

# Industrial Ecology and the Greening of Business History

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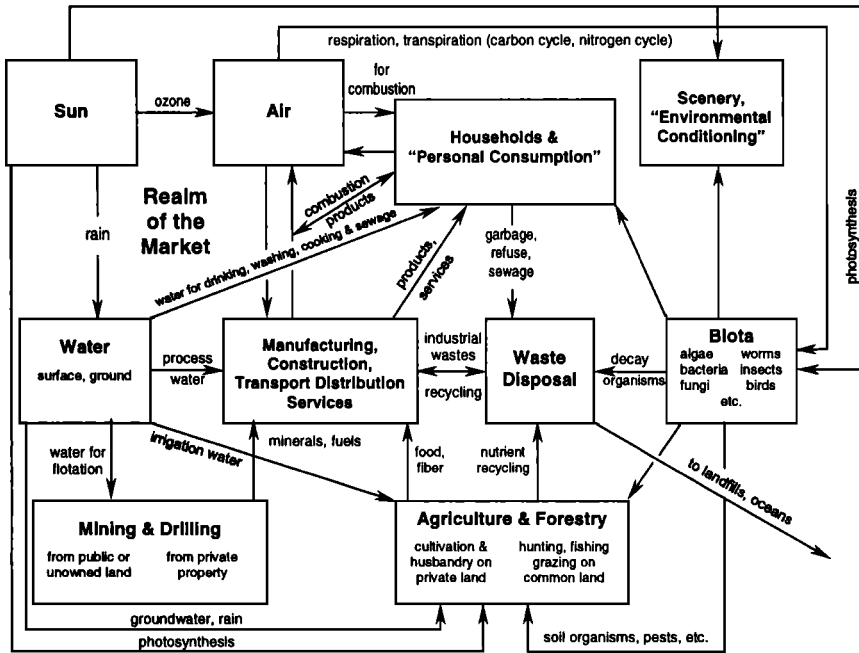
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The purpose of this paper is to explain and argue for a new conceptual approach for thinking about the history of business – a new way of thinking about business that will promote the integration of business history with environmental history and, in a broader sense, the history of society. The new approach is based on the concept of industrial ecology. Industrial ecology is a systems approach to thinking about the relationship between industrial activity and the natural world that was developed in the late 1980s by engineers seeking more effective ways to approach the challenge of minimizing the harmful environmental impacts of industrial waste. It is based on the recognition that the material and energy flows that define the operation of industrial systems are analogous to the materials and energy flows that define the operation of biological ecosystems. Just as a biological ecosystem is the whole system of biological and chemical processes that convert carbon, hydrogen, and other materials into the food and energy on which the plant and animal life in a biological ecosystem depend, so an industrial ecosystem is the whole system of physical processes that, through the application of labor and capital, convert raw materials and energy into finished products and waste. This system of industrial materials and energy flows parallels and is intimately interconnected with the larger system of the earth's natural water, carbon/oxygen, nitrogen, and sulfur and other materials cycles. The industrial flows are also intertwined with the biological cycles by which living things move through an endless process of birth, life, death, decomposition, and reconstitution into living material [Tibbs, 1991; Lowe, 1993; Richards, Allenby, and Frosch, 1994; Ayres, 1994; Graedel, Allenby, and Linhard, 1993].

The interconnections between industry and the natural world are depicted in Figure 1, which shows the whole integrated collection of physical processes that convert raw materials and energy, plus capital and labor, into finished products and wastes [Ayres, 1994, p. 24]. The diagram shows how materials and energy flow from one sector of the industrial system to the next, linking the manufacturing sector with extractive and agricultural sectors on the one hand and the consumption and product disposal sectors on the other. At every point in the extraction-manufacturing-consumption-disposal process, industrial flows of materials and energy are integrated into the natural

ecosystem of the surrounding world, as defined by the sun air, water, biota, and land, from which the materials and fuels were originally derived and into which they are finally disposed. This integration occurs on two levels: through introduction of materials and energy from the physical world during the extraction, production, and consumption processes, and through the discharge of wastes during extraction, production, and consumption.

