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RESEARCH

Shifting Definitions of Hazardous Wastes

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This paper addresses the emergence of concern with hazardous wastes and the legal liabilities attached to them long before the first federal legislation in the U.S. explicitly using the term; a simultaneous search for marketable by-products during the first three quarters of the twentieth century as a means to decrease the volume of wastes while also diminishing the perceived threat; and the eventual adoption of a legal tactic that asserted absence of liability before formal federal definitions of hazardous wastes. Based on a review of industry and waste management literature, it exposes deliberate efforts on the part of major industry trade organizations to dampen public calls for litigation by making the case that wastes were manageable, recoverable, and non-threatening. These steps sought to offset potential disruptions to their operations by imposing additional costs on waste treatment. When federal legislation became a reality in the 1970s, defenders of industrial practices that created hundreds of hazardous waste sites made the arguments that hazardous properties of wastes were unknown at the time of their disposal. The litigation that swirled around the federal laws proved disruptive and reflect a issue delayed not eliminated.

Keywords: hazardous waste; legal liability; USA

Introduction

News accounts of the infamous Love Canal chemical waste dump in 1978 inserted a dreadful new threat into US public's geographical imaginary, or its conceptualization of environmental risks stemming from industrial by-products. Toxic substances seeping from an abandoned canal that contained more than 20,000 tons of industrial by-products percolated into basements in the surrounding residential neighborhood and instilled fear of cancer, birth defects, and other maladies. This news unleashed two simultaneous transformations: innocuous industrial wastes became a proximate danger, and a bucolic suburb turned into a terrifying landscape. The question that followed was how many other comparable situations existed in the backyards of innocent homeowners elsewhere? Also, what were these hazardous wastes that had captured the public imagination and what could people do to avoid ill effects?

The US Congress had only recently passed the Resource Conservation and Recovery Act (RCRA) in 1976, but the regulatory agency, the US Environmental Protection Agency (USEPA), had yet to draft its rules and regulations for managing current hazardous waste operations. Love Canal exposed an additional problem that the existing law neglected: long-abandoned dumps. In a 1979 report, Congress conceded that 'little was known about the true magnitude of the problem' other than acknowledging that 'millions of tons of toxic wastes are disposed of each year in an environmentally unsound manner resulting in what have been aptly labeled "ticking time bombs" which pose imminent and untold hazards to man and the environment' (US Congress, House 1979: ix). Homeowners could not feel comfortable with these potentially dangerous conditions in their neighborhoods. The term 'hazardous waste' became everyday parlance and disrupted public attitudes and governing organizations. And in some respects, hazardous wastes became as prominent as social disruptions as they were actual risks.

Although the public was shocked by the revelations that flowed from the re-discovery of Love Canal and a host of other sites, industry experts, water resource authorities, and public health officials had been addressing the issue of hazardous wastes for decades, albeit in a subdued manner largely within the confines of professional literature and practice. Passage of RCRA in 1976 provided for the drafting of a formal legal definition, and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), or Superfund Act, in 1980 firmly attached financial liability for abandoned dumps and prompted waves of litigation over damages caused by casual disposal of hazardous wastes from previous decades. Adoption of 'hazardous wastes' as the umbrella term simplified the public's appreciation of their risks, but complicated litigation in the ensuing years. As the public gained awareness of what Congress labeled 'the single most significant environmental health issue of the decade', industry faced an unprecedented disruption to decades of casual practices along with stringent regulations and potential legal liabilities. In response, corporate officials set about obscuring the historical memory of their waste management

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decisions over the preceding three quarters of a century (US Congress, House, ix).

This paper addresses the emergence of concern with hazardous wastes and the legal liabilities attached to them long before the first federal legislation explicitly using the term; this includes discussion of a simultaneous search for marketable by-products during the first three quarters of the twentieth century as a means to decrease the volume of wastes while also diminishing the perceived threat, and the eventual adoption of a legal tactic that asserted absence of liability before the drafting of a formal federal definition of hazardous wastes. In doing so, I hope to examine the evolving definition of a particular type of waste and the conceptualization of waste risk and liability by those involved in industrial waste management. How have industry and regulatory practitioners portrayed waste in their discussions about environmental liabilities? And how has the recognition of hazardous properties of waste and legal liabilities proved disruptive in terms of adding costs for implementing new techniques for managing wastes or new legal obligations for policy makers and manufacturers? Finally, how are the memories of past waste management practices used in recent litigation resulting from the socially disruptive influence of this category of waste?

