in the modern corporation of the twentieth century.

The modern corporation notwithstanding, other types of firm are still commonplace. Private companies and partnerships are typically small enterprises, although some are huge, like clothing manufacturer Levi Strauss. Syndicates and holding companies are a passive form of ownership without direct management, more popular in Britain than in the USA. State-owned enterprises have been a major component of most economies, though they are currently out of favor; they vary from wholly owned to quasi-public companies with minority government holdings, like the US postal service.

Size is a key dimension of the firm. Economists long ignored the question of size, following Alfred Marshall's (1890) assumption of a world of small firms that guaranteed price competition. Yet large corporations only became bigger as the twentieth century wore on, driven by economies of scale and throughput (as explained by historian Alfred Chandler, 1977). Only Ronald Coase (1937) saw clearly that in some cases small firms are the most efficient way of organizing production, and in other cases large firms. The comparative cost of large versus small units depends on the characteristics of product and commodity chains, technical competence and patent control, and size and reliability of markets. This is usually put, following Oliver Williamson (1985), in terms of "economies of scale and scope" in production (the advantages of combining or separating production systems) versus "transactions costs" of market exchange or administrative hierarchies. In practice, firms decide to take on new functions or divest themselves of peripheral activities they are not capable of managing.

Another way of putting this puzzle of company size and activity mix is to go back to the division of labor. The general question is where to draw boundaries around clusters of social labor. Only the smallest firms still specialize in only one product: most quickly diversify into several related products and many diversify into a wide range of product groups. Some, like the gigantic *chaebol* of Korea, orchestrate multisectoral industrial empires (Amsden, 1989). Management may handle such complexity by setting up autonomous divisions or profit centers. But firms today have become remarkably cautious about branching into domains outside their core competency.

Complexity and managerial strategy raise three key boundary problems in industrial organization and economic geography. First, an industry may consist of firms of varying sizes (and internal arrangements). Second, companies cross over industry lines. Third, the same sector may be organized differently in different countries (or regions). In short, there is no single best solution, and no a priori unit of production to be located. Not only do sectoral technologies and economics diverge, but local history, politics, and institutions also make a real difference. German industry never consolidated into giant firms to the degree that American industry did. British industry remained a province of family firms and holding companies longer than either. France and Taiwan relied more heavily on large state-owned companies in key sectors, yet both have many small family firms as well (Chandler 1990; Herrigel, 1996; Hsing, 1998).

Recently, firms of all nations, especially in high-tech sectors, have been rushing to form agreements, alliances, and joint-ventures of all kinds, which blur company, industry, and national boundaries. This presents another sharp challenge to management: how best to operate in a matrix of global relations. The hot-button idea of the last decade has been the "network firm" and how to build up and manage a complex set of contracts and alliances with complementary firms across an effective range of products and technologies (Castells 1996; Cooke and Morgan, 1998).

Changes in business practice have leveled off the percentage of the economy controlled by large corporations, with the proliferation of small and medium-sized enterprises in many sectors, especially those with rapid innovation like electronics and biotechnology. But disaggregation is effective in sectors such as fast-foods, where McDonald's and Burger King expand by franchise and keep the core firm focused on managing and marketing the whole assemblage. An extreme trend is toward the "virtual firm," in which all non-core functions, including production, supply, and sales, are externalized (Davidow and Malone, 1992). This has had a significant effect on industrial geography.

In classical location theory, the firm and the workplace were identical and focused on a single product. This reductionist approach was later countered by "corporate geography," which took as its object the sprawling patterns of operations within the large enterprise. At their best, studies of corporate strategy can be indicative of broad trends in the spatial economy (Schoenberger, 1997). But this approach, too, has run into limits. Economic geographers have recently directed their attention to clusters of smaller firms and factories, rediscovering insights of Weber on "agglomeration effects" and Marshall on "industrial districts" that had been neglected by mainstream economics and location theory. This research demonstrates that industrial districts have mutually beneficial effects, or external economies, that make them viable alternatives to the large factory and giant corporation (Storper and Salais, 1997; Scott, 1988b). Indeed, they have undergone a substantial revival in our times (Amin, this volume).

