



Project Summary

Nineteenth Century Technology— Twentieth Century Problems: A Retrospective Mini-Assessment

Vary T. Coates, Thecla Fabian, and Margaret McDonald

The systematic attempt to anticipate future environmental problems has usually been associated with the assessment of new or emerging technologies. In recent years, however, it has become clear that environmental problems may suddenly come to light, stemming from aging or obsolescent technological systems, or from industrial practices that have already been discounted or superseded by improved methods.

This retrospective mini-assessment of nineteenth-century technology has identified industrial and urban technologies of the pre-World War I era which may be the sources of present-day environmental problems or threats to public health and safety. Four case studies were given particular attention in the assessment: (1) arsenic, which was used widely in a number of industries during the last century; (2) coal, which is being reintroduced as a major energy source; (3) iron and steel, the major heavy industries of the nineteenth-century; and (4) old dams, which potentially contain hazardous materials in the trapped sediments.

This Project Summary was developed by EPA's Office of Exploratory Research, Washington, DC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The systematic attempt to anticipate future environmental problems has usually been associated with the assessment of new or emerging technologies. In recent years, however, it has become clear that environmental problems may suddenly come to light, stemming from aging or obsolescent technological systems, or from industrial practices that have already been discounted or superseded by improved methods. Examples of such problems are subsidence or acid drainage from abandoned mines, unsafe bridges, leaking waste depositories, and eroded earthen dams.

The nineteenth-century was the period when burgeoning technology and industry transformed America from an agrarian, developing country to an industrial, urbanized nation. In 1800, only 6 percent of the U.S. population lived in urban areas; by 1900, the figure had grown to 40 percent, and two decades later the 50-percent mark had been passed.

Industries that have spanned the last 100 years are now subjected to environmental, health, and safety regulations that did not exist in their early days. Some of the residues of earlier, unregulated practices, such as dumping wastes on the site or in flowing streams, have never been cleaned up. Some of the materials that were freely used in

consumer products or in construction are now (and in some cases, were even then) known to be hazardous. These materials may exist today in items that are still used or that are collected, in buildings that are used or uninhabited; and in materials in "latent storage" (dust and debris in abandoned buildings, refuse piles and pits, or built-up sediments at the bottom of bodies of water).

The residual contaminants from the last century are undoubtedly dwarfed by the detrimental by-products of the chemical revolution in American industry during and after the Second World War. But in some local areas, there may well be a serious — and unrecognized — problem. There are recurring episodes of the discovery of old waste dumps and resulting public alarms.

Hazardous materials such as arsenic, lead and mercury were used in many consumer products in the past. Today, Victorian houses and furnishings are much sought after for restoration. If some of the materials or components of these items entail even low-level risks of chronic or acute toxicity, either during their rehabilitation and restoration or to eventual users, warning to the public or instructions for careful handling may be needed.

This mini-assessment was developed to probe the likelihood that as yet unidentified environmental problems may derive and arise from events far in the past. The major criterion for the selection of case studies was that they be related to nineteenth-century industry and that they have a potential for environmental effects that could have survived or endured for many decades.

This retrospective assessment was approached from two viewpoints. First, prominent nineteenth-century industries were surveyed to find potential hazards. Second, twentieth-century concerns (especially the List of Toxic Substances) were reviewed and considered for their historical antecedents. In both exercises, historians and technical experts were consulted. The lists that emerged from these exercises included industries, technological systems or clusters or systems, raw materials and other inputs, and products or by-products.

Items were then examined in terms of the following criteria:

Risk: Does the subject involve the possibility of risk to health and safety, or environmental damage?

Persistence: Could the source of risk have survived over time? Could it be generating detrimental impacts today? Could it be capable of generating such impacts in the future, if the source were brought out of storage, either deliberately by restoration or inadvertently by excavation or dredging? In this assessment, the emphasis was on only present and future risk or problems, not historical ones.