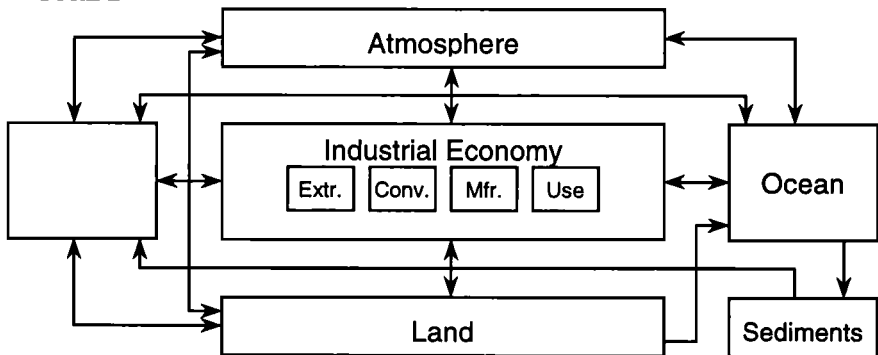
FIGURE 1



Conceived of in these systemic terms, the interface between business activity and the environment is a complex, multi-directional interchange between the natural and man-made worlds that takes place throughout the entire life of a product, not just during the manufacturing process. Figure 2 provides another schematic view of an industrial ecosystem that highlights the role played by the concept of the product life cycle in the theory of industrial ecology [Tibbs, 1991, p. 13]. The product life cycle starts with extraction of the raw materials that go into the product and progresses through the manufacturing of the product, continues through the distribution and consumption of the good, and concludes with its ultimate disposal. By incorporating consumption and disposal into its conception of the industrial economy, industrial ecology directs historians to recognize the importance of looking *downstream* as well upstream from the manufacturing process, drawing attention to the importance of including analysis of the history of consumer behavior and its impact on the environment in our understanding of business history. T-shirts, cars, furniture, canned goods, and other manufactured products usually have envi-

ronmental effects while they are being used, cleaned, and maintained. They also persist, in whole or in part, in the environment in landfills and other waste sinks after they have been thrown away, where they continue to have environmental effects until the materials they contain are reabsorbed into the biosphere. Although business does not control the consumption and disposal of its products in the way that it controls capital investment, procurement of supplies, and personnel management, consumption and disposal are extensions of the product life cycle initiated by product designers, given shape by manufacturing engineers and factory personnel, and influenced by marketing managers. Their environmental impacts are as much a part of the natural ecology of our industrial system as those generated by resource extraction and manufacturing.

FIGURE 2



This way of conceptualizing the interface between business and the natural environment has profound implications for the writing of business history. What the industrial ecological perspective does is quite simple, yet also revolutionary. It asks that business historians acknowledge the extensive business-society-environment interconnections described above and treat them as an integral part of business history. To do this, the business history field must be broadened far beyond the scope of Chandlerian institutional analysis. Indeed, it must be stretched beyond the boundaries of the various post-Chandlerian conceptual frameworks that have recently been proposed to establish socio-cultural perspectives in business history.

The purpose of this paper is to describe the parameters of this new, environmentally grounded approach to business history. The systems analysis principle on which industrial ecology is based suggests that business historians must attend to a variety of business-environment interactions in order to weave the history of business into the history of the environment. These interactions fall into three distinct categories: the history of industry's impact on the environment, the history of the environment's impact on industrial development, and the history of society's response to industrial environmental degradation. I will discuss each in turn in an effort to establish the conceptual foundation for how we may approach the task of incorporating the

environment into business history. I will then describe some recently published historical work that illustrates the way this sort of attention to the interface between business and the environment can be used to inform and strengthen our attempts to understand the history of business. I will conclude by suggesting a theoretical way to link this environmental approach to conceptualizing business history with the mainstream, institutionally focused Chandlerian paradigm.