Background of Hazardous Wastes

Historical studies of the emergence of the hazardous waste issue present several overlapping themes. Joel Tarr's pioneering work on the subject considers the long-term public attitudes toward waste since the nineteenth century—both everyday urban refuse and industrial process by-products. The distinction between the two classes of waste relates to his ultimate purpose to consider changing perceptions about the health effects of wastes. Concepts of sanitation, etiology, toxicology, and environmental processes framed how society dealt with sewage, refuse, and other more harmful wastes. Local governments dealt with sewage and urban garbage largely as a sanitation problem. Industrial wastes, on the other hand, remained a matter of corporate concern, although private or public nuisance suits could seek to abate offensive pollution by manufacturers. Tarr observes that the 1970 Solid Waste Act mandated that the USEPA investigate hazardous waste disposal which led to a 1974 report on the subject. The report and subsequent legislation provided a legal definition of hazardous wastes, and policies that greatly restricted how they were managed. Within this evolving context, he observes that environmental degradation was not always a willful act of the disposer, suggesting a naiveté in terms of knowledge about the environmental risks associated with land disposal of wastes and a crisis-driven science that led to safe waste management—such as the discovery of Love Canal (Tarr 1985; USEPA 1974). Nonetheless, his concept of the 'search for the ultimate sink' is built around the notion that legislative bodies took action when wastes prove socially disruptive.

Martin Melosi's review of legal liability for hazardous wastes also traces the waste management from urban refuse and sewage in the nineteenth century to the more recent past. He notes the recognition of industrial wastes as a problem, but one largely confined to surface-water quality. Managing industrial effluents was complicated by the absence of an adequate legal classification. Legal remedies fell into two camps: self-regulation favored by industry and government regulation. Nuisance law and a diverse set of state laws before 1950 provided an inconsistent legal context across the country. However, even where local laws existed, enforcement was lax owing to the tendency for states to accommodate manufacturers by avoiding stringent regulation. The absence of specific hazardous waste legislation hampered any comprehensive control. Since hazardous waste was largely a product of private-sector industry, eliminating its introduction to the environment was more difficult than addressing public sewage and garbage, a responsibility borne mainly by municipalities (Melosi 1988).

Tarr and Melosi broach topics that confounded enforcement and ultimately became part of the arsenal of those defending waste disposers in the post-Superfund period: (1) the absence of liability due to the inadequate knowledge of health and environmental risks posed by industrial wastes; (2) the lack of clear legal definitions of what constituted a hazardous waste. Additionally, both Tarr and Melosi touch on the issue that Travis Wagner makes most emphatically: in the absence of widespread public attention, hazardous waste legislation and regulation remained off the legislative calendars. Knowledge of the risks and environmental process that certain knowledge of hazardous substances remained sequestered among experts in industrial waste and environmental sciences. Industry consistently sought to limit public release of the chemistry of its wastes to protect trade secrets about its products. Hazardous waste failed to move off the political back burner due to its extremely low visibility and the failure of the term to take root in the country's popular 'vernacular' or geographical imaginary (Wagner 2004). Wagner argues that public attention with hazardous wastes rose to unprecedented levels following a federal government program that dumped waste nerve gas canisters into the deep ocean in 1970. Public reaction to this incident reflected rising national environmental awareness during the post-*Silent Spring* era. But ocean dumping of nerve gas did not prompt the attention that suburban Love Canal inspired several years later. Nonetheless, the term hazardous waste became part of the legislative agenda as part of the Resource Recovery Act of 1970, which produced the first ripple of legal disruption for manufacturers. Wagner notes that various legislative efforts to address hazardous wastes floundered before 1976. Love Canal changed all that in 1978 when the national media propelled it into a highly visible position. According to Wagner, the media and public concern about health risks to neighbors of the dump, which constituted an intensely disruptive social situation, impelled congressional action. Wagner's take on events corresponds to new geographies of waste that portray waste as disrupters of normal social and political activities. According to Sarah Moore, by labeling certain industrial wastes as 'hazards' they acquire meaning through contact with society and are inseparable from human actions. Inextricably rooted in the nature-society domain, hazardous wastes are bound up in social,

political, and economic matrices as much as in biophysical processes (Moore 2012).

