What has happened to our water?

A Study Guide for the film WATER AND THE DREAM OF THE ENGINEERS

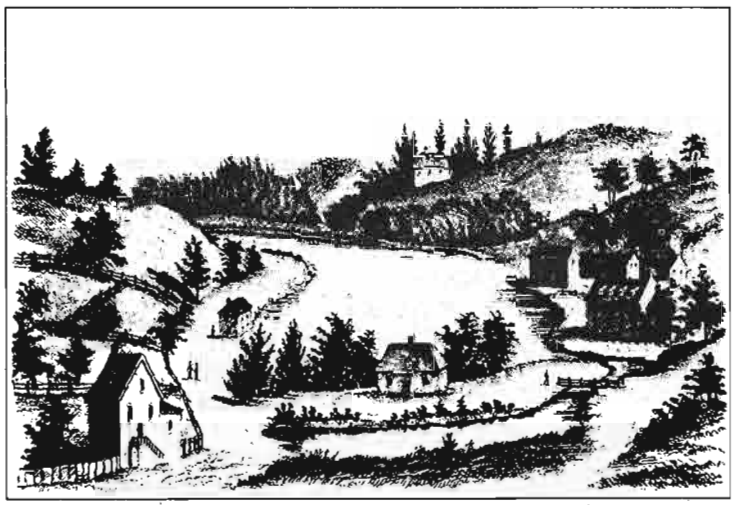
by Richard Broadman, John Grady, and Roy Rosensweig

This Study Guide is intended as an orientation to the four parts of the film WATER AND THE DREAM OF THE ENGINEERS. It presents the perspective of the film and offers general background material for teachers unfamiliar with the subject. For further reading, a brief bibliography is provided. At the end of the notes for each section is a set of study questions teachers might use with their students. Some of these questions are answerable from the material in the film; others identify issues that the film raises.

The film is available in two parts:
Part I focuses on water history; Part II on modern water conflicts. Two short sections of the film – *"Water Wars: California"* and *"Upstream-Downstream: New Orleans and River Contamination"* – are available separately.

WATER AND THE DREAM OF THE ENGINEERS
Richard Broadman, Director
John Grady, Research Director
Nicholas Doob, Cinematographer
Stephen Olech, Production Manager

A CINE RESEARCH PRODUCTION
Cine Research Associates
32 Fisher Avenue, Boston, MA 02120
(617) 442-9756



A view of the Collect Pond, 1800, the natural water supply for New York City. (Courtesy New York Historical Society, New York City.)

HISTORY

The history of American water systems is a subject known mostly to students of engineering and technological history. Yet these systems, like other parts of the urban infrastructure, are an underpinning of modern life. They have made it possible for us to live without fear of citywide fires and bacterial epidemics. In the nineteenth century, new water systems were heralded for bringing enough safe water to cities. They were – and still are – envied and imitated throughout the world.

SHORTAGES

In recent years the growth of some cities has outstripped the capacity of older systems to supply enough water. Environmental concerns and massive costs have generated opposition to new waterworks. Now cities face the hard choices of conserving water, limiting development, or building and paying for new waterworks in the old tradition.

CONTAMINATION

Since World War II, new chemical compounds have contaminated our rivers, lakes, and underground water. The nineteenth-century criteria of "safe" water – freedom from bacteria and viruses – is no longer sufficient in the twentieth century. Yet our cities, with water systems designed on the old model, are often unwilling to pay the massive costs of new technology for the detection and removal of chemicals in our water.

CONFLICT

Our water systems – once a source of American pride – are now the source of diverse economic and environmental conflicts. These controversies take different forms in different parts of our country, depending on water scarcity and the source of each supply. In the absence of any consensus on a national water policy, Americans once again face the dilemma of how to provide enough safe water for future generations.

This publication made possible by a grant from the Massachusetts Council on the Arts and Humanities.

OVERVIEW

The Natural Environment and the Growth of Cities

Today we are living through a period of environmental crisis. We worry whether our way of life, and the use of natural resources required to sustain it, constitute a violation of nature. Are we living on "borrowed time"? Will our natural resources dwindle and disappear? Will our strip mining, oil drilling, and lumbering alter our natural environment in dangerous ways? When we discharge our wastes, are we polluting water resources we will need in the future?

The history of our cities is an ideal starting point to study these questions. For cities are not only locales where the natural landscape has been most changed, but they are also the places where most of the decisions that shape our world are made.

In our cities we find traces of the first great environmental crisis of modern society – and its resolution. This crisis centered around the use of natural water supplies by growing urban populations. Here we can see how the sanitary and waterworks systems of the nineteenth century freed us from the ravages of waterborne epidemic disease.

Today our cities are the focus of new environmental conflicts – over the exploitation of parkland for the mineral resources required by industries, over the regulation of emissions from cars and factories, over the dumping of toxic wastes into water bodies, to mention but a few. In the case of the relationship between cities and the water environment, we find that the solution to the original environmental problem (local natural water supplies polluted by a growing population and industries) has created modern environmental problems – ever-expanding water consumption and the pollution of larger water bodies. In this way a look at the growth of cities in relation to their water environment offers new ways of looking at environmental issues.