Geography Unbound: International Divisions of Labor

In a globalizing economy, industrial location can no longer be treated at the national level alone. There is a "new international division of labor" that demands attention from economic geographers. This has replaced, in part, the old trading system between those nations that exported manufactures and those consigned to the export of natural resources. There are several aspects of this global geography that grow out of what has already been said about sites, industries, firms, and goods/services. These have to be supplemented by considerations of national and continental scale boundaries.

With globalization, local sites of production become specialized within a worldwide division of labor, whether in tourism, steel, or textiles. A handful of factories may supply the demands of the entire world, such as watch makers in Hong Kong and Switzerland. The auto industry counts perhaps one hundred assembly plants in all. Studies show that the degree of geographic specialization is increasing with global integration (Storper, 1997). Such specialization is usually attributed to the lowering of barriers to trade and improvements in communications and transport.

Often forgotten, however, is the power of production at the workplace or industrial district. If a locale is to have global reach, it must be able to serve an immense number of customers, which requires a high level of productivity (and acceptance of mass-produced goods), as in tire manufacture. Or, local producers must offer a specific but widely desired product (technically sophisticated or highly fashionable), such as machines to etch silicon wafers from Applied Materials in Silicon Valley. In addition, large multinational corporations have been major carriers of investment and industry across national boundaries, helping to expand the industrialized world by leaps and bounds. In so doing, they imprint their internal hierarchies of labor and management on the global arena (Dicken, 1992).

Most big industries operate at a variety of territorial scales, from the local to the global (Storper, 1997; Scott, 1998). This can make their worldwide locational pattern seem "all over the place," and it takes closer analysis to reveal a geography of large and small clusters, networks of linkages between nodes, and sub-specialization and hierarchy. Aircraft, for instance, have a global geography that includes not only focal points such as Boeing in Seattle, but components in Los Angeles, electronics in Orange County and Silicon Valley, assembly in Alabama and Missouri, jet engines in Connecticut, or in Europe (around Toulouse, in southwest England, Silicon Glen, southern Germany, and central Italy) (cf. Dedrick and Kraemer, 1998).

A different geography prevails where products don't travel well. Manufactured goods are often contrasted with so-called services in this regard. Yet some services, like finance, consulting, and tourism, travel exceedingly well. Conversely, some basic activities, such as retailing, electric power, and prepared foods, are relatively immobile. Such local-serving industries tend not to have a strong spatial division of labor; rather, they are replicated from locale to locale. A way around this limit to size is to clone, either by merging regional firms (as in paint manufacturing) or creating a chain of identical facilities from place to place (as in fast foods). A false contrast is often set up between localized and globalized industries, when Taco Bell, for example, can be both.

There are, of course, boundaries that limit the flow of goods and services, not to mention labor and capital. Industrial production systems are not all internationalized, much less globalized. They still flourish within certain bounded arenas. National borders are the most obvious of these bounded spaces. Modern economic development cannot be understood apart from the emergence of nation-states since the eighteenth century (Hobsbawm, 1990). Consolidation of national markets and trade barriers has confined many industries within national boundaries, with distinctive patterns of production, business organization, labor relations, and consumer preferences (Chandler, 1990; Biernacki, 1994). For example, almost all large industrialized nations have their own automobile, weapons, garment, and machine-tool industries. They also have their own favorite specialities and competitive advantages that continue even as trade barriers break down, from fashion shoes from Italy to modernist wood furniture from Scandinavia, based in long-nurtured national skills, well honed tastes, or government favoritism (Best, 1990; Porter, 1990; Walton, 1992). The reported death of the nation-state has been greatly exaggerated.

One of the most striking shifts in global geography has been the independent development (endogenous growth) of newly industrialized countries. This is

particularly true of East Asia's amazing rise to near parity with North America and Europe over the last fifty years. First Japan, then the "Four Tigers" (Taiwan, Korea, Hong Kong, and Singapore), and now China and Southeast Asia have industrialized at a breakneck pace (Amsden, 1989; Wade, 1990; Tabb, 1995). Their expansion has depended less on foreign direct investment than on high rates of internal saving and investment, under hothouse conditions forged by strong national states (Wade and Veneroso, 1998). They have often specialized in labor-intensive and technically unsophisticated products, dramatically altering the global pattern of industries like toys and garments in the process. This pattern depends a little on corporate hierarchies, to some extent on technical change (see below), and mostly on international differences in skills and wages (Webber, this volume).

