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Defining a Nuisance:

Pollution, Science, and Environmental Politics on Maine's Androscoggin River

Abstract

During the first half of the twentieth century, science, and chemistry in particular, played a key role in sanitary engineers' efforts to understand and control pollution in America's waterways. This study explores how people's views of science and the environment were reshaped during the transition from localized nuisance control to concerted environmental action, from the 1940s to the 1970s. Conflict occurred when environmental managers refused to follow in the public's footsteps by embracing the scientific discipline of ecology. This case focuses on chemist Walter Lawrance's efforts to control offensive odors on Maine's Androscoggin River, which were largely the result of several polluting pulp and paper mills along the river. While Lawrance and local residents disagreed over proper methods for pollution control, both parties frequently went beyond the boundaries of science through subjective odor observations or emotional appeals. These individuals and their ideas were influenced as much by the river itself as by the myriad scientific and political communities that they represented.

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Introduction

In 1941, along Maine's fetid Androscoggin River, houses freshly painted white turned to black as hydrogen sulfide rising from the water reacted with the paint, a direct result of pollution from upstream pulp and paper mills. Inside Leo Good's drugstore, the river odor was so strong that "people would order ice-cream and go away without eating it."[1]

These conditions prompted Maine residents along the Androscoggin River to demand that something be done. In 1942 an engineering report submitted to Frank Cowan, the attorney general of Maine, noted that "few streams in the United States of comparable size show evidences of such extreme pollution," most of which came from three major pulp and paper mills.[2] Cowan took action. The mills agreed to reduce their production levels during the low-flow summer months, to impound pollution in lagoons, and to assess conditions by sampling the river frequently. The smell appeared to diminish. Yet five years later, the *Bates Student*, the Bates College newspaper, reported that the Androscoggin River "went hog wild again in what seemed like an effort to gas everybody."[3] In 1947, by order of the Maine Supreme Court, Walter A. Lawrance, a Bates chemistry professor, was appointed rivermaster of the Androscoggin River, becoming the sole person in charge of managing the river.

Lawrance's detailed annual reports on the Androscoggin, starting with his work as a consultant in 1943 to his retirement in 1978, make it possible to trace changes not only in the river but also in the public's and Lawrance's own evolving ideas about pollution. His reports include detailed observations on the public response, odor, measurements of water quality, and newspaper clippings related to the Androscoggin and pollution throughout the nation. The broad scope of Lawrance's work affords an occasion to reexamine the shifting forces of science and politics in the mid-twentieth century. Terence Kehoe argues that sanitary engineers "shunned what they called 'the emotional approach' to pollution control and instead tried to chart a pragmatic course that would maintain consensus and make efficient use of economic resources."[4] Like these engineers, Lawrance often used science to ignore the pressing moral and political questions surrounding him. However, unlike other engineers across the country who worked together on state water pollution control boards, Lawrance was the sole person responsible for managing the Androscoggin River. Left alone to navigate the transition between nuisance control and concerted environmental regulation, Lawrance's case shows how his failure to keep up with the growing environmental consciousness from the 1940s to the 1970s ultimately contributed to the very nuisance that he was appointed to remedy. Even as Lawrance found himself stepping outside the boundaries of science, his narrow

focus on odor control reveals a broader conflict that occurred when many scientists and sanitary engineers refused to consider the public's embrace of ecology.

Before the Clean Water Act of 1972, American citizens concerned about water pollution had legal recourse through what were known as "nuisance cases." When individuals or communities were affected by a nuisance such as a neighboring noxious gas plant, they could sue the plant's owners to have the nuisance abated. As industrialization intensified throughout the nineteenth century and early twentieth century, the rate at which nuisance cases were brought to the courts increased. But courts were not always sympathetic toward plaintiffs, concerned that successful cases might slow economic growth. Moreover, as historian Martin Melosi argues, the piecemeal approach of nuisance law offered little regulatory protection against systematic degradation of the natural environment.[5]

By 1951 all but three states in America had created administrative agencies to control water pollution. While these agencies were given much discretion in cleaning their state's waters, most of their efforts focused on studying which polluted streams were worth protecting against the competing claims of industry and individuals impacted by the pollution. Thus citizens continued to rely on court action, often using the precedent of nuisance law to argue for enforcing pollution control.[6]

In 1941 the Maine legislature created its own administrative agency, the Sanitary Water Board, to study pollution in response to the public's demands for action. However, the Sanitary Water Board was given limited funding and no power to enforce pollution control. It was not until the Maine Supreme Court, using the precedent of nuisance law, appointed Lawrance as rivermaster in 1947 that an agency or state official had the power to control pollution. The court gave Lawrance specific powers to control pollution coming from the Androscoggin River's pulp and paper mills, but he also had a much broader mandate to stop the river from stinking. As Lawrance evolved to meet the demands of this complex problem, he discovered that public attitudes about pollution, along with the river itself, were also changing, making it impossible for him to find an objective measure of a clean river.