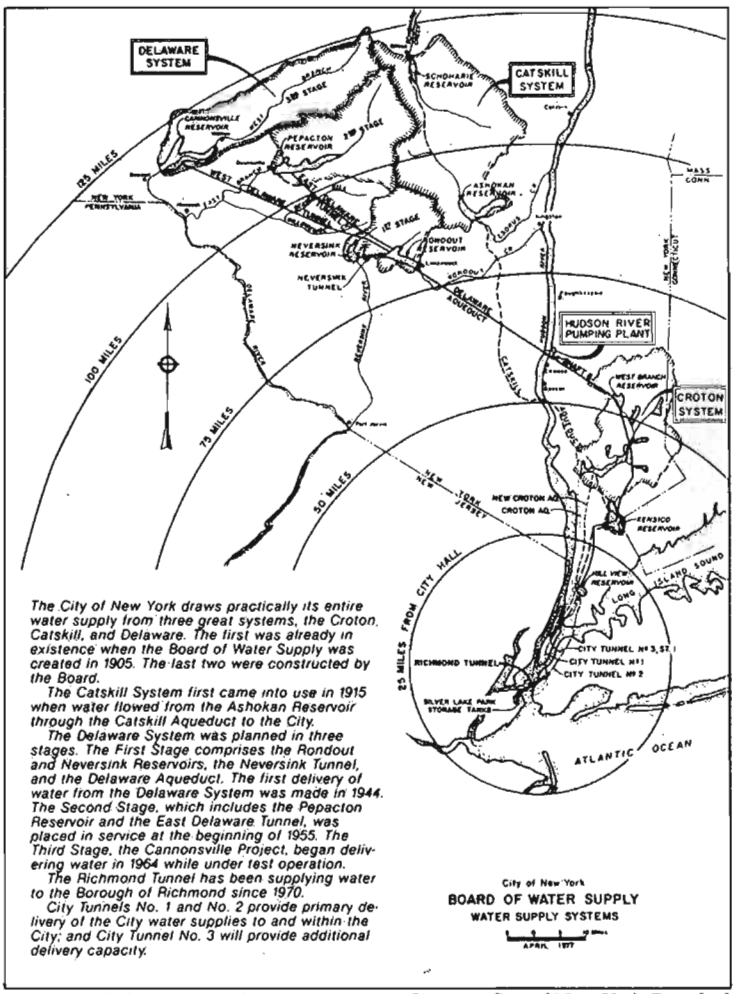
The Built Environment

People's relationship to the natural environment is mediated by a "built environment" – a constructed world of buildings, parks, roads, transportation networks, gas, and electric power lines. Our water and sewer systems are part of this constructed environment. Though we often take this world for granted, we should remember that it is the product of a multitude of past decisions by those that came before us. Past planners, reformers, businesspeople, politicians, and engineers helped to shape the waterworks, power, and transportation networks of the present. Past generations of taxpayers and workers paid for and constructed them. The town and city environments in which we make our daily lives are their legacy.

We rely on the built environment for our immediate survival, though much of it is invisible to us, hidden beneath our feet. Life as we know it would be impossible without our water/sewer, electric, and heating systems. If any one of these systems malfunctions our cities are thrown into chaos.

At the same time, this built environment is directly tied to the natural world. For example, the natural gas, coal, and oil supplies that heat our houses and businesses are resources created over millions of years; they must be mined and transported over great distances before they are of use to us. Similarly, our city water supplies are piped from adjacent rivers or lakes, or distant reservoirs. Wherever human beings have created a town or a city, they have drawn upon – and altered – the natural environment.

Like previous generations, our own generation faces choices that will shape people's lives in the future. In this context our water and sewer systems offer an interesting – and seldom considered – case study. By providing aqueducts and sewer lines, past generations have helped to make life in crowded urban centers possible. Our present choices concerning the development and use of natural resources – like water – will help to shape the lives of future generations, the cities in which they live, and their relationship with nature.



The New York water supply system in 1977. (Courtesy City of New York Board of Water Supply.)

The Reluctant Community

When a new transportation system links two or more different groups of people – immigrants of two different nationalities, perhaps – or when watershed residents are linked to city dwellers by a new aqueduct, a "reluctant community" has been brought into being. The growth of cities has created many such reluctant communities of strangers – assemblages of people whose daily routines bind them firmly to those from whom they may differ widely and whom they may not even know. The interdependence of these groups is often unspoken and unacknowledged. At the same time, linking these communities or interest groups more often than not creates "winners" and "losers," and a spectrum of modern conflicts.

The various social and economic interests (and interest groups) whose positions pervade our debates over public issues, our referendums, and our politics are a reflection of the conflicts generated by our urbanized society. Today, cities are the centers of networks that link mines to factories, farmers to markets, producers to consumers. Each group makes its demands and lobbies in its own interest; each benefits or loses in different ways in the relationship.

Closely paralleling the physical growth of the industrial city has been our concern with issues of equity and fairness: What have we the right to demand from others? How far do our obligations extend? In the planning of a new roadway, for example, whose property should be taken? In the construction of a city's water system, who is the original user of that water, what losses will that user suffer, and who will pay the bill of new construction?

Tracing the history of one of these systems – water delivery and waste removal – illustrates how we are bound to the people upstream from whom we take our water and bound to those downstream who are forced to receive our wastes – and to workers and engineers who build and maintain these systems.

BACKGROUND TO SECTION I A: "WATER FOR ALL"

New York City Water System History

Unprecedented growth transformed cities in the nineteenth century. Cities had to house, feed, clothe, and provide water for the massive influx of people from the countryside and from foreign lands. In this new situation, political leaders were confronted with a myriad of legal, moral, and public health problems. For some, the survival of the city as a settlement became a primary issue. Nowhere was this more clear than in the threat that nineteenth-century urbanization posed for the human need for fresh water. And nowhere in America was the issue more dramatic than in New York City.