### **The Conceptual Foundation**

#### ***Business's impact on the history of the natural world***

First, and most obviously, thinking about business history from the view point of industrial ecology makes clear the importance of analyzing the impacts of business activity on the natural environment over time. The entrepreneurial creativity, managerial decision making, technological innovation, financial dealing, marketing, and manufacturing activity that gave rise to modern business institutions led to the extraction of materials and energy from the natural environment and the flow of wastes back into the environment. Business historians must explore how these economic processes were related to historical changes, biological ecosystems, and climate, as well as natural landscapes. We must, for example, investigate how the cutting open of mountains for the establishment of coal, iron, copper, and other mineral mines and the damming of rivers and streams for the construction of water-powered mills and hydroelectric power plants affected the flora and fauna of the surrounding countryside. We must investigate how the harvesting of plants and fish and other animals from lakes, rivers, and oceans to feed markets for food, drugs, and other consumer goods altered the balance of nature in aquatic environments. We must work to understand how the clearing of forests, meadows, and wetlands for the establishment of plantations and farms and the construction of factories, transportation systems, homes for workers, and the growth of towns and cities affected biological ecosystems, natural materials cycles, and weather and climate patterns.

Perhaps most important, business historians need to begin taking a close look at the impact industrial waste has had on the natural world. A key insight of industrial ecology is that the metabolic materials flows of industry, though analogous to those of nature in many respects, differ from the earth's natural material flows in a very important way. Whereas the natural materials flows are closed-loop processes that constantly recycle materials through biological ecosystems, industrial materials flows are open. Materials used in manufacturing flow from the biosphere into the production process and back into the biosphere in the form of air and water pollution and solid waste. From there they are rarely returned to the production process. Humans have done little to recycle the materials used in the industrial world largely because they have lacked the technological know-how needed to optimize waste minimization and reuse, and the market has traditionally given them very little economic incentive to develop and implement such know-how. In Ayres words, "the industrial

system does not generally recycle its nutrients" [1994, p. 25]. It is essential that business historians turn their attention to this aspect of the business-environment interaction. This means taking a much more serious and sustained look at environmental consequences of industrial pollution and toxic waste. It also means examining the impact of mass marketing and the emergence of a culture of disposable consumption on natural ecosystems. Economic activity has played an important causal role in a variety of large scale global environmental changes with potentially profound implications for all life on this planet, including human life. It is currently implicated in global warming, acid rain, changes in the protective atmospheric ozone levels, and species extinction. No history of business can be complete until these and other large and small scale environmental changes are examined and their relationship to economic development and the evolution of modern business institutions analyzed.

In our effort to investigate the history of business's harmful impacts on the natural environment, it is necessary that we bear in mind that human beings are members of the biological ecosystems on which business has over time impinged. One of the great insights of the industrial ecologists is their recognition that human beings are part of the great webs of life and materials and energy flows that constitute the natural world. This means that business history ought to encompass the study of business's impact on human health, as well as the health of non-human species and more general global environmental conditions. Business historians need to give more attention to the subject of occupational hygiene and study how factory workers have been affected by the use of toxic chemicals in industrial production. We also need to look beyond the factory walls and study how business's emissions of toxic chemicals into the air and water supplies have affected human health [Ponting, 1991, pp. 161-407; Simmons, 1993, pp. 29-47, 57, 63-64; Roberts, 1989, pp. 155-181; Sellers, 1997].

### *The Impact of the Natural Environment on the Development of Business*

In addition to directing that business historians examine business's impact on the natural environment, the industrial ecology perspective requires that we investigate the role played by the natural environment in the evolution of business. As Figures 1 and 2 make clear, business is and always has been an integral part of the world's natural environmental system. As a result, the natural environment has over time affected business development as profoundly as business has affected the environment. The environment has not only played a role in the location of factories and other business facilities requiring access to raw materials, energy sources, and water transportation, but has played a key part in the stimulation of technological change and the emergence of new industries. For example, when the exhaustion of wood as a source of fuel led to the development of technologies based on the burning of coal at the start of the industrial revolution in England, the discovery and exploitation of oil huge reserves stimulated the development of the petrochemical industries during the late nineteenth and twentieth centuries in Europe and the United States. Mankind's quest for and exploitation of precious metals, coal, iron, timber, and other natural resources has been one of the

driving forces in the development of business enterprise in both the agricultural and industrial sectors. The damming of rivers for the generation of electrical power provided energy that spurred the development of industry as well as allowed consumers to plug the fruits of that industry into wall outlets, expanding markets for electrical appliances and other consumer goods. The development of irrigation systems and the tapping of aquifers allowed agribusiness to flourish in California's fertile but arid Central Valley and other parts of the west and the high plains. Floods, hurricanes, earthquakes, fires and other natural disasters have stimulated developments in the insurance industry as well in architectural and product design. People's desire to experience nature stimulated the development of many parts of the tourist industry [Ponting, 1991, pp. 267-294; Worster, 1985].

