

Industrial Waste Disposal in the United States as a Historical Problem

JOEL A. TARR
Carnegie Mellon University

ABSTRACT

This paper explores the manner in which historians have dealt with the issue of industrial pollution in the United States. It reviews the existing literature, suggesting reasons for the subject's neglect in the past. It also raises a series of questions for historians of pollution to focus upon. These questions include the need to understand societal values and knowledge that determined how society reacted to past pollution that threatened its health and the quality of its environment; the need to identify major turning points in the understanding and regulation of these wastes; the need to clarify how different professional groups have related to the issue of industrial pollution; the need to explore the development of indicators for measuring and regulating industrial pollution; and, the importance of clarifying what past responsible parties understood about the risks of industrial pollutants and how they had gained this knowledge. These issues are important not only to clarify the historical record but also to inform public policy.

Introduction

For the past quarter of a century or so, the subject of hazardous and toxic wastes, primarily from industrial activities, has occupied considerable public attention. Since the 1970s, the U.S. Congress has approved a set of laws that attempt to limit hazardous emissions into the air, water, or land.¹ Given the widespread public and governmental contemporary concern over risk from hazardous wastes, it is fair to ask what history has said about past aspects of this problem. That is, are our present concerns a new phenomena or do they have a historical dimension? And, if the latter is true, how is this reflected in the historical literature?

Recently, with Jeffrey Stine of the Smithsonian Institution, I reviewed how studies in the history of technology dealt with the environment.² We noted that while it was difficult to write technological history without touching on some environmental element, a survey of the literature indicated that until approximately the last decade or so, most histories of firms or of technologies that might involve environmental issues neglected such concerns. In many cases, while historians might have made token references to the environment, especially when the history dealt with the period since the formation of the Environmental Protection Agency in 1970, there was no attempt to consider

¹ Samuel P. Hays, *Beauty, Health, and Permanence: Environmental Politics in the United States, 1955-1985* (New York: Cambridge University Press, 1987), 171-206; Richard N. L. Andrews, *Managing the Environment, Managing Ourselves: A History of American Environmental Policy* (New Haven: Yale University Press, 1999), 227-317.

² Jeffrey Stine and Joel A. Tarr, "At the Intersection of Histories: Technology and the Environment," *Technology and Culture* 39 (Oct., 1998): 601-640.

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pollution generation nor disposal and possible environmental impacts. More recently, in a special issue of the *Business History Review* focusing on "Business and the Environment," Christine Meisner Rosen and Christopher C. Sellers made similar observations on the paucity of environmental considerations within the field of business history.³

This is not to say that our survey found absolutely no literature. We did discover a scattering of studies dealing with various industrial waste issues but we did not find a sustained or systematic body of literature that explored this issue. The absence of a historical literature was true not only for the smaller and more scattered industries such as tanning and rendering, but also for major industries with large manufacturing complexes. It is important to recognise the importance of not imposing contemporary concerns on the past and to appreciate that the concept of "environmental" damage is of relatively recent vintage or may have had different social, scientific, and legal constructions in the past. However, the subject still requires investigation, since it appears that some obvious opportunities for important scholarship have been missed.

How does one understand this lack of attention to the environmental variable in industrial histories, even in studies written within the last several years? It cannot be because of a lack of sensitivity to environmental issues, since historians appear to possess environmental values that are at least as strong as those of the general public. A partial explanation may be found in the path taken in the evolution of environmental history as a field. In the 1980s, for instance, as environmental history emerged, it focused on issues relating to natural environments, on the American West as a region, and on natural resource questions.⁴ Except for a few studies, literature that dealt with the possible relationships between industry, technology, and the environment over time was lacking. Or, to think about it from a different perspective, the framing devices or paradigms used by historians to think about environmental issues did not necessarily include industries and cities but focused on the previously mentioned themes.⁵

More concretely, a further possible explanation for this vacuum is a paucity of historical records relating to pollution concerns within company archives. Managers of firms themselves often neglected or ignored the effects their wastes might have had on the outside environment unless such wastes produced a nuisance that exposed them to regulatory or legal action. Many

³ Christine Meisner Rosen and Christopher C. Sellers, "The Nature of the Firm: Towards an Ecocultural History of Business," *Business History Review* 73 (Winter 1999): 577-600.

⁴ Richard White, "American Environmental History: The Development of a New Historical Field," *Pacific Historical Review* 54 (Aug. 1985): 297-335; Mart A. Stewart, "Environmental History: Profile of a Developing Field," in *The History Teacher* 31 (May 1998): 351-368.

⁵ The sociological concept of framing has been applied to the rise of the Environmental Justice Paradigm. See, Dorceta E. Taylor, "The Rise of the Environmental Justice Paradigm," *American Behavioral Scientist* 43 (January 2000), 508-580.

firms did seek to convert their wastes into useful products that could produce a profit, and this is reflected in the many "trade wastes" citations found in industrial and engineering directories in the late nineteenth and early twentieth centuries.⁶ But beyond these attempts at recycling, records usually did not comment on waste disposal and pollution. In the absence of such records, historians frequently ignored the issue of possible harm, adopting the position of plant managers who viewed waste production and disposal as a normal part of running a factory — that is, to use an economic concept, as an "externality," that could be disregarded unless shown to generate a profit.⁷