Reaction to an Odor Crisis

During the nineteenth and early twentieth century, industry dominated all three of Maine's major rivers: the Androscoggin, Kennebec, and Penobscot. Of Maine's primary waterways, the Androscoggin was the best suited for industry because it had a steeper gradient than the state's other major waterways, dropping an average of 8 feet per mile. By 1927 there were twenty-one dams along the

164 miles of the Androscoggin River, distributed from the New Hampshire headwaters to the Merrymeeting Bay in midcoast Maine.

As the number of dams multiplied, they reduced the Androscoggin's ability to process an increasing amount of organic matter and lowered dissolved oxygen levels. When water in the Androscoggin passed over its many falls, it absorbed atmospheric oxygen and raised dissolved

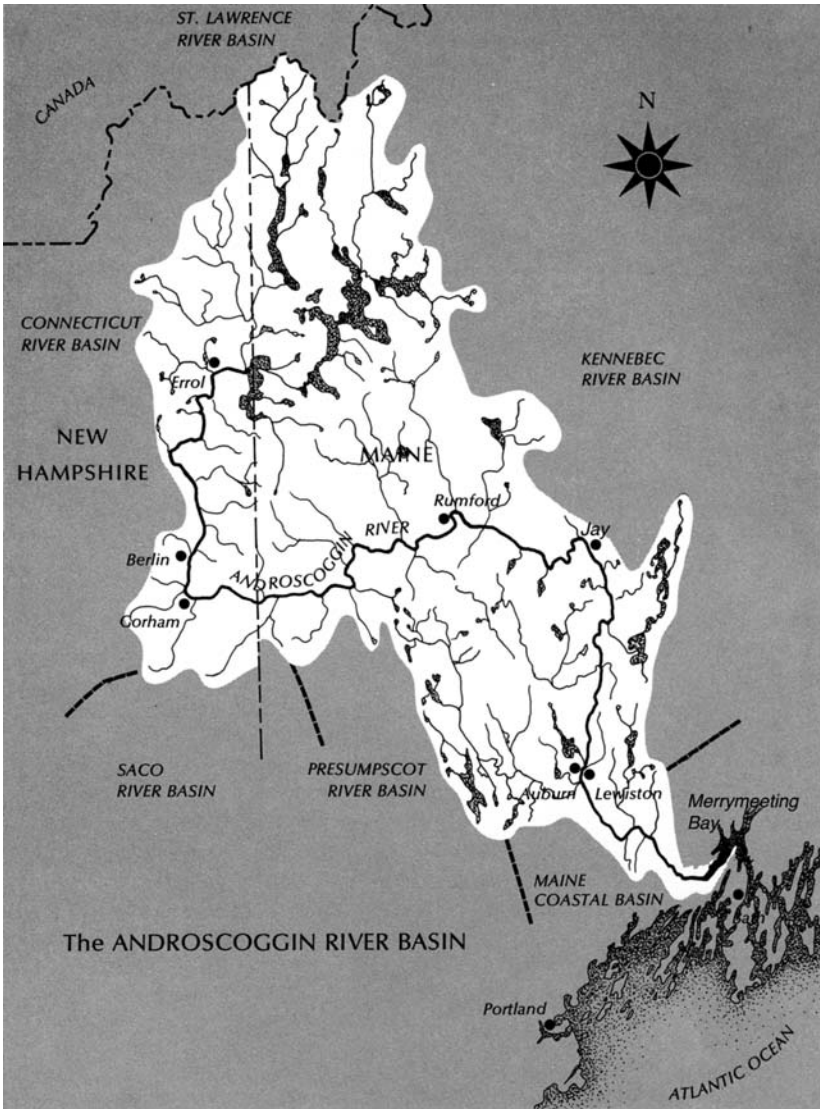

Figure 1: Map of the Androscoggin Watershed, 1975. Credit: Page Helm Jones, Evolution of a Valley: The Androscoggin Story (Phoenix Publishing,1975).

oxygen levels. However, with each new dam the self-aerating capabilities of the river decreased.[7] The large amounts of organic matter in the waste that pulp and paper mills dumped into the river created a biochemical oxygen demand, lowering dissolved oxygen levels as the oxygen-consuming bacteria digested organic matter. These dams allowed industry to grow, creating jobs and cities. Attracting thousands of French Canadian immigrants, the new industries changed the social makeup of the Androscoggin's largest urban center, the twin towns of Lewiston and Auburn, and brought new problems of filth and crowding.[8]

At the turn of the nineteenth century, as conditions worsened, Lewiston no longer obtained its drinking water from the Androscoggin. Rather than clean the river, town officials chose the less costly solution of sourcing its water from nearby Lake Auburn. This decision was consistent with the driving principles of the Progressive era conservation movement, which sought to preserve natural resources and to use those resources more effectively and efficiently. Thus pollution control during this time focused on water filtration techniques that dramatically reduced the incidence of waterborne diseases and were much more cost effective than sewage treatment plants. Yet these techniques did little to address the source of the problem: pollution from pulp mills.[9]

Figure 2: Large volumes of foam and scum in the Androscoggin River (seen here in this ca. 1930s photograph at the twin cities of Lewiston and Auburn, Maine) made it impossible to ignore the increasing level of river pollution. Credit: Androscoggin Historical Society, Auburn, Maine.