In short, the concept of industrial ecology reminds us that business has evolved in an environmental context that has shaped, in very important ways, the very factors of production on which markets and economic activity depend. This is most obvious in the case of the energy, raw materials, and capital supplies needed for business development. The environment is also implicated in the changes in labor supplies that affected the evolution of business. Climate changes, pestilence, droughts, crop blights, and other environmental disruptions have stimulated migrations of peoples from one place to another, affecting the availability of labor, the nature and patterns trade, and the diffusion of technology throughout human history. Even waste disposal has played a role in the history of the development of business. In preindustrial and early industrial days, resource scarcity led to high materials costs that supported active recycling of all kinds of materials used in industrial production. Peddlers went door to door buying old rags and goods containing metal and other materials that could be resold to industry. Impoverished immigrants scavenged in town and city dumps for the same reason. As industrial development proceeded and the cost of raw materials fell, the incentives to recycle diminished, door to door peddlers disappeared, and privately and municipally owned, sometimes Mafia controlled, garbage collection and landfill businesses proliferated. More recently, huge corporations have taken over the waste disposal sector of the economy (renamed waste management), partly in reaction to public agitation over and regulation of toxic waste and environmental conflicts relating to the siting of new landfills. Business historians have an obligation to situate their analysis of the history of business institutions in their environmental contexts and to recognize that they are, in fact, investigating connections between business and environmental history [Ackerman, 1997, pp. 14-15, 181; Frosch and Gallopoulos, 1990, pp. 42-54].

### *Society's Response to the Industry-Environment Connection*

The third issue that the industrial ecology concept directs business historians to examine is the question of how the environmental changes caused by business have affected the evolution of human cultural, social, and political systems. Economic activity is implicated in all kinds of environmental conditions that have shaped the social, cultural and political structure of human

communities. The relationship is particularly obvious in ancient societies that were closely tied to the land. For example, irrigation made possible the agricultural activity that enabled hunting and gathering people to settle down and develop the social, political, and cultural institutions that gave rise to the ancient Sumerian civilization that emerged in the Tigris and Euphrates river valleys of Mesopotamia. Irrigation also led to environmental changes that helped destroy this civilization. Historians believe that one of the primary causes for changes in the center of power from southern to northern Mesopotamia and the civilization's ultimate decline was the poisoning of agricultural land as a result of the accumulation of toxic salts in farm land due to irrigation [Ponting, 1991, pp. 56-59,69-72; Roberts, 1989, pp. 129-131].

The links between business, environment, and societal development are not confined to ancient civilizations, however. Relatively recent history is also full of such connections. The establishment of textile mills and other manufacturing enterprises in New England during the industrial revolution changed the way people related to and made use of local rivers, encouraging people to abandon subsistence farming on the region's rocky, unproductive soils and move into towns and cities and become absorbed into the market economy as well as attracting immigrants in search of jobs. All this economic, demographic, and environmental change simultaneously reshaped local landscapes and natural ecosystems, transformed local social and political structures, and led to significant modifications in lifestyle and cultural values. Similar environmental and social transformations took place in mining areas where the economic opportunities mines offered immigrant and domestic workers led to the creation and growth of often badly polluted mining towns. Throughout the developed and developing world, capitalist exploitation of natural resources has made possible the multifarious social, cultural, and political changes associated with urbanization, industrialization, and cultural modernization. These environmentally related broad societal developments need to be incorporated into business history [Steinberg, 1991; Dublin, 1979; Dawley, 1976)].

