THE DEVELOPMENT OF WATER POLLUTION LAW IN LATE NINETEENTH-CENTURY AMERICA: 1870-1905

by

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Introduction: The Social Milieu

America in the late nineteenth century witnessed an upheaval of contradictory ideas concerning the use of its natural resources. Water was one of most fundamental of those resources. Water quality declined in the Eastern part of the United States throughout the nineteenth century, due largely to the intense industrialization and urbanization of the region. Industrial by products were poured into rivers and streams without regard to the injurious effect to human populations that might arise as a result. Cities discharged their wastes into the same rivers and streams with only a vague awareness of possible harm from water-bourne agents of disease such as cholera or typhoid. In reaction to this state and municipal laws governing water use underwent considerable change in the period of 1870 to 1905. This essay examines three aspects of the development of a corpus of water law suitable for confronting the new problems of water pollution: the development of a technological infrastructure to remedy the problem through the invention of filtration systems and the detection of specific bacterial agents of disease, the paralysis of common law or case law that arose from two conflicting remedies for water pollution cases, and the application of bureaucratic or administrative law, specifically in the state of Massachusetts where state laws were formulated and executed by a state health board.

Water law was a great importance in the Gilded Age. Experts in water law proliferated during this period, but most dealt with the disposition of water with respect to quantity rather than quality. The preponderance of water cases of the period revolved around who owned or controlled the flow of a stream or river. A majority of water law articles in legal journals throughout the late nineteenth and early twentieth century dealt with Western problems of who should have access to a scarce commodity.[1] The quality of

the water under discussion was seldom of any importance as long as it made crops grow or provided the means for separating valuable minerals from expendable ores. An example of this type of water law and its effect was the dispute over the Arkansas River brought before the Supreme Court by Kansas against the State of Colorado. Water quality received little attention in the testimony.[2]

The water-rich Eastern seaboard presented a different picture. Here the problem of water quality impinged upon the lives of millions of individuals, yet legal thinkers paid little attention to the rat's nest of problems created by urban development and industrial growth. The power of law was little used by judges or lawyers to redress the myriad problems caused by river and stream pollution. Because of the intransigence of traditional legal authorities the freshets of change flowed from sources outside of the legal community. In Massachusetts and New York, to name only two states, regulatory power was brought to bear through the action of concerned citizens, primarily from the emergent medical and scientific, professional elite. Physicians possessed a strong awareness of the need for pure water. As the century progressed medical science became better able to discern with some exactitude the etiology of diseases such as cholera and typhoid. Even prior to the elabration of the germ theory by Koch and Pasteur, physicians made a connection between disease and impure water.[3] Dr. John Snow, a prominent London physician, pointed to water as the bearer of the miasma of cholera as early as 1854.[4]

The advance of scientific knowledge coupled with public pressure brought about a demand for clean water in both Europe and America. In the 1860s and 70s cities such as London and Hamburg led the way in devising and constructing filtration systems directed toward removing the enigmatic agents of disease from urban water supplies.[5] American engineers and medical professionals

were profoundly influenced by the European example. James Kirkwood, an American waterworks engineer, toured European filtration facilities in the 1860s returning to America with a report of the technological progress he witnessed on his journey.[6] Although medical professionals and waterworks engineers such as Kirkwood were impressed with the wonders of European technology, this message usually fell upon deaf ears when communicated to contemporaries in business and government. As a result America did not have a sophisticated water filtration system until the construction of the Lawrence, Massachusetts filtration works in 1893.[7] Nevertheless the lanquid pace of American acceptance of this technology, and its concomitant legal mechanisms, did not deter leading physicians and members of the emergent sanitary movement from proselytizing for pure water.

Indeed the sanitary movement, loosely organized around a elitist medical profession and other scholarly societies such as the Social Science Association (1868), provided a convenient vehicle for addressing the problem of water pollution.[8] The chief concern among sanitarians was the occurrence of epidemic disease in urban areas. In most cases sanitarians viewed the squalid living conditions of the poor as the breeding ground for disease. However, the epidmics of cholera and typhoid that assaulted America throughout the nineteenth century were not selective; the victims of plague came from all social classes.[9] Thus sanitarians moved beyond problems such as tenement ventilation and dirty streets to deal with what appeared to be the primary breeding grounds of disease, impure air and water. While Scientific evidence mounted for the indictment of water as the primary vector of epidemic disease, sanitarians in the industrial northeast shifted their attention to an intensive campaign to create state and national regulatory bodies for maintaining the purity of urban water supplies. In 1886 the state of Massachusetts became

one of the standard bearers of this movement as it enacted laws which provided for a state health board with the power to enforce water pollution laws that were quite stringent for the period.

In its early days the sanitary movement possessed an almost religious devotion to moral rectitude which was transmitted to the late nineteenth-century public health movement in Massachusetts as well. The Bostonian Lemuel Shattuck, an advocate of sanitary reform in defining physical health as "clean living, self control, and moral integrity."[10] Later sanitarians incorporated this dictum into their demands for an orderly, organized effort to maintain the purity of rivers and streams. In 1885 a physician addressing a national sanitary convention of Ypsilanti, Michigan compared the demand for clean water to the sanitary practices of the ancient Hebrews which in his words elevated "man morally as well as socially and physically."[11] Thus the sanitary movement enfolded pragmatic scientific proposals in a rhetoric possessing a moral and ethical fever.

An elitist ethical fervor accorded well with the political mood of the place and the time. Massachusetts underwent profound change in the late nineteenth century as the brahminic strata of society pushed for the cleansing of political life through such changes as a reform of civil service hiring practices.[12] This dovetailed with the demand for greater efficiency in government on a state and municipal level. As a consequence many functions of government were centralized and placed in the hands of civil servants who possessed particular forms of expertise instead of place seekers who were only interested in getting a job. Although this transition was not smooth or complete, it formed the context for the development of a centralized public health agency in Massachusetts: an agency that employed scientists and engineers trained to deal with the problems of maintaining clean water and clean air.

The sanitary movement, the efficiency-conscious trend toward the centralization of governmental functions and the development of water filtration technology shaped the development of water pollution law in late nineteenth-century Massachusetts. However, these trends did not have much influence on legal culture or common law. An exclusively legal resolution of the problem of water pollution was frustrated by countervailing interpretations of an archaic body of caselaw and common law. In contradistinction the creation of administrative laws, enforced by state bureaucracies, was the primum mobile of water pollution law in this era. This study is primarily concerned with this aspect of the growth of environmental law in the late nineteenth century.

As Marx frequently intoned, the basis of social change is technological change.[14] The rapid evolution of techniques for filtering large quantities of water preceded the development of corresponding water pollution laws by a generation. Without the existence of an effective technology for ameliorating the problems of water pollution, laws governing water use would have had little impact. Despite the fact that applied science provided concrete solutions to the many problems generated by water pollution by the end of the century, the national government and the legal community lagged far behind in their appreciation of the significance of these developments. The state government of Massachusetts had a better grasp of how to integrate law and applied science but even here common law continued to delimit the compelling need for technological solutions to water pollution problems. In any event the story of water pollution law begins with the introduction and development of water purification technology.

Chapter 1

The Technical Fix

The fear of epidemic disease provided the initial stimulus for thinking about clean water in late nineteenth-century America. Successive epidemics of cholera, carried from Europe to America on immigrant laden ships, swept through the populous East in the 1850s and 60s. Thereafter the occurrence of this disease mysteriously subsided only to be replaced by even more terrifying epidemics of Typhoid in the late nineteenth century.[15] The onset of typhoid was swift and inexorable. In 1885 Plymouth, Massachusetts suffered an onslaught of the disease in early April. Within a month the town of 8,000 souls lost 114 of it citizens, a tenth of those who contracted the disease.[16] This was not an isolated case as statistics from the year 1880 indicate. The death rate per 1,000,000 population from typhoid fever was about 57.6 for Philadelphia, 59.0 for Baltimore, 42.4 for Boston: an incredible number in comparison to the national average of 31 per 1,000 in 1900 and 22 per 1,000 in 1910.[17]

Physicians and Sanitarians reponded to these statistics—not merely numbers but also human beings who died in a most excruciating manner—with increasingly vehement demands for the institution of a technical infrastructure for dealing with the problem. In 1883, Dr. Morton Prince of Boston pointed to the dangers of impure water in a book entitled The Dangers from the Domestic Use of Polluted Water. He offered numerous examples of the way in which polluted water endangered life, emphasizing the fact that dirty water carried such diseases as typhoid and cholera. Moreover he vigorously contended that absolutely "no water supply should be contaminated with the slightest amount of sewage or polluted with organic matter of any kind."[18]

In Prince's view the only solution lay in the filtration of water as practiced in Europe. However, most Americans paid little attention to this prescription until late in the century, long after a number of European cities had resolved the problem through the construction of elaborate filtration stations.

The emergent science of bacteriology was a strong factor in providing leverage in the demands for the filtration of water in America. Throughout the late nineteenth century European scientists such as Pasteur, Roux, Koch and Eberth slowly constructed etiologies for some of the most pernicious contagions affecting mankind. In 1880 Karl Eberth identified the water bourne bacillus responsible for typhoid fever. In the same decade Robert Koch, the great German bacteriologist, identified the bacterial agent of Asiastic Cholera. Even so the isolation of Vibro comma was only a brief interlude in his search for organisms that caused tuberculosis, a task that which proved to be the zenith of his scientific career. The importance of bacteriology in the quest for pure water is further illustrated by a letter from a young research scientist, R. W. Greenleaf to Henry P. Walcott, director of the Massachussetts Board of Health in March of 1893. Greenleaf's defense of a request for aid from the Board's biologists portrayed the newly won confidence in the dogma of bacteriological theory:

> I have set about the problem of finding the missing link in the chain of evidence as to my hypothesis for the origin of intermittent fever.
>
> I do not think "Miasm", nor nearness to the river, except as it may overflow its banks, has anything to do with its Etiology. nor drainage either.
>
> It seems to me that the evidence thus far known, warrants the belief that the hemotozooa has a habitat in swampy growth such as being parasitic on some algae or other vegetable, possibly animal organism and that a little further search will reveal it.[19]

Bacteriological evidence in combination with the emergent methods of chemistry made it possible to engage in more precise biological and chemical

descriptions of the rivers and streams of America, a heretofore unavailable made of description. Moreover, the new knowledge of the existence of microscopic agents of disease provided further evidence of the effectiveness of extant methods of water filtration.[20]

Experiments had long been conducted with various types of filtration in France and Britain. As early as 1804 one of London's private water suppliers utilized a process of settling and filtration in order to provide clear water to its clients. Indeed it was turbidity rather than the unknown bacterial pollutants that first excited an interest in filtering water. By the 1860's Britain had developed more sophisticated water filtration methods than existed any where in America.

In 1866 the American engineer, James Kirkwood, journeyed to Britain and Europe in search of an effective way of reducing the turbidity of the Mississippi river water through the process of filtration. He was sent by the Board of water commissioners of the city of St. Louis, who defined his mission in the following terms:

> Resolved that James P. Kirkwood Esq; our Chief Engineer, be requested to proceed at once to Europe, and there inform himself in regard to the best process in use for the clarifying river waters used for the supply of cities, whether by deposition alone, or by deposition and filtration combined, making such an examination in each instance as will enable him to report to this Board the general dimensions and special characteristics of the specific works visited by him, so that this Board may be able to appreciate how far the same mechanisms, and the same or similar combinations of materials, are likely to be adaptable to the purifying of the Mississippi water at St. Louis.[21]

Kirkwood visited London, Hamburg, Berlin, and several cities in France and Italy. He devoted most of his attention to the London water works, pumping stations, and filter beds. In his report to the commissioners, Report on the filtration of River Waters for the Supply of Cities. As Practiced in Europe. Kirkwood described these filtration systems in great detail,

appraising the advanced state of the art of filtration as practiced in London, at the same time pointing to several flaws that required further refinement of the system. In evaluating the relationship between water clarification and public Health, Kirkwood acknowledged the limits of chemical and biological knowledge:

> "In this place, it may be well to keep in mind that the water which will satisfy a chemist will not always be a safe water for public use. Chemistry cannot always detect the nicer shades of impurity which should render a water objectionable to the consumer. Impurities which sense of smell or of taste can detect, the researchers of chemistry fail to expose, and for that reason are apt to ignore". [22]

By the end of the century the chemist's art became more subtle than the nose or tongue. But this was beyond Kirkwoods ken in 1867.

Kirkwood's work was ill-rewarded. The commissioners decided that conditions did not merit further exploration of filtration as a viable mechanism for cleansing the muddy Mississippi's water. He moved on to greener pastures, and in 1872 was invited by the city of Poughkeepsie, New York to construct a slow sand filter like those he saw on his European travels. Through Kirkwood's report and his subsequent work in Poughkeepsie, America at large became acquainted with the technology of slow sand filtration. In 1878 the Massachussets Board of Health sent Dr. William Ripley on a tour of European waterworks and he returned with a similar report. Other cities and state health boards were attracted to this solution as the decade of the '80s waned. In New York State an awareness of the problem of water pollution and its effective treatment dawned upon the elders of Albany and Troy as it became evident that citizens of Albany were drinking "a residual portion of the sewage of Troy and a large part of their own sewage".[23] A dispute arose over the jurisdiction in this particular case between the various committees of the legislature. The upshot was that the filtration unit was never purchased at the then astounding price of $200,000. Thus Upstate New York forfeited the

honor of being among the first to experiment with slow sand filters.[24]

Massachussetts with its concentration of mental wealth and political scruple became the focal point of experimentation with water filtration. In 1886 the State Health Board of Massachussets instituted the Lawrence Experiment Station. This became one of the prime sources of knowledge pertaining to water pollution and purification in the decades of the 1880s and 90s. Each year the station published a series of monographs and reports on a wide spectrum of problems relating to sewage treatment and water filtration.