By the spring of 1907, 20-foot drifts of yellow-brown foam coming from the canals in Lewiston served as a grim reminder of the mounting consequences of industrial pollution. By eliminating access to spawning habitat, dams had already made the river's once famous salmon runs, which had formerly extended as far north as Rumford, Maine, a distant memory. But it was pollution from the pulp and paper mills that made the Androscoggin truly inhospitable to salmon and other fish.

Papermaking involves two separate steps: first the pulp is created out of wood or rags, and then the actual paper is created. Pulping generated the greatest pollution in New England rivers, and wood pulp, which first came into use in Maine along the Androscoggin in 1868, was the most polluting. Not only did the manufacturing of wood pulp contribute to pollution entering the Androscoggin, the logging necessary to provide the wood for pulp mills also contributed to deforestation and sediment entering the river.

In 1888 the introduction of a new sulfite pulping process in Maine's mills dramatically amplified pollution. First put into commercial use in the 1880s, sulfite was particularly effective at breaking down the tough fibers from spruce, which were abundant in Maine. Sulphurous acid and lime were boiled with the wood chips until the wood was broken down, and then the waste with its high levels of dissolved organic matter was discharged into the river. Beginning in 1888, three major sulfite pulping mills were built along the Androscoggin; by 1930 these companies would be known as the International Paper Company in Jay, Maine; the Oxford Paper Company in Rumford, Maine; and the Brown Company in Berlin, New Hampshire. Androscoggin pulp and paper mills grew steadily until 1941; by this time they produced 5,800 tons of sulfite pulp every week.[10]

The sulfite pulp process had particularly pronounced effects on oxygen. Anaerobic bacteria broke down the sulfates in the sulfite waste liquor into hydrogen sulfide gas, driving levels of dissolved oxygen to levels unsafe for most aquatic organisms. Despite the mills' increasing power and near monopoly over Maine's rivers, in 1929 public pressure forced Maine's Republican governor, William Gardiner, to request that the pulp and paper mills investigate the health of Maine's rivers. The subsequent 1930 report argued that rivers should be defined as polluted when oxygen levels fell below 3 parts per million (ppm), even though the report acknowledged that warm water fish would begin to experience the deleterious effects of low oxygen when levels dropped below 5 ppm. The Penobscot and Kennebec both had average dissolved oxygen levels above 5 ppm; only in the Androscoggin did levels fall below the recommended 3 ppm. Adjacent to Lewiston, oxygen levels in the river dropped below 2 ppm. The fact that some of the lowest oxygen levels existed adjacent to Lewiston-Auburn meant that these communities were

the first to rediscover their river as an open sewer. In 1930 even the management of the pulp and paper mills considered the Androscoggin severely polluted.[11]

The sulfite process also had another unintended consequence: it made the river reek. In addition to mountains of drifting foam, a result of both natural and industrial sources including the resins and fatty acids in the pulp mill waste, and the decline in aquatic life as oxygen levels dropped in the river, residents began noticing the Androscoggin's stench. Lawrance later described 1935 as the first year that hydrogen sulfide and other odors emanated from the river. Hydrogen sulfide, which smells like rotten eggs, was a direct result of the sulfite waste liquor discharged from sulfite mills upstream.

Odors continued to mount until conditions during the summer of 1941 generated what Lawrance called an intolerable situation. The pulp and paper mills had ramped up production to meet wartime demand, consequently increasing their wastes. The Great Falls in Lewiston and Auburn dispersed the hydrogen sulfide gases; as the water misted into the air, a rotten egg odor wafted across the two cities. Some store owners had to shutter their doors, and freshly painted homes were blackened as the hydrogen sulfide reacted with lead compounds in the paint. During some of the hottest days of the year, sweaty home owners were forced to keep their windows shut at night while they burned pine candles to combat the miasma. One local resident, Nere Duval, remembered how he became weak because he could not "sleep or eat"; Leo Good "came across the bridge one morning and threw up" in the middle of the street.[12]

Revulsion soon morphed into action as residents held meetings, wrote editorials, and made trips to the state capital, Augusta, asking for solutions to the pollution. Lewiston businessmen tried to frame the problem in economic terms, arguing that the stench was hurting downtown businesses whose employees became inefficient as the odor nauseated and distracted them from their work. But the state's Bureau of Health responded by warning that the only sure solution to the mills' smells was closing the mills, which would mean economic doom for the entire state, not just for a few local businesses affected by smells. As a result, state officials responded cautiously to public requests for limits on mill pollution. Rather than regulate the pollution directly, the state legislature decided to call for more research before taking action. It established the Maine Sanitary Water Board in July 1941 and vested it with the power to study pollution. In August this board commissioned the Boston engineering firm of Metcalf and Eddy to investigate pollution and recommend remedial measures for the Androscoggin.[13]