Peter Skinner and I explore the topic of hazardous waste from a different perspective. Rather than focusing on legislation dealing specifically with hazardous wastes as a response to public outcry, we analyze the historical literature of waste management, toxicology, environmental processes, and engineering—in addition to the legal context—to document the prevailing state of knowledge among industrial waste managers before 1970. We present a broad historical context of the related bodies of expertise that would have framed decision making, and within that context, we consider how practitioners used the knowledge to mitigate environmental harm and prevent corporate liability from legal action in several case studies. Our book documents that experts in industry and in the public sector had ample knowledge about the hazards that existed in industrial wastes, the processes that could introduce dangerous substances into surface and ground waters, and the contemporaneous legal liabilities (Colten and Skinner 1996; Colten 1991). Hazardous waste, as a concept even if not legally prescribed, was firmly established in the professional geographical imaginary. It was within this framework, and the somewhat ambiguous legal situation, that corporations made decisions about how to treat wastes, or alternately to discard them in non-secure settings during the first half of the twentieth century. Even without explicit definitions of 'hazardous waste', prevailing notions of nuisance, trespass, and property damage offered legal means to impose liabilities on careless disposers. Not all wastes were considered equal, and statutes commonly specified particular categories of industries and their wastes as harmful. State laws also provided means to protect both surface and ground waters (Goodell 1905, Johnson 1905, Besselievre 1924). We take the position that industrial wastes with hazardous properties proved disruptive within professional communities and industry before 1970, even if the shock waves of the newly discovered time bombs only reached the broader public later. The high media visibility given to Love Canal and other dumps prompted an unprecedented fear that similar sites might be in the 'back yards' of communities across the country. This awakening thoroughly disrupted the public's geographic imaginary of hazardous wastes. It was with a robust body of knowledge that American chemical manufacturers reported to Congress in 1979 that they had operated some 3,383 waste disposal sites that received approximately 762 million tons of wastes since 1950. Some of them made it onto the initial Superfund National Priorities List of 786 sites in 1984. Of course, none of these sites were designed to meet the post-1980 USEPA hazardous waste disposal standards, and 29 percent of the industry reported in 1979 that the facilities they had used were non-secure landfills, pits, ponds, and lagoons (US Congress, House, x and xviii). Nonetheless, the USEPA standards, when drafted, were built both on knowledge that preceded the law's passage and on decades of experiences and research on wastes in the environment. The fact that industry officials could readily account for this multitude of disposal sites reflects their own awareness of their practices. The 'environmentally unsound' practices described by Congress suggest that, despite a legal framework that could restrict unsafe disposal, the industry did not consider litigation a serious threat or potential disruption. The approach to hazardous wastes in the late 1970s reflects a desire to assign a clear definition to a group of industrial by-products that were entangled in a complex nature-society situation. The debates surrounding passage of hazardous waste legislation and implementation of those laws amplified the disruptions.

Dangers and Liability before 'Hazardous Wastes' Became Illegal

Well before there was a formal legal definition of 'hazardous wastes', practitioners recognized dangerous properties of wastes and the environmental liabilities that they posed. With those recognitions in mind, industry experts consistently have attempted to present the notion that wastes were manageable by-products — to shift them from socially disruptive to beneficial. The first interstate pollution battle heard by the US Supreme Court addressed toxic emissions from a copper smelter and found a remedy in a waste recovery process (Maysilles 2011). In the late nineteenth century and early twentieth century, oils and tars that coal gas manufacturers dumped into waterways or into pits were hugely disruptive, and looked upon as a serious nuisance. Charles Greenough, an attorney, published an extensive compilation of legal issues relating to coal gas wastes in Great Britain and the United States. It identified the rights and liabilities of coal-gas producers. In doing so, he framed wastes as public risks, both in environmental terms and as legal/financial liabilities. His treatise references numerous court cases that attached liabilities to gas wastes that contaminated surface or groundwater (Greenough 1883, 131–133). After several years of dealing with pollution conflicts, the American Gas Association, the leading trade association for the industry at the time, created a waste management committee in 1918 to facilitate discussions and the exchange of knowledge about proper waste management within the industry. In addition to presenting several treatment techniques, it recommended by-product recovery. Companies found ways to use tars in roofing materials and in surfacing roads (American Gas Association 1919, 'Removal and Disposal of Tar' 1907; Tarr 2014). In addition, a trade waste text recommended ammonia recovery (Wilson and Calvert 1913, 26–29). While such options were not always embraced, they indicate a clear concern with reducing pollution due to liabilities, and a desire to transform wastes into marketable or usable products. Experts also pointed out that 'the impression that the [industrial] wastes cannot be successfully treated is in many cases not true' (Eddy 1917, 32–36). Such statements conceptually re-classify wastes from threats into treatable effluent and thereby render them innocuous.