Prior to the 1830s, New York City had relied on wells, streams, and ponds for drinking water. As the city grew, these sources became unavailable or hopelessly polluted. New Yorkers responded to this challenge by relying on the engine of private enterprise. Water wagons made their rounds throughout the city and the newly formed Manhattan Company built a small reservoir and piped water to portions of the city through hollowed-out logs.

Attempts to build a large reservoir outside the city limits, an aqueduct, and a citywide delivery system were each opposed as an unwarranted intrusion of government into private affairs. But in 1832 New Yorkers were ravaged by a terrible cholera epidemic. While the city had learned to fear epidemic disease, cholera held a special terror. The majority of those infected would die, and die horribly within twenty-four hours, their skin turning blue. Only three years later, over one hundred square blocks of prime residential and business property burned to the ground. The city's volunteer fire organizations and bucket brigades were inadequate to the task of saving the city.

These citywide concerns created a mandate for city officials and state legislators to build the Croton reservoir in nearby Westchester County and a twelve-mile aqueduct to reservoirs in Central Park on the present site of the New York Public Library. Billed as the "eighth wonder of the world," this massive project entailed deficit financing on an unprecedented scale and the taking of land from farmers. Possibly out of this came the idea that government should anticipate growth and build a material infrastructure capable of fulfilling future needs.

Since that time New York City has continued to expand its water system. Over a billion gallons of fresh water flow to the city from protected reservoirs in the Catskill Mountains and from the Delaware River, each hundreds of miles away, through two tunnels twenty-four feet in diameter and as much as eight hundred feet underground. This system, based almost entirely on gravity, requires virtually no pumping and has served the city for nearly seventy years. But along with this extensive water-supply system have come conflicts with watershed residents, other users, and a complicated and costly set of maintenance problems.

The aqueducts, for the most part built between 1880 and 1940, are growing old. So are the pipes beneath the city streets. This aging system contributes to large losses of water. Leakage and breakage have prompted an ongoing pipe replacement campaign in the city. At the same time, the age of the aqueducts has prompted fears that if they were closed for repairs they could not be reopened due to faulty valves. In response to this last problem, New York has once again invested massively in its water system in the construction of its "Third Tunnel" linking the two older tunnels in the system. It will enable either of the older tunnels to be closed for repairs without cutting off the water supply to any part of the city. In this way the city's waterworks engineers continue the tradition of planning for the wellbeing of future generations.

Sanitary Engineering

Today engineering is viewed as a commonplace, if lucrative, profession. But in the past sanitary engineers were revered as heros—human colossuses who had made the world safe from fire and epidemic disease.

In the early nineteenth century, disease was seen as an affliction that the wicked and the profligate brought upon themselves. "Contagionists," as they were called, believed that those who lived under the worst conditions—the poor and immigrants—had brought their misery upon themselves and that those who were well off could best protect themselves from contagion by quarantine, isolation, and restricting immigration. Others, "Anti-contagionists," realized that such policies would both cripple commerce and strangle the desperate American need for imported labor. They believed that disease was created by climactic conditions and filth. Sanitary engineering as a profession emerged from the concerns of this latter group of health reformers and sanitarians.

By the end of the nineteenth century and the beginning of the twentieth, sanitary engineers had reshaped the physical landscape of American cities and had been credited with playing a major role in the virtual elimination of contagious disease. They built supply systems that brought abundant fresh water to cities, and sewers that took waste and sources of contamination away from the city itself. Inspired by the discovery of the "germ" theory of disease, they developed filtration and treatment systems for purifying water previously contaminated by the bacteria from other cities' wastes. Today, their reservoirs and pipes are connected to faucets that we routinely assume will provide us with clean water. Their sewers are linked to toilets we flush and then forget. But sanitary engineers remind us that infant and child mortality is now a rarity rather than one of the all-too-common facts of life, and that it is previous generations of sanitary engineers who made this possible. Abel Wolman, who appears in the film, represents this nineteenth-century tradition.

These engineers pridefully point to the New York City water and sewer systems as the solution to the first great environmental crisis of the modern world—the epidemic diseases fostered by the ignorance of sanitation. They remind us that the foresight, courage, and professionalism of this tradition have given us our present water systems; that these are a national resource that would be prohibitively expensive to replicate today.

However, the practices of sanitary engineering, based on ensuring "germ-free" water, today have new critics and detractors. Taxpayers and corporations often resist the enormous expenditures required to expand and upgrade these systems. Environmentalists oppose aqueducts and reservoirs in wilderness watersheds. Rural farming and wildlife interests try to keep water for their own uses. And ecologists and public health officials critique the design of some systems as not protecting people from modern chemical compounds in their water. In these ways, the old principles of sanitary engineering face many challenges. These are treated in the remaining sections of the film.

STUDY QUESTIONS

1. At the opening of the film a voice (Abel Wolman) comments that "engineers are the agents of civilization." Yet often, their contributions to our way of life are taken for granted. How did waterworks and sanitary engineers shape modern life?
2. Worldwide epidemics—like the cholera epidemics of the 1830s to 1870s—still occur in other parts of the world. What have engineers done to prevent them in the United States?
3. New York City became America's leading city after the construction of its first aqueduct. How were its tremendous economic and population growth tied to its waterworks?
4. The film shows that small towns in upper New York State were submerged to create reservoirs for New York City. How would you attempt to balance the needs of a city versus the needs of the distant countryside?
5. At the end of Section I, the narrator asks "who would question this dream" of providing health and prosperity for all through massive public works projects. Can you think of any groups on the American scene today who would oppose the engineers' dream?