Records are often available, however, in situations where pollution did encounter opposition. Attempts of the city of Chicago to regulate Pennsylvania Railroad smoke pollution, for instance, resulted in the railroad creating an extensive file of correspondence about the issue within the firm between the firm's officials, and between the railroad and the regulators.⁸ The absence of laws in regard to many industrial pollutants, however, meant that usually no corporate records were created. But in the United States during the nineteenth century, even in the absence of regulation, the nuisance effects created by manufacturing, damage to property and creation of objectionable smells and vapours and other forms of environmental pollution, could sometimes result in legal action. Christine Meisner Rosen's on-going work on urban nuisances and the law, for instance, as well as that of younger scholars such as Jouni Paavola, show how legal case reports can be used to explore the environmental effects of nineteenth century industry.⁹ In addition, in many municipalities, city councils passed statutes relating to pollution from industrial activities such as coke and charcoal production, gas manufacturing, rendering, slaughterhouses, and tanning, thereby putting pressure on their operations. Such municipal statutes drove relocation to the fringes of the city or even to more distant locations, although effects were generally limited.¹⁰ By

the 1910s and 1920s, based on nuisances and effects of pollution, the

The most common Second World War period historians tended to focus on business. While the new those on the environment of business history, the internal evolution of but also neglected pollution. Sellers observe, the dependence and impact they wrote at a time of increasing conflict and movement.¹¹

Recently, however history of industrial pollution history have sought perhaps motivated by Superfund legislation concerns over toxicity made by historians of technology and urban these new studies.¹² A firm can provide new

These new works focus on land. They include processing; of the environment and river pollution by industries such as metal and coking; and of industrial addition, historians have

⁶ The first text on trade wastes was published in 1913 in both Great Britain and in the United States. See, H. Maclean Wilson and H.T. Calbert, *A Text-Book on Trade Waste Waters: Their Nature and Disposal* (London: Charles Griffin & Co., and Philadelphia: J. B. Lippincott Co., 1913).

⁷ Rosen and Sellers, "The Nature of the Firm," 577-600.

⁸ David Stradling and Joel A. Tarr, "Environmental Activism, Locomotive Smoke, and the Corporate Response: The Case of the Pennsylvania Railroad and Chicago Smoke Control," *Business History Review* 73 (Winter 1999): 677-704.

⁹ Christine Meisner Rosen, "Noisome, Noxious, and Offensive Vapors, Fumes, and Stench in American Towns and Cities, 1840-1865," *Historical Geography* 25 (1997): 49-82. See also, Jouni Paavola, "Industrial Water Pollution and 19th Century Common Law: Bargaining on Environmental Quality," Chap. 3 of "Governing Waters: The Development of Water Pollution Policy in the United States, 1850-1980," (unpublished Ph.D. Dissertation, Michigan State University, 2000); and Martin V. Melosi, "Hazardous Waste and Environmental Liability: An Historical Perspective," *Houston Law Review* 25 (July 1988): 741-780. Rosen is working on a two-volume study of the history of industrial wastes and the law.

¹⁰ See, Joel A. Tarr, *Search for the Ultimate Sink: Urban Pollution in Historical Perspective* (Akron: University of Akron Press, 1996), 56, for a brief discussion of such relocation in the New York area. For the chemical industry, see Craig E. Colten, "Creating a Toxic Landscape: Chemical Waste Disposal Policy and Practice, 1900-1960," *Environmental History Review* 18 (Spring 1994): 85-116.

¹¹ Christine Meisner Rosen and *Economic History* 26 (February) for an alternative method of viewing the development of technological identified with historians of environmental themes. For example, Hounshell, "Hughesian Histories: Departures, and Critics," *History of Technology* 12 (1991): 1-16.
¹² See, for instance, David P. Russell III, "The Strange World War II," *Technology and*

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the 1910s and 1920s, as will be discussed, the courts had gone beyond rulings based on nuisances alone and had begun to take a stand on health-related effects of pollution, broadening out the areas open to enforcement.

The most common paradigms used by business historians in the post-Second World War period also neglected issues of industrial pollution. These historians tended to focus on studies of the entrepreneur and the rise of big business. While the negative effects of trusts and cartels were fully explored, those on the environment were not considered. The emergence of a new form of business history, pioneered by Alfred D. Chandler, Jr., emphasised the internal evolution of the firm and its response to outside market conditions but also neglected pollution and environmental questions. As Rosen and Sellers observe, the "inattention" of business historians to "big business's dependence and impact on the natural world ... persisted despite the fact that they wrote at a time of mounting public outcry over industrial pollution and increasing conflict between business and an ascendant environmental movement."¹¹

Recently, however, historians have begun directing more attention to the history of industrial pollution. Increasingly graduate students in environmental history have sought out topics involving industry and the environment, perhaps motivated by the development of issues relating to the United States Superfund legislation (1980) and the creation of urban brownfields, as well as concerns over toxicity and health. Important also have been the contributions made by historians trained in related historical sub-fields such as the history of technology and urban history, as well as environmental history, in generating these new studies.¹² Approaching such issues from a perspective outside the firm can provide new insights.

These new works fall into all areas of environmental media: water, air, and land. They include studies of extractive industries and raw materials processing; of the environmental effects of waterpower development; of lake and river pollution by industrial pollutants; of pollution caused by specific industries such as metals, chemicals, detergents, pulp and paper, petroleum, and coking; and of industrial contamination of plant sites and groundwater. In addition, historians have also produced studies of smoke pollution in a

¹¹ Christine Meisner Rosen, "Industrial Ecology and the Greening of Business History," *Business and Economic History* 26 (Fall 1997): 123-137; Rosen and Sellers, "The Nature of the Firm". An alternative method of viewing the development of corporate America is to focus on the development of technological systems managed by system builders — this approach is most closely identified with historian of technology Thomas Parke Hughes — but it also largely neglects environmental themes. For a comparison of Hughes' approach and that of Chandler, see David A. Hounshell, "Hughesian History of Technology and Chandlerian Business History: Parallels, Departures, and Critics," *History and Technology* 12 (1995): 205-224.