Rising productivity in these places creates new patterns of international trade and takes a competitive toll on many industries in the advanced capitalist nations (Walker, 1999). This has forced a reconsideration of the dynamics of international competitiveness. Students of comparative development, such as Michael Porter (1990) and Peter Evans (1995), have come to realize how much of the "competitive advantage" of one country over another is not due to pre-given conditions, but to the way that labor productivity, product quality, and business capability can be improved through innovation, education, state assistance, and industrial strategy (Sheppard, this volume).

Another limit to globalization is the embrace of the three great continental trading blocs of the developed world, which have been growing faster than the global economy. The European Union (EU) is the leading exemplar, followed by the North American Free Trade Alliance (NAFTA) and the East Asian sphere. There has been a dramatic shift in Europe toward production for the EU and away from national markets, accompanied by increased competition and consolidation across national borders, whereas trade beyond the bloc has diminished (Urwin, 1995). The North American Free Trade Alliance consolidates American economic integration under US domination; here, too, Canada, the USA and Mexico are each other's largest trading partners (Orme, 1996). The countries of the East Asian region lack an equivalent to the EU and NAFTA, but Japan's overseas investment has fueled explosive growth in Southeast Asia, while investment from Hong Kong and Taiwan has done the same for China (Hsing, 1998; Brenner, 1998).

Industrialization: The Rising Tide of Production and Technology

The idea of a spatial division of labor is a powerful one, but remains static. Economic geographers must capture the relentless dynamism of modern industry. The great flaw in classical location theory is the belief that one already knows beforehand what industry looks like, and that industrial location consists of finding the best location for a known product and technique of production. Location, in this view, is like arranging furniture. One is searching for the optimal (least cost, highest profit) assignment of chairs and sofas, given the shape of the rooms. Once that arrangement is found, the furnishings are said to be at equilibrium. Location theory becomes a sort of economic *feng shui*, putting things in harmony with the gods of commerce.

This misses the dynamism of industrialization and industrial geography. As economic geographers discovered in the 1980s, industrial restructuring repeatedly breaks up the furniture in one corner of the house while adding new pieces in another. Accepted assumptions about industry are forever thrown into disarray along with the landscape. One has to rethink fundamentals, reject equilibrium and optimization analysis, and go back to classical political economy with its emphasis on the sources of growth and development (Storper and Walker, 1989; Swyngedouw, this volume).

The term industrialization has a somewhat antiquated ring today; one speaks of "technical innovation" instead. The technology of production has been rapidly and continuously improved over the last two centuries. "High tech" is the popular term for the leading edge of technology in our times, including such things as electronics, genetics, and aeronautics. But the age of High Tech is nothing new: flour and spinning mills were the high tech of the early nineteenth century, slaughterhouses and steel furnaces the wonders of the late nineteenth century, and electricity and chemicals the breakthrough domains of the early twentieth century. The Industrial Revolution is not a single event, but an upheaval that still goes on today (Landes, 1970; Mokyr, 1990; Pursell, 1995).

Industrialization is, first, a process of improving production methods, raising the productivity of labor and other inputs. Such improvements include the use of better tools, rationalization of tasks, application of machinery, automatic control of machines, moving assembly lines, savings on materials, and the like. Rising productivity means falling costs per unit of output, which translates on the consumer side into declining prices. This, in turn, brings more customers into the market and sharpens competition between best practice and lagging producers (Rigby, this volume).

Just as important are improvements to products and the creation of entirely new goods and services. From early on in the Industrial Revolution factories have sent forth a stream of commodities that never existed before, such as the locomotive, metal-cutting lathe, or analine dyes. That stream has become a veritable Mississippi of invention, making product proliferation an essential strategy of every industry from soft-drinks to software (now called "niche marketing"). Moreover, one of the clearest lessons of the new global competition has been the importance of quality control, design, and performance of goods. Not that this is a wholly new idea: consider the design of Wedgwood pottery or the reliability of Ford's Model T (Forty, 1986; Hounshell, 1984).