BACKGROUND TO SECTION IB: "WATER WARS: CALIFORNIA"

California Waterworks

If the waterworks engineers saved New York City by eradicating epidemic disease and citywide fires, they can be said to have created Southern California.

Beginning with the Los Angeles Aqueduct in 1908, waterworks engineers constructed an ever-expanding network of dams, reservoirs, tunnels, and canals to draw billions of gallons of water a day from the Sierras in the northern and eastern part of the state. Most of this water is used by the farms, industries, and cities of the south, enabling the Los Angeles/San Diego area to grow from a population of several hundred thousand in 1900 to over fifteen million today. This region is a major part of California's economy, which would rank as the eighth wealthiest in the world if California were a separate country.

But in a part of the world where water is scarce and where rapid development of formerly barren land can make quick and fabulous fortunes, moving water from one place to another has been accompanied by conflict and violence. This is true of the American west in general, but California's water history has been particularly colorful. To this day, historians are still trying to uncover the real story of the building of the Los Angeles Aqueduct from Owens Valley. For some, William Mulholland – the self-taught chief engineer for the Los Angeles Department of Power and Water – was a visionary genius who accomplished the impossible, bringing water several hundred miles across the Mojave Desert. For others, he is the villain enshrined in the film *Chinatown*, a master of deception and double-dealing whose ruthless quest for wealth and power destroyed many of the small farmers of the Owens and San Fernando Valleys. Engineers Phillips and Jones, who appear in the film, knew and worked with Mulholland; they have long been associated with the Los Angeles Department of Power and Water, which owns and maintains the Owens Valley Aqueduct.

However this history of land takings, aqueduct bombings, and shoot-outs is assessed, most commentators agree that political power has shifted from the north to the south and is now vested in those who own the land that water has made desirable: real estate owners and agribusiness.

The Peripheral Canal is one of the latest – and most expensive – planned systems to move water from the northern to the southern part of the state, primarily to the Los Angeles/San Diego region. This gigantic aqueduct would entrap the Tuolumne and the Stanislius, which normally flow into the Sacramento delta, creating areas where salmon and bass spawn and marshes where waterfowl live and breed, and making rice and fruit farming possible. Although efforts have been made to protect northern water interests as part of the plan, a 1982 statewide referendum saw the project defeated. At issue were an array of concerns for northern Californians including the fears of farmers and environmentalists that as fresh water were drawn off, the water in the delta area would become increasingly salty. At the same time, many northern Californians felt that they would be paying taxes to send their own water south to stimulate the growth of a competing region. What most surprised observers, however, was the fact that a majority of *southern* Californians – the beneficiaries of the aqueducts that now make southern California livable – also voted against the new waterworks. Their reluctance to support further development is a testimony to the appeal of new equity and environmental arguments as considerations in planning for future growth.

Environmentalism

Americans have long had an ambivalence about the land they occupy. They have marveled at its beauty and natural splendor, but they have also enjoyed it as a vast resource for economic growth. Until 1900, Americans were able to evade many of the choices that making use of the landscape entailed. With the closing of the frontier, the rise of coal-fired production techniques, and the expansion of the consumer goods industries, Americans first came to grips with the spectre of vanishing resources. One response was the conservation movement, in which figures like Theodore Roosevelt advocated the regulated development of wilderness resources. A second response was that of John Muir, founder of the Sierra Club, who rejected any violation of wilderness areas.

While the conservation movement was not uninterested in the natural beauty of the environment, its major concern was resource management – ensuring that valuable economic resources in forests, lakes, etc. – were protected for future generations' needs and for the stability of economic interests and corporations. While conservationists would have agreed with John Muir that Yosemite Valley should be preserved as a natural wild place forever, they saw no reason why part of it could not be dammed to provide drinking water for the city of San Francisco. For Muir, damming Hetch-Hetchy Valley in 1914 was an abomination and a sacrilege and gave his followers a point of view distinguishing them from the conservationists: that the environment was valuable in and of itself and that it was the task of people to adapt to the natural world, rather than to bend the natural world to their wishes.

A scene from the construction of the Owens Valley Aqueduct, 1908. (Courtesy L.A. Department of Water and Power.)

During the Great Depression and World War II other issues were of greater concern to Americans, and the arguments of both conservationists and environmentalists appeared marginal. But after World War II the situation began to change. Pent-up demand and government policy led to one of the greatest economic booms in American history. Farms were turned into tract developments. Superhighways crisscrossed the nation and Americans purchased more cars than ever before and drove them everywhere. By the early 1960s a growing number of Americans were increasingly disturbed by what appeared to be a massive assault on the environment. During the 1960s and subsequently a new environmental movement was born. Like Muir and his followers, this movement idealized unspoiled nature, but unlike the earlier movement they focused their wrath on the policies of the corporate sector and government. Variously, they indicted overpopulation, the consumer goods industries and the "throw-away" society they created, and society's increased reliance on nonrenewable forms of cheap energy. The ideology of growth, which had given earlier generations hope, was depicted as a disease, a cancer, that would destroy both a fragile planet and our populations.

Today the environmental movement has many factions, in some ways reflecting the older split between conservationists and Muir's followers. David Brower, who appears in the film, left the Sierra Club to form the more militant Friends of the Earth. Barry Commoner, a biologist and ecologist (appearing later in the film) represents yet another environmental position. His work fuses environmental concern with the explicitly human priorities of the earlier sanitary engineering and public health movements.