George Whipple, a prominent sanitarian and director of the biological laboratory of the city of New York's Dept. of Water Supply, in his history of State Sanitation in Massachussetts described the Lawrence station as it appeared in 1917, undoubtedly much the same as it looked throughout the late nineteenth century:

> The Lawrence Experiment Station itself is far from impressive. A group of low, wooden buildings; and a few circular tanks near the riverbank in an out of the way part of the city are all that one sees at first glance. Inside there are all sorts of tanks, some of wood, some of tile, some of galvanized iron, some of glass. Water or sewage is being applied to them in various ways and in different quantities. Gauges measuring and sampling devices are to be seen everywhere, and periodically. Through the day and night, the attendants make the necessary measurement and collect samples for analysis.[25]

Some of the earliest work in the development of testing methods for river and stream pollution was done there. In 1886 the Massachussetts State Board of Health commissioned F. P. Stearns to determine the level of pollution in the major rivers of the state. Stearns established the experiment station at Lawrence and tested water at various points on the Blackstone, Charles and Merrimac rivers. In 1890 he published a report which represented the results of two years of testing. It pointed to the need for establishing standards of water purity and demonstrated the existence of "invisible" pollutants that

did not always possess a demonstrable odor or taste. (These pollutants were measured primarily by determining the level of nitrogen content of the water—a high nitrogen content per capita (consumer) represented a danger zone that indicated high bacterial contamination as well.) A later and more extensive report by Goodenough established the acceptable rate of flow per 1000 persons before discharge of sewage or industrial waste would not be dangerous. (3.5 cubic feet per second per 1000 persons)[26]

A staff member at Lawrence and former student of Stearns, Allen Hazen, carried the gospel of water filtration back to Albany, New York in 1897, presenting a design for a slow and filtration plant to the town council. In the interlude between the mid-eighties and 1897 the town council along with an old and new water commission had wrangled continuously over the type of water filtration system that Albany would eventually possess. Throughout this period the battle raged between proponents of the new American system of rapid mechanical filtration introduced by John Wesley Hyatt and others in 1880 and the old methods of slow sand filtration. The new rapid method which consisted of jets of water applied on the surface of the sand along with reverse wash and revolving sand agitators was effective in most cases and, indeed, after many refinements eventually superceded the old method. However, in this instance Hazen believed that the tremendous flow of the Hudson demanded the use of the European or slow sand method. He was further supported in this by the medical society of Albany. The plant was completed in 1899 and Hazen wrote in a paper delivered in 1900 that the plant "removed part of the color and all of the suspended matter and turbidity" as well as producing a bacterial efficiency of 99%.[27]

As the century closed the race went to the advocates of rapid mechanical filtration. Nonetheless there was an explosion of activity in the late

nineties as cities and moderately sized towns joined the race to provide pure water to their citizens. Tremendous progress is illustrated by this development from Kirkwood's cautionary remarks concerning the public health efficiency of London's Filtration system to the confident comment by Hazen concerning the bacterial content of filtered Hudson river water. By the end of the century many large cities had either completed or initiated filtration projects. There was a demonstrable lowering of the death rate as cities passed from the dark ages of using unfiltered water into the sunlight of the relatively pure water provided by filtration plants. In Lawrence, Massachusetts the typhoid death rate plunged from 114 per 100,000 to 25 per 100,000 after its filtration plant went into operation in 1893. In Paterson, New Jersey the same pattern prevailed as the Typhoid death rate was reduced to 15 per 100,000. In 1880 only 30,000 Americans enjoyed the benefits of purified water, by 1920 that number had grown to 20,000,000. Thus it became apparent in the 1880s and 90s that tyhpoid and other diseases could be defeated by the application of technology.

Not everyone accepted the new science immediately. City councils wrangled over money, the religious described contagion-born disease as the desert of an immoral humanity, and many simply wanted to continue living in their own Dickensian filth unbounded by the constraints of modern society. Richard Schoenwald in a paper concerning the sanitary movement in Victorian England, suggests sanitarians overcame these obstacles through the introduction of a new morality, at first, slow to catch on, but eventually becoming a part of the unconscious modern canon:

> The task of the nineteenth century was to teach men that they must change fundamentally; and to show them that they could. The sanitary demands increasingly made on dwellers in Victorian cities helped them to become conscious of having a self which needed and repaid watching and regulating.[29]

Sanitarians in America such as George Waring grasped this and invoked the great shibboleths of democracy in the service of this cause: "The huge task is one whose doing can be compassed only by force of an aroused public opinion; our task; hardly less huge, it must be to awaken and varify that opinion"[30] A measure of the effectiveness of this retraining can be seen in an article by Dr. Henry Leffman of Philadelphia entitled, "Sensationalism and Dogmatism in Sanitary Matters."[31] Leffman saw a public too easily swayed by the new gospel of public health. "The public has often been thrown into needless alarm by unwarranted suggestions as to the injurious character of certain substances or special conditions, and violent measure inaugurated for the suppression of imginary evils". In Leffman's view the public was even then becoming much to sensitive about the condition of civic water supplies.

> There can be no question that a pure water supply is of great importance, but there can be also no question that in some respects water analysis is the quackery of chemistry. It has long been believed that the danger in water was in the organic matter, and various processes have been devised to determine the amount and character of this. Each process has had its turn of favor, and while in fashion has been arbitrarily used as a basis for judging of the wholesomeness of samples. It is curious to notice how the sensational language of certain authorities has become popular in this department of hygiene. The organic matter is rarely spoken of under this simple title. It is called pollution, sewage, organic impurity, etc., all terms calculated to alarm, and by no means always correctly describing its nature.[32]

In a backhanded manner Leffman described a public that was already attuned to the need for pure water--a citizenry that was becoming "conscious of having a self which needed and repaid watching and regulating". Still the question remains open as to how consistently educated that public was, even as late as 1919, Kansas Citians preferred clear, contaminated well water to turbid but bacteriological cleansed water from the city's filtration plant.[33]

Economic resistence was another major obstacle to building of large-scale water purification systems. The primary element in the Albany water dispute was the amount of money that had to be spent to guarantee clean water.

Sanitarians countered these complaints by showing the diseconomies resulting from water borne pestilence. Typical of these subtle admonitions is a report published in the Journal of the American Medical Society in 1880: "Impure water—in Canton, Mass.; the Employees of the rolling department have been prostrated by drinking impure water to such an extent that it is feared it will be necessary to close the works of the Kinsley iron and machine company".[34] The threatened closing of a plant with resultant diminished profits was enough to make many businessmen sit up and take notice. It became obvious that the loss of life due to typhoid or other water borne contagion could be calculated in financial terms.

Ill health and loss of life on a large scale was seen as a clear economic disadvantage by many of the early advocates of public health and clean water. Edwin Willetts, President of Michigan State University, discussed this aspect of the problem in 1885 pointing out that human life could be evaluated in economic terms:

> A number of people who should produce $3,000,000 when in good health, could produce when not in good health only $2,000,000. Here is a loss of one-third, much of which could be saved by applying the simplest sanitary precautions. It is the duty of a community to keep these human earning-machine in good condition of health or earning capacity, even from economical motives. A community has the legal right to do this.[35]

As Willetts demonstrated,life was a calculable commodity that could be translated from years into money and back again. In 1887, Dr. George Rothe in a paper delivered to the American Medical Association at their general meeting in Chicago gave some idea of how many years could be saved by more efficient water purification. Citing the English sanitarian Edwin Chadwick, Rothe pointed out that Great Britain had saved 1,800,047 man-years since it began its historic effort to clean the water of its rivers and streams. Of

course all of those saved years had enormous productive value as well and could be translated into monetary terms.[36]

George Whipple's The Value of Pure Water was the summa of economic arguments for clean water.[37] Whipple, a student of the Massachussetts Sanitarian, W. T. Sedgwick, estimated that human life was worth from $1000 to $7000.00 dollars depending on the age of the person. Moreover Whipple calculated that the attendant medical costs of treating typhoid or cholera victims was approximately $100.00 per case, thus the loss of one soul at 30-35 years of age, the time when life value is at its zenith, represented the waste of 7,100 dollars. Whipple rested his case on the improvement resulting from the above mentioned Albany filtration plant. He pointed out that the plant completed in 1898 had reduced the death rate from Typhoid alone by 75/10000. With the application of simple multiplication of 75 x the average value of human life, calculated by Whipple to be 4,635.00, it was revealed that Albany had saved $347,625.00 per 10,000 people. This was not an inconsiderable figure in the late nineteenth century.[38]

Whipple concluded his argument with a comparison of filtration costs and the savings resulting from the reduction of the death rate. Citing the Albany situation once again, Whipple presented a compelling argument to the rational capitalist mind:

> Looking at the matter in another way, it may be said that the purification of a polluted water is a sort of life-insurance for the people, the value of which is equal to 10 cents per capita for each unit decrease in the typhoid fever deathrate per 100,000 which it brings about. Such a sum capitalized represents a large amount of money. In Albany, for example, where the typhoid fever deathrate has been reduced 78 per 100,000, the annual saving of life-value would be $7.80 per capita. Capitalized on the basis of an annual life insurance premium of $17 per thousand, this would represent an insurance policy of about $460 per year for each inhabitant, or $2,300 for each head of a family.[39]

In every respect, Whipple argued, the value of pure water far outweighed the initial cost of an elaborate filtration system.

Economic arguments of this nature proliferated in the late nineteenth and early twentieth centuries. Its suasive value can be measured by observing the number of towns and cities that initiated the construction of water filtration plants in this period. The number of people served by filtration works in cities having populations of above 2500 increased from 310,00 in 1890 to 10,805,000 by 1910.[40] However, progress in the interpretation of riparian law did not parallel this technological juggernaut. American lawyers and judges remained firmly entrenched in Blacktone, Angell and Cooley. The legal cozening of economic development did not coincide with an appreciation of the need to reshape water law to meet the needs of a new technology and the problems of water pollution.

Chapter 2

The Problem of Reasonable Use: Common Law and Water Pollution in Nineteenth Century America

Nineteenth century Americans were possessed by a dynamic impluse to build, to mine, to expand the vast topography of the virgin "territory ahead." However, this was not unmixed with a longing for a bucolic firmament that existed somewhere in the territory behind, an imaginary agrarian republic that antedated the anxious struggle for wealth and power that characterized the era. This ambivalence permeated the literature, politics and cultural life of the period from the boyish romance of Huck Finn to the visionary politics of the Farmer's Alliance. It was evident in the literature of the law as well. One of the most striking examples of this vacillation between nostalgia and pragmatism is afforded by an investigation of water pollution litigation in the late nineteenth century.

The legal system of that era devoted more attention to private property rights than to the "exercise of rights common to all." Water pollution disputes fell under the rubric of nuisance or riparian law. In theory riparian law grew out of nuisance law and then became a distinct entity, but some confusion revolved around the interpenetration of the two categories. Although sharp theoretical distinctions were drawn between the two sets of legal rules, the outcome of water pollution cases was more influenced by the peculiarities of each case than by a hard and fast legal doctrine. James C. Carter, a prominent corporate lawyer and legal authority declared that the ultimate standard of law was founded upon the unconsciously perceived dictates of society. In Carter's view the common law, an heirloom of our English heritage consisting of an ever evolving melange of caselaw, custom, and doctrinal tradition, provided the instrumental means for probbing that societal subconscious.[41]

Blackstone's Commentaries from 18th century England and Chancelor Kent's Commentaries from early 19th century America provided the foundation for the interpretation of common law. In referring to the pollution of rivers and streams, Blackstone invoked the doctrine contained in the latin phrase, "sic utere tuo, ut alienum non laedas" (loosely translated it reads "use your own property in a way that will not cause damage to another's"). In stating this, Blackstone drew a connection between an ancient biblical dictum and the action of the law: "so does the law of England enforce that excellent rule of gospel morality of doing unto others, as we would they should do unto ourselves."[42]

Joseph Angell in his Treatise on Watercourses (1824) followed the pattern prescribed by Blackstone and Kent with reference to cases involving pollution and water law in general.[43] In addition to reiterating the doctrine of sic utere, Angell also amplified the common law doctrine known as currere solebat, which stated that the natural flow of a river or stream should arrive unobstructed or unsullied to the downstream users. In Angell's view all but the most insignificant cases were actionable under these doctrines. However, the explosive economic situation of the early nineteenth century did not incline Americans to follow the measured injunction associated with a more placid, feudal ideal.

The clear logic of Angell did not stand long as a source of interpretion. The core of Angell's treatment of these doctrines was radically altered in 1827 by U. S. Supreme Court Justice Joseph Story's opinion set down in the case of Tyler v. Wilkinson.[44] The nebulous thrust of Story's opinion influenced the development of water law thereafter; indeed, it continued to be an influence well into the twentieth century. Morton Horwitz's study of early nineteenth century law as an instrument for economic growth,

The Transformation of American Law: 1780-1860 offers the most trenchant interpretation of that decision.[45] Horwitz views it as an attempt to open the way for economic expansion. According to Horwitz, Story's decision only ambivalently reaffirmed the doctrines of natural flow and sic utere. In contradistinction to these rather clearcut doctrines Story introduced a new concept of the use of resources that came to be known as the test of reasonable use. In practice this test provided a means for exploiting the economic potential of rivers and streams, a potential that had been denied by the old doctrines of common law. However, the "the soothing, oracular quality" of the decision did not explicitly deny the validity of Angell's position. Thus the two views of water use persisted side by side making it possible to pull numerous contradictory opinions out of the legal hat. As Horwitz says, "Story's opinion is the classically transitional judicial opinion, filled with ambiguities sufficient to make any future legal developments possible."[46]

Treatises reamined a constant source of guidance in an age when law schools were few and most lawyers learned their profession through practical experience known as reading the law. Thomas M. Cooley was one of the most prolific and influential artificers of legal interpretation in treatise form. A Jacksonian of the old school, he attained fame for his authoritative study of constitutional law, Constitutional Limitations (1868).[47]

In 1879 Cooley published a treatise on tort law, The Elements of Torts which gave a clear definition of reasonable use as a means toward achieving economic freedom and equity.[48] Without adverting to older doctrines of common law Cooley indicated that cases involving the fouling of streams should be decided by juries instructed to apply the test of reasonable use to the particular circumstances of each case. Cooley emphasized that the most

important consideration in all situations should be the advancement of industry: "A very large proportion of the value of all the streams in the country would be sunk and lost if mills might not be erected upon them because some taint to the water was inevitable to it from their use. It would therefore seem that there may be some change in the natural condition of the water without legal wrong, and the question of how much and what shall constitute legal wrong must be a question of what under the circumstances is a reasonable use."[49]

Cooley was very clear about what he meant when he utilized the term, reasonable use. Casting aside both the doctrine of natural flow which was intrinsically troublesome for development and the nuisance doctrine of sic utere which also presented problems for the release of energy, Cooley went straight to the most convincing argument for the interests of the burgeoning industrial growth of his age. However, in most cases, Cooley's prescriptive advice was ignored. Each case was treated as sui generis, with natural flow invoked in one instance to protect the rights of the victim and in another to advance the cause of the polluter. And reasonable use, so clearly articulated by Cooley as a means to advance industry, sometimes became a method for determining the rights of the victim instead of the shield for economic liberty.

Peter Junger, professor of law at Case-Western Reserve, in a paper concerning the public welfare and the use of water resources made a survey of water pollution case law from the vary early days of the Republic to the present. Junger concluded his survey with a plaintive question: "How can a court follow a rule that says that every riparian owner can make us of a stream?"[50] In looking for a typical formulation of the reasonable use rule, Mr. Junger reports that he was unable to discover a prototypical case. My own investigation of case law in the period 1850-1920 reveals the same lack

of consistent interpretation. A few examples must suffice to demonstrate the diversity of opinions delivered in this welter of cases.