Changes in technique alter the input mix of manufacturers, which changes their locational calculus (in the terms of Weber). Improvements in meat-packing, for example, shifted the beef industry from East Coast butchers to Chicago's industrial packers at the turn of the last century. At the same time, shifts in competitive advantage and market share of firms and workplaces due to production advances will rearrange the overall geography of an industry. The industrial chicken-house has made the poultry districts of the South into major agribusiness centers (Boyd and Watts, 1997; Page, this volume). Finally, wholly original products give rise to new sectors of industry. The invention of the movie camera made a motion picture industry possible, leading to Hollywood, while a shift from mini- to micro-computers in the 1980s favored Silicon Valley over Boston's Route 128 electronics complex (Saxenian, 1994).

Organizational forms and management practices have come to the fore as an arena in economic geography. It used to be thought that business organization was rather static and foreordained; technological innovation referred to machines and chemicals. Firms were either small or large, competitive or oligopolistic. Little attention was paid to progress in management practices or the possibility of competitive advantage through organizational change, except to make the one-time jump from small to big (Chandler, 1977; but see Pollard, 1968; Beniger, 1986). This view has passed with the recognition not only of international differences in organizational methods, but also the rapid learning and innovation taking place in the face of just-in-time supply, global networking, small firm spin-offs, and flattening hierarchies of control. The Japanese system of mass production through better integration within and across firms shifted the geography of automobiles and consumer electronics dramatically toward East Asia during the 1980s, for example (Kenney and Florida, 1993). Today, the Silicon Valley networking model, which has given the place such a decisive advantage in global electronics, is all the rage with managers and governments around the world (Davidow and Malone, 1992).

Technology means human knowledge as much as machines, circuitry, or genetically altered organisms. The latter are the embodiment of a state of knowledge, involving scientific research, skilled labor, and practical know-how. This means that the education, training, and technical competence of the labor force is an essential consideration to industries and their locational calculations. A premium on technologically sophisticated labor keeps many industries operating within the compass of the advanced countries and has long been a barrier to the spread of industrialization to the backward areas of the world economy.

Moreover, knowledge acquisition, application, and improvement are part and parcel of technical innovation. That is why economic geography has taken a keen interest in "learning by doing" in the process of technical innovation. Early research on the geography of innovation concentrated on the location of corporate research and development labs, showing that these units demand the skilled scientific labor best found in favored regions such as New England, southeast England, or California (Malecki, 1980). But attention has shifted toward "learning regions", or the way collective interaction, practice, and creativity contribute to innovation and production improvements throughout an industrial territory (Storper, 1997; Malecki, 1997).

For all the R&D and learning involved, technology would not progress very far without the investment of large sums of money, which is the province of capitalists and governments. Nor would it proceed with such fearsome, manic energy without the spur of capitalist competition and lust for accumulation. Rates of technical change and productivity improvement track rates of investment rather closely, and the latter track rates of profit (Brenner, 1998). High rates of investment have been vital to such rapid growth places as Japan or California over many decades (Japan took advantage of high savings and capital controls; California benefited from massive stocks of gold, silver and oil; Walker, 2000). Nor should we forget the unfortunate spur that military competition and warfare have given to technical innovation, from the invention of interchangeable parts in the early nineteenth century in France and New England, to the creation of computers in the mid-twentieth century in Britain and the United States (Hounshell, 1984).

Uneven Development: Many Paths of Industrialization

Industrialization does not proceed evenly across the whole front of the division of labor or the whole world of industrial places, despite the rapid circulation and diffusion of new ideas. Different industrial sectors and segments have their peculiar conditions of production to cope with, including the nature of the product, type of demand, level of competition, and labor traditions. The result is that the same abstract forces compelling technical change are applied differently from one sphere to another (Storper and Walker, 1989).

Thus, only some kinds of industries are fruitful areas of mass (quantity) production, while others work in batches, and some by special order. Cars can be made en masse, but work stations are made in large batches, and specialized machinery for steel mills must be crafted on a custom basis. Big mass production factories tend to locate in more dispersed places than batch and custom workplaces, where unstandardized inputs, skilled labor, and continual interaction with customers and suppliers are the rule. The latter types of production generate strong agglomeration economies, as pointed out by observers of industrial districts (Scott, 1988a; Amin, this volume). Custom and batch production have also generated some of the most dramatic innovations of our time (Saxenian, 1994; Scranton, 1997), while many producers have backed off from the fetish of sheer volume in favor of a more careful coordination of supply with demand along the whole chain of production.