¹² See, for instance, David Stradling, *Smokestacks and Progressives: Environmentalists, Engineers, and Air Quality in America, 1881-1951* (Baltimore: Johns Hopkins University Press, 1999), and Edmund P. Russell III, "The Strange Career of DDT: Experts, Federal Capacity, and Environmentalism in World War II," *Technology and Culture* 40 (Oct. 1999): 770-796.

number of cities.¹³ But while the literature on industrial pollution is increasing at a relatively rapid rate (and this is true in Europe as well as the United States), there are still many gaps in the record and questions that need to be explored. In the remainder of this paper, I will present five issues that I believe should be addressed by historians exploring issues of industrial pollution. These questions apply largely to the period before the formation of the US Environmental Protection Agency and extensive regulatory activity at the federal level.

Some Major Unanswered Questions in the History of Industrial Pollution

1. What is the larger meaning of pollution?

Some historians are attempting to comprehend the significance of industrial waste generation and pollution from a larger perspective. That is, they are trying to understand attitudes by the public, the legislatures and the courts towards industrial emissions in terms of the society's larger values and priorities. In addition, they are attempting to understand industrial wastes from a comparative perspective relative to the treatment of other wastes. The concepts of pollution and of waste are largely intertwined in contemporary environmental discussions. Economists and policy makers have normally viewed wastes as externalities, something outside the productive process, which enters into the ambient environment. Historically wastes, if they could not be recycled, have been part of a "waste stream" that is disposed of in an out-of-the-way place, or "sink." Hopefully, this "sink" would not lead to damage to either property or to individuals.

Pollution, therefore, can be viewed as "matter-out-of-place" that needs to be restored to its proper place in the natural world where "waste" does not exist. In such a site, it theoretically degrades in a manner that will return it to the physical environment, restored, but in a different form.¹⁴ In the nineteenth and twentieth centuries, at different time periods, various wastes have been recycled into useful products. However, this has been a cyclical process, dependent on market conditions as well as regulation. Many wastes also degenerate at very slow rates, and have long-term persistence in the

¹³ For bibliographical references see Jeffrey Stine and Joel A. Tarr, "At the Intersection of Histories: Technology and the Environment," *Technology and Culture* 39 (Oct., 1998): 601-640. More recent works dealing with technology, industry and the environment include John T. Cumbler, *Reasonable use: The People, the Environment, and the State, New England, 1790-1930* (New York: Oxford University Press, 2001); Scott Hamilton Dewey, *Don't Breathe the Air: Air Pollution and U.S. Environmental Politics, 1945-1970* (College Station: Texas A & M Press, 2000); Hugh S. Gorman, *Redefining Efficiency: Pollution Concerns, Regulatory Mechanisms, and Technological Change in the U.S. Petroleum Industry* (Akron: University of Akron Press, 2001); and John D. Wirth, *Smelter Smoke in North America: the Politics of Transborder Pollution* (Lawrence: University of Kansas Press, 2000).

¹⁴ Martin V. Melosi, "Waste," in *The Encyclopedia of the Environment*, ed. Ruth A. Eblen and William R. Eblen (Boston: Houghton Mifflin Co., 1994), 789-793; Kenneth D. Durr and James H. Lide, "A 'New Industrial Philosophy': World War II and the Roots of Corporate Recycling," paper delivered at the 1999 Conference of the American Society of Environmental History, April 14-18, 1999, Tucson, Arizona; and Joel A. Tarr, "From City to Farm: Urban Wastes and the American Farmer," *Agricultural History* 49 (Oct. 1975): 598-612.

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importance of industrial waste. That is, they are structures and the courts assign larger values and understand industrial wastes as different from other wastes. The changes in contemporary thinkers have normally viewed the productive process, industrial wastes, if they could be disposed of in an out-of-sight place, not lead to damage to

the "place" that needs to be protected. "Waste" does not mean something that will return it to its original form.¹⁴ In the nineteenth century, various wastes have been a cyclical phenomenon. Many wastes have shown persistence in the

14. "At the Intersection of Environment and History," 39 (Oct., 1998): 601-640. Comments include John T. Sweeney, *England, 1790-1930* (New York: Oxford University Press, 2000); Hugh S. Gorman, *Biological Change in the U.S.* (Oxford: Oxford University Press, 2000). Ruth A. Eble and William H. R. Murray and James H. Lide, "A History of Recycling," *Environmental History*, April 14-18, 1998, 14-18, *Wastes and the American*

environment. These wastes often visibly contaminate our landscape in the form of slag and slack heaps, and polluted streams. When mines and mills are working, these features formerly often connoted "progress." When they are abandoned, they become "wastelands."¹⁵

Among the questions that need to be addressed are the following: what values and knowledge, for instance, determined how society reacted to pollution problems that threatened both the health of society, the quality of its environment, and its physical landscapes? How did these values differ among various groups in society? Anthropologist Mary Douglas has emphasized the larger cultural meaning of pollution and how pollution fears reflect other social anxieties. Does her hypothesis have relevance to the historical American experience and in what manner?¹⁶

In a thoughtful paper, Adam Rome has noted that in the late nineteenth and early twentieth centuries the liquid wastes produced in manufacturing processes such as chemicals, oil refining, and metallurgy were often referred to as "trade wastes" and, after 1900, as "industrial wastes." In contrast to these wastes were the biological wastes that for nineteenth century sanitary reformers signified "pollution," wastes often imbued with a moral meaning. By the turn of the century, however, Rome observes that pollution had largely become a descriptive term, losing its moral content, and became an engineering problem. For public health physicians and sanitary engineers the worst pollutants became those related to epidemic disease, especially sewage.¹⁷ The sinks that were utilized for the disposal of organic wastes, therefore, because of their association with disease, became especially critical.