A case decided by the Pennsylvania Supreme Court, The Pennsylvania Coal Company v. Sanderson and Wife (1886), illustrates the wide spectrum of opinion during the period that the technology of water testing and purification was becoming available.[51] The facts of the case give a microcosmic view of the way in which the landscape, in this case the watershed of a small stream, has been transformed by Americans. Mrs. Sanderson purchased land on a stream, known as Meadow Brook, in 1868. In that year her husband, Gardner, walked to the headwaters of Meadow Brook "to see if there was anything deleterious coming from any place there that might vitiate the waters of this stream."[52] After making the examination Gardner Sanderson was "satisfied that the stream was pure and that it would be fit for such uses and purposes as they designed to make of it." In the same year the Sandersons constructed a house in that idyllic setting and drew water from Meadow Brook with the use of a hydraulic ram. The Sandersons also erected a dam downstreams from the house for "ornamental as well as useful purposes" such as fish culture and the storage of water during the infrequent dry spells.[53]

About the same time the Pennsylvania Coal Company began excavating exploratory tunnels a short distance above the headwaters of Meadow Brook. In sinking a shaft in 1870 the company encountered water and siphoned it into nearby Gypsy Grove Swamp out of which Meadow Brook flowed. In the early seventies the Sandersons discovered that the pure water of Meadow Brook had undergone a change, as a result "they had to abandon it for washing and cleaning purposes, for culinary purposes, and in general for all the useful purposes of the house."[54] In 1874 the final blow took the form of death as the fish went belly up in the artificial pond. This was the straw

that broke the camel's back, and as a consequence the Sandersons filed suit against the coal company in 1875. The ensuing litigation involved numerous appeals from the coal company over a period of eleven years, finally reaching its conclusion with a decision handed down by the Pennsylvania Supreme Court in 1886. In the third hearing in 1879 the plaintiffs (Sanderson's) attorney employed the services of a chemist to determine the purity of the stream. Mr. Gifford, "a chemist from Brooklyn", made a comparative analysis of the water in the stream, using as a standard an undisturbed tributary of the same stream. The unsullied stream also harboured live fish. The results of the chemist's tests indicated that Meadow Brook has a "deleterious amount" of sulphuric acid present - a substance only minimally apparent in the stream utilized as a standard. Beyond that there existed the very graphic evidence of the fish kill in the pond fed by the polluted Meadow Brook in contrast to the thriving fish in the stream that was relatively free from chemical pollutants. The case for the Sandersons was obviously convincing when viewed in combination with the attorney's citation of the twin doctrines of natural flow and sic utere. In this first inning of a lengthy legal battle the Sandersons were awarded a settlement of $2872.74 by the court.[55]

However, upon appeal the State Supreme Court reversed its opinion in response to the coal company's pointed attack upon the Sandersons as persons who sought to impede progress and economic growth and thus demanded that their individual interests take precedence over those of the community. They also argued that the doctrine of sic utere could be construed as a defense of the coal company's interests: "If in our case, we cannot use our land for the natural purpose of mining coal because our neighbor cannot keep his tame fish in his pond, the same rule should apply to him." Morover they relied heavily upon the test of reasonable use stating bluntly the underlying

rationale for its existence: "The trifling inconveniences to particular persons must sometimes give way to the necessities of a great community. The only question here is what constitutes a reasonable use."[56]

Sanderson v. the Pennsylvania Coal Company was heard several times by the high court of Pennsylvania. Each time the principal judges swung back and forth, unable to determine decisively which rule of law had priority, reasonable use or the doctrines of natural flow and sic utere. The persistence of the legal representatives of the Pennsylvania Coal Company, doggedly entering appeal after appeal, was repaid with a decision for the company in 1886. The court reversed its earlier decision, which had upheld damages awarded to the Sandersons in the trial court, finding for the forces of development and thus aligning itself with the dynamic process of growth which most historians agree is the overwhelming characteristic of nineteenth century America. A statement delivered by Justice Paxson in a dissent to an earlier decision handed down in the Sanderson's favor captures the texture of opinion that eventually swayed the court toward the needs of industry as opposed to the right of individuals to enjoy an unpolluted environment: "If the flow of mine water is an injury for which the owner of the mine is responsible in damages, I am unable to see how such mines can be operated in the future, except by the consent of the riparian owners. It is impossible under any system of government or any code of laws, that equal and exact justice sould be meted out in all cases. Under no state of society, save the savage can a man enjoy all his natural rights. He is compelled to relinquish a portion of them for the common good."[57] This was quoted with approval in the final opinion and has all the marks of the prevailing legal and economic mentalité of that period in American history.

In other respects, especially in regard to the technical foundations of the law, the outcome of the case was not at all simple. Tribute must be paid to old doctrines even if they seem to have lost their usefulness. In order to establish the unequivocal rights of the coal company it was necessary to show that the fish pond was artificial and therefore the Sandersons in daming the stream had altered it themselves. Thus they also were guilty of altering the natural flow of the stream: "If, in our case, we cannot use our land for the natural purpose of mining coal because our neighbor cannot keep his tame fish in his pond, the same rule should apply to him. He should not be allowed to maintain a fish pond so near our mine that we cannot use it. His pond as effectually prevents our mining coal on our own property as it he should turn a stream into our shaft and fill it to the level of the ground." [58] In this way the coal company lawyers were able to turn the ambiguous nature of these congeries of doctrine to their own advantage.

This provides further evidence of the ambivalence that one discerns throughout the history of this case. In reading the lawyer's depositions and the decisions and dissents of the various justices, it is difficult to escape observing that all parties involved were grappling with issues that they could only barely articulate, issues that shaped the thinking of an epoch. The court, itself, was deeply, albeit reluctantly, divided. This aspect of the case is best illustrated by the final remarks of Chief Justice Woodward: "It is with the greatest reluctance we conclude to revise and reverse a former judgment of this court. We feel much more embarrassed in so doing because of the well known learning and ability of the learned judge who delivered the previous opinion."[59] This case exists then as a representation in miniature of the dilemma surrounding the confused state of water law in this period. In one sense it is the quintessense of judge-made law

responding to the economic imperative of the "age of energy." On the other hand it demonstrates the agonizing efforts made by many courts in this age to walk their views of economic reality through the eye of the needle of legal doctrine and precedent. The result prods one into echoing the aforementioned query of Professor Junger: "How can a court follow a rule that says that every riparian owner can make use of a stream?" Obviously the court could not in this case and other of the same type, yet tradition demanded, at least, lip service to the ancient diktat of common law. Nonetheless the faultline in the law was lodged in the particularly American conflict between Mr. Adams' dynomo and the contradictory values represented by the agrarian myth so aptly described by Leo Marx in The Machine in the Garden.[60] The bifurcated views of the court can then be explained as the product of human sentiment, judge-made law responding to conflicting values growing out of the society itself, not very different from the societal subconsciousness described by James Carter.

Reports of earlier and later water pollution cases support the view that these cases were riddled with inconsistencies. No matter what line of argument was utilized, be it riparian rights or nuisance law the outcome of each case was contingent upon how the presiding judge construed the law. In an earlier case in Massachusetts, Merrifield v. Lombard (1866), the judge invoked the old doctrines of water law, citing the usual combination of contradictory precedent Angel, Tyler v. Wilkinson, and English common law.[61] In handing down his decision, the judge adverted to the older English construction of the law: "The law requires of a party through whose land a natural watercourse passes that he should use the water in such manner as not to destroy, impair or materially effect the beneficial appropriation of it by the proprietors of land below on the same stream."[62] But six years later in the

same court in Merrifield v. the City of Worcester involving the same plaintiff, Merrifield, a different judge handed down a very different verdict.[63] In this case the rule of reasonable use was followed to the advantage of the city of Worcester. In expounding his decision the judge avered, "The natural right of the plaintiff to have the water descend to him in its pure state, fit to be used for the various purposes to which he may have occasion to apply it, must yield to the equal right in those who happen to be above him."[64] Thus the inconsistent application of the diverse elements falling under the rubric of water law was a constant in the nineteenth century. This again, points to the fact that the social, political, and ideological elements involved in legal decision-making militated against predictability.

A further illustration of this emerges from the examination of Parker v. American Woolen (1907).[65] In this case the court created a new definition of reasonable use as it applied to water pollution cases: "The right to use the stream to carry away mere waste matter in a reasonable manner and to a reasonable extent is not so to be extended as to include a right to discharge into the stream noxious and deleterious matter to such an extent as sensibly and materially to foul the water and destroy its purity and fitness to be used by others."[66] This dictum handed down by the high court of Massachusetts reflected a willingness to use the doctrine of flow supplemented by contemporary scientific knowledge to enjoin the pollution of a stream. This was certainly indicative of the enlightened state of particular jurisdiction but without the undergirding of state or national law it was merely one more item of case law to be used or ignored, and this is reflected in later water pollution cases throughout the early twentieth century which demonstrated the same inconsistency in the interpretation of the broad canon of water law doctrine.

Some contemporary analysts of the legal aspects of water pollution regulation have been struck by this ambiguity in the efforts of nineteenth century courts to adjudicate cases of this kind. Peter Davis, in an exhaustive statistical analysis of water pollution case law, opined: "The cases constitute a morass of conflicting doctrines, and represent efforts to deal with individual situations rather than to provide clarity in defining legal rights."[67] In a similar vein the earlier mentioned study by Peter Junger, concluded that the cause of this cacophony of opinion was to be found in the phenomenon of judge made law: "Undoubtedly different judges at different times and places will apply the rules of riparian rights and of nuisance in different ways in differing factual situations. Except for broad changes in attitude over time there is little one can make of this diversity, except to say that it leaves the rights of the parties ill-defined."[68] The making of water pollution decisions relied, then, upon a number of variables, none of which reflected the state of scientific expertise at the time, but, instead, evolved out of the consciousness of the individual judges, juries, and lawyers who participated in the cases. In the spirit of James Carter's "unconsciously perceived" standard of law, it is necessary to look to the temper of the age in order to resolve the ambiguities of these rulings.

The lack of a linear thread connecting the opinions of various courts with respect to pollution reflected a deep fissure in the Victorian mind. Instead of dividing the nineteenth century into separate camps this particular fissure existed in the life of each man and woman. This inner conflict rested primarily upon values evolving from an already disappearing agrarian age in contest with the forces of urban, industrial modernism. T. J. Jackson Lears in a recent study of cultural transformation in this period, No Place of Grace

points to this as an actuating principle in the lives of many eminent and not so eminent men and women of this period. He identifies it as an attitude of anti-modern ambivalence.[69]

This ambivalence flowed from the inability of most Americans to deal with the contradictory realities of their age—a period when industrial capitalism was restructuring the environment in a multisensual fashion, obliterating the rural ambience that many people had known as children. Farms began to utilize the industrial model with huge grain harvesters pulled by teams of fifty to one hundred horses and mechanical threshers belching steam in to the autumn prairie sky. Yet in the face of this epic transformation or, perhaps, because of it, people half-heartedly maintained values that harkened back to an earlier bucolic epoch. On the other hand there was a dawning cognizance of the improvement of material life fostered by the booming factory system. According to Lears even reformers shared this ambivalence:

> Half-committed to modernization, anti-modernists unwittingly allowed modern culture to absorb and defuse their dissent. Unable to transcend bourgeois values, they often ended by revitalizing them: ambivalent critiques became agenda for bourgeois self-reformation; anti-modern craft ideologues became advocates of basement workbench regeneration for tired corporate executives; anti-modern militarists became apologists for modern imperialism.[70]

The same sense of dislocation and ambivalence is communicated in water pollution cases such as Pennsylvania Coal Company v. Sanderson and Wife.[71] On the one hand there is a rural nostalgia expressed in the recourse to the common law doctrines of natural flow and sic utere, on the other a clear recognition of the needs of modernity was expressed in the adherence to the test of reasonable use.

An inspection of water pollution case law in the nineteenth century reveals a legal muddle which possessed a tortured cognizance of the opposing

needs of urban industrialism and an agrarian past identified with purity in both a metaphoric and material sense. Without a modernist base the concept of pure water or clean water was a nostalgic enigma to the courts of this period. Thus the ambivalence of the legal community with it foundation in the ambivalence of the age led to an impasse in regard to water pollution regulation. A different kind of ambivalence characterized the actions of the scientific and medical community in this period. Although grounded in the same cultural milieu as the lawyer, the, scientist looked for laws and concomitant techniques that would take Americans forward to what they viewed as an accommodation with the reality of urban/industrial development creating in the process a different type of nostalgic, agrarian/industrial myth.

Chapter 3

The Massachusetts Board of Health: Law as Moral and Sanitary Education.

The legal community in the nineteenth century was unable to create workable procedures for dealing with water pollution because of an ambivalent marriage to the past and a confused awareness of the processes of industrialization and urbanization developing right in front of their noses. Although professional men of science and medicine shared that myopia, that ambivalence, the end result was quite a different creature. Instead of serving two masters, the evolving scientific community transmuted "gospel law" into public morality. The scientists of the sanitary movement were able to translate their conservative views, the product of an agrarian, religious mentalité, into the foundation of an almost revivalistic effort to create a new type of sanitary consciousness. The sticking point for the legal community was the necessity to preserve individual economic freedom in a society that was becoming more oriented toward the expanding corporation and moving away from the seeming verities of frontiersman, yeoman farmer, and independent businessman. As a result of the strain of these contradictory currents, the law was in a muddle as it tried to apply private remedies to public problems. Sanitarians were not troubled by this dichotomy. Personal morality still stood at the base of their view of health. Public sanitary law was seen as a logical consequence of the application of religious and moral principles to the education of the people. Thus the conservative, agrarian, almost whiggish, principles of the early sanitarians remained the standard for the later workers in the vineyards of the public health movement.

In contradistinction to the inconsistent situation confronting American legal culture vis a vis water pollution, sanitarians were fortunate in that they were provided with the technical means to apply their moral purge to a

select group of social and environmental problems, producing an integrated vision. The slow sand filter, invented and perfected in European cities, was slowly accepted in America as a direct result of the efforts by sanitarians to promulgate its use. Legalists concerned with the same problems in law were never able to attach that concern to an objective which had statistical and theoretical credence—or an avatar that was as convincing as the slow sand filter. Scientific data concerning invisible agents of microbial destruction did not mesh well with the very visible needs of a developing nation. And if there were some unpleasant aspects of the hegemony of Mr. Adams Dynamo then it was unavoidable—the needs of Home Economicus must be advanced, risks must be taken. In law, this was all an abstraction. But in scientific terms the abstract infusaria had measurable effects on the human body and soul. The human being was revealed as both a biological and moral creature, and from a bacteriological point of view the two characteristics were symbiotically intertwined. Disease caused by little beasties was the meeting point of the moral and the biological. The law stayed in a muddle because it did not fathom the new science in its American manifestation, a science framed in traditional moral terms yet conceived, also, as a means of solving moral problems in a very progmatic and efficacious manner. It stands as one of the most egregious examples of the process of transmuting moral reform into sometimes progressive, at least prophylactic, but most often conservative measures.