Modern environmentalism has had many successes. Its proponents lobbied for and won strong legislation to protect the environment during the 1970s. They have convinced many that our world is threatened by pollution and contamination. Yet the questions concerning growth and the environment remain: how can we provide homes, jobs, food, and water for a growing population without adversely affecting the environment of future generations?

STUDY QUESTIONS

1. In the film the engineer Phillips says that the development of water systems in California "turned the state upside down." What does he mean?
2. Environmentalists opposed the growth of both San Francisco and Los Angeles. Name some ways the growth of a city affects the environment.
3. California's water systems have linked Los Angeles to Owens Valley and to Northern California. What has been the impact of these systems on these more rural areas?
4. Teddy Roosevelt and John Muir are often depicted as heros of the environmental movement, yet their visions differed. How? Do we see the same divisions in the environmental movement today?
5. In the film Ernest Callenbach asserts that "growth is the ideology of the cancer cell." Is it reasonable to use this biological metaphor for urban and economic growth?
6. California's human-made water systems permitted the settlement of Southern California. Yet the majority of Los Angeles residents voted against expanding this system to include the Peripheral Canal. Why? Do you think they will continue to vote against waterworks expansion in the future?
7. At the end of this section an environmentalist, David Brower, referring to Los Angeles' growth, says "we cannot continue to pile more people on the earth if it demands the resources of other living things, if we're dependent on those other living things." But engineer Phillips describes Los Angeles with its water supply as "one of the most ideal, most sought-after spots in the world....I don't see why it's a sin [to develop and grow] as long as you don't hurt anyone else while you're doing it...."

   Whose perspective makes the most sense to you? Why?

BACKGROUND TO SECTION IIA: "UPSTREAM-DOWNSTREAM: NEW ORLEANS AND RIVER CONTAMINATION"

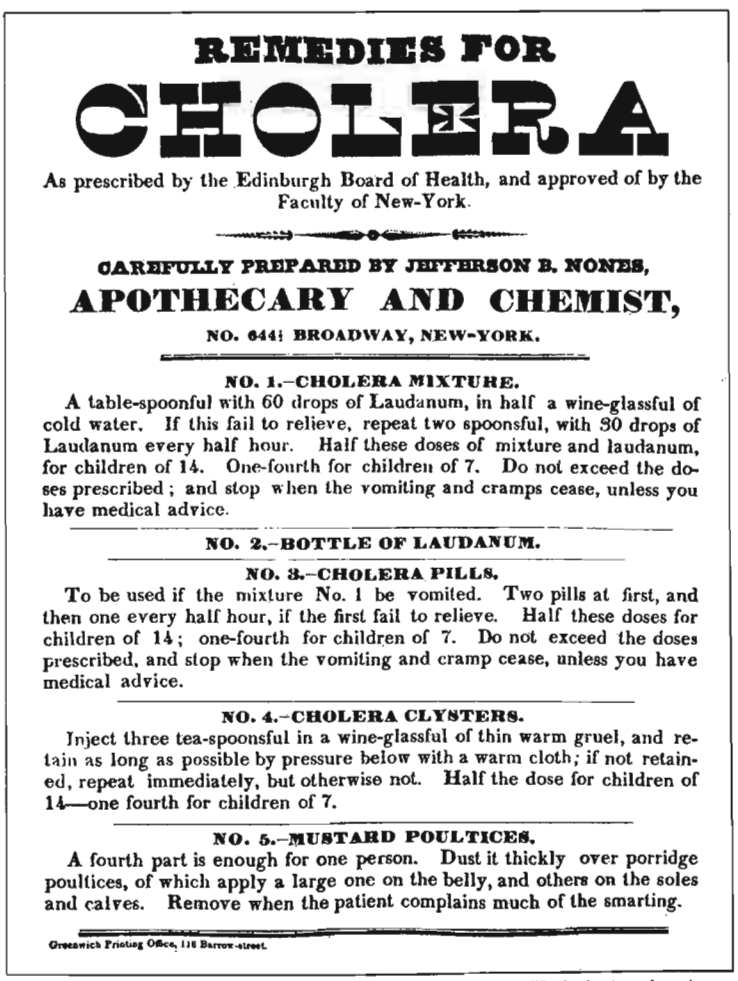
The New Orleans Water System

Unlike New York City and Los Angeles (cities that derive their water from protected reservoirs), New Orleans relies on the Mississippi River. The Mississippi has provided New Orleans' engineers with two great problems: flood control and decontamination. That a great city has managed to survive and grow to over a million people is a source of pride, but it hasn't been easy.

Most of New Orleans is built on low-lying delta land below the river's crest. It is protected by a vast network of levées, canals, and pumping stations which, under most conditions, keep the river from inundating the city. But the Mississippi delta is a region that is geologically unstable and where the river over time tends to change its bed. It is also a region that is susceptible to sudden tropical storms and torrential downpours.

The second major problem is decontaminating the Mississippi River and making it fit to drink. Engineers are confident that their water filtration and purification plants enable them to transform the muddy brown stream that enters their water intake pipe into a safe supply.

In 1974, however, health researchers were startled to find a growing cancer rate in the parishes (counties) adjacent to the Mississippi River in Louisiana, including New Orleans. As most of these communities derived their water from the river, the weight of scientific opinion was that the river was to blame. The three most common heavy metals found were chromium, zinc, and lead (the latter being extremely toxic); among the chemicals discovered were benzene and carbon tetrachloride. Estimates of the number of trace chemicals in the water ranged in the hundreds.



REMEDIES FOR

CHOLERA

As prescribed by the Edinburgh Board of Health, and approved of by the Faculty of New-York.