What then was the attitude toward industrial wastes? Did they have the same set of associations as did sewage? Were they less loaded with moral meaning than sewage had been? In his study of Connecticut River pollution, John Cumbler argues that late-nineteenth century New England reformers believed that pollution involved not merely stream aesthetics, but also "the health of the citizens of the state, the economic well being of the state, and its political stability." That is, industrial pollution also involved moral issues. Essentially, this hypothesis about industrial pollution rested on the anti-contagionist theory of disease, but in the late nineteenth century, as germ theory replaced anti-contagionism, industrial wastes lost some of the opprobrium that had been associated with them. A number of "experts" argued that industrial wastes were "cleansing agents killing germs," and therefore performed a positive function.¹⁸ They had lost the moral burden that they formerly possessed. For

¹⁵ For example, see Robert B. Gordon and Patrick M. Malone, *The Texture of Industry: An Archaeological View of the Industrialization of North America* (New York: Oxford University Press, 1994).

¹⁶ The cultural concept of risk, as it involves the nexus of technology and the environment, is explored in Mary Douglas and Aaron Wildavsky, *Risk and Culture: An Essay on the Selection of Technological and Environmental Dangers* (Berkeley: University of California Press, 1982).

¹⁷ Adam W. Rome, "Coming to Terms with Pollution: The Language of Environmental Reform, 1865-1915," *Environmental History* 3 (July 1996): 6-28.

¹⁸ Nicholas Casner, "Polluter Versus Polluted: The Pennsylvania Railroad and the Manufacturing of Pollution Policies in the 1920s," *Journal of Policy History* 11 (1999): 188.

Cumbler this shift is particularly significant because he argues that it had political meaning, that is, "the germ theory facilitated the focusing of health reform discussion on sewage pollution and away from industrial pollution," and germ theory became "politically expedient for the opponents of industrial waste reform."¹⁹

Cumbler's argument is suggestive and worthy of further investigation. The issue of the association between pollution and "morality" is an interesting cultural question, especially if it influenced political actions. Further investigations of attitudes toward industrial pollution and hazardous wastes might be linked into with changes in the larger culture of society. For instance, why was society prepared to accept risk in regard to pollution from some technologies but not from others? To what extent do cultural attitudes affect our reactions to pollution issues? While some of these questions have been investigated in regard to environmental trends, further study needs to be done probing the history of changing attitudes towards various industrial hazards especially in regard to new products that promised benefits as well as costs.²⁰

2. Identifying major turning points

If the movement from anti-contagionist health theory to the germ theory marks an important (but arguable) dividing point in efforts to control industrial pollution, what other similar type of turning points can be noted?²¹ In a recent paper Nicholas Casner has written about an important Pennsylvania case involving a suit by the Pennsylvania Railroad Company against several Pennsylvania coal companies that were damaging the reservoirs the railroad maintained to provide clean water for its steam locomotives. This case involves, as Casner notes, "polluter vs. polluter," but it is also important because of the role of the health factor.²² That is, while in the previous decades the courts had occasionally taken action against industrial polluters because of damages to property, they had been much more reluctant to act because of public health considerations. In this case, however, threats by industrial polluters to the public health specifically entered into the equation.

The essentials of the case involved problems with pollution caused by mine

¹⁹ John T. Cumbler, "Whatever Happened to Industrial Waste?: Reform, Compromise, and Science in Nineteenth Century Southern New England," 39 *Journal of Social History* (Fall, 1995): 150-171. Harold Platt also makes the argument that the New Public Health, by focusing on bacterial issues, diverted attention away from the harm of an industrial effluent, in this case locomotive smoke. See, Platt, "Invisible Gases: Smoke, Gender, and the Redefinition of Environmental Policy in Chicago, 1900-1920," *Planning Perspectives* 10 (Jan. 1995): 67-97. Adam Rome has criticised Platt for failing to distinguish between public health physicians and physicians more generally. See, Rome, "Coming to Terms with Pollution," 25, footnote 28.

²⁰ For example, see Russell, "The Strange Career of DDT."

²¹ I have argued that another major turning point that had implications for industrial waste was the decision to focus on water filtration rather than a combination of water filtration and sewage treatment to control threats from water-borne disease. Industrial wastes were to be kept in the stream in order to neutralise bacterial wastes in sewage. See, Tarr, *Search for the Ultimate Sink*, 159-178.

²² Casner, "Polluter Versus Polluter," 179-200.

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acid drainage. In a famous opinion dating back to the 1880s, the Pennsylvania Supreme Court refused to grant damages to a plaintiff whose property had been damaged by acid drainage because the damage was a "natural" result of the mining of coal (a "private nuisance"). Casner notes that the decision reflected the court's recognition of the importance of coal mining to the state's economy compared to the "trifling inconvenience" (the court's words) of the injuries. Casner also notes, however, that in only a few states was such a pro-industry position taken. In most states, courts were less likely to follow a balancing doctrine.²³ The burden of the Supreme Court's application fell on Pennsylvania streams and water supplies.

Clean water was required for both drinking water purposes and for industrial uses. The Pennsylvania Railroad lawyers, recognising the distinction between private and public risk, suggested that the corporation sell excess supplies to public water suppliers, hoping therefore that the police power of the state could be used to secure greater protection to water quality. The railroad proceeded to market its water, with supplies eventually going to a population of over 75,000. When mine acid pollution appeared in the water supply, the Pennsylvania Railroad and its Dunbar Water Company went to court to seek redress. It was joined in this suit by the State of Pennsylvania, the state attorney general, the state commissioner of health, and the city of Pittsburgh. Here we have the interesting situation where a large corporation (itself a pollution generator) sued other private companies (29 coal companies) for pollution that endangered the public health, although the underlying motivating factor was the desire to reduce damage to its property. While this was not the first such case, it had significant implications.