I am not the only business historian arguing these days that business history should not be limited to institutional analyses that focus only on what is going on inside business organizations, but must broaden to encompass analysis of the social, cultural, and political ramifications of business development. Where I depart from most other business historians who share this interest in broadening the scope of business history is my insistence that business historians recognize and investigate the environmental dimensions of the business-society interface. It is crucially important that we acknowledge and bring our skills as historians to bear on questions concerning the role that managerial strategies, manufacturing and mining technologies, and marketing techniques have played in the exploitation of resources, the destruction of biological ecosystems, and all the other environmental changes discussed earlier and relate this back to the evolution of social, cultural, and political structure. It is crucial that we then relate our analysis of the social, cultural, and political ramifications of industrial environmental impacts back to the evolution of

business institutions and the history of business's impact on the environment. Systems analysis is at the heart of industrial ecology. What I am arguing for is a systems approach to studying and attempting to understand the interface between business development, environmental change, and the history of society.

In my view it is particularly important that business historians investigate the variety of ways in which people have made sense of and adapted themselves to the undesirable, ugly, and hazardous landscape changes, destructive ecological impacts, and often unpleasant noises, smells, and sights associated with business activity and industrial development. We must also begin studying what people did to protect themselves and their environments from the environmental change and degradation caused by business.

To explore this dimension of business history, business historians must recognize the role that environmental protest movements, nuisance litigation, environmental regulation, public health reform, and zoning played in the evolution of modern business. Recent research into the history of pollution control in 19th century America shows that community groups protested and tried to stop business activities that they felt caused intolerable damage to the environments in which they lived. City council and state governments debated the need for regulation, took legal action against some businesses for causing public nuisances, and appointed commissions to study the degradation of rivers and streams. Individual property owners sued polluters for damages and/or injunctions for relief. The courts grappled with the legal issues raised by this regulation and litigation, modifying traditional nuisance doctrines and developing new ones to adjudicate such conflict. Case law and records of government debates provide insight into society's ambivalent feelings about the public's right to be protected from the environmental harm business caused and the right of entrepreneurs to develop their property regardless of the environmental effects, revealing confused, conflicting, and shifting attitudes about the costs and benefits of requiring business to abate its pollution.<sup>1</sup>

As necessary as it is that business historians investigate how individuals and communities responded to and sought to protect themselves against industrial environmental degradation, it is probably even more important that we look at how business managers did and did not do this. We are business historians; this is where our expertise lies. Although it is often assumed that American business managers were oblivious to the environmental consequences of their actions until the 1970s, when tough Federal clean air and water regulations were passed, this is not the case. Pollution abatement has a long, if troubled, history, as nineteenth century nuisance case law and scholarly articles and records of debates in engineering, public health, and trade journals show.

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<sup>1</sup> For a general overview of work on law and pollution and hazardous waste in the United States, see Melosi, [1988, pp. 741-749; 1980]. For an overview of the British response to industrial pollution see McLaren [1983, pp. 155-221]. See also Rosen [1993, pp. 303-381; and "Noisome, Noxious, and Offensive Vapors, Fumes, and Stenches in American Towns and Cities, 1840-1865," *Historical Geography* (forthcoming 1997)].



Businessmen not only resisted reformers' efforts to regulate pollution, ignored public complaints about pollution, covered up the toxic risks associated with chemicals used in their manufacturing processes, and fought law suits for as long as they could, but they also experimented voluntarily with abatement technologies, recycled wastes in many creative ways, and spearheaded smoke control movements and other environmental reform movements. Business historians have an obligation to investigate the wide variety of often conflicting responses business managers made to the environmental problems their firms generated and to put these activities in the broader context both of the evolution of the firm and the evolution of the natural environment.<sup>2</sup>

### **Green Business History in Practice**

What will a business history that embodies the principles of industrial ecology look like? Three books written by environmental historians on the relationship between business and the environment illustrate various elements of the environmental approach to conceptualizing business history outlined above. These studies not only provide models for business historians interested in the environmental dimensions of business history to follow, but also provide evidence that this kind of research is germane to the mainstream, Chandlerian interest in the institutional development of business.