A similar pattern of increasing public concern with oil wastes and the associated fear of regulation prompted the formation of an industry committee dedicated to controlling the situation occurred in the US. After complaints of oil pollution on New Jersey's beaches, the US Bureau of Mines collaborated with the American Petroleum Institute (API) to prepare a report on the problem (US

Bureau of Mines 1923). Congress considered legislation to address the broader question of oil pollution of navigable waters both marine and inland. Representatives from the American Petroleum Institute (API) and Standard Oil made the case that the majority of oil wastes came from maritime vessels and that oil refineries responsibly removed most waste oil using separators (Manning and Hays in US Congress House 1924, 40–50). Despite congressional attention to the public objections to oil pollution, industry's arguments prevailed and the Oil Pollution Act passed in 1924 addressed only marine waters and not inland waterways or refineries. Refineries were not required to do anything more than continue their existing level of recovery. Nonetheless, seeing the writing on the wall, the API prepared the first of its manuals on refinery waste disposal by 1930. Its foreword states that with manufacturing growth, industry experts had to develop 'methods and equipment for handling and disposing of objectionable wastes' (API 1930, 1). The first volume addressed only waste water containing oil, and encouraged refiners to use the principles and practices in the manual in order to avoid disrupting public interests. API members assembled the expertise of corporate practitioners and disseminated a manual that sought to minimize the impacts of water pollution. The manual emphasizes the role of separators to recover oils, as did subsequent textbooks and technical articles through the 1950s (Eldridge 1942). Thus, recovery of oils was a prominent theme and created an impression that discharge volumes were reducible. A waste treatment expert reinforced the complementary notion that all wastes were treatable and hence not dangerous: 'It is a matter of record, based upon the handling of many industrial waste problems over a period of years, that there is no waste discharged for which there is not a treatment' (Besselievre 1931, 501–503).

The API's 1951 chemical waste manual introduces discussions of byproducts with hazardous properties, namely toxicity and acidity. It reviews pollution impacts to surface water and proposes a number of steps for treating wastes. The manual includes ponding among the options for direct disposal of caustic solutions, but explicitly warns against creating water pollution problems either by overtopping or seepage (API 1951, 31). This discussion indicates concern with environmental consequences of harmful residues and illustrates the guidance the trade association provided to prevent undesirable outcomes. Also during the 1950s, Roy Weston, a leading oil waste management consultant, pointed out that not all wastes were recoverable. In an industrial waste text, he notes that skimmings from separators were unfit for return to the processing operations. So, this residue, along with others, was not recoverable. Acids, for example, he suggests could be neutralized with lime (Weston 1953, 425 and 440). By using appropriate treatment, manufacturers could transform hazards into benign residue. Despite such acknowledgments, other experts continued to emphasize recovery. Fred Gurnham's 1955 text advises that the optimum solution to waste disposal is 're-use of materials' (340). While this option was not possible in all circumstances, it reflects a persistent goal of reducing waste volumes by rerouting by-products back into the manufacturing processes, along with reducing their associated disposal costs and environmental liabilities. Both through recovery and treatment, experts suggested that dangers would be controlled and conflicts minimized.

The manuals, texts, and trade literature indicate an acute awareness of surface water pollution by oils and a corresponding concern with groundwater. Oil was obvious on water surfaces and prompted lawsuits. State laws had commonly identified oil as a substance prohibited from 'waters of the state' in the early twentieth century (Goodell 1905). As states reworked and fortified water pollution laws, particularly after World War II, oil became increasingly prominent in the wording of those laws (US Congress, House 1939; McGuinness 1951; MCA 1959). Oil also was one of the sources of groundwater identified in a survey of litigation compiled by the American Water Works Association in 1957 (Task Group 1957). Thus, even if recovery process were in place, liability for oily wastes was firmly in place and widely recognized by the 1950s.

The Manufacturing Chemists' Association (MCA) followed the AGA and the API, and formed a Committee on the Prevention of Water Pollution in 1936 to offset the threat of regulation and litigation costs. By 1945, its members, waste management experts representing leading chemical producers, adopted the goal of 'the elimination of pollution from streams and waters' (MCA1945, 1) and subsequently changed its name to the Water Pollution Abatement Committee, specifically to include groundwater within its mission (MCA 1949, 2). As its API counterpart, the MCA committee prepared manuals that provided expert guidance on waste management that also revealed concerns with potential liabilities. The 1948 general manual discussed increasing state regulation of water pollution and declared that 'a progressive company which is law-abiding and jealous of its good name would certainly want to abate all pollution …' (MCA 1948, 4). It also acknowledged the distinction between municipal sewage and industrial wastes (see also Melosi 2000). The committee reported that municipalities were dumping huge quantities of sewage into waterways, and that a comparable amount of industrial wastes also flowed into rivers and streams. While some wastes were merely objectionable, it noted that industry released toxic compounds, acids, and inorganic materials of various kinds. Without using the term hazardous, it reported some industrial wastes had properties that presented different concerns than oxygen-demanding and potentially bacteria-laden sewage—properties that later received the official hazardous label (MCA 1948, 3). The MCA recommended that companies delegate pollution abatement to individuals with adequate authority to dedicate sufficient funds to treatment and ensure the company considered pollution control at every stage of industrial development – from site selection for new plants through manufacturing operations (MCA 1948, 4–5). It called on staff to stay up to date on the existing literature, which was growing in volume at the time, and to study treatment methods and consider recovery options (MCA 1948, 6–8). Its 1955 manual on oil and tar wastes cautioned against relying on burial and ponding. While those methods might reduce direct surface water pollution, they posed the risk of pollution of groundwater or