The Metcalf and Eddy engineers offered a stark assessment, noting, "few streams in the United States of comparable size show evidences of such extreme pollution." Ninety-two percent of the pollution

entering the Androscoggin originated at the pulp and paper mills. The report made it impossible for the mills to skirt their responsibility for the odor crisis, but the suggestions for cleanup efforts were constrained due to the authors' limited experience with "unproved processes for treatment of industrial wastes." The authors' uncertainty regarding the treatment of industrial wastes was consistent with other engineers across the nation; not until 1955 did the American Public Health Association publish a separate chapter on industrial wastes apart from its discussion of sewage treatment. Given these constraints, Metcalf and Eddy did not recommend treating pollution at its source. Instead, the report recommended maintaining oxygen levels above 2 ppm to prevent obnoxious odors from returning, acknowledging that those levels would not be high enough "to support fish life."[14]

The state legislature decided that rather than have the Sanitary Water Board, which had commissioned the report, act on its findings, responsibility for the cleanup of the Androscoggin would be left to the courts. Maine's attorney general, Frank Cowan, took the next step. Taken together with the testimony of residents along the Androscoggin, the 1942 report provided Cowan with ample evidence to take action against the three major pulp and paper companies. Cowan submitted his case to the Maine Supreme Court on May 29, 1942, and the court concluded that sulfite waste liquor discharge from the Brown Company, Oxford Paper Company, and International Paper Company was causing noxious odors in the Androscoggin. On December 17, 1942, the Maine Supreme Court issued their first Stipulation limiting the amount of sulfite waste liquor each mill could put into the Androscoggin.[15]

In response to Cowan's suit, in May 1942 the three paper companies formed the Androscoggin River Technical Committee (ARTC), which included engineers and management from each company on the board. The stated goal of the ARTC was to study pollution in the Androscoggin River and find ways to eliminate nuisance conditions. It also became the organization charged with carrying out the Stipulations of the court. While the ARTC's members had vested interests in cleaning up the Androscoggin, their allegiance lay with the mills and therefore with the techniques least intrusive to business. Similar conflicts of interests occurred across the country. Events such as the American Chemical Society's 1946 symposium on industrial wastes arose in reaction to the public's interest in pollution legislation. Like the ARTC, the society focused on maintaining its control of pollution management, in this case by presenting what it viewed as the best scientific methods to members of the public who might have used approaches that focused more on political and economic solutions.[16]

In 1943 the ARTC hired Lawrance as a consultant, but unlike the other members, he had no formal affiliation with the mills. There is no record of why the ARTC appointed Lawrance, but by the 1940s,

the study of water quality relied heavily on the discipline of chemistry, and Lawrance was an able chemist who lived in Lewiston adjacent to the Androscoggin River. After receiving his doctorate from the University of Toronto in 1921, Lawrance had joined the Department of Chemistry at Bates College in Lewiston, a position he held until his retirement as full professor in 1965. Given the court's decision, the mills were responsible for funding all of the research on the Androscoggin, and Lawrance's entire budget for his work on the Androscoggin came from the mills. Lawrance himself was conscious of how his position might be viewed; at the end of his 1946 report on the Androscoggin, he wrote of the three paper companies: "They have permitted complete freedom to report all facts and to comment upon them in any manner the writer deemed fit and proper."[17]

Throughout his study of the river, Lawrance focused on the nuisance conditions that brought the mills to court in the first place. From 1943 until his retirement as rivermaster in 1978, Lawrance undertook "on a scientific basis . . . the task of daily odor observations at eight stations in the Lewiston-Auburn area." Essentially these scientific odor observations involved Lawrance sniffing the air at each location and recording the intensity and types of odors that were present. Lawrance wrote, "The odor intensities were estimated by the effect upon an observer's olfactory nerves." He understood that the system was "not very satisfactory," but he argued that because he "made all of the odor