One of the most outstanding studies on the environmental dimension of industrial development, William Cronon's award winning book, *Nature's Metropolis: Chicago and the Great West* (1991), is an environmentally grounded historical examination of the rise of the Midwestern agricultural commodities industries from the 1830s through the early 1890s. The heart of the book as a detailed, institutional history of the grain, lumber, and meat industries that would make Alfred Chandler proud. Displaying an encyclopedic Chandler-like attention to detail, Cronon explains how entrepreneurs like Swift exploited market conditions and new technologies to create incredibly successful big businesses that transformed the nation's industrial economy. In contrast to Chandler, however, who rarely looks beyond market forces to explain institutional change, Cronon places his analysis in the broad framework of an equally detailed and vividly described examination of the environmental context in which these industries developed. He examines what the farmers and timber company owners were doing at this time to generate the ever increasing supplies of agricultural commodities needed for the big grain, lumber, and meat packing companies to grow, explaining how the rise of these great industries transformed the natural ecosystems of the surrounding countrysides. In the process, he weaves together a fascinating analysis of the complicated, mutually interdependent relationships between nature, capital investment, technological innovation, and entrepreneurship in the rise of big business in Chicago,

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<sup>2</sup> For a more detailed discussion of published work on these topics see Christine Meisner Rosen, "Businessmen Against Pollution in Late Nineteenth Century Chicago," 71 *Business History Review* (Fall 1995), 387-396.

explaining how bison, pine trees, plants, and other flora and fauna that “had once been members of ecosystems defined mainly by flows of energy and nutrients and relations among neighboring organisms” (p. 266) were transformed into economic commodities that were produced, processed and bought and sold in vast quantities in the marketplace. Cronon’s book is a brilliant example of how historians should approach the task of doing research that illuminates both the role the environment played in the history of business and the role business played in the history of the environment. It not only provides a comprehensive institutional analysis of the history of the agricultural commodities industries but also an insightful examination of biological ecosystem change in the upper Midwest, which, he shows, was an integral part of the development of these businesses.

Andrew Hurley’s book, *Environmental Inequalities: Class, Race, and Industrial Pollution in Gary, Indiana, 1945-1980* (1995), concerns the rise of a powerful environmentalist movement in Gary, Indiana, after World War II and its relationship with U.S. Steel. It is a fascinating exploration of how a large industrial city’s different ethnic groups and social classes responded to an industry’s increasingly serious environmental impacts. Hurley explores the interface between industry, the environment, and community by describing the social geography and municipal politics of industrial environmental degradation and environmental reform in Gary. Hurley charts the emergence of environmentalism in Gary’s middle class and working class suburbs in the 1950s and 60s in response to worsening pollution in Lake Michigan, increasing fears about the health hazards associated with the air pollution generated by the steel mills, and efforts by U.S. Steel and other businesses to site industrial landfills and other industrial facilities along the lake in close proximity to recreational beaches and marinas. Although U.S. Steel met some of the reformer’s demands by agreeing to weak regulatory controls it could easily meet, it fended off efforts to impose stronger controls by threatening to cut back employment in the city and portraying environmentalism as a suburban threat to the economic health of the industrial inner city. The suburban/inner city divide prevented significant progress from being made throughout the 1950s and most of the 1960s, leaving the poor, mostly black inhabitants of the inner city to suffer particularly acute levels of industrial pollution. Hurley explains how this changed in the late 1960s, when the city’s African American civil rights movement, after years of refusing to challenge the city’s industrial employers on the issue of pollution, embraced environmentalism and entered into a multi-class, multi-racial coalition with middle and working class white environmental groups. The coalition was strong enough to take on U.S. Steel and win the passage of tough pollution regulations. The African American embrace of environmental issues strengthened efforts to organize the black community into a powerful political force, helping pave the way for the election of the city’s first black mayor and other political changes that made city government more responsive to the interests of Gary’s black residents. The book is a pathbreaking contribution to our understanding of how community efforts to

deal with industrial pollution and toxic waste have shaped and reshaped urban political culture and structure in postwar America.

*The Fisherman's Problem: Ecology and Law in the California Fisheries, 1850-1980* (1986), by Arthur F. McEvoy weaves detailed business history into an exploration of resource ecology, public policy, and the law in the California fishing industry. McEvoy describes the different ways in which different groups of Californians have harvested and managed the region's fisheries, from Native Americans in the pre-European contact era, to nineteenth century European and Asian immigrants, to twentieth century sports fishermen and the modern, mass production commercial fishing industry. The book is a masterful examination of all three of the themes discussed above. It examines the impact the fishing industry had on the natural ecology of fish off the California coast in the different stages of its evolution, the role that the resulting changes fish ecology in turn played in the development of the fishing industry, and the business and community cultures associated with the different fishing regimes. McEvoy also discusses public policy debates that surrounded efforts to protect the industry from over-fishing and examines the rather ambiguous role regulation has played in reshaping both the fishing industry and the fish ecology on which the industry depends. The book is a brilliant example of how historians can do systems analysis of the industrial ecology of an industry that explores a wide variety of interdependencies and interactions in the interface between business, the environment, and society.