The conservative tone was evident from the beginning. Lemuel Shattuck, a teacher and bookseller by trade, laid the moral foundation for the Massachusetts Sanitary Commission in 1850. Shattuck's credentials portray a man who lived at the very center of the civic life of Boston. He was a founding member of what would become some of the most prestigious learned societies in America, such as the American Antiquarian Society (1831), the

New England Historic and Genealogical Society (1844), the American Statistical Society (1839), and the Massachusetts Historical Society (1830).[72] Moreover he authored the legislation that established the United States Census in 1850. It was Shattuck's interest in genealogy that led him to statistics and an awareness of the importance of mortality tables. In 1841 at the behest of the Boston City Council Shattuck compiled a statistical analysis of the trends in births and deaths for the period 1810-1841. The study revealed a degeneration of health within the city with a steadily increasing infant mortality rate. The death toll of older Bostonians was on the increase as well. Shattuck guessed that this resulted from the amplification of epidemic disease due to an increase in population. Thus awakened, Shattuck proceeded to alert his fellow citizens to the existence of the problem.[73]

Shattuck was also a very religious man. Growing up in a country village in the early 1800s Shattuck was touched by the Second Great Awakening. This shaped his moral sensibilities profoundly. He remained firmly committed to the ideals of simple country living and religious and moral rectitude throughout his entire life. Moreover these religious, moral attitudes permeated his vision of Bostonian society as it stood in 1841, subject to the will of God yet falling rapidly into the hands of the devil.[74] Death was taking the best men and women and leaving behind only the dregs. As member of the first Massachusetts Sanitary Commission appointed by the Medical Society, Shattuck authored the famous Report of 1850. In the report Shattuck gave a very palpable account of the decline in morality that lay at the base of Boston's plight. "There is a most fatal and certain connection between physical uncleanliness and moral pollution".[75] But in Shattuck's view the community could be regenerated through a cleansing of its environment:

> The object of the measures we recommend is to remove filth and prevent disease, to introduce those accommodations which allow, and reform those habits which prevent the elevation of the physical man,

> and social nature and moral condition of our fellow-beings. They are the best handmaids we can give to prosperity, morality and religion.[76]

This complex correlation of physical health and public morality, expressed in the context of religious imagery was not a frivolous proposition. It would serve in various ways as the pretext for future efforts to reform the moral and physical environment throughout the nineteenth century.

The primary obstacle to the achievement of these goals in the 1850s and 60s was an extremely primitive view of etiology of disease and the concomitant absence of the technological means to address those problems. However, major breakthroughs in the medical perception of disease occurred in midcentury that instigated the development of new insights into the disease process and its environmental determinants. In England Dr. John Snow mapped the incidence of Cholera in a London epidemic of 1854. Through statistical, epidemiological methods that would match those of modern centers for disease control in skill if not in sophistication, Snow determined the nodal point for the origin of the plague. The famous Broad Street pump out of which flowed clear but contaminated water stands as a turning point in the nineteenth century view of public health. This gave birth to far-ranging efforts to build effective purification projects in London and its environs and also excited a parliamentary inquiry that slowly produced legislation designed to combat waterbourne disease of an epidemic nature.[77] A series of parliamentary commissions meeting in 1857, 1865 and 1868 eventually gave birth to a plan which demanded the creation of a board to oversee the purity of "all rivers and streams in England", through the office of inspectors who would detect incidents of pollution and in an auxillary capacity facilitate the construction of purification plants through educational and financial means. This plan was given executive form in the Rivers Pollution Act of 1876.[78] The Act followed the

advisory of the Commission of 1868 in three areas of pollution: the deposition of solid matter in rivers and streams, discharge of untreated or unfiltered sewage into rivers and streams and the deposition of liquid and solid wastes from factories.[79] The cumbersome and obscure language of the act made enforcement of many of its clauses difficult. As a result legal commentators had a heyday with the vast latitude for interpretation provided by the Act. Writing in Journals such as the Justice of the Peace and The Poor Law Journal, the legal experts battled over these vagaries of legalese often forgetting in the process the original intent of the Act.[80]

Be that as it may, the Rivers Pollution Act of 1876 had some influence upon American sanitary law as well. While American legal culture remained largely unaware of the act, sanitarians throughout the nation referred to it continually as a standard against which American law should be measured. The 1877 Report of the Massachusetts Board of Health published the act in full—with this preface:

> An Act passed in England during the past year is of sufficient interest in connection with this subject to be given entire. It has not fully met with the approval of all the sanitarians; but more stringent bills have failed to go through both houses of Parliament; and Mr. Sclater-Booth, President of the Local Government Board, the office where the bill was drawn up, was fully convinced that the people of that country are not ready for any more advanced measures now. He thought it better to be satisfied with a moderate gain that is practicable, and which will make a vast improvement in the rivers, rather than leave the evil in its present magnitude until all the requirements of sanitary law could be fulfilled in a better Act.[81]

Moderation was a key aspect of the approach of sanitarians in the 1860s and 70s. It remained a significant characteristic of the execution of sanitary law as the movement gained momentum in the latter two decades of the century. Thus in combination with the religious imperative enunciated by Leumel Shattuck, the scientific and administrative example of the British provided the essential elements for the growth of the public health movement

and the collateral drive to purify the rivers and streams of America. The organizational spirit that was born in the Sanitary Commission of the Civil War years was another necessary foundation for the mobilization of the forces of regulatory activity. All of these conditions further exemplify the conservative nature of the movement.

In consonance with this there existed a national imperative to direct public health reform toward an educational rather than an authoritarian approach to the solution of these problems. Elisha Cook, a prominent sanitarian, addressed this concern at a meeting of the Social Science Association in 1869. In a paper entitled "Health Laws and their Administration," Cook applied John Stuart Mill's discussion of the dichotomy of governmental intervention in the Principles of Political Economy to the ministrations of public health boards that were in a nascent stage of organization. Cook, following Mill, divided the function of public agencies into an authoritive mode and an auxillary mode.[82] He defined the auxillary mode as the process of instructing the public through advisories and the establishment of exemplary situations. In Cook's view the instructive function was "by far the most permanent and important, and has been the most carefully studied." Indeed, although Cook pointed to need to enforce the authoritative aspects of the sanitary laws, he consistently maintained that without education the executory provisions were mere rhetoric.

This, in large measure, was the final stone in the foundation of the public health movement as it developed in the last half of the nineteenth century. It was also reflected in the development of the board of health in the state of Massachusetts. After its establishment in 1869 under the leadership of Dr. Henry Ingersoll Bowditch, a former abolitionist and student of Dr. Oliver Wendell Holmes, the Board continued to exemplify the moral

imperatives pursued by its spiritual father Lemuel Shattuck. The primary mission of the Board was to ameliorate both "the physical and moral environment" of the citizens of the commonwealth of Massachusetts. This was given concrete form in reform efforts in the tenements of Boston and the early emphasis on the necessity for pure water research, both of which were seen as problems of education, and, finally, action.[83]

Bowditch, an energetic man of diverse interests, commissioned several studies of river and stream pollution in the years 1870 - 1879. Perhaps the most important study was that conducted by James Kirkwood of St. Louis, and William Ripley Nichols, a chemist and professor of the Massachusetts Institute of Technology, published in 1876 in the Seventh Annual Report of State Board of Health.[84] The study was an exhaustive examination of the water basins of the Blackstone, Charles, Taraton and Neponset rivers. Kirkwood made clear the debt which his study owed to methods established by the Rivers Pollution Commission in England. The study itself dealt with several types of pollution from industrial and urban sources. What strikes the modern reader of the report most vividly is the level of uncertainty with which the results were stated. Although numerous tables and charts indicated varying levels of chemical pollutants in the water basins under examination, there was great doubt as to the meaning of the results. In order to provide baseline information, minnows and goldfish were given variable doses of the chemicals discovered in the contaminated rivers. The results of this test proved little because it was observed that minnows were far more tender than goldfish and succumbed to almost any level of toxic substance. The goldfish, however, maintained a hardy indifference to extremely high levels of contaminates. It was therefore difficult to assert any positive correlation between the fate of

these unfortunate fish and those which lived in the natural environments of the several water basins under investigation.[85] The most palpable result of the study was the suggestion that there simply wasn't enough knowledge available at that time to establish clear-cut guidelines. In any event, following the example of the Rivers Pollution Commission of England and the Act of Parliament of 1876, a model legislative bill was suggested. Kirkwood was most emphatic in suggesting that abatement of pollution at its source was actually more effective than purification. However, he stopped short of recommending a harsh regime for the enforcement of this rule. In fact, he echoed Cook in suggesting that education rather than punitive action was the proper course:

> To devise and perfect a system as varied in its modes of action as the fluid impurities emanating from the different kinds of works and from ordinary sewage will require, must, as has been hinted above, be a work of time; and, while authority must be lodged somewhere to begin this work, and probably to expend some money in ascertaining sometimes how to begin, it seems obvious that the authority given, should, in fairness to cities and manufactories, be exercised in the first instance only conditionally, and that in the case of any fluid impurities requiring to be stopped from entering the stream and to have their poisonous qualities destroyed, and the residue rendered innoxious before being passed into the stream, the authority having the power to require this course should be required to show how it can be done, and the apparatus or material required to effect it. In other words, that authority must be prepared to indicate or teach the mode of purification before taking legal action against it, the party required to act in the particular case being, however, at liberty to follow any process which he may prefer having in view the same end.[86]

One more extensive study of stream pollution was done in 1877 before the demise of the Board of Health. It demonstrated the same conditions described in the Kirkwood report. In addition it published the 1876 River Pollution Act of the English Parliament in full. This led to a law enacted by the Massachusetts legislature prohibiting pollution of rivers and streams in 1878. Although the law was passed, it was virtually impossible to enforce. Hidden in section 3 was a familiar legal stipulation which effectively

disabled the law. It declared that the law should not abrogate prior agreements or "destroy or impair prescriptive rights of drainage or discharge to the extent to which they lawfully existed."[87] Throwing it back to the courts simply allowed anti-pollution efforts to be frustrated by the elements of law discussed in Chapter III.

In the years following the publication of the Report on River Pollution and Streams a knowledge of the basic factors of the chemical and biotic aspects of the pollution problem slowly developed, while political infighting temporarily halted the efficacy of the Board of Health. Due to political and economic pressure, the State Board of Health was dissolved in 1879 and was reconstituted as the Board of Health, Lunacy, and Charity.[88] Henry Bowditch was convinced that this came about as a result of corrupt politics and refused to join the reconstituted body. The new regime was, indeed, riddled with corrupt political appointees and little effective action amanated from its offices during this period which ended in 1886.

In the same years, 1879 to 1886, the nation was gently rocked by the gentleman reformers of both parties who became known as Mugwamps. Much like Bowditch and Shattuck who were concerned with morality of material conditions, these men were primarily concerned with the corrupt and greedy condition of the political jungle. In setting out to cleanse the Augean stables on both a state and national level they reflected an elitist and conservative temper which was concerned with the cleansing of human character. Barbara Rosenkrantz, in her study of the development of the Massachusetts Board of Health, suggests that the principle actors in the reform effort that eventually brought about the rebirth of the Board of Health in 1886 were of the same disposition. In her view they were convinced that pure politics and pure water were congruent entities.[88] In an article in the Boston Medical

and Surgical Journal of 1882, entitled "Bad Drinking Water and Bad Politics" an anonymous writer gave a profound indication of this sentiment declaring:

> "It needs no elaborate argument from us to prove that the public health is not sufficiently attended where only the rich can have pure water to drink and where temptation to the poor to drink bad rum is increased. Nor shall we endeavor to show that public morality is low where important public trusts such as the management of public water supplies are made subservient to politics."[89]

This traditional moral formula was invoked consistently by the advocates of clean water. Moreover the rising prestige of professionalism combined with this moral argument produced experts who preached and acted in accord with both protestant rectitude and scientific certitude. Herman Biggs, who would become director of public Health in New York City, followed this direction as a youth in 1881, when he wrote these words in his senior thesis at Cornell:

> Health, loyalty, intelligence, morality, and prosperity among a people demand as the essential conditions of their existence, pure air and pure water in abundance, sufficiently commodious dwellings and most of all cleanliness. To ensure the existence of these conditions everywhere among the people there should be some governmental inspection of the public health, there should be suitable national sanitary and quarantine regulations adopted and proper means for their enforcement provided.[90]

George Waring, another New Yorker, launched an attack on garbage and waste in the streets of New York City with the same compound of moral zeal and scientific faith. Among his many innovations as Street Cleaning Commissioner of New York, Waring required his crews to wear white uniforms and line up each morning for inspection. More profoundly, Waring's recognition of the importance of clean water for human health was approved by the great and the small. Indeed, upon his death from yellow fever in 1899 while visiting the Phillipines as Teddy Roosevelt's special health commissioner, Waring was mourned by the entire city with a turnout of 5000 people at a memorial service at Cooper Union.[91] Throughout his life Waring pleaded

eloquently with both the public and the powerful to practice the science of the concrete. In addressing the fortieth annual meeting of the American Medical Association in 1889, Waring illustrated the catastrophic effect of water bourne disease through telling statistics. In concluding his remarks he challenged the medical men to action:

> "What is necessary is that you and not only you, but all of your professional brethern, and not only they, but all who subject to their professional ministration and to their influence shall be made to know and to feel that this great clamity is upon us and has been upon us in consistently increasing degree for all time, and that it lies within our power to hasten its decrease in the future until the conditions of life of this whole people shall have been made what they might be and should be"[92]

Like some old testament prophet, Waring vociferously announced the agenda that should be followed by the professional people of his day.

The call to professional and moral zeal had an effect in Massachusetts as well. The Board of Health, Lunacy and Charity was constantly involved in political controversy as various members of its Board were caught with their fingers in the public till or simply not performing their assigned tasks. As a result of the constant agitation by Bowditch and his colleagues the Board was reorganized once again in 1886, in the process shedding its responsibility for charity and lunatics.[93] All political appointees, the object of the most controversy, were dropped from the organization and replaced by people from the civil service list or by men of high professional reputation.