CAREFULLY PREPARED BY JEFFERSON B. NONES,

APOTHECARY AND CHEMIST,

NO. 644½ BROADWAY, NEW-YORK.

NO. 1.—CHOLERA MIXTURE.

A table-spoonful with 60 drops of Laudanum, in half a wine-glassful of cold water. If this fail to relieve, repeat two spoonsful, with 30 drops of Laudanum every half hour. Half these doses of mixture and laudanum, for children of 14. One-fourth for children of 7. Do not exceed the doses prescribed; and stop when the vomiting and cramps cease, unless you have medical advice.

NO. 2.—BOTTLE OF LAUDANUM.

NO. 3.—CHOLERA PILLS.

To be used if the mixture No. 1 be vomited. Two pills at first, and then one every half hour, if the first fail to relieve. Half these doses for children of 14; one-fourth for children of 7. Do not exceed the doses prescribed, and stop when the vomiting and cramp cease, unless you have medical advice.

NO. 4.—CHOLERA CLYSTERS.

Inject three tea-spoonsful in a wine-glassful of thin warm gruel, and retain as long as possible by pressure below with a warm cloth; if not retained, repeat immediately, but otherwise not. Half the dose for children of 14—one fourth for children of 7.

NO. 5.—MUSTARD POULTICES.

A fourth part is enough for one person. Dust it thickly over porridge poultices, of which apply a large one on the belly, and others on the soles and calves. Remove when the patient complains much of the smarting.

Greenwich Printing Office, 118 Barrow-street.

A poster on cholera "remedies" from the epidemics in New York during the nineteenth century—the germ theory of disease was not yet understood.

The source of the chemicals remains a matter of dispute. The huge petrochemical industry ninety miles upstream is one culprit. Attracted by Louisiana's lenient environmental regulations, this industry gained enormous profits by spending little on anti-pollution technology. Since the drinking water controversy occurred, the industry has been pressured into spending more on cleanup, but the problem remains acute because of the federal Environmental Protection Agency's loose interpretation of the Clean Water Act and lax enforcement by state and federal officials. (The New Orleans drinking water study was actually a factor in the passage of the U.S. Clean Water Act in 1974. This act sought to limit emissions into water bodies throughout the nation.)

But the concerns of the Clean Water Act and environmentalists conflict with the political economy of the petrochemical industry. Louisiana is one of the poorest states in the union and its politicians have been eager to entice new industry to the state. The petrochemical industry has been attractive because it provides highly paid jobs (though it does not employ large numbers of people). Thus, whether through intent or neglect, the state has made the health concerns of unionized workers and local communities of secondary importance to the needs of private corporations for profits.

As the film demonstrates, the problem of contaminated water in New Orleans and throughout the nation is larger than this controversy. Groundwater, lakes, and rivers are being contaminated by petrochemical compounds produced since World War II. These compounds are emitted not only by petrochemical plants, but by industrial users of petrochemical products and by farmland where chemical fertilizers are used. To clean up and protect water bodies to match the relative quality of New York's protected reservoirs, this larger problem must be addressed.

The nineteenth-century solutions of the sanitary engineers to the problems of contaminated water are not sufficient. While effective in preventing waterborne bacterial diseases, chlorine and steeling and filtering in the nineteenth-century manner will not protect a population from the presence of chemical compounds in their water.

The Ecological Perspective

People throughout history have known that they live in a world of dependencies and mutual relations, both with nature and other people. Simpler societies codified a bewildering array of maxims in the form of legends, customs, and myths that sought to regulate the way people lived with nature. Many of the beliefs were premised on the understanding that the cycles of human existence were only part of a world that included other priorities, other cycles.

One of the most important beliefs of the modern industrial world is that all aspects of existence are ultimately knowable and that they can be manipulated for human purposes. Biologists were among the first to question this approach: they have demonstrated that any life form seems to be involved in a multiplicity of relations with other life forms in a given environment and that their relations can precipitate changes in the environment itself. The work of ecologists in particular has not only influenced the scientific community, but also played a key role in the environmentalism that emerged in the 1960s. The ecological perspective has given the environmental movement an intellectual rigor lacking in both Muir's early movement and, to a lesser extent, the conservation movement that preceded it.

The ecological line of reasoning raises this issue: if engineers cannot explain what the environmental effects of one of their projects will be because they are unaware of the ecology they are changing, then how can the public be assured that the impact will be benign? Might not their tampering set in motion a chain of events that could be disastrous? (In the film, Barry Commoner, a biologist, represents the ecological perspective.)

Today, a renewed debate about the nature and impact of industrial society is taking place. Because this debate touches on the many interests differing groups have in the use of the environment, it has become acrimonious and heated. Some critics use ecological jargon to attack technological innovations that may affect the environment, while their opponents seize upon their overstatements to dismiss the entire question.

Environmental engineers have become major figures in this debate due to the technical requirements of environmental impact statements that now often precede development. The promise of this new profession lies in its potential for the transformation of engineering practices through a deepening of scientific sophistication and in its grounding of environmental concerns in an ecological perspective. Environmental engineering represents an invaluable resource for the citizens in a democracy to understand the implications of current environmental and developmental choices.