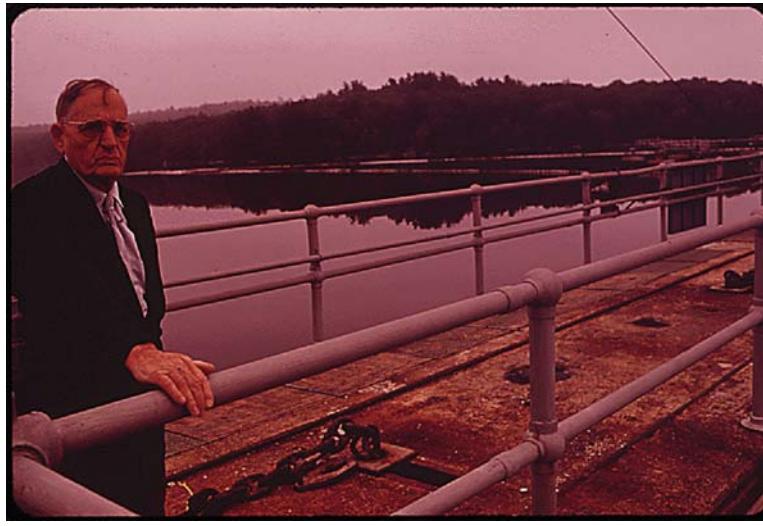

Figure 3: Walter Lawrance at Gulf Island Dam, one of the most polluted sections of the Androscoggin River, where Lawrance focused his efforts to control the environment through technology. Credit: Charles Steinhacker, Walter Lawrance, Rivermaster, at Gulf Island Dam at Lewiston, on the Androscoggin River, 1973. National Archives and Records Administration.

observations . . . this fact makes comparison of the seasonal data somewhat more valuable."[18]

The odor of the Androscoggin, as well as its effect on people, was specific to that time and place. Joy Parr argues that the subjectivity of smell and "its evanescent characteristics—in the absence of precise scientific measurement and interpretation—amplified doubt" for those people affected by noxious and environmentally hazardous odors. Published odor observations allowed Lawrance to track odor levels and to offer certainty to anxious residents unsure how to interpret such offensive smells. Lawrance's willingness to use his nose depended on his understanding of residents' tolerance threshold for different odor types. However, every person responded differently to the odors; Connie Chiang's study of fish odors on California's Monterey coastline shows how race and class could affect people's interpretations and tolerances of odors. Yet despite residents' varied responses, Lawrance initially found an effective medium between science and political protest in his odor studies.[19]

Within his study of odor in the Androscoggin, Lawrance made specific observations. For odor intensity he worked with a scale from 0 to 5, which he obtained from the American Public Health Association's methods for studying potable water. The scale read: "0, no odor; 1, very faint; 2, faint; 3, distinct; 4, decided, and 5, very strong." Lawrance used these odor intensity numbers to compare the total odor for each year, and he made elaborate graphs comparing river flow, pollution load, water temperature, and biochemical oxygen demand with odor intensity.[20] Scientists and sanitary engineers across the country recognized that these variables were interconnected in complex ways; a rise in water temperature, for example, could offset any of the gains made by a reduced pollution load. Beginning in the 1930s, innovations in organic sampling made it easier for scientists to measure organic pollution. In turn, this technology allowed scientists to better recognize the problem of organic pollution and its effect on public health and dissolved oxygen levels, even if they failed to create solutions for reducing this pollution.[21]

Although the sampling of inorganic pollutants did not become widespread until the 1960s, Lawrance understood, at least in part, the impact that inorganic compounds had on the river. When mills discharged sulfite liquor into the Androscoggin, this waste not only contributed to the odor, but the highly acidic waste also altered the river's pH.[22] At fourteen different locations along the river, Lawrance and his lab workers sampled for dissolved oxygen and oxygen-consuming bacteria levels, along with pH, turbidity, gas, floating sludge, and foam. Lawrance publicized his odor readings, but he only sampled for odor around Lewiston, whereas he tracked the Androscoggin's water quality from its oxygen-rich headwaters above the mills in Berlin, New Hampshire, to the lifeless Lewiston Canal.