Each of these books explores a completely different aspect of the interrelationship between the history of business and the history of the environment. Together they show that it is possible and indeed very edifying to place business in its environmental context and explore one or more dimensions of the business-environment interface. This kind of research enhances our understanding of both the nature and processes of environmental change and the evolution of business. Interestingly enough, however, all three books were written by people who call themselves environmental, rather than business historians.

### **But Is This Really Business History?**

The growing interest of environmental historians in the business-environment interface raises questions about the legitimacy of the argument I am making in this paper that, first, business historians need to recognize that the wide array of complex business-environment-society interactions and interdependencies described here are an integral part of business history and second, that the conceptual parameters of the business history field must be expanded to incorporate analysis of these interactions. If environmental historians are already beginning to do a good job of examining the business-environment connection, is it really all that important that business historians do so as well? Does it really make sense to envision mainstream business historians taking environmental issues seriously? The language used, the literatures cited, the paradigmatic questions at the center of analysis in books

like *Nature's Metropolis*, *Environmental Inequalities*, and *The Fisherman's Problem* are so different from those at the heart of research in what is today considered to be mainstream business history, that one has to wonder whether "green business history" can ever be incorporated into mainstream business history. Even the ideological orientations of the historians in the two fields differ. Historians writing in the mainstream business history tradition tend to situate their analyses of the rise of modern multidivision business institutions in the context of a neo-classical market analysis of managerial decision making that fits the conservative, pro-market philosophical orientation of the business schools that nurtured Chandler and some of the other leading figures in the business history field. In contrast, environmental historians like Bill Cronon, Andrew Hurley, and Arthur McEvoy come out of more left leaning history and American Studies departments and produce work that is critical of business. Their research is often informed by the left's interest in Marxist theory. Perhaps by its very nature green business history is destined to be a sideshow to the main event in business history, the history of business institutions. Perhaps we are better off to assume that it should and will be done primarily by non-business historians?

I'd like to conclude this paper by arguing that it is wrong to assume that green business history cannot or should not be considered an integral part of the field of business history. It can and should be conceptually linked up with and integrated into the Chandlerian paradigm. It is not difficult to think of how this conceptual synthesis can be made.

The link with theme number two is particularly obvious. As I point out in the section of this paper on the impact of the natural environment on the development of business, the natural environment has over time shaped the factors of production on which markets and economic activity depend, influencing labor supplies as well as the availability of capital and raw materials. The Chandlerian paradigm is based on the neoclassical model of the profit maximizing business manager responding in rational ways to market conditions, making strategic and organizational decisions that increase the efficiency of firms. It is certainly not a great leap for business historians to broaden the conceptual framework of the Chandlerian paradigm to include analysis of the role the environment has played in shaping the market conditions to which rational business managers have responded as they structured and restructured their corporate business strategies, manufacturing technologies, and internal organizational systems.

It is a much bigger leap to imagine mainstream business historians extending their analysis in the other direction so that they begin to incorporate a consideration of the environmental consequences of management decision making into their work on the institutional development of the modern corporation. Yet here, too, it really doesn't take much to extend the Chandlerian paradigm so that it accommodates industrial ecology.

The neoclassical economic model at the heart of the Chandlerian concept of the firm is a powerful conceptual tool that has enabled Chandler and other mainstream business historians to analyze in unprecedented detail

and with impressive understanding the process by which large, integrated, multidivisional corporate organizations have evolved in modern economies around the world. The model that enabled the field of business history to move into the new age of social science analysis, superceding the comparatively unsophisticated, highly moralistic robber baron/industrial statesmen schools that dominated business history until the 1970s.