STUDY QUESTIONS

1. Geography has helped to determine the relation between the city of New Orleans and its "water environment." How is this environment different from that of Los Angeles? New York City? What did engineers do differently here?
2. In the film Barry Commoner asserts that the substances produced by the petrochemical industry since World War II are "new to nature." How have these substances affected the systems created by sanitary engineers at the turn of the century? Would a growing petroleum industry affect the New York reservoir system in the same way?
3. In the film an environmentalist asserts that the Louisiana water problem came about because Louisiana has been a "right to profit" state. Do you agree?
4. The lobbyist for the petrochemical industry says that "clean is a matter of interpretation." Do you agree? If you worked for a regulatory group like the Environmental Protection Agency, on what basis would you set standards for Louisiana's drinking water?
5. Environmentalists in California and Louisiana each criticize engineers and business interests, but for different reasons. How is the environmental debate over the use of natural resources and urban growth different in these two states?
6. New Orleans' drinking water can be contaminated by waste from upstream cities like Chicago and by upstream businesses like the petrochemical industry. Yet each city and industry has its own engineered water intake and disposal system. Do the engineers who designed these upstream systems have any responsibility towards downstream communities like New Orleans? If so, why? If not, why not?
7. In New Orleans, bottled water consumption is rising at the rate of 20 percent per year. Yet only some people drink this bottled water. Why? How does this new situation reflect upon the nineteenth-century "dream of the engineers?"

BACKGROUND TO SECTION IIB: "THE SLUDGE DUMPERS"

Waste Disposal Systems

In the ancient cities of the Indus Valley – Mohenjo-Daro and Harappa – archaeologists were surprised to find evidence of a well developed and apparently effective sewage system. Streets were provided with drains that connected to larger pipes that in turn deposited wastes into the river. From antiquity up through the nineteenth century, few cities could match even these rudimentary waste disposal techniques. Until the late nineteenth century, urban waste disposal was a service provided to those who were better off. The less well-to-do experienced the consequences of inadequate waste disposal – high infant mortality and epidemic disease.

The key to waste disposal is the removal of human and animal wastes (food, excrement, carcasses) to an adequate distance from the places people eat, drink, sleep, and work. Take water from upstream and deposit wastes downstream.

The extraordinary growth of commercial and industrial cities in the late eighteenth and early nineteenth centuries transformed the endemic problem of local waste disposal into what might be termed the first great environmental crisis of industrial society. Sheer numbers of people created an environment of cesspools. Wells and natural streams were polluted by the overflow from latrines and the effluents of industrial processes. New rounds of epidemic disease, especially cholera, terrified urban residents. While the well-to-do could often escape to the surrounding countryside, the poor could not.

One of the first responses of urban civilization was the creation of safe water supplies. In the short run (often lasting a generation), this solution aggravated the waste disposal problem. More water led to more water use, feeding new toilets and bathtubs. Without sewers, the streets and urban environment became even filthier, especially in low-lying immigrant neighborhoods.

By the end of the nineteenth century, sanitary engineers and municipal officials had constructed a network of drains and pipes that took liquid waste away from residential areas. While this achievement is credited as one of the major factors in the eradication of epidemic disease, in retrospect most American cities became wedded to a technology they now find problematic: the combined sewer system.

In the late nineteenth century, academic engineers had been convinced that there was no reason for a city to build two separate sewer systems – one for human wastes from households, and a storm drain for rainfall. It seemed far too expensive: human wastes really could not be used, and there were no apparent health hazards associated with a combined system. This faith rested on the belief that large bodies of water could absorb and purify the wastes drained into them. Therefore engineers designed systems that would dump wastes into oceans and rivers.

By the 1920s, urban growth had progressed to the point where large river cities were dumping waste several miles upstream from where other cities took their drinking water. There was conclusive evidence that outbreaks of typhoid resulted. While some public health officials wanted restrictions on waste dumping, academic engineers convinced government officials that it would be cheaper (and just as sanitary) to purify water intake by chlorination and filtration. (This is the approach taken in the New Orleans water supply system.)

In the short run, they were correct. Epidemic disease was virtually eliminated from cities in the advanced industrial world.

In the present, however, we have new cause for worry. Our waste disposal systems have become a central element in a new environmental crisis – the pollution of streams, rivers, and ever-larger bodies of water. The sheer volume of human waste and of chemical, solid, and radioactive wastes is a problem of increasing proportions. In this situation, the sewage and disposal systems designed to protect urban populations are creating a new health problem, environmental concerns, and conflicts between cities and states sharing the same water bodies.

The toilet was a key component of the sanitary engineers' system to prevent the spread of epidemic diseases.

The Debate Over Growth

Growth was the watchword of the postwar years. Media celebrated the ever-increasing numbers of highways, cars, and houses. These statistics represented the success of the American way of life to the world community; yet today they are used with caution. For many observers they now indicate inventories of waste and inefficiency rather than progress.

In the last fifteen years we have come to doubt whether our growing use of economic resources and consumer goods is an indication of wellbeing. Rather, we worry that we are witnessing a society out of control – at war with itself, at war with nature. This war, many believe, we cannot win.

There is an intellectual tradition in the West that has criticized our civilization in terms of the moral consequences and inequities of materialistic culture. The environmental movement of the late 1960s added an important dimension to this debate by arguing that material progress might be no progress at all; that it might not work even on its own terms and might destroy nature's capacity to sustain human life. For many environmentalists, the principal problem in this scenario was the ideology of growth.

Americans in particular have relied on sustained economic growth to avoid making hard economic and moral choices about the kind of world we want to live in. It is interesting to speculate just how influential this view would have become if the economic boom of the postwar era had continued. Instead, the 1970s and 1980s were a period of economic dislocation characterized by shortages of various resources and inflation. In this new era, the world of modern technology suddenly appears fragile. Today the environmentalist challenge to the ideology of growth finds echoes among many of the political, economic, and academic élites who, a few short years earlier, had been the most vocal proponents of the ideology of growth.