Different industries follow their own peculiar paths of industrialization. Most elementally, every sector has a sort of "technological backbone" that aligns the body of work around certain characteristics. Agriculture, for example, has never been assimilated into theories of automation based on manufacture, and health care does not conform well to conventional theses about mechanization. Ideas derived from automobile assembly do not carry over well to pharmaceuticals or textiles, where products and methods of production are so different. This means that sectoral studies are essential to economic geography and that abstracting from many sectors, rather than generalizing from only a few, is the only way to grasp the essential tendencies of geographical industrialization (Storper and Walker, 1989; Page, this volume).

Beyond the technical spine of industrialization lies the "soft body" of social development, which is anything but formless. One of most exciting ideas in contemporary economic geography is that industrial history is literally embodied in the present. That is, choices made in the past – technologies embodied in machinery and product design, firm assets gained as patents or specific competencies, or labor skills acquired through learning – influence subsequent choices of methods, designs, and practices. This is usually called "path dependence" or "industrial trajectories" (Dosi, 1984). It does not mean a rigid sequence determined by technology and the past, but a road map in which an established direction leads more easily one way than another – and wholesale reversals are difficult. This logic applies to industrial location, as well: a Silicon Valley, once established, takes on a life of its own, driving the electronics industry and building on the accumulated advantages of the past (Saxenian, 1994).

Technical and institutional practices of industry vary across regions, countries, and continents, as well as sectors. Economic geographers no longer make simple presumptions about the homogeneity of capitalism and industrialism, or a common trajectory for all industrialization. Japanese industry is not a replicant of American industry, which did not replicate British industry. When Japanese managers applied the lessons of American Fordism to their situation, they came up with a new hybrid, "Toyotism;" and when American car companies tried to learn from the Japanese, in turn, they came up with an altered system of "lean production" (Schonberger, 1982; Womack et al., 1990).

One can therefore speak of "national systems of innovation," "national patterns of business organization," and even "national capitalisms" because habits and styles of industrialization diverge between countries (Freeman, 1995). There are also substantial regional variations in technologies and industrial practices within supposedly homogeneous countries such as Canada and the United States (Rigby, this volume), and continental scale differences, as in comparing North American labor markets (flexible hire and fire, high youth employment, low entry wages) with those in Europe (greater job security, high entry wages, high youth unemployment) (Freeman, 1994). The same may be said of the contrast between East Asian statist development and American liberalism with its dread of state intervention (Wade, 1990).

The Production of Place and New Industrial Spaces

Recent upheavals in the world economy and its geography have forced geographers to come up with a more forceful way of imagining how the industrial map has been put together over time. In a dynamic world, production is not just the production of goods and services; industrialization is the production of industry itself and of the industrial world. Before the Industrial Revolution there were no corporations, no factories, no captains of industry, no high tech; there was nothing to locate. The whole apparatus of industrial production had to be created out of whole cloth, and with it the landscape of modern industry.

The act of industrial creation has not been once-and-for-all but a thing repeated over and over – industrialization itself. Before the invention of open-hearth furnaces, there was hardly a steel industry and no Ruhr Valley metals complex. Before the internal combustion engine, there was only a small oil industry, and no Houston petroleum equipment and refining district. Before the automobile, no Detroit or Coventry. Today's economic geographers may delve into the secrets of Silicon Valley, but California was no more than a province of Spain when the iron furnaces of Derbyshire and cotton mills of Lancashire were creating the first industrial landscapes of Britain. Or they go in search of the miracles of Chinese and Malaysian industrialization, hardly thought possible a generation ago.

Industries and their locales have to be built from scratch. Studies of industrial districts have been illuminating in this regard, because they call attention to the way industrial growth creates new pieces of itself continuously, whether through product innovation, firm spinoffs, or new machinery. Industrial district growth does more: it generates collective learning, new labor skills, machines never before seen, and new organizational forms. An expanding division of labor and proliferating external

economies give a new twist to the theory of industrialization, which has traditionally focused on rationalization and mechanization within the factory. But the power of the district lies in the way the place produces more of itself (Scott, 1988a).