In 1924, after the county court had denied the plaintiffs, the Pennsylvania Supreme Court held in favour of the railroad. Overturning the Sanderson decision, the court held that its opinion was "controlled by one fact and a single principle: the fact that the stream had been polluted, and the principle that this creates an enjoined nuisance, if the public uses the water." Thus the court distinguished between private and public nuisances, holding that if a nuisance degraded a public water supply, it was subjective to injunctive court imposed relief. Mining could go on, but not the discharge of waste that endangered public uses — the state would now act to prevent such threats to the public health.

State intervention in this case and the creation soon after in Pennsylvania of a sanitary water board (following a Massachusetts model) that used a stream classification system to regulate water quality provided the basis to begin systematic industrial waste regulation. This board attempted to balance health, economic, and social concerns from a co-operative perspective. This co-operative approach succeeded in some cases but ultimately failed as a public policy to deal with industrial pollution. Similarly, the co-operative approach

²³ Christine Meisner Rosen, "Differing Perceptions of the Value of Pollution Abatement across Time and Place: Balancing Doctrine in Pollution Nuisance Law, 1804-1906," *Law and History Review* 11 (Fall 1993): 303-381.

was only partially successful in other states where it was tried.

The Pennsylvania case suggests several avenues for further investigation. Why co-operative regulation between industry and the states failed needs fuller explanation, leading as it did to eventual federal regulation in the post-Second World War period. Was it because of a lack of industrial co-operation? Were the state regulatory bodies too subject to capture? Were the issues that needed to be dealt with primarily scientific and technological and therefore beyond the capabilities of the regulatory authorities to deal with adequately? What of the role of the interstate compacts or associations, such as the Ohio River Sanitary Commission or the Interstate Commission on the Delaware River, each of which had to deal with problems of industrial wastes as well as sewage? In what areas were they successful and where did they fail?²⁴

Further questions involve the growing rise of health concerns in relationship to industrial wastes as opposed to nuisance issues and property damage. In 1922, for instance, an American Water Works Association committee reported that industrial waste had damaged at least 248 public water supplies. Research on industrial pollution of municipal water supply systems, however, is very limited and we have almost no information about how this problem was managed. Nor do we know much about changes in regulations regarding the disposal of industrial wastes in municipal sewers in order to prevent damages to water filtration and sewage treatment facilities. On the science side, while interest in the toxicology of industrial wastes was growing between the world wars, it was largely the concern of a group of industrial hygiene specialists, not of sanitary engineers.²⁵ Indeed, one of the major clues to understanding the development of this issue may relate to how the various scientific and technical professions have dealt with the issue of industrial pollution.

3. *How have different professional groups related to the issue of industrial pollution?*

In an important paper, Christopher Sellers has discussed the manner in which different professional groups dealt with the issue of industrial hazards, both in the factory and in the ambient environment. Sellers observes that from the 1910s through the 1930s, industrial hygienists developed a scientific and professional field concerned with health within the industrial microenvironment. Interaction between engineers and physicians produced "more precise, quantitative ways of dealing with environmental chemical hazards."²⁶ Since industrial hygienists and various public health experts were aware of the health hazards of industrial effluents to workers in the plant, queries Sellers, why

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²⁴ See Edward J. Cleary, *The ORSANCO Story: Water Quality Management in the Ohio Valley Under an Interstate Compact* (Baltimore: Johns Hopkins University Press, 1967), 249-283.

²⁵ Christopher Sellers, *Hazards of the Job: From Industrial Disease to Environmental Health Science* (Chapel Hill: University of North Carolina Press, 1997).

²⁶ Christopher Sellers, "Factory as Environment: Industrial Hygiene, Professional Collaboration and the Modern Sciences of Pollution," *Environmental History Review* 18 (Spring 1994): 56-7.

²⁷ Ibid., 74-5.

²⁸ David Rosner and
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²⁹ Tarr, *Search for*

wasn't there a larger awareness among those concerned with pollution in the ambient environment?

One explanation is that laws governing both the workplace and the environment (water especially) were quite different in their specificity. Workplace injury from exposure was easier to observe, and the importance of bacterial risk to drinking water supplies from sewage was still the major concern of sanitary engineers and public health authorities. Furthermore, sanitary engineers and other water pollution researchers, largely concerned with risk from bacterial hazard, devoted little attention to chemical hazards in water supply beyond taste and odour problems and threats to water filtration and sewage treatment facilities. Almost no attention was paid to the concept of the safe concentration level, both because of limited knowledge about health effects and the lack of wet and instrumental procedures permitting measurement. Thus, the rise of modern scientific professionalism produced a set of technical approaches to problems that was "at once more precise and more arcane," that is, an "intellectually fragmented enterprise."²⁷

While other scholars of the history of industrial hygiene, such as David Rosner, Alan Markowitz, and Claudia Clark, have emphasised the failure of industrial hygienists to fully protect workers health (they often displayed, these historians argue, a pro-industry bias), the professional hypothesis about divisions among specialists still deserves further analysis as an explanation of the lack of progress.²⁸ It would be useful to explore, for instance, why the interdisciplinary centres, such as that at the Lawrence Experiment Station in Massachusetts that helped make great advances in water analysis at the beginning of the century, became less significant between the world wars. The same question might be asked in regard to the role of state sanitary experiment stations. Is it possible that increased specialisation both accelerated and retarded progress?