Dispersion and Scale: If a risk or problem exists, would it be of importance? A risk was considered important if it met any of the following criteria: (1) Widespread, affecting many people or large parts of the country; (2) Highly concentrated in one or more regions or localities in which it might present severe problems; (3) Capable of exposing categories of people, segments of the population, or special environments to special risks.

Portability, Transport: Could the problem have expanded over time? Could the surviving sources of risk spread? Could they have been relocated? For example, toxic substances can be transported by natural forces — leaching, erosion, or water currents; contaminated soil might be used elsewhere as a landfill. This would make any hazard doubly unsuspected and hard to identify.

Historical Unawareness: Was the risk or problem recognized in the nineteenth-century? The toxicity of some materials has been recognized only recently due to advances in medical science and biological science and in measurement capabilities, or because the detrimental impacts are very slow to mature or are cumulative. The hypothesis was that materials whose risk was well recognized would have been handled more carefully. However, research indicates that even when dangers were well known (for example, arsenic) disposal was not necessarily handled so as to protect either nineteenth-century workers or future generations.

Current Understanding: Is the problem well-known today? Is research underway or have remedial programs been initiated? Since the purpose of the mini-assessment was to identify unforeseen problems, the emphasis was on identifying possible problems whose existence is not proven and

where the probability of occurrence, in fact, may be quite low.

Using these criteria, eleven topics were selected as being of particular concern: arsenic, asbestos, cyanides, lead, mercury, electroplating industry, iron and steel industry, tanning industry, coal industry, dams and sediment, and canals (containing waste).

From these, arsenic, the coal industry, the iron and steel industry, and dams and sediments were selected for greater attention through case studies. Arsenic was chosen as exemplary of toxic substances used in a variety of industries. Coal is having a resurgence of utilization, and under some circumstances could regain its nineteenth-century preeminence as a source of energy. The iron and steel industry is also a prime target for reindustrialization or modernization in the near-term future, and there is a real possibility that either demolition or repair and rebuilding of the industry's facilities could bring old wastes to the surface. Old dams are of particular interest at present for two reasons. First, there is the question of structural safety and the environmental problems associated with either failure or repair. Second, there is an active program of rehabilitating old dams for hydropower development. The report provides an in-depth analysis of these topic areas distilling the most potentially significant concerns and providing recommendations for further research by the U.S. Environmental Protection Agency (EPA).

Results

Arsenic

Arsenic and arsenic compounds were used in the nineteenth-century in a wide variety of manufacturing processes and consumer products. Arsenic is an element that persists, and its toxic properties endure. A number of areas were identified where nineteenth-century arsenic residues are likely to be found and result in exposures today. These include:

- In residual mine tailing and manufacturing waste dumps close to the site of old mines and factories, either on the surface or subsurface where they may be encountered in excavation.
- In sediments in reservoirs, lakes, rivers, canals, or bays, either as a result of water-based disposal or through erosion of agricultural lands treated with pesticides.

- As residues embedded in buildings once used for processing and manufacturing.
- In a variety of nineteenth-century consumer products still in use, being refurbished, or collected and displayed as curious or historical objects

Coal and Coal Products

The coal industry was in its heyday between 1870 and 1920, when coal was the dominant fuel for America's industry. Coal also heated America's homes, and for a few decades, coal gas illuminated its streets, public buildings and residences. Coal-based chemistry also provided many widely used industrial materials and consumer products.

Sources of enduring environmental problems left over from the nineteenth-century coal industry include mining, combustion, and coal products. The problems left over from nineteenth-century mining are well recognized, widespread, severe, and, to a large extent, not yet solved. The problems associated with coal combustion in the past have in part gone with those who suffered from them, and those problems that remain — such as damaged art work and deteriorated building facades and bridges — can hardly be distinguished from the results of twentieth-century contaminants. Coal-based products are not known to contain carcinogens, and here the residuals from the last century are less studied and less well recognized. Unless the lessons of the past are appreciated, these problems may well recur if the national policy of encouraging coal use is successful.