The new chairman, Dr. Henry P. Walcott, defined and guided the mission of the Board for the next eight years. Walcott was the epitome' of brahminic origin and rearing. A graduate of the Fisk Latin School, Harvard College, and Harvard Medical School, Walcott enjoyed life as a practicing physician well mixed with the benefits of the upper reaches Boston's social life. As a member of the Saturday Club Walcott mingled with men of literature and science. Deeply devoted to fulfilling social responsibilities Walcott served

in many different capacities at Harvard, the most prominent of which was acting president during one of Charles Eliot's peregrinations to Europe. Walcott's other affiliations festoon his official biography like so many lights on a Christmas tree: a two term presidency of the Massachusetts Medical Society, a member of the board of the Carnegie foundation, president of the 15th International Congress of Hygiene and Demography in 1912 and so on.[94] Walcott viewed himself as a strong advocate of social reform. However, the societal reform he practiced was one directed by the best, the educated men of science and belle lettres who knew better than the mass how to create a world free from the taint of corruption. In this revolution from above the loutish maneuverings of politicians and lawyers were not well received. In fact Walcott had a rather low opinion of lawyers, even those who represented the views of the brahminic order. Walcott's crystalline vision of the world harked back to an organic view of an agrarian republic guided by the best. Wealth, in his view, had become "sensible of its duties" in the latter half of the nineteenth century. Science could be enlisted to maintain the quality of that world. Certainly Walcott did not see science as a potential enemy of the well-managed bucolic state that he envisioned. In this sense, also, Walcott perceived the law as means to reform unsatisfactory conditions while at the same time causing "The least disturbance or injury to the rights of others."[95] It was within the parameters of this somewhat constrained and contradictory world view that Walcott conceived his duties as chairman of the board of Health.

In the same year as his appointment to the chairmanship of the Board, Walcott authored a document which gives lucid insight into his view of the water pollution problem. In his capacity as a member of a commission appointed by the state to investigate the purity of inland waters, Walcott

wrote the preface to the report requesting the creation of in "expert authority to consult with towns and cities looking for pure and adequate water supplies, or searching for unobjectionable methods of sewerage."[96] Walcott began with the strong proposition that every property owner "however absolute and unqualified be his title, holds it under the implicit liability that his use of it may be so regulated that it shall not be injurious to the rights of the community."[97] Nonetheless there were serious questions in regard to individual rights that led the commission to concoct a formula that in many ways softened the blow of the summary enforcement of a blanket law forbidding the pollution of inland waters; indeed it was thought that a severe law would impair enforcement. Had not the law of 1878 been virtually ignored? With these considerations in mind Walcott speaking for the commission advised a different approach:

> But mindful of the tenderness with which Massachusetts has always treated her industrial classes, we think it would be wise to embrace in the enactment one peculiarly characteristic feature borrowed from the act establishing a roalroad commission, and which has proved strong enough to enforce amply all rights of the public in that class of highways called railroads. This distinctive trait is the use of advisory as distinguished from mandatory power.[98]

In carrying out this task Walcott envisioned the creation of an institution devoted primarily to research and instruction much like the agricultural extension of land grant universities. In Walcott's opinion the power to advise was much more efficacious than the enforcement of laws that would possibly result in the complete disruption of already existing towns and manufactories. However, in the case of excessive violation of the statutes he thought it necessary to refer cases to the state's Attorney-General for action at law.[99]

It was the educational or auxillary mode that appealed to the conservative Walcott above all. With this as his standard Walcott proceded to

establish a research effort that would not be rivaled anywhere else in the nation until the advent of the twentieth century. In 1886 at the behest of the state legislature Walcott hired the engineer Hiram Mills to set up a laboratory at Lawrence for the purpose of studying the purification of sewage-polluted water. The experimental work got underway in 1887 and within a few years the team of scientists of engineers at Lawrence were ready to dispatch experts to any village, town or industry seeking advice on the purification of water.[100]

In 1888 the Board under Walcott's supervision hired William Thompson Sedgwick of the Massachusetts Institute of Technology to oversee the biological work of the Station. The combined effort of the disciplines of engineering and biology produced a revolution in the design and implementation of water purification systems. Sedgwick provided a bridge between the volatile but dead world of the engineer and the chemist and the organic, living milieu of the biologist. He viewed the sand filter as a living organism populated with bacteria and algae that did the work of purifying the water sullied by human beings. In making use of this metaphor Sedgwick created the paradigm for a system which could be used to develop ever more sophisticated modes of cleansing water. Moreover the articulation of the biotic world with the dead allowed sanitarians to utilize the full constellation of scientific tools that had evolved in the period since John Snow's revelation of the deleterious effect of contaminated water and James Kirkwood's early experiments with the purification of water. Sedgwick employed statistical analysis to show correlations between germ-laden water and disease, devised chemical tests that demonstrated the existence of the waste products of the metobolic activities of micro-organisms in aquatic environments and in the process he showed that bacteria were not fully removed by the diluting action

of the natural flow of a river: instead these organisms persisted and flourished with the breeching of certain thresholds of riparian contamination.

Of course none of these concepts emerged full-blown from Sedgwick's brain like a Pallas Athena of the Gilded Age. He slowly assembled the elements of this structure as he applied his biological training to the praxis of solving the day to day problems of research of Lawrence and to the process of formulating responses to communities in search of pragmatic solutions to immediate pollution problems.

One must look beyond Sedgwick's scientific persona to discern other sources for the development of his work at the Lawrence Experiment Station. His roots were embedded in the same soil of privilege and gentility that nourished the lives of Walcott and so many other involved with health reform in Massachusetts. He was reared in Hartford, Connecticutt in the bosom of a bourgeois family associated with the best of Hartford society.[101] As a boy and young man, Sedgwick spent summers on his family's farm near Hartford where he imbibed great draughts of an almost idyllic, bucolic life. The nostalgia for this frame of existence remained influential in his working life and, in large measure provided the impulse that led him to the study of biology. A colleague, Edmund B. Wilson, remembered Sedgwick's strong affection for the natural world in these terms:

> Prominent among one's early memories of him are his intense love of nature and his delicate literary gift. He was country-born and bred and never lost his affection for the New England hills and woods through which he loved to roam. Of these experiences he knew how to write with a charm of style and warmth of feeling that was at first surprising to one who had thought him as concentrated on the technical aspects of science.[102]

In this sense Sedgwick's genteel botanizing in the Connecticutt woods was the template for his strong desire to provide the technical means for effecting a change in the trends toward environmental degradation. After

undergraduate work at Yale, Sedgwick continued his biological training at the Harvard Medical School. After only two years at Harvard, Sedgwick jumped at the chance to work at Johns Hopkins, then the epi-center of significant, basic research in biology. Graduating from Johns Hopkins in 1882, Sedgwick was called to the Massachusetts Institute of Technology as a professor of biology. His burgeoning professional life was intertwined with the development of a science of public health in the decades of the 80s and 90s. M.I.T. reflected this growth in understanding with a concomitant increase of the number of graduates in the public health curriculum, rising from two in 1887 to six in 1892 and twelve in 1898.[103]

This growth in numbers also evidenced a new appreciation of the importance of sanitary science. With new developments in sanitary science there came almost yearly the introduction of new courses of instruction, beginning in 1883 with a course on "Germs and Germicides" which metamorphosed into a course designated "Bacteriology" in 1888, the year of Sedgwick's appointment to the Lawrence Station. Courses in sanitation were introduced concurrently under the supervision of Sedgwick, starting with the omnibus "Ventilation, Heating and Drainage" in 1884 which eventually flowered into a diversity of courses on ventilation and water pollution.[104] With Sedgwick's appointment to Lawrence new instructional opportunities opened as students and faculty became involved with the work at the experimental station. As more sophisticated methods and theory evolved through their endeavours it became possible to organize the knowledge of sanitary science into a curriculum under the rubric "Municipal Sanitation" (1900). Beyond these administrative changes Sedgwick was responsible for many research instruments that further quantified the attack on water purification problems. With the aid of his students he perfected a method and device for counting the number

of micro-organisms in a given amount of water (Sedgwick-Rafter Method, 1888-89).[105] This remained the standard procedure for testing municipal water supplies until the introduction of electronic calibraters in the 1960s. In addition, Sedgwick pioneered the science of epidemiology with the investigation of an enormously destructive epidemic of Typhoid fever that raged through the Merrimac River Valley 1890s. The statistical methods he engineered for this study had a profound effect on the infant science of epidemiology, providing new tools for illustrating the connection between water supply and human health.[106]

All of these technical achievements were encompassed by Sedgwicks almost mystic apperception of the hegemony of nature. Like Shattuck and Walcott he based his work on a quasi-theological foundation that justified the necessity of his mission. Unlike his predecessers he broke free from the reins of orthodox religion but in its place he conjured a religion of science. However, this new scientific theology resonated with the older faith of the brahminic order in its call to duty, rectitude and "certain knowledge". Sedgwick echoed Shattuck's call to moral purity in an address entitled Science and Conduct:

> And is it not, after all, the truth, the whole truth with all its consequences for us and for others , which shall most effectively promote temperance and continence and honesty and faithfullness and kindliness and charity? Will not the path of duty be more than ever the way of glory, when we see not in a glass dimly, but clearly and face to face, all the consequences, alike of rectitude and wrongdoing, for ourselves, for the race, and for all mankind? [107]

His words ring with the orotund fullness of his Puritan forebearers, although the hand of God has been replaced with the manipulative grasp of science.

Sedgwick also shared the prevailing view of the integration of education with the implementation of health laws. Like Walcott and Cook he envisioned

a system that would first educate and only later enforce. In his view the state should provide the financial means for the pursuit of that objective. Addressing the problem of the attitude of the state toward scientific research (especially with reference to water pollution) at a meeting of the American Society of Naturalists in 1900, Sedgwick cited the health laws of Massachusetts as a beacon for the rest of the nation to follow. Along with creating the most stringent pollution laws in the nation the legislature had provided $30,000 in funding for the establishment of the Lawrence Experiment Station, thus enabling the board of health to do the work of giving direction to the process of cleansing polluted rivers and streams. In a more general sense he did not see the work stopping there as the compound of science and government would lead to a more upright community as "the introduction of more science and more scientific investigation into the civil service means the development and extension of a rational system of government based upon merit, rather than partisanship or spoils." [108]

The scientific personnel at the Board of Health represented the first rank of those civil servants that Sedgwick so glowingly described. The Board's engineers and biologists were scientific missionaries who acquainted the citizens of the commonwealth with the gospel of clean water. In many cases it required little convincing as small towns and villages petitioned the board for testing and advice. An exmination of Henry Walcott's correspondence in the years 1893-1894 reveals several requests for advice from the Board of Health.[109] In one instance a committee of citizens from Belmarsh, a community on a stream used by Massachusetts General Hospital for disposal of its sewage requested a survey of the stream by the Board's inspectors. Through the mediation of Walcott the hospital and the committee from Belmarch eventually agreed to share the rather considerable expense of the

survey($266.78). Neither the selectmen of Belmarsh, who negotiated through a Boston attorney, one Frederic Dodge, nor the trustees of the hospital evidenced any discomfort with the sharing of the expense.[110] Other communications from Concord and Millbury demonstrated a willingness to perceive the board as a quasi-judicial institution. In a letter requesting Walcott's presence at a meeting of the Selectmen of Concord interested in "preventing River pollution", E. W. Emerson speaking for the selectmen declared; "We wish to follow your advice so as to serve the general benefit of the commonwealth ... therefore we appeal to you for advice as to the best method of procedure."[111] George Webber, chairman of the local health board at Millbury, shows much the same supplicatory attitude as Emerson in seeking the aid of the State board in determining the source of typhoid fever that had already killed five people (living with "50 to 75 ft" of one another) in the summer of 1893. Receptacles for sampling water were sent to Webber and the subsequent results confirmed his suspicions.[112]

In each annual report of the Board of Health selected advisories in each area of its authority were published. In a case involving the Metropolitan Park commission of the city of Boston the Board's method of mediation is well illustrated. The Park Commission complained of pollution of the Charles River by the Boston Paper Company. In response the Board sent one of its engineers to examine the source of the pollution. The engineer discovered that the paper company had been using red earth to produce a red-tinted paper stock. The discharge of the substance into the Charles had discolored the river for several miles downstream. However, in consultation with the company, the Engineer learned that the material was no longer used. Moreover testing at the board of health revealed that the material was "inorganic" and, in the board's view, innocuous.[113]

In 1894 the Board received a request from the water commissioners of Rockport to notify the owners of a glue company to desist from polluting the water shed of the Rockport water supply. The Board had tested the water in 1893 and 1894 and, subsequently, in 1894 reported that the water was rapidly becoming unsatisfactory for human consumption. However, they were unwilling to act independly of the water comissioners of Rockford. Instead the Board suggested that Rockford submit the report along with supporting statements to the proprietors of the glue company. Moreover, the Board made evident its support would be forthcoming in any legal action as it sent a "marked copy of the general laws relating to the pollution of sources of water supply"[114]

The Board possessed great extra-legal power in resolving the problems of water pollution. This can be readily discerned in the number of towns that built water—purification plants under the aegis of the Board; 30 communities with populations above 2500 constructed systems between 1893 and 1917, the years of the board's greatest activity.[115] This is most impressive when compared to national statistics which show that between 1890 and 1910 the number of people served by water purification increased from 310,000 to 1,860,000. George Whipple, a student of Sedgwick, produced a study of the emergence and development of the Massachusetts Board of Health in 1917. In addressing the legal and material impact of the Board Whipple declared:

> There is nothing in the general law which compels the cities and towns of the state to follow the advice given by the Board in matters of water supply and sewerage; it would be possible for a city to disregard it, and it would be possible, of course, for the legislature to act contrary to it, but so great has been the confidence of the public in the rulings of the Board that it letter of advice had come to have almost the force of law, and it would be difficult for cities and towns to obtain the necessary funds for sanitary works constructed contrary to the opinion of the State Board of Health.[116]

Moreover Whipple praised the letters of advice published in the annual report

as models for students of state sanitation, complaining only of their sometimes indirect nature. Whipple's assessment must, of course, be taken with a grain of salt. The study, as a whole was intended as an encomium to the Board's work, but it also portrays the enormous respect engendered by this work in the community at large and, therefore, adumbrates the source of strength of the Board in its efforts to negotiate sometimes thorny pollution disputes.