This "production of place" connotes something even more general and powerful than external economies and entrepreneurial start-ups. It means the creation of whole urban landscapes, from the factories to the houses of the workers, from the infrastructure to the commercial life of cities. It begins with capital investments, building workplaces and installing machines. It grows as the workforce and firms expand and proliferate. It draws in new migrants, who in turn support a mass of secondary industries and ancillary activities. It pays taxes to governments which build supporting infrastructure and develop their own dense bureaucracies. It generates profits to support further investment, in an upward spiral (Storper and Walker, 1989).

Large urban agglomerations like Tokyo mix a variety of industries that make metropolitan economies much more than a set of industrial districts, and send the scale of modern cities off the charts with each passing generation (the largest are now on the order of 25 million people) (Tabb, 1995; Hall, 1998). Industrialization has, in time, built up the entirety of the modern urban system of advanced capitalist countries and the great production heartlands of the English Midlands, the Midwest, the Rhine, or Lombardia. Very simply, it has created the industrialized world as we know it.

Industrialization does not unroll its wonder like a red carpet to the future, however. It jigs and jumps and explodes from one epoch to another, one place to another. New factories open up, while others close down. New firms rise like the phoenix, while others go bankrupt. Entirely new industries, never before imagined, march across the face of the earth setting up outposts like the Assyrians of old, bedecked in silicon and gold. Newly industrialized countries sprout on the margins of the world. One of the most important topics of investigation in economic geography is the development of such "new industrial spaces" – the impact craters of the meteor showers of industrialization (Scott, 1988b).

These spaces open up in the course of every sector's evolution. Industries normally relocate and rebuild several times over the long term. Steel in the USA began as iron-making in the ferrous bogs of New Jersey in the seventeenth century, then shifted west in the eighteenth century to eastern Pennsylvania's iron deposits and woods where charcoal could be made. When cast iron began to be produced with coal in the nineteenth century, the industry clustered around the anthracite regions. But with the shift to bituminous coal and Bessemer furnaces after the Civil War, Pittsburgh became the transcendent steel center. That pattern was altered as the iron deposits of Lake Superior came into use and the Midwest's boisterous demand for steel drew factories to the Great Lakes in the twentieth century. The sharp decline of American steel in the 1980s left the playing field open to a wave of Japanese and Korean mills in new sites across the Midwest.

New industrial spaces are not confined to the expansion of single industries. Industrialization periodically hurls huge new landscapes onto the map, as can be seen in the expansion of industrial Europe outward from Britain in the nineteenth century (Pollard, 1981), or in today's "Edge City" developments of north Dallas, the Francelline arc of southern Paris, and Orange County, California (Scott, 1998b; Garreau, 1991). They can revolutionize the geography of nations with remarkable

speed. Mexico, for example, has been turned upside down geographically twice in the last half century: the tornado of Mexico City sucked in millions of people during the national industrialization era of the 1940s to 1960s; then came border industrialization under US auspices that put the North back atop Mexican development (Cravey, 1998). The way vigorous national economies enter the global scene is another case of new industrial spaces, as seen in places like Italy, Thailand, and Brazil. Indeed, the whole continental zone of East Asia swept onto the field of play of the industrialized world in our time, in the same way North America rose to challenge Europe a century before.

Nor should we forget the virtual deindustrialization of the former Soviet Union. One should never imagine that the unstable and uneven development of industrialization only moves in one direction, the upward curve of progress. Deindustrialization, which smote the northern cities of the USA, Britain, and France with such ferocity from the 1970s to the 1990s, is the frowning face of the geography of capitalism (Bluestone and Harrison, 1982). This has been a repeated threat since the dawn of industrial revolution, as can be seen in the ruins of the once-glorious iron district of Shropshire or the silk-weaving region of Lyon.

Conclusion

Our tour of the geography of production has no real conclusion. The restless hand of industry writes and then moves on, and the book of industrial revolutions has yet to be closed. Thus, economic geography is not a stale field of study, but partakes of the most startling developments of political economy. It forces history upon a reluctant social science and futurism upon recalcitrant historians. And it demands spatial imagination and a geographical turn of mind among every economist, technologist, or sociologist studying capitalism and the immense powers of production it has unleashed. As Marx and Engels (1848) put it eloquently in the year of the California Gold Rush, "All that is solid melts into air." Melts, rather, into space – a geography full of the sound and fury of modern industrial production.

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