The difficulty is that the Chandlerian paradigm has generally assumed, implicitly at least, that markets have been perfect and that therefore rational managerial responses did in fact enhance economic efficiency and economic welfare, hence the generally conservative, pro-business, march of progress tone of most work done in the field. In fact, however, markets have always been imperfect. As economists recognize, they have been flawed by a variety of factors, including monopoly power, imperfect information, public goods, externalities, and the bounded rationality of the people who manage businesses and consume what business produces. Although mainstream business historians have grappled with the problem of monopoly in the development of the modern corporation, they have not been particularly interested in exploring the impact that the other market imperfections played in the history of business. Yet these imperfections have constantly distorted the rational economic decision making of intelligent, if boundedly rational, profit maximizing business managers – and consumers as well.

Once one recognizes that markets are and have always been imperfect, the logic of integrating industrial ecology into the Chandlerian paradigm is clear and the way to reconceptualize it obvious. The relationship between business and the environment is one that is uniquely plagued by market imperfections, including externalities, public goods, imperfect information, and bounded rationality. Perhaps most importantly for business historians, pollution and other forms of industrial environmental degradation have been negative externalities in the history of business, social costs of production that were not internalized in the price the market puts on the value of a raw material or manufactured good. As a result, the rational business managers who created modern business enterprises had few market incentives to control their pollution, and rational, utility maximizing consumers had no economic reason to be concerned about the environmental costs associated with the products they bought. To complicate matters, the impact of business activity on natural ecosystems, human health, and global climate change has over time been so poorly understood and so politicized that managers and consumers would not have been in a position to respond in truly “rational” ways to market signals about environmentally destructive extraction, manufacturing, and disposal processes and product designs, even if their responses had not already been grossly distorted by externality effects and their own bounded rationality.

The theory of industrial ecology asks not that business historians throw out the Chandlerian paradigm, but that we modify it to accommodate the reality of an imperfect market in which boundedly rational managerial and consumer responses to market conditions had a wide range of destructive impacts on the environment. We must explore these impacts. We must also

examine the ways these environmental impacts fed back into the market place – both through their impact on the factors of production and through their impact on public protest, public policy, legal rules, and consumer behavior – shaping and reshaping the market context in which boundedly rational managers made subsequent decisions about organizational structures, product design, and manufacturing process choices. We must also examine how these managerial decisions in turn impacted the environment, and so on. From an industrial ecology perspective, it makes no sense to separate the environmental dimensions of management decision making and industrial development from the non-environmental aspects. Everything was related to everything else. This is the essence of the systems analysis perspective.

In sum, what business historians can and must contribute to the understanding of business's impact on the natural environment is research and insight into the managerial decision making and strategic thinking, organizational structuring, technological innovation, financial deal structuring, marketing, and other business activities that have contributed to species extinction, climate change, ecosystem degradation, human health problems and other changes in local, regional, and global environments. It is our job to look inside business – to use our skills as business historians – to develop an understanding about why businesses have exploited the world's natural resources so ruthlessly and had so many often harmful impacts on the environment. We must also explore all the other dimensions of the interface between business and the environment suggested by the concept of industrial ecology.

When we do this, the tone of our business histories will change: our work will become less whiggish, less about the march of progress, more troubling than that of current mainstream business history. But this is the direction we must move in if we are to be honest about the character of our subject matter. We should not confine our analysis to capitalist business history; some of the worst industrial degradation on earth occurred in Eastern Europe and the Soviet Union during the communist era. As American historians living in a market economy, however, we have a particular obligation to investigate the environmental consequences and dimensions of the history of our own, market-based businesses and those of other market societies. We must confront one of the central paradoxes of our field: the fact that in the process of creating increasingly productive, increasingly efficient commercial enterprises, profit maximizing business managers and utility maximizing consumers have made ostensibly rational economic decisions that have had significant, often devastating impacts on the natural environment and human health – here in our own country and in the world as a whole.

It makes no sense for us to cede the subject of business's interface with natural environment to historians in other fields, problematic though the subject may be. Taking a broad, systems approach to integrating business and environmental history is an exciting, interesting, and important thing to do. The concept of industrial ecology gives us a way to use business history to address one of the most profound and troubling issues of our day: industrial environmental degradation. Let us embrace the opportunity to explore the

development of modern business in all its complexity in the broad context of its relationship to the world's environmental problems and related social, cultural, and political developments.

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