Certainly the job of getting concrete results was not always easy. As William Woodward, a sanitary officer of New York, complained, the high ideals of Health Boards were not always translated into immediate action:

> The scientific problems connected with the sanitation of cities are much nearer solution than are the administrative. Experiment and Laboratory and library tell what ought to be done, and may even suggest how to do it, but when the executive offices comes to act. he encounters at once as established order of things which he cannot ignore or alter. He must adapt the recommendations of science to the requirements of law and custom, and sometimes, after the adaptation there is but little evidence that science has ever been consulted.[117]

Some of the advisory reports published in each issue of the annual report of the state board of health indicate the sometimes refractory nature of the parties involved in disputes. These cases illustrate the shadow side of Whipple's evaluation of the Board of Health's effectiveness. Certainly the Board held enormous power in a charismatic sense, but when substantive legal power was necessary all the Board could do was issue reports and advisories with no legal effect. One of the most egregious examples of this was evident in the case of Hull and Cohasset which was played out over the years 1879 to

1905 with continual reports issued by the Board without effect. The nature of the problem was such that no point source of pollution could be identified although small amounts of sewage had been discharged into the watershed over the years. In large part the central source of trouble was Straits Pond which filled with algal growth in dry periods and emanated rank odors. The board suggested in 1900 that the pond be dredged and the bottom replaced with sand and pebbles. However, no action ensued, and in 1905 the same complaint was lodged with a subsequent response from the Board suggesting the same course of action. For at least twenty six years the board patiently surveyed the watershed issuing consistently redundent advice. "Examinations made in response to your petition do not show that there has been any material change in the conditions...." and so forth.[118] However, the good people of Cohasset and Hull never acted upon the Board's advice.

Other advisory reports indicate a rather long hiatus between the issuing of the Board's suggestions and the implementations of same. The Worcestor Lunatic Hospital required over ten years to install cesspools in order to abate the pollution of lake Quinsigamond, a source of water for Worcester and several other small villages. Eventually, the work requested by the Board alleviated the problems, but this seems to have been a rare case.[119]

Perhaps one reason for compliance with the Board's advisories was related to the question of who would pay the bill for any purification or sewerage facilities. According to state law the towns and villages effected by the pollution were required to make expenditures necessary for the construction of these facilities. In a case involving an interstate dispute with Rhode Island concerning the pollution of the Ten Mile River which provided part of the water supply for East Providence, R.I., the Board indicated that the problem could be resolved by the residents of that city

providing funds for the construction of sewage facilities upstream from them. Asking that the State Board of Rhode Island locate the source of the pollution the Massachusetts Board then suggested the remedy once that was accomplished: "In the enforcement of laws for the prevention of pollution of water supplies in this State, it is custom of the cities, towns, and water companies interested to make all necessary changes in structures which are sources of pollution of their water supplies at their own expense."[120]

Thus the State Board acted as a genteel police force in detecting and abating the sources of water pollution in the State of Massachusetts. In this quasi-judicial fashion it discharged its task with a circumspect but firm attention to its delicate position within the frame of government and law in the commonwealth. The Board was fortunate in its possession of the technical methods for ameliorating most of the problems it confronted. These methods afforded by Hiram Smith of the Lawrence Experiment station and W. T. Sedgwick and his students served as the very material way of bringing substance to the moral and spiritual imperatives of the Board. However, these mechanical and scientific aids were not enough to ensure respect for the decisions of the Board. As the examination of specific cases indicates a certain amount of political horsesense was necessary as well. In this regard the Board was able to promote its objectives without engendering malice from the sometimes powerful violators of the pollution laws. In contrast to the serpentine, often muddled, meanderings of the stream of water pollution nuisance cases tried in the course of this era, the State Board of Massachusetts demonstrated an uncanny ability to reach clearcut resolutions of pollution problems.

This was the legacy of Shattuck, Walcott, Sedgwick and men like them. Their goal was to purify the natural environment that had been polluted by

human error, and concomitantly to wash corruption out of the soul of man and cleanse his institutions. Their concern about the existence of water pollution was just one aspect of a total system of thought aimed at restoring order to Massachusetts and even the world. Mary Douglas, the British anthropologist, notes this same urge amongst non-literate peoples and compares it to "civilized" attempts to attain a state of purity.[121] In her view the search for purity is a process of rejection that produces a categorical system of order and stability. Thus dirt is cast out and spiritual unity is restored. In a corollary sense real or imagined danger is averted by ritualistic attention to purity. The commonwealth of Massachusetts in the late nineteenth century confronted numerous destabilizing conditions in the middle phase of industrialization and, the late phase of immigration. The brahminic element of society, so well represented by the sanitary reformers, sought to recreate the order that had once existed in both nature and society. In this sense law and science as they effected the issue of water pollution offered the opportunity for producing change in an efficacious, ritualistic fashion. What the Board of Health did with reference to pollution worked, disease was reduced, water was purified and in the process a sense of order and control was restored.

Chapter 4

The Futile Quest for National Regulation

The work of the Massachusetts Board of Health with its burgeoning scientific and advisory apparatus represented the epitome of water pollution consciousness and control in nineteenth century America. Other states in the Northeast and Middle West such as, New York, Michigan and Wisconsin possessed the same sense of urgency connected with the problems of pollution.[122] However, this was not an all pervasive attitude. Throughout the nineteenth century public health hazards such as water pollution were largely seen as local problems without any impact on the nation as a whole. The Sedgwicks, Walcotts and Warings were the exception rather than the rule: men who had been able to influence the course of affairs in their own states but without any great national following. Professional and learned societies such as the American Medical Association and the American Social Science Association frequently called for a national apparatus to deal with public health problems but they had little effect on policy making in Washington.

There was an ineffective stab at the formation of a national public health service in the late 1870s with the enactment of a law creating the National Board of Health (March 1879).[123] This came about largely as the result of an enormously destructive epidemic of yellow fever which swept through the Mississippi Valley in 1878. Struck by the terrible power of the epidemic, Congress enacted a bill that had been sponsored by the American Public Health Association, thus giving birth to a national agency for cordinating the fight against epidemic disease. The National Board was almost immediately thrust into a storm of political controversy. In constructing the act Congress had ingenuously removed quarantine powers already possessed by the Director of the Marine Hospital Service which up to that

time had provided the backbone of any federal response to the incidence of epidemic disease through its various coastal and inland hospitals. The Director of the service, James Hamilton, bridled at this assault on his power and agitated in congress for the abolition of the Health Board. The embryonic Health Board also confronted the nettlesome problem of states' rights. In 1880 the board enthusiastically went out to do battle against an epidemic in New Orleans, and, in the process, antagonized both local and state authority in Louisiana. Both of these encroachments upon traditional bastions of authority proved to be the undoing of the Board. The act establishing the Board had to be renewed by Congress every four years; thus in 1883 the quarantine powers were removed by Congress and returned to the Marine Hospital Service. The Board was defunded as well, which effectively ended its existence and allowed it to be gradually absorbed by other governmental departments.[124]

The short life of the Board demonstrated the weak position of advocates of sanitary reform in the arena of national politics. Nonetheless, there was continual agitation for a national public health service with collateral water regulation powers throughout the rest of the century. Henry Walcott was in the thick of this battle. In the years 1893 to 1894 Walcott corresponded with several State Health Board directors throughout the nation. The correspondence reveals the undaunted hopefulness of these men as well as the extensive nature of their organizational effort. Dr. Irving Watson, secretary of the American Public Health Association, evidenced this in his instructions to Walcott prior to an 1893 meeting of a committee of the American Medical Association of Chicago: "We now have strong allies in the medical profession, as evidenced in the action of the American Medical Association, the Pan-American Medical Congress, and in other medical societies, and it is possible

that we may think best to make more specific recommendations than were embodied in our last report."[125] Dr. U. O. B. Wingate, Commissioner of Health for the City of Milwaukee was even more optimistic in his preparations for the same meeting declaring that "no power existing in this country will dare to stand up against a solid front in our profession. If we can maintain such a position we can accomplish what we desire, if not it is our own fault".[126] But this optimism was apparently premature because this particular initiative did not result in any substantive change in national public health laws. The basic weakness in their position resulted from the almost exclusively professional nature of their constituency. However, this represented a vanguard of professionally based reform that swept the nation in the early twentieth century eventually giving birth to a strong public health service in 1912.[127]

The control of water pollution was a primary concern of the professional sanitarians and physicians who strongly supported a governmental agency with power to maintain and regulate water purity. In June of 1892, Dr. Benjamin Lee chaired a session on State Medicine at the Detroit meeting of the A.M.A. the subject of which was "responsibility of the national and state governments for the protection of the purity of the water supplies."[128] In preparing for the meeting Dr. Lee concocted a questionnaire addressed to the secretaries of state health boards. The first question, "Has your State(sic) any laws prohibiting the pollution of streams of inland waters?" received an affirmative response from thirteen states, among them Massachusetts. The most interesting replies came in response to questions 6 and 7. Question 6 was an inquiry into the attitude of the State towards the use of streams as "sewers" for the free discharge of any waste material. The secretaries of six health boards "doubted the feasibility of possibility of preventing

pollution to a very considerable extent" and declared "in favor of permitting streams to be used freely and unrestrictedly as sewers." (note: those states were Alabama, Florida, Louisiana, Oklahoma Territory, Rhode Island and South Carolina.)[129] A second group of seven states held that each case should be decided on its merits. (note: Massachusetts was among these respondents and this fits well with the tenor of the cases in the annual report.) A third group of eleven states demanded complete purity of streams. (note: among these states were New York, Delaware, Missouri, and Maryland). But the most interesting responses came in answer to the seventh query. "Do you consider it expedient, in view of the fact that so many of our streams pass from one state (sic) into another to petition Congress for the passage of a law forbidding the pollution of streams throughout the entire country and establishing a "Rivers Conservancy Commission" for the purpose of enforcing such law?"[130] The secretaries of fourteen state health boards supported the foundation of a national commission for the purpose of regulating the purity of waterways. Dr. C. W. Chancelor of the State Board of Health of Maryland was particularly vehement in his response, asserting:

> "I am decidedly in favor of a "Rivers Conservancy Commission" with strong laws to prevent pollution of any waterway. The general government will be forced at an early period to enact a law to protect the water supply of Washington-City, which is already greatly polluted by the States of West Virginia, Virginia and Maryland. Congress alone can remedy the evil."[131]

The overwhelming weight of the responses was skewed in favor of the establishment of national control of some sort. Naturally, those states most acutely afflicted by pollution were the most interested in the creation of a national agency to regulate it.

An anomaly in the response to question seven was the disinterest in national regulation expressed in the reply of Massachusetts. However, an

explanation may lie in the fact that Massachusetts was relatively untroubled by polluted waters from other states flowing into its major population centers. Moreover, as demonstrated in the last chapter the health board of Massachusetts had established exceptional instruments for control of pollution within the state. Furthermore, as the preceding correspondence indicates, there is strong reason to believe that Walcott had altered his opinion by 1893.

In any event Lee's conclusion after presenting the complication of opinion in response to his questionnaire was a stentorian argument for national regulation of water pollution. Lee insisted that "local jealousies," "inherited prejudices" and "the bogy of centralized power" be set aside in order to provide security and safety to thousands of Americans.[132] Although both the AMA and the American Public Health Association made strong efforts to promote national regulation of water pollution little was done in response to these protestations. The only national water pollution act of any importance was the Rivers and Harbors Act of 1899. The basic intent of this act was to prevent the sedimentation of shipping channels through the discharge of foreign material from shore or ship except for liquid sewage. In order to dump anything into harbours and navigable water ways, a permit had to be secured from the Army Corps of Engineers. The act was strongly worded, calling for "United States Attorneys to vigorously presecute all offenders against the same whenever requested to do so by the secretary of the Army or by any of the official hereinafter designated..... And provided further that whenever any arrest is made under such sections, the person so arrested shall be brought forthwith before a commissioner, judge or court of the United States for examination of the offenses alleged against him; and such commissioner, judge or court shall proceed in respect thereto as authorized by law in case of crimes against the United States."[133] Although the language was

harsh, the act was seldom invoked until 1970 when Senator Gaylord Nelson used it as a means of securing more stringent legal action against pollutors than was available in the Water Quality Improvement Act (1970).[134]

The attempts to establish national juridiction over water pollution foundered as a result of many of the same conflicts that mitigated against the institution of consistent legal principles. Just as the application of the common law in court cases revolved around the contest between individual rights defined on the one hand by the principles of agrarian democracy (or nostalgia) and on the other by the drive to foster urban and economic growth, so the efforts to nationalize pollution regulations were frustrated by conflicts between states' rights and federal power and internecine fights between various government agencies. These struggles reflected a similar conflict — an ambivalence which was really never overcome on the level of national politics or within the precincts of the law, the legal community or legal culture. Only the scientist reformers of the local boards of health made an approach to a resolution of the problem and this extended only to pollutants such as urban waste, (sewage) and other sources of bacterial contamination.

The problem of industrial pollution was not effectively addressed by any of these groups. Conflicts involving industrial pollution appeared most often in courts of law as nuisance cases. As I have shown, these cases were subject to a wide variety of interpretations based on the will of the judge. Upon those occasions when industrial pollution cases were investigated by local health boards there was a tendency to leave their solution to the good will of the company involved. Another strategy employed by the health boards was to ask the victim of pollution to build filters which would alleviate the problem but result in no expense to the pollutor.[135] However, this was not always

possible as Ernest Phelps, a chemist who taught chemical biology at M.I.T. (1908-13) and directed the Division of Chemistry, Hygienic laboratory of the United States Department of Public Health (1913-1919), made clear in the Ravenal jubilee fest shrift for the American Public Health Association, A Half Century of Public Health.[136] Phelps pointed to the fact that the first incisive and authoritative scientific studies of industrial pollution weren't conducted until 1905 when work was initiated at the Sanitary Research laboratory of the Massachusetts Institute of Technology. In view of this lack of hard knowledge those sanitarians campaigning against industrial waste could only intimate the danger of situation as compared to the much more definitive nature of the information concerning pollution derived from sewage or bacterial pollution; in view of this ignorance they were unable to provide the necessary engineering solutions to the problem.

The form of pollution which had received greatest attention prior to the turn of the century was bacterial. In 1900 this seemed to be an incontestable area of scientific certainty. Bacteriological studies had established the etiology of epidemic, waterbourne diseases such as cholera and typhoid. The technology of water purification had demonstrated its efficacy in disease control in numerous instances in Britain, Europe and America. It was this successful process that most sanitary experts utilized as a defense of their pleas for a nationalization of water pollution regulation.