But not everyone agrees. Many industrialists, worried about their businesses, wonder how they can survive in a world that sets limits to growth. Labor unions see the attack on growth as a way of cutting workers' standard of living. And some theologians see the concern with growth as a selfish venture in self-protection by those who have already benefited from growth and reaped its rewards only to deny them to others.

This debate – whether growth is seen as pernicious or as our greatest accomplishment, whether it should or can be controlled – is at the center of a disintegrating political consensus that reflects, in part, a world economy in disarray. The stakes are high, and the New Deal coalition that emerged in the Depression (labor unions, minorities, reformers, and liberal corporate leaders) and based its progress on furthering economic growth has disintegrated. What new alliances will fill this vacuum remains unclear.

One thing, however, is certain. The debate over growth will increasingly focus attention on the nature of industrial society and the quality of its social relations. Whatever may be said of growth, it made possible a rising standard of living for several generations. In America it made it possible for a flood of immigrants to have hope for the future and for their children. Whether we like it or not, we are the inheritors of this process. Our generation must decide for future generations how, and to what extent, we will develop our resources. We must decide whether we will continue to grow and whether we will offer future immigrants the same benefits and hopes that America offered our own ancestors.

STUDY QUESTIONS

1. In the film the engineer Able Wolman asserts that "without us, half of you would be dead." What does he mean?
2. The toilet was a key component of the water/sewage system that helped prevent epidemics like cholera. But this nineteenth-century invention seems to have contributed to a modern problem. How? Why would this concern have surfaced only in recent years?
3. In the film Barry Commoner says that the nineteenth-century engineers designed a water system "like a machine," where "something comes in one end" and "something else comes out the other end." How do city water systems fit this description? Is this a description of other kinds of engineered systems?
4. Commoner makes the point that the early engineers did not take into account the principles of ecology. How is an ecological system different from the human-made water systems designed by engineers?
5. New York City's waste has to go somewhere. If you worked for a regulatory body like the federal Environmental Protection Agency, what would you tell New York City to do with its waste?
6. The final section of the film raises the issue of whether or not we should use our environmental resources – like water – for the expansion of our city populations. David Brower, the Californian environmentalist, says we should remove the motto from the Statue of Liberty that says "send me your tired, your hungry, your poor."

   John Gale, the first mate on the sludge barge, disagrees with Brower. Speaking of people from other countries, he says America "takes them in. ...we don't always take in the best, but that second generation shapes up." Is he talking about modern immigrants only? How is his vision of America and growth different from Brower's?

   With which of these two visions – Brower's or Gale's – do you agree? Why?

BIBLIOGRAPHY

General Reading

William Ashworth, *Nor Any Drop to Drink.* (Water issues).

Michael Cooley, *Architect or Bee.* (Planning issues).

Cousteau Society, *Cousteau Almanac, An Inventory of Life on Our Water Planet.* (Environmental issues and viewpoints).

J.B. Jackson, *American Space.* (The American landscape as a "built environment").

David Noble, *America by Design.* (Applied technology in America).

John Teaford, *The Unheralded Triumph.* (Municipal government in America).

Sam Bass Warner, *The Urban Wilderness.* (Overview of American urban history).

Section IA: "Water for All"

American Public Works Association, *History of Public Works in America.*

Norton Blake, *Water for a City.*

Robert Daley, *The World Beneath the City.*

Pat Choate and Susan Walter, *America in Ruins.*

John Duffy, *A History of Public Health in New York City* (2 vols.).

Harry Granick, *Underneath New York.*

Pamela Jones, *Under the City Streets.*

David McAuley, *Underground.*

Fern Nesson, *Great Waters.*

Charles Rosenberg, *The Cholera Years.*

Barbara Rosencrantz, *Public Health and the State.*

Charles Weidner, *Water for a City.*

Abel Wolman, "The Metabolism of Cities", in *Scientific American,* 1964.

Lawrence Wright, *Clean and Decent.*

Section IB: "Water Wars: California"

Harry Dennis, *Water and Power.*

Mary Douglas and Aaron Wildavsky, *Risk and Culture.*

Stephen Fix, *John Muir and His Legacy.*

Walter Goldschmidt, *As You Sow, Three Studies in the Social Consequences of Agribusiness.*

Merril R. Goodall et al., *California Water.*

Samuel Hays, *Conservation and the Gospel of Efficiency.*

Abraham Hoffman, *Vision or Villainy.*

William Kahrl, *California Water Atlas.*

William Kahrl, *Water and Power.*

John McPhee, *Encounters with the Archdruid.*

John Weaver, *Los Angeles: The Enormous Village.*

Section IIA: "Upstream-Downstream: New Orleans and River Contamination"

Cousteau Society, "The New Orleans Cocktail," *The Cousteau Almanac: An Inventory of Life on Our Water Planet,* pp. 611-616.

Marise Gottlieb, Jean Carr, and Daniel Morris, "Cancer and Drinking Water in Louisiana," *International Journal of Epidemiology,* 1981, V. 10, No. 2.

Pierce F. Lewis, *New Orleans, the Making of an Urban Landscape.*

Arthur Morgan, *Dams and Other Disasters.*

Charles Perrow, *Normal Accidents.*

Section IIB: "The Sludge Dumpers"

Barry Commoner, *The Closing Circle.*

Barry Commoner, *The Science of Survival.*

Martin Melosi, *Garbage in the Cities.*

Joel Tarr, "Retrospective Assessment of Wastewater Technology in the United States (1800-1972)", National Science Foundation, 1977.

RED SUN PRESS