migration off site (MCA 1955, 8). Various treatment and recovery methods appear in the manual. Recovery continued to be a desirable option since it could reduce the volume of wastes requiring final treatment or disposal or transform a liability into potential profit. Chemical manufacturers such as Monsanto even launched a waste treatment subsidary by 1969 to tap an emerging market for its own internal treatment and recovery expertise (Spears 2014). By the 1980s, some entrepreneurs who ran waste disposal firms dreamed of double profits to be gained through recovery. They received payment for transporting chemical wastes from processing plants and then tried to concoct marketable by-products from the complex waste stew. The MOTCO site in Texas and the PPI site in Louisiana became Superfund sites as a result of such recovery ambitions that failed (Goldsteen 1993, 97–102 and 148–157). As with oil wastes, the notion that treatment or recovery would effectively eliminate environmental risk and potential litigation remained a guiding principle, if one that was not fully achieved.

Well before the first federal definition of hazardous waste, the term appears in the trade literature. In 1939, I.F. Harlow of Dow Chemical Company discussed chemical company wastes in a special issue of *Industrial and Chemical Engineering*. He includes a brief paragraph on 'nonhazardous' wastes that could be discharged to a nearby river without injury to fish except at low flow (Harlow 1939, 1346). While he did not use the term hazardous, he introduces methods used to control the release of brines and phenols to avoid damaging the waterway—an implicit designation of a harmful effluent. The National Safety Council, in 1948, published a safety pamphlet for industrial waste disposal that specifically uses the term hazardous wastes. It lists numerous industries that had to contend with wastes that presented risks and cautioned that manufacturers should consider using disposal practices that would exclude damage both on plant grounds or outside their boundaries (National Safety Council 1948, 1). Monsanto Chemical Company appeared to put this notion in use with a 1940s factory plan that explicitly depicts a 'toxic waste dump' (Monsanto Chemical Company 1940s). More than a decade later, but well before the passage of RCRA, the MCA released a safety guide for recommended and safe procedures for hazardous waste disposal (MCA 1961). Its definition of hazardous wastes included flammable, toxic, and corrosive materials that might create an air or stream pollution problem. The manual recommended that waste managers consult with the corporate medical team, which would be aware of the potential human toxicity of their wastes. The guide provided a cursory listing of treatment options that included burial, but with the caution that water soluble material could escape the site by leaching into streams or wells (MCA 1961, 1–3). Additionally, a compilation of 'dangerous materials' was readily available to those concerned with risks both in the workplace and beyond the factory fence line (Sax 1951). Engineer Rolf Eliassen, in a 1969 report on solid waste, observed that some solid waste residues were hazardous to humans, plants, and animals. In addition, he noted that despite nature's capacity to disperse, degrade, and absorb some wastes, residue from land disposal could 'poison, damage, or otherwise affect one or more species in the biosphere, with a resultant ecological shift' (Eliassen 1969, 2). The notion of a landfill as a secure repository for dangerous wastes had been dismissed by practitioners and a more substantive disruptive legislative wave was on the move.

Widespread recognition of landfill risks compelled Congress to mandate that the USEPA produce a study on hazardous wastes in the early 1970s, and it assembled a sizable report of the topic and moved the discussion toward a more formal definition: 'Any waste or combination of wastes which pose a substantial present or potential hazard to human health or living organisms' (USEPA 1974, 3). Among the wastes included under this term were substances that were toxic, flammable, radioactive, explosive, or biological. The report noted several careless disposal incidents to highlight threats to the public and the environment—among them were the use of pesticides in military or agricultural activities. It also acknowledged that 'all disposal processes have the potential for adverse public health and environmental effects if used unwisely or without appropriate controls' and explicitly admitted that adequate treatment and disposal were more expensive than the 'environmentally offensive' options. This economic disparity, in the eyes of the USEPA, justified the passage of more hazardous waste regulations that provided financial incentives to reduce the fiscal burdens on industry (USEPA 1974, 9, and 12). The USEPA expressed interest in mitigating financial disruptions to business.