Although this doctrine was accepted as incontrovertible dogma by scientists, lawyers and judges were less assured of the certainty of the legal or prescriptive efficacy of scientific theory. This was demonstrated dramatically in a case which occupied the attention of the United States Supreme Court from 1900 until an opinion was handed down in the fall term of 1906. In the State of Missouri vs. the State of Illinois and the Chicago

Sanitary District the issue of water pollution on the interstate level was considered in extravagant detail in testimony collected in the summer of 1900 in Saint Louis, Missouri and at various locations along the Illinois river in the summer of 1903.[137] M. O. Leighton who digested the testimony for the United States Geological Survey haled the testimony taken in the case as the "best symposium on river pollution, its biological and chemical aspects, and its general and special sanitary significance that has ever been assembled."[138] The testimony presented by the panel of various experts marshalled by both the plaintiff and the defendent filled 8000 printed pages. Special experiments were devised and executed to prove or disprove the charges and countercharges that cascaded through the volumes of print: pages that are permeated with the ambiance of steamy courtrooms in river towns in the humid cauldron of mid-summer. Despite all of this, the expert testimony, the charts, the tables, the meticulous experiments conducted according to the best scientific standards of the day, the verdict that concluded the days and months and years of debate and cross examination was quite as ambiguous as almost any of the common law water pollution cases tried in the late nineteenth century. The High Court seemed untouched by the scientific revolution that had unfolded in the period immediately preceding the case and, indeed, was obviously perplexed by the apparent inability of men of science to close ranks and render a seamless verdict on the nature of microorganisms and rivers. In this respect they failed to perceive the inquisitorial nature of science, seeking, instead, concrete answers from men who were trained to entertain all possibilities: men who trusted the logic of experiment rather than the precedents established by tradition or custom. Scientists, unlike lawyers, probed the natural world lying outside of the practices that bound human communities together. Often this led to the formulation of ideas that shattered preconceived notions of

how things worked. The law, on the other hand sought the means to resolve conflict within the realm of societal order. While scientists attempted to discern the order of nature, lawyers directed their attention to maintaining social harmony. As a result the law and science were on a collision course in the Chicago case.

An epidemic of catastrophic proportion set off the chain of events that led to the trial. From its inception, the lakefront, swampy city of Chicago had been no stranger to the miasmic fevers of malaria, typhoid and cholera. However, the typhoid epidemic of 1885 was devastating even by Chicago standards. Over 12% of the population succumbed to the toxin of the water-bourne bacillus, one out of every eight people. Flood waters that year exceeded anything the city had previously experienced and the receding waters concentrated all the sewage and filth that had been heretofore untouched by water, thus providing the necessary innoculant for a massive culture of the virulent bacteria.[139] The epidemic spurred the civic fathers to establish a Drainage and Water Supply Commission in 1886. In 1887 the commission published a report which recommended that Lake Michigan, the primary source of drinking water for the city, be protected from invasion by the flood prone Des Plaines and Chicago Rivers. After considering a number of alternative plans the commission recommended the creation of a new channel that would drain southward out of Lake Michigan into the Des Plaines at a point far removed from the city and thelake. Chicago's raw sewage would be drained into the canal or "Big Ditch" as it was affectionately ordained; from there the dilute sewage would be carried into the Des Plaines thence into the Illinois River. The Illinois River traversed the state which bore its name, losing its identity as it joined the Mississippi at Grafton, a small town situated a few miles north of the confluence of the Missouri and the Mississippi. The city of Saint Louis

was only a few miles downriver below a site known as the Chain of Rocks.[140]

The commission made no serious effort to study the possible deleterious effect this massive drain would have on points downstream. Nonetheless, the plan was adopted with enthusiam by the people of Chicago who voted overwhelmingly to create the Sanitary District of Chicago, thus implicitly supporting the concept of the drainage canal. Construction started in 1892 with great ceremony. The 28 mile length of the canal was carved out of earth and rock requiring the invention of several new pieces of equipment which later provided templates for the technology that excavated a ditch through faraway Panama. The Sanitary District encountered legal difficulty from the very beginning with the Secretary of War who was responsible for navigability of rivers and harbor conditions, however, these problems were ameliorated long enough for the necessary permits to be obtained. The main concern of the government of the United States in its military capacity was the problem created by the alteration of flow in the rivers affected by the project; little or no concern existed with reference to possible pollution of downriver sites.[141]

With the completion of construction in 1899 a second legal complication arose. Several cities downstream, among them Joliet, Peoria and Saint Louis voiced objections to the canal in late 1898. The Health Board of Illinois laid the pleas of Joliet and Peoria to rest. However, the city of Saint Louis was not so easily calmed. The Sanitary District, cognizant of the threat by Saint Louis to seek injunction, quietly opened the channel on January 2, 1900. The deed was done and Saint Louis rather tardily petitioned the high court of United States two weeks later, thus initiating a legal battle that simmered for nearly six years.[142]

The decision to hear the case produced excitement in the ranks of those who had been touting national regulation of rivers and streams. Charles Claflin Allen, an attorney from Saint Louis and an advocate of the city's

cause coupled cause of national regulation with an old common law principle in his lengthy evaluation of the case appearing in the American Law Review, "National Control of the Pollution of Public Waterways":

> ....The case is interesting because it applies to a cause of action between two sovereign states the well-defined principle of law that a reparian owner is entitled to have the water of a river come to him in a pure state and that any material impairment of the purity of the water can be the subject of injunction against one who pollutes it. Second, the case opens the door to recognition of the principle that the national government has jurisdiction of the great interstate rivers in respect of the quality of the water for drinking purposes, and the right to prevent the pollution of that water, as well as the uses for navigation or other commercial purposes.[143]

The remainder of the article is devoted to the discussion and the citation of various cases that established the federal government's right to intervene in the affairs of the several states, beginning in Claflin's view with Marshall's opinion in Gibbons vs. Odgen (1824).[144] The most critical aspect of Claflin's argument, however, was his use of the common law doctrine of natural flow as means of justifying the expansion of national power to meet the needs of those afflicted by pollution. The record of the use of this particular defense was long and convoluted even at the time that Claflin suggested it (see Chapter III), but he had introduced a novel twist, developing it in conjunction with a plea for national control of pollution. Nevertheless the outcome of the case of the Chicago drainage canal would demonstrate once again the remarkable plasticity of the common law as used by different people on different sides of a case.

Perhaps the most interesting and certainly the most voluminous part of the case is found in the testimony of the experts. It was, indeed, a symposium on water pollution with both the complainant, Saint Louis, and the defendant, Chicago, producing a stable of prestigious experts to confront the issue at hand.

The scientists summoned by the city of Saint Louis gave the first testimony in the case. William T. Sedgwick of M.I.T. and the Lawrence Experiment Station provided the backbone of the complainant's case. His testimony was supplemented by that of several colleagues and former students from the Lawrence Experiment Station and a number of leading physicians and sanitarians from the Saint Louis area. Sedgwick constructed his approach to problem on the basis of the testimony of Amand Ravold, professor of bacteriology at Washington University. The substance of Dr. Ravold's statement was that Saint Louis had experienced an increase in the incidence of typhoid fever in the three years subsequent to the evacuation of Chicago's sewage into the Illinois River. This was compared to the frequency of cases three years prior to that event with the finding that there was a doubling in the number of cases overall: 1807 cases in the years 1897 through 1899 as compared to 3,426 cases in the years 1900 through 1902. Moreover Ravold pointed out that the number of cases in the years 1890 to 1897 had declined as a result of the use of a new source of water — the Mississippi river below the Chain of Rocks, a point a few miles downriver from the confluence of the Illinois and the Mississippi. Furthermore, Ravold stated that a reliance on the data indicating incidence of cases was not entirely sound because physicians often neglected to report cases that did not end in death. As a result of the failure to report these situations there were always a large number of cases that escaped the attention of the local statisticians. Previous investigations showed that the usual death rate during an epidemic of typhoid was ten percent of those infected by the disease. Ravold used this percentage to extrapolate the actual number of cases in Saint Louis in the three-year period prior to and following the year 1900. Using this rule indicated that the difference between the triad of years prior to the canal's use and the triad of years following this was 3200 cases to 8880 cases. The utilization of this mode of

of interpreting the data enhanced the rather grim picture of the increase of typhoid in Saint Louis in the years following the release of Chicago's sewage into the Illinois River.[145]

With Ravold's testimony in mind W. T. Sedgwick discussed the relationship of the occurence of typhoid to river pollution with particular attention to the epidemic at Lowell he had surveyed in the late 80s. Sedgwick asserted that the Lowell outbreak of typhoid resulted from a very small amount of water from Stony Creek contaminating a large body of water, the Merramac River. Using this example and others Sedgwick pointed to the fact that dilution of the bacteria in a large volume of water would not significantly reduce its lethality or viability.[146] In support of this he cited Ravold's experiments with the organism, Bacillus prodigious. This non-pathogenic bacillus was only rarely found in American waters. It was first discovered by the German bacteriologist Paul Ehrenberg in a rather odd connection:

> The name was derived from the fact that in European countries the host in the Chalice of Catholic churches has a red growth upon it which in early times was declared to be the blood of Christ. The red growth was investigated and found to be in one case a micro-organism which produces within its cell a red pigment. This is the legend connected with the name, and it was called therefore, B_1 prodigious.[147]

The other important distinguishing characteristic of B. prodigious was its similarity in life cycle to the bacterial agent responsible for typhoid, B. typhosus.

On November 6, 1900 Ravold succeeded in dumping 103, forty gallon barrels of broth containing approximately 1,000,000,000 B. prodigious per cubic centimeter into the Illinois river just below the point where the Drainage Channel entered the river. This was done under the cover of darkness in order to avoid any confrontation with the local authorities. The bacillus was first discovered at 8:45 a.m., December 4 at the Chain or Rocks, and, thereafter the

frequency of findings increased at various places above St. Louis and from within the city, the final sample being collected on December 7. In the first instance this established the viability of B. prodigious in rather "unfavorable conditions." In the second instance it demonstrated the probable speed with which the typhoid bacterium was borne downriver, depending, of course, upon river conditions. Other experiments conducted in Ravold's laboratory confirmed a viability of from fifteen to thirty days for the bacterium known as B. typhosus.

Sedgwick alluded to these experiments in his insistence on the fact that under most circumstances rivers are incapable of purifying themselves from any foreign discharge into them. He referred to the Rivers Pollution Commission (1874) of Great Britain in support of this, stating that this had become an axiom of sanitary science. At the conclusion of his testimony Sedgwick delivered his solemn evaluation of the effect of the Chicago Drainage Canal upon the city of Saint Louis:

> After having carefully considered the question and the assumptions which it contains, and in view of my studies of the typhoid fever statistics of the city of Saint Louis to which I referred in my testimony of yesterday, I believe that beyond all reasonable doubt the principal factor of the annual increase of Typhoid fever mortality of the city of Saint Louis since January 1, 1900, has been due to the pollution of the water supply of the city of Saint Louis by the unpurified sewage of the Sanitary District of Chicago.[148]

Other testimony for the complainant echoed Sedgwick's authoritative statement. Former students and colleagues from M.I.T. and the Lawrence Station provided further evidence of the correlation between the unpurified sewage of Chicago flowing downstream and the eruption of typhoid fever in Saint Louis and environs. George Whipple, a graduate at M.I.T. (1889) and Director of the Mount Prospect Laboratory of Department of Water Supply, Gas, and Electricity of New York City, indicated that he had discovered a diatom

peculiar to Lake Michigan in the water below the Chain of Rocks in October and November of 1901. Under questioning from the complainants attorney, Whipple described his discovery:

> *Q.* Are you able or not to say from your examinations and your knowledge upon this subject whether any particular species of these diatoms or micro-organisms came from Lake Michigan or not?
>
> *A.* There were certain diatoms found during my examination which appeared to be characteristic of Lake Michigan and Lake Michigan alone—I would like to change that—Lake Michigan and nowhere else excepting the streams below to which the water from Lake Michigan has access.
>
> *Q.* Can you say whether or not any of the micro-organisms which were peculiar to Lake Michigan were found in the Mississippi River at the intake? And, if so, state which ones they were and how they got there.
>
> *A.* There was an organism which I will describe as *Synedra pulchella* variety *subprolongata* which was found at the intake of the waterworks at the Chain of Rocks, and which was found also in the water of Lake Michigan, but which was not found in the water of the Missouri River or the water of the upper Mississippi River, or in any of the tributaries of the Illinois River unless we consider the Chicago Drainage Canal as being a tributary. (1924).[149]

This coupled with Ravold's experiments with B. prodigiosus provided fairly conclusive evidence that the flow from the drainage canal was altering the biotic life of the downstream flow.

The defendant's team of witnesses was composed of several leading sanitary experts intermixed with some rather unusual sources of testimony. Three of the twenty-five witnesses appearing on Chicago's behalf were managers of distilleries on the Illinois River. Their presence on the stand was largely a result of Chicago's effort to show that Saint Louis was the victim of pollution from several large feedlots along the Illinois River. Each distiller testified to the fact that all these establishments taken together fed distillery waste to approximately 40,000 to 50,000 head of cattle between the years 1895 - 1901. This resulted in a huge tonnage of cattle manure, most of which was dumped into the river.[150] Thus Saint Louis had already been subject to pollution from these sources prior to the opening of the drainage

canal. However, the problem with this evidence was that the typhoid organism was not usually found in the intestinal tracts of organisms other than man, therefore it was unlikely that the feedlot pollution would have occasioned the outbreak of typhoid in the years 1900 - 1901. The point of the testimony was that pollution was pollution and not subject to the fine distinctions drawn by Sedgwick, Ravold and Whipple.

The Chicago team then drew up its heavy artillery in the person of E. O. Jordan. An 1888 Graduate of M.I.T. and a coworker of Sedgwick's at the Lawrence Experiment Station, Jordan went on to teach Public Hygiene at the University of Chicago in 1892. Jordan's testimony was directed toward proving that rivers were self-purifying systems. In the first part of his statement he demonstrated through data from several experiments that, in his opinion, the illinois River was capable of purifying itself of a bacterium commonly found in the human intestinal tract and also in sewage, Bacillus coli communis (now known as Escherichia coli).[151] Thus other bacteria associated with sewage were very likely eliminated in the same way. Moreover Jordan questioned the meaning of the results of Ravold's experiments with B. prodigiosus, indicating that the few samples discovered at the Chain of Rocks were a "relatively insignificant number" demonstrating that the bacillus did not survive for any extensive time in the hostile environment of the River.[152] This also provided further proof of the tendency on the part of rivers to purify themselves.