In addition to investigations of relationships between specialists in disciplines relative to industrial pollution we also need studies of the rise of these professions. For instance, no extended study of the rise of sanitary engineering nor the evolution of environmental engineering is currently available, nor of the relevant fields of analytical chemistry and zoology. Harvey Brooks has made the point that analytical chemistry was a "backwater" before the Second World War, limiting the types of environmental analysis that could be conducted. While an "instrumental revolution" that began in the 1930s accelerated during and after the war, the uses of such techniques in regard to environmental pollution were limited until the 1950s and 1960s.²⁹ How do we measure the significance of such inactivity? Would the passage of federal

²⁷ Ibid., 74-5.

²⁸ David Rosner and Gerald Markowitz, *Deadly Dust: Silicosis and the Politics of Occupational Disease in Twentieth-Century America* (Princeton: Princeton University Press, 1991); Rosner and Markowitz, eds., *Dying for Work: Workers' Safety and Health in Twentieth-Century America* (Bloomington: University of Indiana Press, 1987); and Claudia Clark, *Radium Girls: Women and Industrial Health Reform, 1910-1935* (Chapel Hill: University of North Carolina Press, 1997).

²⁹ Tarr, *Search for the Ultimate Sink*, 375-379.

legislation, such as the Lonergan bill and other pieces of anti-pollution legislation during the New Deal, have stimulated research into these areas? Certainly both the depression and Second World War must be held responsible for the delay, although some states and various interest groups, including the U.S. Public Health Service itself, opposed vesting such power in the federal government.³⁰

4. *What were the available indicators for regulating industrial pollutants?*

Indicators are a critical factor in the ability of a society to control risks from various environmental hazards. Over time various indicators have evolved to determine pollution by bacterial wastes and by industrial wastes. By the first decades of the twentieth century the Committee on Standard Methods of Water Analysis of the American Public Health Association (APHA) had devised a set of valid indicators for detecting sewage hazards in water supplies that used bacterial analysis to determine the presence of coliform bacteria. The United States Public Health Service (USPHS) used bacterial analysis in 1914 for standard setting when it issued the first standards for water that was furnished for [potable] purposes in interstate commerce. Eventually these standards furnished the nation's basic measure of water quality.³¹ These indicators were used in conjunction with filtration methods and chemical treatment (chlorination, 1908) to provide drinking water of potable quality. No comparable set of indicators existed, however, for industrial pollution, a more complex problem, including a much greater variety and number of compounds.³²

Most studies of industrial pollution before Second World War focused on organic wastes. Public health authorities targeted organic industrial wastes because by consuming dissolved oxygen they reduced the natural assimilative abilities of streams, thus increasing the likelihood that human wastes containing harmful bacteria would remain unoxidized. The USPHS also investigated industrial pollutants that might create taste and odor problems in filtered and chlorinated drinking water supplies, such as phenols.³³ (These problems could drive populations to shift to the use of untreated water supplies, such as wells.)

The USPHS Center for Pollution Studies in Cincinnati conducted important stream pollution investigations in the 1920s. But while it considered industrial wastes, it did so mainly in the context of the oxidation of sewage or

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³⁰ For a discussion of failed initiatives during the 1930s, see "The Development of a Federal Role in Water Pollution Control," Chap. VII, in Joel A. Tarr and Francis McMichael, *Retrospective Assessment of Wastewater Technology in the U.S.* (Springfield, VA: National Technical Information Service, PB 275 272/3SL, 1977).

³¹ Patrick Gurian and Joel A. Tarr, "The First Federal Drinking Water Quality Standards and Their Evolution: A History from 1914 to 1974," in *Improving Regulation: Cases in Environment, Health, and Safety*, ed. Paul S. Fischbeck and F. Scott Farrow (Washington: Resources for the Future, 2001), 43-69.

³² Tarr, "Industrial Wastes, Water Pollution, and Public Health, 1876-1962," in *Search for the Ultimate Sink*, 364-370.

³³ Tarr, "Searching for a Sink for an Industrial Waste," in *ibid.*, 395-403.

³⁴ Tarr, "Industrial

³⁵ *Ibid.*, 367.

³⁶ *Ibid.*, 367-8.

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the efficiency of water purification and sewage treatment plants. The leaders of the Public Health Service were reluctant to aggressively investigate the effects of industrial pollution because they believed that they were limited by its charter to study "the causes and effects of stream pollution..., either direct or indirect, upon the public health," and that they lacked clear understandings about how industrial effluents affected health. Thus, only in cases where industrial wastes had a "sanitary aspect," would they intercede.³⁴ In taking this position, the USPHS resisted pressure from professional organisations, such as the American Society of Civil Engineers, to conduct a broad investigation of "the cause, extent and effect of pollution of waters by industries, that methods of mitigating such evils be investigated, and that existing legislation be reviewed in order to determine what if any legislation is required to cope with the situation."³⁵ It would take until the 1960s and 1970s before such steps were taken.

Reluctance to conduct such investigations must be viewed as an institutional bias. USPHS officers believed that waste disposal was "a duty of the industry" and that the function of the governmental agency should be to stimulate and perhaps direct the efforts of treatment by industry. USPHS leaders feared that "if the governmental agency assumes responsibility for devising a treatment process the industrial interests are apt to hold the government responsible for any shortcomings in the process and to sit back complacently awaiting a perfected process." Rather than investigate specific issues relating to industrial wastes, the USPHS personnel at the Cincinnati station believed that its main objective was to establish "fundamental relationships which may be applied to studying and remedying stream pollution conditions in general, thus greatly simplifying and improving the methods at present applicable."³⁶

In the 1920s, chemist Earle Phelps and sanitary engineer H. W. Streeter of the Cincinnati station developed the "oxygen sag" curve theory, by which the self-purification characteristics of streams were understood in terms of the measurable phenomenon of dissolved oxygen (DO) and the biochemical oxygen demand (BOD) characteristics of various wastes under certain conditions of time and temperature. The Streeter-Phelps model provided an approach that circumvented the heterogeneous character of industrial wastes by agreement on a common characteristic. It thus provided the first quantitative model available for the analysis of water quality changes due to inputs of various types of wastes. Following the development of these analytical procedures for pollution assessment, health departments adopted a standard approach for estimating the comparative effects of industrial and human pollution on streams.