By the early 1970s, a host of state and federal laws applied to the management of hazardous materials in the workplace, during transport, and when released to the environment, but a huge loophole existed for land disposal sites. With the post-World War II upsurge in water pollution laws and the generation of complex chemical wastes, industry had responded by diverting more and more wastes to land sinks (Tarr 1984). Enforcement of existing laws when applied to dangerous substances had been haphazard. A chemical producer in California dumped toxic wastes in the 1940s and had to modify its waste treatment practices after officials recognized the effluent impacted distant groundwater supplies (Pickett 1947). New York authorities allowed Hooker Chemical to place tons of wastes in an abandoned canal during World War II. Legal action did not occur for nearly 30 years (Colten and Skinner 1996, 157–161). Michigan officials took a manufacturer to court when its toxic plating wastes tainted public water supplies in the 1950s (Olds 1952,). Trade publications reported on these incidents to their specialized audiences, so they gained little public notoriety and instilled little corporate fear of costly litigation. Practitioners, nonetheless, were not naive to the dangers.

With momentum building for more effective regulation of hazardous wastes, the USEPA held public meetings in 1975 to allow comment on legislative options. Several chemical company representatives offered statements. In general, their comments illustrated they were comfortable with using the term 'hazardous waste' and that there was general agreement that it provided a generic term for a spectrum of wastes. The USEPA was not broaching an unfamiliar term of art. The industry spokespeople

generally shared a similar understanding of the term's meaning with the agency, although they consistently recommended a more precise definition. They also expressed a shared view that no additional regulations were necessary. Industry representatives argued that existing water, air, and transportation regulations provided sufficient checks on environmentally damaging practices. What was overlooked in their comments was that the legislation on the books had allowed the situation to reach the point where, even in the absence of public outcry, Congress was beginning to advocate for more effective controls. Industry spokespeople sought to dampen that concern. Donald Eby from Monsanto offered the valuable insight that industry knew what its wastes were and were able to determine their toxicity. Philip Palmer from DuPont pointed out industry was constantly seeking uses for by-products and suggested economic incentives for recycling—transforming waste into profit (Eby and Palmer in USEPA 1976, 67–78). More regulation would be disruptive to business, and if there was a danger, industry would recognize it and minimize public risks through recovery or treatment.

This line of thinking took more complete form in the notion of Pollution Prevention Pays. This approach emerged in response to greater scrutiny with hazardous wastes and legislative steps to formally define hazardous wastes in 1976. A modest book (Royston 1979) on the topic was published in the US in 1979, but attracted little immediate attention. Nonetheless, the 3M Company adopted this approach and reported on its successes in the early 1980s (Susag 1982). The basic concept involved several related objectives: reduce the volume of wastes and thereby reduce the costs of treatment, use a lower volume of hazardous inputs that would reduce the hazardous quality of the waste stream, and recover useable by-products and either sell them to other manufacturers or redirect them into the company's production process. To encourage this approach, the State of Illinois's Hazardous Waste Research and Information Center established a service to link waste generators with companies seeking by-products for use in their production in the mid-1980s. Pollution Prevention Pays was the post-RCRA updated reframing of waste recovery, an idea that had been around for a century. Indeed, the 1976 Resource Conservation and Recovery Act, which was the first full-blown federal regulation of hazardous wastes, stressed recovery in its title. It provided the means to define hazardous waste and guided policies to reduce hazardous waste generation and create an oversight system for tracking waste 'from the cradle to the grave'. Although the USEPA did not complete its regulations before 1980, this legislation offered a legal turning point, and one that defenders of careless waste disposal used to declare that before RCRA there were no hazardous wastes—at least by legal definition.

Obscuring the Toxic Legacy

Passage of the Superfund Act (or CERCLA) in 1980 imposed strict liability on manufacturers and even property owners who contributed to environmental damages from their hazardous waste disposal—that is they could be held liable for damages that arose from activity even decades before the federal legislation's passage. This 'strict' liability gave rise to multiple lines of litigation. The federal government began pursuing payment for clean-up operations among the most obvious 'potentially responsible parties' (PRPs), the most prominent and easily identified former owners or operators. When faced with multi-million dollar clean-up costs, companies sought to expand the pool of PRPs and sued other entities that sent even tiny quantities of waste to a shared disposal facility or that temporarily owned the property. Another line of suits sought to extract partial payment from the federal government. In this line of litigation, companies that operated facilities during World War II or the Great Depression and were subject to government policies or decisions by government employees sought to impose PRP liability on the federal government. A third line of litigation, which is of interest here, involved companies facing huge liabilities that sued former insurance companies, claiming that off-site property damage was covered by general liability policies, which typically covered, for example, broken windows in neighboring buildings stemming from on-site explosions. These cases tended to turn on the question: was the potential for damage 'expected or intended'? That is, when companies in the 1940s and 1950s discarded wastes with hazardous properties, did they consider the risk of off-site migration of their wastes, did they foresee the risk of off-site damages and liabilities? The full range of Superfund litigation proved disruptive and costly to businesses.