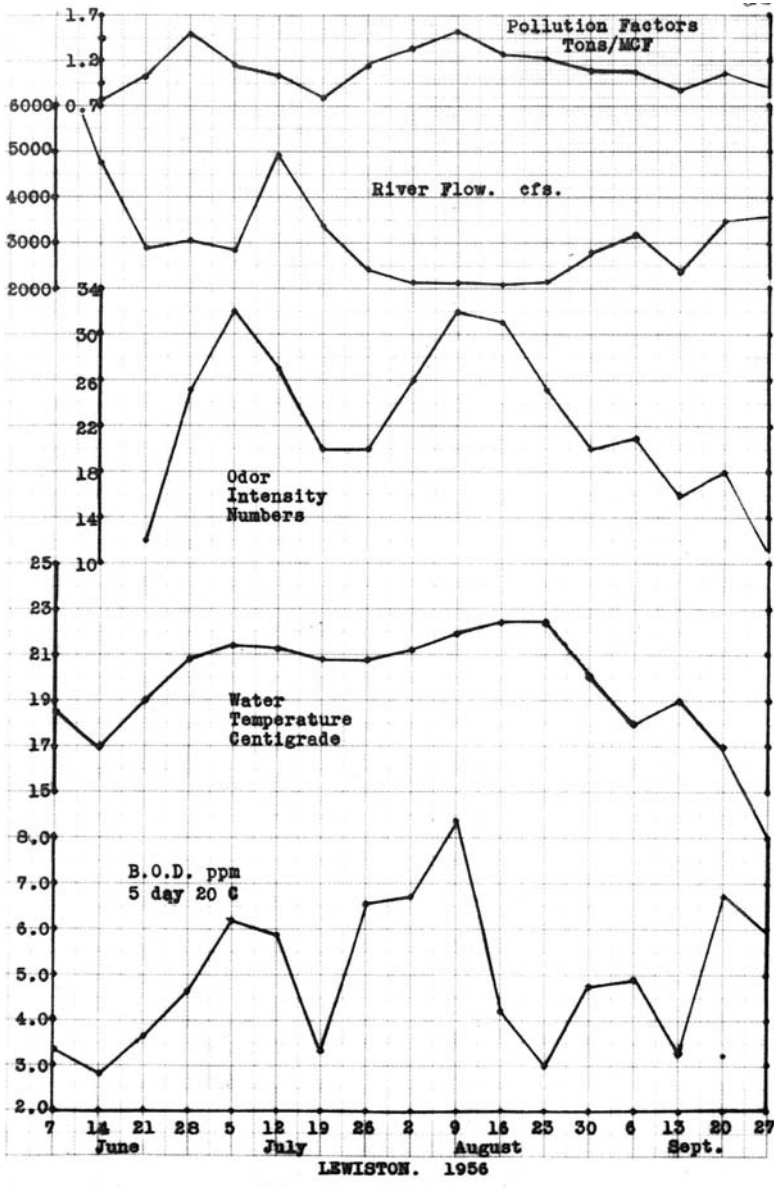

Figure 4: Lawrance correlated his measurements of odor intensity with a wide range of other readings he took along the Androscoggin River, including pollution load, river flow, water temperature, and the biochemical oxygen demand. Credit: Androscoggin River Studies Annual Report 1956, 25. Walter A. Lawrance papers. Edmund S. Muskie Archives and Special Collections Library, Bates College.

When the foul odors returned in 1947, the Lewiston Community Association threatened legal action, claiming that "the stench is nothing which has dropped from Heaven. Someone is responsible. It comes from the river."[23] These residents understood how nuisance law could hold the offending parties responsible, even when the noxious smells came from a complex river system instead of directly from the mills' smokestacks.

Facing a public outcry, the new attorney general, Ralph Farris, ordered the mills to reduce their discharge limits, and the Maine Supreme Court appointed Lawrance as rivermaster. Overnight, he became the sole person responsible for managing the Androscoggin. The following year, the Maine Supreme Court gave Lawrance the authority to set weekly sulfite pulp quotas. By 1948 Lawrance had the legal power to limit sulfite waste entering the river and also the power to conduct experiments on the river to test other scientific methods for reducing pollution levels.[24]

Although Lawrance did not have legal power over river pollution until he was appointed rivermaster in 1947, his work from 1943 to 1947 as a consulting scientist for the pulp mill association ARTC set the precedent for managing the Androscoggin. He would focus on accepted scientific tests and practices, avoiding management decisions that emphasized the economic, political, and moral consequences of pollution. Lawrance's appointment came from the Maine Supreme Court, and without a legislative mandate he was limited to nonconfrontational solutions, but as Lawrance tried to exert the authority of science, he found his work no less contested than if he had tried to yield the power of eminent domain over every home along the river.

Across the country, sanitary engineers grappled with similarly weak mandates. In the 1940s and 1950s, Congress left pollution control to the states, and they resisted federal involvement. In 1948 the U.S. Congress passed the Water Pollution Control Act, which created a Division of Water Pollution Control under the Public Health Service. While it encouraged cooperation between agencies, it did not interfere with the work of state-appointed scientists like Lawrance. The Public Health Service could study water quality, but the creation of laws and funds to control pollution was primarily left to the states.[25]

To address pollution issues, state governments hired sanitary engineers, and they relied on the informal cooperation with groups such as the Pulp and Paper Association, a pollution program that Kehoe calls "cooperative pragmatism." Without a legislative mandate, the pollution boards of states like Michigan were filled in part by polluting interests just as the ARTC was composed of paper mill executives. The engineers nominated to such boards were forced to navigate between many competing demands, including increasingly frustrated and informed citizens who looked to less established scientific disciplines such as ecology for solutions. Abel Wolman, who founded Johns

Hopkins's Department of Sanitary Engineering, noted in 1946 that "a scope of activity has been defined for the sanitary engineer of the future which can be no longer delimited by the purely technological."[26]

Perfuming the River

As rivermaster, Lawrance tried to rely solely on scientific principles. "Legislation, whatever its merits," Lawrance said, "cannot solve scientific problems."[27] But he found himself facing political resistance from many sides. Mill executives complained about the restrictions Lawrance implemented, and community activists wrote editorials decrying the river's continued stagnation. Congresswoman Margaret Chase Smith, the Republican representative from Maine, saw the problem as needlessly complicated: "It seems as though there ought to be a way to correct this problem without hurting anyone." For Smith, this meant recognizing that Maine was an industrial state and that whether through science or other methods, industry itself could remedy the "problem of pollution" without outside interference.[28]