This body of research and theory supplied an important set of indicators about stream health and sanitation, especially in regard to biological

³⁴ Tarr, "Industrial Wastes, Water Pollution, and Public Health, 1876-1962," in *ibid.*, 370-373.

³⁵ *Ibid.*, 367.

³⁶ *Ibid.*, 367-8.

conditions and aquatic life. However, these indicators had direct reference to the public health only in regard to the reduction of the dilution power of streams, although they might serve as surrogates or indicators (in the way that coliform counts did for bacterial wastes) of organic wastes with potentially dangerous characteristics. These indicators also supplied no direct information concerning the presence or danger of toxic metals, and toxic organic and inorganic mixtures, although again they might serve as surrogates. For many of these substances only limited qualitative or quantitative methods of chemical analysis existed, and full information was lacking on their effects on both aquatic and human life. Even in cases where treatment processes had been studied and recommended by the USPHS or state boards of health, polluting industries made only limited application of these methods because of cost issues or because of the reluctance of the state to apply sanctions.³⁷

The major question of interest here involves the pace of the development of analytical methods and indicators that could indicate dangerous levels of pollution. What research was being conducted in these domains and with whose support? What was known about various substances and the risk[s] associated with their use? What was the relative attention paid to ecological risks as opposed to human health risks? What were state departments of fish and game investigating as compared to state departments of health, those usually responsible for pollution questions? If research was not being conducted, how do we understand the failure? What lines of investigation were not undertaken that would have led to major advances in the measurement of environmental degradation?

5. *What did responsible parties understand about the risks of industrial pollutants and how did they know it?*

In more recent situations involving litigation regarding both environmental damage and adverse health effects from industrial pollutants, there are relatively wide differences of opinion about the state of knowledge at different times. The range of opinions can be summarised in the following manner: (1) industry had full knowledge about the possible environmental damages its wastes might produce but still proceeded to discharge them into environmental sinks, ignoring possible negative effects; (2) industry was often sloppy in the methods by which it discharged its wastes, but had only limited information about proper disposal and did not deliberately do harm (the "sloppy housekeeping" hypothesis); and, (3) industry usually tried conscientiously to discharge its wastes in a responsible manner to avoid environmental damage, availing itself of the latest knowledge and technology for treatment and disposal.

Much of the discussion concerning these issues has taken place in the

³⁷ Anthony S. Travis, "Experimentation in the Environmental Chemical Analysis of Synthetic Organic Chemicals, Trace Metals, and Contaminated Water and Soil," in *From Classical to Modern Chemistry: The Instrumental Revolution*, ed. Peter J. T. Morris (Cambridge: RSC, 2002).

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context of hazardous waste disposal, groundwater pollution, damages to drinking water supplies, and health damages to effected populations. Perhaps the leading academic spokesperson for the position that industry has historically ignored available knowledge in regard to its waste disposal practices is the historical geographer, Craig Colten. Colten has stated this position in a number of publications but perhaps most comprehensively in *The Road to Love Canal: Managing Industrial Waste Before EPA*, written with lawyer Peter N. Skinner. Here Colten and Skinner divide corporate decision-making processes between "sensitizers and desensitizers" in terms of shaping a "toxic landscape." For Colten and Skinner, "sensitizers made managers more aware of their responsibilities to provide long-term control for hazardous substances, while desensitizers offered a rationale for deferring control." This conclusion is backed by a judgement that "qualified individuals in the appropriate positions had access to sufficient tools to recommend, and some did recommend, more complete and technologically available waste control measures than were commonly implemented."³⁸

Colten bases his conclusions on a wide body of research, much of it involving the chemical industry and available information about groundwater pollution. His essential goal appears to be to stake out a position concerning the origins of America's present "toxic" landscape, that is, arguing that much of our present environmental degradation from industrial pollution was caused by firms and managers who knew better and who could have prevented such damages if they had followed existing knowledge and recommendations. (In the background of this research is the Superfund legislation and various state bills which make it possible, in principle, to identify those responsible for past environmental degradation and to force them to help pay for cleanups.) Colten also attempts to cast doubt on the argument that full knowledge about the dangers of hazardous waste disposal, especially in relation to groundwater, only appeared in the 1970s, a position often based upon the assertions of environmental practitioners in legal cases.³⁹

But while there is much in the historical record to support the argument that knowledge existed about risks from various industrial wastes, about the possibilities of groundwater pollution from such sources, and about dangers to drinking water supplies, this information often lacks specificity in regard to issues such as migration rates of pollutants and thresholds of concern. Moreover, there is considerable ambiguity about how widely such knowledge was held, how it was disseminated, and what actions could have flowed from

³⁸ See, Craig E. Colten and Peter N. Skinner, *The Road to Love Canal: Managing Industrial Waste before EPA* (Austin: University of Texas Press, 1996); also, Colten, "Creating a Toxic Landscape," 85-116.