Not surprisingly, sharp disagreement has emerged among those involved in the thriving consulting practice that arose to serve the litigants. Defenders of historical industry practices make the case that in the absence of a clear legal definition, wastes that fell into that category after 1976 would not have been regarded as dangerous before passage of RCRA. Fred Hart, for example, argues that industry in the immediate post-war years did not recognize environmental problems and did not understand the effects of chemicals in the environment beyond company fence lines (Hart 1995). This attitude, as some argue, was guided by the notion that the environment would absorb or attenuate any substances interred in land disposal sites. Engineers Robert Mutch and Wesley Eckenfelder claim that 'the [earth's] subsurface was viewed as having an almost limitless capacity to absorb, filter and attenuate waste materials' (Mutch and Eckenfelder 1993). Another line of argument has imposed post-1980 standards on historical actors, a severe form of presentism deployed by scientists and engineers with no advanced training in historical scholarship, by asserting that only the use of 1980s methods would have enabled scientists to detect contaminants in the environment (Jackson 2004). Hence, before that date, detection was impossible. Furthermore, industry defenders argued that litigation was imposing modern standards on past actions that were innocent because there was insufficient knowledge of the historical risks.

The argument that companies were unaware of environmental threats asserts that there was no real warning about links between the environment and industrial chemicals before Rachel Carson's *Silent Spring* in 1962.

Certainly, Carson alerted the broader public to the threat of persistent chemicals in the environment particularly through bioaccumulation, but a host of industry and technical experts had been studying both the ideas that Carson wrote about for decades (indeed she drew on scientific studies from the 1940s) and the more specific issues of risks tied to industrial wastes, both non-hazardous and hazardous (Colten and Skinner 1996, 27–29). In addition, industry trade groups had been attentive to the issue of environmental damages for decades, used the term hazardous wastes well before the public awakenings that followed *Silent Spring* and Love Canal (1978), and took actions to form pollution abatement committees within major trade associations. Sheer ignorance of environmental risk is not evident in the historical record.

The assertion that industry relied on the environment to eliminate risks contradicts the ignorance argument; if they relied on the environment to control the hazard by dumping in pits, there was an implicit recognition of the hazard. Furthermore, the use of numerous treatment technologies by industrial waste experts does not reflect reliance on environmental controls. Likewise, the numerous incidents of environment damages and industry officials' response to them, along with contemporaneous testimony by industry representatives documents awareness of serious issues (Colten and Skinner 1996; Ross and Amter 2010; Travis 1997). Publicly reported studies from the 1920s and 1930s indicate chemicals moved through soil and could contaminate groundwater (Stiles et al. 1927; Caldwell 1937; Caldwell and Parr 1938). Groundwater pollution incidents that gained considerable attention within professional circles include organic chemical contamination in Montebello, California, chemical pollution from the Rocky Mountain Arsenal in Colorado, and toxic metal contamination in Long Island, New York. Among other examples, these cases clearly demonstrated the threat of harm and industry awareness that the soil was not a vault for locking up dangerous substances (Davids and Lieber 1951; Walker 1961; Pickett 1947). Reports by the American Water Works Association and a team of MIT engineers underscore the long-standing nature of the issue and the recognition of chemical mobility in the environment (Task Group 1957; Stanley and Eliassen 1961).

The use of presentism to justify the dumping of the widely used solvent trichloroethylene (TCE) and lack of awareness about its long-term environmental threats emerged in the 1990s. Industry used TCE as a de-greaser in many operations including metal plating, aircraft manufacture, and countless others. An all-too-common disposal method was to dump the used solvent on the ground. TCE is denser than water and tends to percolate downward to the bottom of the water table. It is not readily soluble in water and thus puddles where it meets impermeable geologic formations. Gradually, small quantities will slowly migrate down gradient with groundwater and analyses have detected it in water supplies decades after its disposal. The application of presentism to this issue involves claims that what is now called dense-non-aqueous phase liquids (or DNAPL's, of which TCE is one) was not an accepted concept among scientists until the 1980s. Secondly, methods for detecting minute quantities of TCE in groundwater also are recent developments (Pankow et al. 1996).