Lawrance's claim that the Androscoggin represented a strictly scientific problem was itself a political claim. His most ambitious attempt to reengineer the Androscoggin was through the dumping of sodium nitrate to reduce pollution. This project, which relied heavily on his knowledge of chemistry, initiated a contentious public debate over the role of science, chemistry in particular, in managing the river. By the 1940s, sodium nitrate had been proven to suppress hydrogen sulfide production and was widely used in the treatment of odiferous waste lagoons. In 1948 Lawrance proposed adding sodium nitrate to the river in enormous quantities, in hopes that it would increase oxygen levels. Because roughly half of sodium nitrate's molecular weight is oxygen, Lawrance believed it might prevent anoxia because "aerobic bacteria can utilize this oxygen when the dissolved oxygen is very low; odor producing anaerobic bacteria do not function in the presence of adequate nitrate." Sodium nitrate, Lawrance argued, would not only raise oxygen levels, it might also inhibit the growth of the anaerobic bacteria responsible for the production of noxious hydrogen sulfide gas.[29]

The dumping project began in 1948 and lasted for twelve years. Between 1948 and 1960, at a cost of half a million dollars (paid by the paper mills), nearly 7,000 tons of sodium nitrate were dumped into the river. According to Lawrance, there had been no other known case of such a large-scale operation anywhere in the world. Although sodium nitrate was first used in polluted rivers in the 1920s, 1,600 pounds of nitrate were daily dumped into the Neponset River outside of Boston, Massachusetts, in 1929 that was still much less

than Lawrance's prescribed daily dose of 15 tons to be swallowed up by the Androscoggin.[30]

The biological results were mixed. Odors appeared to decline, but it was not clear that aquatic health improved significantly. Public perceptions were equally mixed. While local residents approved of the reduced odor, their feelings toward the actual nitrate program were not entirely positive. In 1952 a reporter for the *Lewiston Evening Journal* commended Lawrance's work simply because of what it did to reduce the "almost unbearable" smell. Other observers, however, accused Lawrance of covering up the pollution rather than addressing its source. One of Lawrance's most vocal critics was the Citizens for Conservation and Pollution Control (CCPC). Founded in 1953, Maine's first statewide antipollution organization, the CCPC considered taking legal action against Lawrance's nitrate program. As CCPC director Dr. Robert Tufts explained, "The strategy of the industrialists is to make the people think that something is being done to cure a sick river. So they come up with this nitrate-perfuming activity." As the emphasis on quality of life grew after World War II, citizen groups such as the CCPC formed at ever-increasing rates, yet as Dr. Tufts's comments suggest, local activists wanted more than mere nuisance abatement.[31]

Some scientists feared the consequences of Lawrance's program went beyond inaction and actually made the river more polluted. According to Dr. Tufts, "The chemicals deposited in the river . . . only cripple the waterway's own ability to recover from the poisons it receives from the mills."[32] The idea that rivers could self-clean themselves dates back to the mid-nineteenth century, but Tufts's description of a crippled waterway reveals an understanding of the emerging discipline of ecology. Unlike the science of earlier sanitary engineers, ecology took all of the chemical standards for which Lawrance measured along the Androscoggin much more seriously than Lawrance himself. An ecological perspective would have considered the consequences of human-made disturbances such as increased nutrient loads and that any change in water quality could strongly affect the entire function of the river system.[33] While Lawrance pointed to improvements in his odor readings, other citizens pointed to dissolved oxygen levels that had not improved. Indeed for Tufts, even a negligible increase in dissolved oxygen levels remained secondary to his concern about an increase in the level of nutrient pollution entering the Androscoggin. For Tufts, Lawrance's program was itself a serious nuisance with the potential to harm the river for miles downstream.

The large volume of sodium nitrate dumped into the Androscoggin likely contributed to eutrophication in downstream ecosystems. By the time Lawrance began his nitrate program, high levels of nutrient pollution had already led to significant areas of eutrophication and the depletion of all of the available oxygen. However, given the

huge inputs of nitrate, the nitrate program may well have increased the duration and severity of eutrophication. Aware of these concerns, Lawrance published his findings that there was no downstream increase "in the concentration of the organic nitrogen compounds." The fact that Lawrance tested for an increase in downstream nitrogen suggests that he did not have a blind faith in his nitrate program.[34] Yet Lawrance's large-scale experiment, only testing for its negative impacts after the fact, reveals a disconnect between Lawrance and many local residents who now were at least as concerned about the inadvertent impact of the nitrates on the river's health as they were about reducing odor.

Despite Lawrance's assurances that his nitrate program was a bridge to a cleaner Androscoggin, lasting only until the mills improved their waste treatment processes, residents' belief that the Androscoggin was severely polluted remained well founded. In the summer of 1957, just north of Lewiston, average dissolved oxygen levels were below 2 ppm, and Lawrance recorded the highest weekly odor intensity since 1948. While groups like the CCPC placed a stronger emphasis on the river's biological health than on the original nuisance conditions, other local residents changed their definition of the nuisance itself. As early as 1952, Lawrance noticed residents' decreasing tolerance for pollution and bad odors. "Increased public sensitivity to odor together with the growth of population near the dams," he noted, "may require a lower operating pollution factor during critical months."[35] Given Lawrance's mandate to abate a nuisance, changing definitions of nuisance impacted the scope of his work.