Iron and Steel

In the last quarter of the nineteenth-century, the United States became the world's leading producer of iron and steel. In 1900, it mined 26 million tons of iron ore and produced 6.7 million long tons of Bessemer steel and 3.4 million tons of open-hearth steel.

Every step of this process, from mining to steel shaping and finishing could conceivably have left behind residual environmental problems and hazards. These include:

- Sediment and soils contaminated with high levels of tar, phenols, cyanide, and naphthalene in areas of abandoned coke ovens and blast furnaces.

- The presence of a substance called "moon dust" in the gas lines and flues of abandoned coke ovens. Chemically, this residue is composed of iron, sulphur, ash, hydrogen sulfide, cyanide, phenol, sulfates, chlorides, and heavy metals. It can be both toxic and explosive. Demolition or rehabilitation of coke ovens could pose significant hazards to workers.

Dams

Before 1900, 1582 dams were built in what is now the United States. Three-quarters of the 1582 nineteenth century dams are located in ten states: Colorado (219), Connecticut (215), Massachusetts (141), Michigan (129), California (103), Rhode Island (94), Pennsylvania (87), New Hampshire (82), Maine (76), and North Carolina (64). About 20 percent of these dams are now hazardous. If they should fail, there could be substantial loss of life. There would almost certainly be significant environmental impacts.

Any dam — nineteenth-century or twentieth-century — may contain toxic wastes in its sediments, from urban run-off, industrial effluents, erosion of agricultural land treated with pesticides and fertilizers, etc. The older dams have been collecting such sediments over a longer period, and are also more likely to have trapped toxic wastes from the 1800's, when mining and manufacturing operations routinely disposed of toxic materials by dumping them into streams or on the ground. Of special concern would be lead, mercury, arsenic, and cyanides, which were used in, or were by-products of, many different nineteenth-century industries. Whether dams fail, are deliberately breached to prevent unexpected failure, or are repaired (which usually requires dredging) these toxic sediments may re-emerge as an environmental, health, and safety problem.

Recommendations

This brief assessment of nineteenth-century industry indicates that there are hazards and problems that remain from the industrial activities that took place in the last century. These problems are neither as severe nor as widespread as the by-products of twentieth-century technology, but they are not insignificant. In some areas, particularly the sites of intensive nineteenth-century manufacturing and mining, they may well represent a serious — and largely unrecognized — problem.

The following recommendations are made by the study:

1. EPA should continue to fund exploratory retrospective environmental impact assessment. High priority areas of concern for more detailed assessments include:

Materials	Industries	Systems
arsenic	coal	dams and reservoirs
asbestos cyanides	electroplating iron and steel	canals urban networks
lead mercury	tanning	

These assessments should be planned so that, should they indicate problems of substantial magnitude and significance, they would lead directly to successive levels of assessment and action programs including regional and site-specific assessments, field sampling, and design of remedial measures.

2. EPA should consider the development of information bulletins directed at local communities to alert them of the possibility of residual risks from nineteenth-century industry, and to suggest that local governments review their industrial history for possible sources of environmental contaminants and structural hazards. Information bulletins should also be targeted at occupational and avocational groups who may be particularly likely to be exposed to such risks.
3. EPA should initiate discussions with other responsible agencies on several areas of overlapping concern, such as:
 - Toxic residuals from the nineteenth-century which may be concentrated in sediments behind old dams (Army Corps of Engineers, Bureau of Land Management/Department of the Interior, and State programs for dams found to be hazardous).
 - Possible health and safety effects of toxic substances to which construction workers, furniture restorers, museum workers, and other occupational groups may be especially exposed (Occupational Safety and Health Administration).
 - Lead, arsenic, and mercury content of nineteenth-century antiques and artifacts (Consumer Product Safety Commissions).

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The complete report, entitled "Nineteenth Century Technology—Twentieth Century Problems: A Retrospective Mini-Assessment," (Order No. PB 82-242 058; Cost: \$13.50, subject to change) will be available only from:

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