Yet, the first reported discovery of a TCE threat in groundwater occurred in England in the late 1940s, and analysts determined its presence using techniques available at the time (Lyne and McLachlan 1949). In addition, prevailing knowledge of groundwater movement prompted authorities to search upgradient for a source. Investigators in the 1940s were able to recognize its threat prior to the introduction of DNAPL to the scientific vocabulary decades later. Furthermore, the 1940s investigators did not have the expectation that detection of parts per billion was necessary. They worked without the burden of subsequent post-1980s standards and their past actions did not need to meet requirements that came decades later. Nevertheless, contemporaneous knowledge and methods proved sufficient to report a contamination incident in a prominent and respected publication. A hearty discussion of this incident has emerged in recent years, and contrary points of view tend to fall on either side of the presentism or historical approaches (Travis 1998; Rivett et al. 2006; Amter and Ross 2013)—intellectual disruption persists in the technical literature. The post-hoc analyses that suggest current standards should apply to past actions attempt to obscure historical knowledge and technical analytical capabilities.

Conclusions

Industry and its representatives were full participants in discussions about hazardous wastes throughout the twentieth century; indeed, trade professionals led the narrative that manufacturers understood risks and liabilities of by-products. Hazards associated with industrial wastes thoroughly permeated the geographical imaginary of practitioners. When public opposition to pollution of industrial wastes emerged, industry experts testified before Congress, commonly asserting they were capable of both treating and recovering wastes without any additional regulation. Through their efforts they sought to dampen regulatory disruption. Experts within specific industries assembled and disseminated current techniques for recovering by-products or treating wastes and asserted there was no waste that defied treatment. Legal experts provided counsel on the liabilities and medical staff advised on toxicity. Government researchers published studies illustrating the environmental consequences of improper waste disposal. This information was available to private sector experts and sometimes was compiled by collaborating government and industry experts. Knowledge of risk and liability went hand in hand in the literature throughout the period before the passage of RCRA in 1976 and the dissemination of concern to the wider public.

The strategy of treating and recovering by-products was a consistent theme in waste management literature dating from the 1910s. In effect, labeling residues as treatable or recoverable shifted them from liability to asset. Asserting there were treatments for any waste implied waste disposal practices would prevent public disruptions. It suggested industry was responsibly handling its wastes,

despite numerous publicly reported exceptions. Industry experts recognized pits, ponds, and lagoons as repositories that could leak, but commonly used them nonetheless and risked legal conflict. Waste recovery had the potential to transform hazards, at least in name, into viable commodities without dangerous properties. In many instances, recovery proved an important means to reduce pollution. By re-imagining hazardous wastes as by-products, experts recast waste management practices as less objectionable to corporate decision makers. Re-labeling wastes reduced the notion of risk and liability. This line of thinking re-imagined disposal as temporary storage. In the 1980s, pollution prevention pays rejuvenated old ideas about extracting profits from residues in the face of new regulations, even as huge quantities of wastes flowed into land disposal sites and some waste companies imagined extracting wealth from recovered by-products.

Finally, when a formal definition of hazardous wastes created consistent standards, expert witnesses claimed that pre-RCRA actions were not dealing with hazardous wastes since there was not a legal definition before 1976. Yet, industry experts before RCRA commonly spoke of a range of chemical wastes that posed both public health and environmental risks. The term 'hazardous' merely provided an umbrella term for this range of substances that was well known. The idea of hazards was not new, just the legal definition. In addition to obscuring damaging historical actions as innocent business behavior, experts declared that in the absence of post-1980 technology and standards, past hazards were unrecognizable. Historical records undermine this presentist argument. The efforts to recast wastes with hazardous properties as recoverable or treatable guided decisions more than did recognition of risk and liabilities.

Efforts to offset potential regulations, seen by industry as disruptive, were a consistent response to public pressure to abate pollution. Re-imagining wastes as by-products or treatable substances diminished their risks. The long-term and consistent campaigns to thwart government anti-pollution legislation through self-monitoring and self- regulation contributed to the eventual creation of Love Canal and hundreds of other hazardous waste sites that so completely readjusted the public's geographical imagination. The litigation and mitigation costs that arose from these sites proved to be more disruptive and costly than the early legislative efforts to rein in careless release of hazardous waste in the environment, but concussions from the time bombs were not entirely unanticipated.

Competing Interests

The author has no competing interests to declare.

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