The coup de theatre of his testimony was the narration of an elaborate series of experiments conducted by Jordan along with Professors Zeit of Northwestern Medical School and Russell of the University of Wisconsin in 1903. The contention of Sedgwick and several other witnesses for the Plaintiff was that B. typhosus survived the long trip from Chicago to Saint Louis in enough numbers to form an innoculant for the spread of typhoid fever through the

human population of Saint Louis. Jordan and his colleagues set out to establish the precise lifespan of B. typhosus, hoping in the process to cast doubt on Sedgwick's assumptions.[153]

The design of the experiment was, indeed, quite elegant. Parchment bags, impermeable to all but water, were placed in the Illinois River at various points between Chicago and Saint Louis. Each of these bags was inoculated with various concentrations of live cultures of B. typhosus. The resultant data demonstrated that the upper limit of viability for the typhoid bacillus was four days. The few remaining bacilli were in an extremely weakened condition and, therefore, subject to further assault from other bacterial toxins present in most rivers with large concentrations of sewage. These data provided further substance for Jardan's contention that the few B. typhosus that survived the long trip downstream were rendered incapable of producing harm.[156]

Jordan also leveled a blow at the statistical methods employed by Ravold and Sedgwick to show the increased incidence of typhoid after 1900. He cautioned against gullibility in the acceptance of statistical interpretations, noting that there were many pitfalls associated with the analsysis of data. In Jordan's view, Ravold's analysis of the data did not take into account varible arising from "age, sex or distribution of social characteristics." Here Jordan was referring to the existence of the large immigrant community in Saint Louis which he saw as a breeding colony for all kinds of disease.[157] In addition Jordan addressed other aspects of Sedgwick's testimony which he considered erroneous. Perhaps the most illustrative segment of the point by point rebuttal he delivered was a correction of Sedgwick's quotation from the British Rivers Commission Report of 1878. Sedgwick had stated that any river was seen by the commission as being incapable of regeneration while Jordan,

reading from the report, pointed to the exact wording which was "there is no river in Great Britain long enough to purify itself from any sewage admitted to it, even at its source". In later rebuttal testimony Sedgwick dismissed Jordan's objection, saying that the popular extrapolation of the statement had been long accepted as a doctrine of sanitary science.[158]

And so the battle raged in quiet, gentlemanly debate. Numerous other witnesses appeared presenting experiments and counter experiments, statistical analysis and counter analysis. In large measure all of it echoed the few examples of testimony presented above. The key issue was whether or not Saint Louis had been subjected to a microepidemic as result of the Chicago Draniage Canal. The State of Missouri acting for Saint Louis presented evidence that the rate of typhoid increased in the critical years 1901-1902. Moreover, this case was buttressed by the contention that the bacillus responsible for typhiod survived the long trip downriver in a relatively virulent condition. Illinois produced evidence to counter these claims, asserting that the water arrived at Saint Louis in a more pure form resulting from its dilution by the relatively unpolluted lake water which ameliorated the usual turgid appearance of the Mississippi as it flowed through the Chain of Rocks region. The case was reinforced through experiments that called into question the survivability of typhoid bacillus and, furthermore, through a series of witnesses who criticized the statistical validity of Sedgwick and Ravold's work.[159]

E. O. Jordan, the lead witness for Illinois and a former student of Sedgwick's who, indeed, worked with Sedgwick on the Lowell typhoid study, questioned his former mentor's assertions in some detail. What motivated this apparent schism within the ranks of those concerned with sanitary science? One can only speculate, but there is some corollory evidence that may throw some light on this problem. Thomas Kuhn in his trenchant study, The Structure of Scientific Revolutions, suggests that when anomalies emerge in the course

of scientific research a shift gradually unfolds that provides the basis for a transformation from one paradigm or overarching model to another. This sometimes appears at the juncture of generations.[160] Was this a factor in the Sedgwick/Jordan dispute? It is doubtful because the questioning of Sedgwick's view did not undermine the basic structure of the sanitarian model. It was not a major concern of sanitary science in this period, although it was later demonstrated that a high density of pollution simply would not allow a river to regenerate itself as it would under natural conditions. In any event, the rift itself was not a long lasting one as Jordan later served as principal author of a festshrift honoring Sedgwick's scientific work. What, then, brought about the difference of opinion. Although it may seem cynical, one is struck by the institutional connections of experts arrayed on either side of the case. Most on the Missouri side were from institutions in Saint Louis or they were associated with M.I.T. On the Illinois side, well over half of the experts were from institutions in or near Chicago. Jordan, himself, had taught at the University of Chicago for nearly eight years when the case opened, long enough to set down roots in the community. Thus the theoretical differences may not be a product of scientific dispute; in fact, it is most probable that regional ties played a large role in determining the testimony of at least some of the expert witnesses.[161] In the same sense Sedgwick's testimony may be viewed as a not entirely impartial consideration of the merits of the case. His long affiliation with the emergent science of human hygiene had obviously engendered a zealous approach to the cause and prevented him from evaluating the substance of the defendent's testimony in a scientific manner. Moreover, the advocacy process, itself, may have intensified a conflict that would have been resolved much differently within the context of scientific debate.

Under the circumstances, the case presented by the scientists at the hearings was not clearcut; instead of consensus the experts on each side attempted to highlight the inconsistencies in the testimony of the other. The fervid, almost religious belief in the efficacy of sanitary science illuminated by the inspection of the movement as manifested in Massachusetts was apparent in the words of Sedgwick and of his students who testified for the complainant. However, this was mitigated by other currents of disputation influenced by disagreements concerning experimental design and regional ties.

The decision of the court was handed down in the October term of 1906. It was a precise and lucid document authored by Oliver Wendell Holmes. In the first part of the decision Holmes discussed the jurisdictional aspects of the case, justifying the court's intervention in the dispute. He noted that the case was of landmark proportion as it would decide the fate of river pollution cases for the next several years.[162] Holmes pointed out that the situation was comparable to an international conflict that could result in war between two nations—in the same sense the states of Missouri and Illinois were at the bar embroiled in a conflict over the future of a "great river". But, in his view, it was not comparable to a simple nuisance case between individuals that could be handled through municipal law. Holmes cautioned that the court's decision should not be taken to open the possibility for the court's interference in every action of a similar nature involving individuals instead of states, these were better left to settled matters of municipal law.[163]

In considering the evidence—"the ingenious experiments" and "subtle speculations" of "modern science"—Holmes first indicated that fifty years prior to the hearing the complainant's case would have been insupportable:

> There is no pretense that there is a nuisance of the simple kind that was known to the older common law. There is nothing which can be detected by the unassisted senses—no visible increase in filth, no new smell.... The plaintiff's case depends upon an inference of the unseen.[164]

Holmes noted that the complainant's case depended upon two "inferences": first, that the incidence of typhoid fever had increased markedly since the opening of the drainage channel, and second, that the typhoid bacillus survived the trip from Chicago and arrived at Saint Louis in a viable condition. But in his view reasonable doubt had been introduced in connection with both of these contentions. Setting forth in condensed form the evidence from both sides, Holmes demonstrated a sophisticated understanding of the process of scientific endeavour. He observed that the experiments and reasoning on both sides were striking, but inconclusive in that the weight of evidence did not seem to support either view in an overwhelming fashion. In his opinion only the future would hold firm answers to questions raised in the hearing of the case. However, in a practical sense he viewed the complainant's case as weak in certain areas. Most important, in view of the fact that Saint Louis already filtered some water coming from the Missouri river, Holmes held that it should be able to do the same for the water coming to it from the Illinois; "What will protect against one will protect against another." In light of this, then, the court decided to dismiss the bill without prejudice.[165]

Because of the inconsistency of the scientific testimony, the court utilized more pragmatic remedies arising from time tested principles of common law. Looking back on the case, George Fuller, a witness for the complainant, an M.I.T. graduate and consulting engineer observed, "as a contribution to sanitary science for the advancement of the art of sewage disposal, the return on the investment in this litigation was comparatively small."[166] In his view the court had ignored the important fact that the drainage canal was an artificial deviation of water into a natural water course. Thus Holmes' assertion in regard to the filtration of Missouri river water, implying that Saint Louis did not come to the case with clean hands, was not grounded in

scientific fact but was, instead a legal consideration that did not have recourse to the importance of the expert testimony.

Holmes, however, was looking for predictability in the law and in science. Moral considerations such as those advocated by many sanitarians were foreign to his interpretation of the function of law. His idealism was expressed in an address before the New York State Bar Association in 1889 when he asserted that the law must depend upon science as the ultimate arbiter of the worth of social ends. However, this was mitigated by his requirement that the law should, above all, provide a strong measure of predictability to an amoral humanity. In this sense, the duty of law was not to evaluate the morality of a situation but, rather, to provide "public force" against those actions that were agreed to be inamicable to the welfare of individuals or the commonwealth: "The prophecies of what courts will do in fact, and nothing more pretentious, are what I mean by the law."[167] The inconsistant testimony of the scientists assembled at Saint Louis and various other places along the illinois river did not provide this margin of predictability in regard to the focus of their profession—water pollution, its origin, effect and control.

Conclusions

What conclusions can be drawn from this examination of various currents of water pollution law in the late nineteenth and early twentieth centuries? Knowledge concerning the engineering problems related to bacterial pollution control, water purification and filtration was firmly established by the turn of the century. The theoretical paradigms of sanitary science were still undergoing change, but not to the extent that radical alterations in the direction of its imperatives was necessary. There was only a rudimentary knowledge of the effects of industrial pollutants, but reseach in this area

was implemented by M.I.T., state health boards, and the federal government in the early twentieth century. Nonetheless, sanitary science could point to many victories in its short existence and as more water filtration and purification systems were constructed the rate of water-bourne epidemic disease declined precipitously. The death rate of typhiod fever alone declined from 31 in a thousand in 1900 to 1 in a thousand in 1940.[168] This would not have happened without the introduction of filtration systems for sewage or the theoretical postulates that provided the foundation for that knowledge.

Therefore it is understandable that the people and institutions responsible for the results of this phenomenon would adopt an almost evangelistic approach to spreading the word. W. T. Sedgwick, and to a lesser extent Henry Walcott, pursued the aim of pure water, of health reform, with an intensity usually only witnessed in religious revival or political revolution. In teaching public hygiene Sedgwick often declared. "The Kingdom of God is within you; and the Kingdom of health is within you."[169] This typified the approach of the public health movement as well and defined its enormous zeal in the pursuit of its goals.

However, this movement did not exist in a vacuum; other forces impinged upon the effort to purify the rivers of the land. The most prominent of these was the legal community. Throughout most of the nineteenth century judges, lawyers, and juries determined the disposal of nuisance cases involving water pollution. These decisions were founded on ancient common law principles harkening back to a more agrarian society or, on the other hand, the application of the doctrine of reasonable use which stemmed from an opinion rendered by Judge Joseph Story in an early nineteenth century water dispute. These cases were not decided in any sort of consistent fashion,

relying, for the most part, on the proclivities of the presiding judge. This resulted in a body of water case law riddled with inconsistency, shifting from a nostalgic respect for an agricultural golden age which, perhaps, had never existed, to considerations of the economic distress caused by the abatement of pollution by mills and mines. Nonetheless, up to the late 1870s this provided the only basis in law for the hearing of these cases.

With the introduction of more sophisticated information concerning water filtration and improvements in the understanding of the theoretical underpinnings of water pollution, the means to resolve certain types of water pollution problems became available in America in the late 1870s and early 1880s. Case law did not provide any basis for abating pollution or implementing the technical infrastructure for the prevention of water pollution. The state of Massachusetts offered the means to do this with the enactment of laws which set up health boards empowered to enforce river pollution laws. In like manner administrative bureaus for the execution of water pollution advisories emerged in many states during the later half of the nineteenth century. But even these institutions had severe limitations. Although they set up research stations and offered advise to those individuals, towns, and cities suffering from pollution there was no effective means at their disposal to enforce any ruling which was disputed by a pollutor. These cases were given to the state's attorney general for enforcement through the court system. Thus even state water pollution law was attenuated in its effect by the antiquated notions of a legal system that was not in tune with the problems of the age.

If the state boards were unable to ameliorate all or most of the problems presented by river pollution, the situation on a national level was even more abysmal. The movement to institute national laws governing river

pollution got underway in the 1880s. Sanitarians, physicians and other professionals banded together to pressure Congress into enacting such legislation, but it was to no avail. The only national arena where the advocates of pollution control were able to get a hearing was before the Supreme Court of United States in the years 1900 to 1906.

In the State of Missouri vs. the State Of Illinois and the Sanitary District of Chicago (1906) the experts on water pollution had their day in court.[170] Unfortunately their usual homogeniety of opinion was influenced by the regional divisiveness expressed in the case and the difference of theoretical viewpoint that prevails in any scientific discipline. In view of this, the Court was unwilling to hand down a verdict that deviated significantly from the water pollution cases of the past. As Justice Holmes averred "What the future may develop, of course, we cannot tell."[171] Scientific pronouncements were set aside because of the inconsistent nature of the experts testimony; in consequence the only source from which the law (and Mr. Justice Holmes) could draw its strength was its own tradition. Although aware of the important scientific dimensions of the case, Holmes saw no reason at that time to abate the discharge of raw sewage into the rivers and streams of the nation. Undoubtedly future scientific research would disclose new strategies for dealing with water pollution, but, in his view, the implementation of the technical fix of water filtration systems was a task best left to those affected by pollution until further unequivocal information became available.

It is clear that the record of the development of water pollution law in the nineteenth and early twentieth century showed a trend toward an improvement of the condition of rivers subject to the disequilibrium caused by the growth of an urban, industrial civilization. However, it is also a record of

national failure to come to terms with the problem in all of its dimensions. Throughout the last seven decades the responsibility of pollution control has rested largely on the shoulders of state health borads, municipalities and individuals. In last fifteen years, with the emergence of a coherent and well-orchestrated environmental movement national laws have been enacted with or eye to averting the damage to the natural and human communities that arises from an indiscriminate utilization of our riparian systems as waste dumps. However, the inadequate riparian pollution law, as described in this thesis, provided the only means of addressing this situation throughout most of this nation's history. It remains to be seen if the present awareness is a lasting one.

Endnotes

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Table of Cases

THE DEVELOPMENT OF WATER POLLUTION LAW IN LATE NINETEENTH-CENTURY AMERICA: 1870-1905

by

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B.A. Kansas Wesleyan University, 1980

AN ABSTRACT OF A MASTER'S THESIS

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ABSTRACT

Water quality became a major concern in northeastern America in the late nineteenth century. The growth of urban areas and the intensification of industrialization brought about the pollution of many rivers and streams. However, few legal avenues existed for those individuals or groups who suffered harm as a result of increased pollution. In many cases the only legal remedy available was couched in the language of an antiquated common law or caselaw system. Lawyers and Judges, moreover, were largely bound by this tradition and therefore unresponsive to issues of public health. The orthodox legal community, then, was almost completely bewildered in the face of this dilemma.

In reaction to this state and municipal laws governing water use underwent considerable change in the period of 1870-1905. This essay examines three aspects of the development of corpus of water law suitable for confronting the new problems of water pollution: the development of a technological infrastructure to remedy the problem through the invention of filtration systems and the detection of specific bacterial agents of disease, the paralysis of common law and caselaw that arose from two conflicting remedies for water pollution cases, and the application of bureaucratic or administrative law, specifically in the state of Massachusetts where state laws were formulated and executed by a state health board.