³⁹ See, for instance, Craig E. Colten, "Groundwater and the Law: Records v. Recollections," *Public Historian* 20 (Spring 1998): 25-43; Colten, "Groundwater Contamination: Reconstructing Historical Knowledge for the Courts," *Applied Geography* 18 (1998): 259-273. For a thoughtful discussion of industrial pollution and groundwater contamination in nineteenth century Europe see Anthony S. Travis, "Poisoned Groundwater and Contaminated Soil: The Tribulations and Trial of the First Major Manufacturer of Aniline Dyes in Basel," *Environmental History* 2 (July 1997): 343-365.

such knowledge. These are epistemological issues that historians need to investigate. In addition, there are issues of interpretation about technical matters that have arisen in regard to certain pollutants, and these also need to be clarified.⁴⁰ The ideal solution to avoid confusion over technical issues may be a working partnership between scientists, engineers, and historians.

A somewhat different interpretation of the causes of industrial pollution has recently been put forth by Hugh Gorman of Michigan Technological Institute. Using the petroleum industry as his model, Gorman asks how did "engineers and technical managers responsible for industrial operations earlier this [twentieth] century integrate pollution concerns into their decisions?" He acknowledges that industrial employees engaged in "sloppy" waste disposal practices, but argues that this was not necessarily the result of "apathy and greed," nor of the ignoring of pollution issues. Rather, he argues, industrial personnel before the 1960s possessed a framework that saw pollution as a sign of inefficiency and operated from a "guiding ethic" of eliminating waste rather than pollution. The elimination of inefficiency, engineers believed, would result in pollution reduction. This was a strategy of industrial "self-regulation" based on the efficient use of resources that many in regulatory bodies agreed with.⁴¹ In addition, nuisance suits caused firms to address some pollution issues.⁴²

By the 1950s and 1960s, maintains Gorman, owing to changes in scale and the rise of new pollutants, it had become increasingly clear that the earlier efficiency strategy had been ineffective and was not protecting the environment. Only by a new strategy of regulation, involving federal legislation, clear standards and strong enforcement, could society deal with industrial pollution of the environment. The pressure for such regulation, however, came from outside the industry, with increasing public concern over environmental degradation or threats to the public health.

The different perspectives on industrial pollution suggested by Colten and

⁴⁰ Richard Jackson, "The Migration, Dissolution, and Fate of Chlorinated Solvents in the Urbanized Alluvial Valleys of the Southwestern USA," *Hydrogeology Journal* 6 (1998): 144-155, and "Anticipating Ground-Water Contamination by New Technologies and Chemicals: The Case of Chlorinated Solvents in California," *Environmental & Engineering Geoscience*, Forthcoming.

⁴¹ Hugh Gorman, "Efficiency, Environmental Quality, and Oil Field Brines: The Success and Failure of Pollution Control By Self-Regulation," *Business History Review* 73 (Winter 1999): 601-640.

⁴² Two papers in the July 2000 issue of *Environmental History* offer variations on this argument. Writing about industrial wastes in the Connecticut River in the Progressive period, John T. Cumbler observes that manufacturers and reformers both shared "in the belief and hope that technology and science could produce a cost-free clean environment." If this vision failed, however, reformers believed that the state should become the ultimate arbiter; John T. Cumbler, "Conflict, Accommodation, and Compromise: Connecticut's Attempt to Control Industrial Wastes in the Progressive Era," *Environmental History* 5 (July 2000): 314-335. In his study of the copper smelting industry, Timothy LeCain observes that the Anaconda Company made use of "eco-efficiency" concepts and new pollution control technologies (the Cottrell electrical precipitator) as a means to disguise "the real environmental and health costs of a dangerous technological system"; Timothy LeCain, "The Limits of 'Eco-Efficiency': Arsenic Pollution and the Cottrell Electrical Precipitator in the U.S. Copper Smelting Industry," *Environmental History* 5 (July 2000): 336-351.

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Gorman raise two important methodological issues. One points towards an approach oriented towards litigation and the placing of specific responsibility for environmental harm. The other is a more broad-ranging and holistic perspective that emphasises the importance of the larger context in understanding the actions of technical personnel. While neither is of exclusive value, from the point of view of the historian and the social scientist, the broader approach will lead to the greatest understanding in the long run of the historical record.

Conclusions

It is clear that there is a need for a thorough investigation of the state of knowledge about various hazards from industrial wastes in the past, the range of options in regard to disposal, and the position of public policy. It is important to understand these issues within the context of available knowledge and recommendations. Such a perspective would involve evaluation of the state of knowledge at different levels of decision-making, issues of communication, and information about actual hazards. Some of these issues are difficult to get at fully in a historical context, but there is no doubt that fuller historical investigation of sources such as corporate, legal, and governmental records, the evolution of treatment technologies, and the availability and use of different levels of detection technology would be invaluable.

In addition, there are important issues from the perspective of science and technology that need to be investigated. Analysis should rest, as much as possible, upon scientific data and information rather than anecdotal information and causal judgements about dissemination. A related issue is just how effective pollution control technology actually was. There are many claims in the literature on both sides, by reformers pushing for control and by the industries themselves, about whether or not control technologies were available, their level of effectiveness, and their cost. It is important that the evidence be weighed carefully in these cases in order that the historian does not become an advocate of one side or the other.

In a recent paper, Christine Meisner Rosen, an environmental and urban historian on the faculty of the business school of the University of California at Berkeley, called for business historians to embrace a "new, environmentally grounded approach to business history." She maintained that the history of industry's interaction with the environment fell into three 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."¹³ The effect of industrial waste on the natural world, she suggested, was most important, since materials used in manufacturing generally flowed from the natural environment into the

¹³ Christine Meisner Rosen, "Industrial Ecology and the Greening of Business History," *Business and Economic History* 26 (Fall 1997): 123-137.

production process and back into the environment in the form of pollution with a minimum of recycling. The environmental effects of industrial waste streams, particularly of many branches of the chemical industry, therefore, are a critical subject for investigation, for historians of technology as well as for business and environmental historians.

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¹ Philip Revzin, "1996, 4.