An Emotional Public

Increasing public sensitivity toward pollution led to new political efforts to change how much industry could pollute the Androscoggin and other Maine rivers. In 1954 the editors of the *Lewiston Daily Sun* were flabbergasted at a state legislative report on Maine's rivers. "Most difficult to understand is the finding," the editorial board concluded, "in the report, that pollution of Maine waters has become an 'increasingly emotional issue.' What is there emotional about wanting clean rivers in Maine?"[36] Lawrance himself was asked how the ARTC felt about the ongoing attacks on the Androscoggin's pollution problem. He responded, "Feelings don't enter it because the committee deals with only highly technical facts."[37] Lawrance could essentially write off many complaints about the river's condition as emotional and unscientific. However, despite his assertions, Lawrance had admitted that his daily scientific odor observations were themselves not highly technical facts. Lawrance's descriptions of public sensitivity to odors appeared in the same annual reports where he presented his charts on dissolved oxygen levels and results from his

experiments. Clearly, Lawrance understood the connection between scientific research and public perception.

While Lawrance retained his faith that scientific expertise could clean up the rivers without the need for legislative action, many citizens believed that political activism offered the best opportunity for achieving a healthier environment. The debate over what to do about Maine's rivers culminated in 1955 at the Maine legislature. That year at least seven bills were proposed to clean up Maine's rivers. They ranged from prohibiting all pollution to authorizing additional studies of pollution before taking regulatory action. Much debate occurred at the hearing that took place in Augusta on April 14, 1955; a reporter for the *Lewiston Daily Sun* noted how "the longest committee hearing of this and probably any other Maine legislative session ended today after nearly 12 hours of oratory about water pollution."[38] The result was a weakened bill calling only for Maine's rivers to be classified by their pollution burden—not to be cleaned up. While many citizens were disappointed, the showdown in the legislature represented a major turning point in Maine's environmental consciousness. According to historians Richard Judd and Christopher Beach, the heated and lengthy nature of the hearing revealed how pollution had taken a new importance in Maine politics that went to the heart of an increasing emphasis on quality of life and what they call Maine's "environmental imagination." The environmental movement in Maine, as with the rest of the nation, was coming into being.[39]

With the increasing attention paid to the environment as an intrinsic good, high pollution levels in the Androscoggin remained a challenge that appeared to pit cleaner water against economic growth. Lawrance had the legal power to limit the mills' sulfite liquor discharges. Since sulfite liquor represented the majority of mill waste and the mills had yet to implement any process changes that would decrease wastes, any limits on discharge that Lawrance decided to enact would mean restrictions on mill production. Most summers Lawrance instituted minimal control measures; however, for several weeks during the summer of 1955, Lawrance required the pulp and paper mills to make cuts upward of 50 percent, essentially shutting the mills down. When Lawrance issued his discharge limits on local pulp companies, he realized there were limits to cooperation with industry. In 1957 an industry representative, Walter Martin, complained that "the paper companies were experiencing hardships as a result of the river nuisance abatement program operated by Dr. Walter A. Lawrance." The editors of the *Lewiston Daily Sun* also objected to Lawrance's discharge limits, arguing that, "Only the foolhardy would desire clean water at the expense of slashed payrolls, lost industry and ghost towns."[40]

In the 1950s, Maine's manufacturing economy was shrinking; it lost over six thousand workers in 1954 alone.[41] The state's paper industry

was the sole sector increasing manufacturing capacity in the 1950s. Maine's pulp and paper mills generated nearly a third of the wealth in the state, yet it accounted for 91 percent of the Androscoggin's pollution load by 1955.[42] Indeed it was the economic importance of the paper industry in Maine and other states like Wisconsin that pushed Sen. Edmund Muskie of Maine and Sen. Gaylord Nelson of Wisconsin to argue for a set of national pollution control standards. In part they recognized that states would have a difficult time resisting pressures from their core economic sectors. But the senators also wanted national statutes so that their industries would not find themselves at a competitive disadvantage if their own states were the first to enact pollution regulations, an argument that the paper industry had used when Muskie and Nelson were governors of their respective states in the 1950s.[43]

The pulp and paper companies found themselves working against another economic sector: a growing tourism industry that did not want one of the most polluted rivers in the nation tarring its pristine image of Maine.[44] Clean water was a vital symbol for Maine's tourism industry. In the early twentieth century, tourism boosters had begun aggressively promoting Maine as a tourist destination. In the 1930s, they coined the term *Vacationland* to describe the state. Even as the Androscoggin became increasingly polluted, tourism officials presented ever more pastoral images of lighthouses and farmland. By the 1950s, the gap between postcard images and reality became obvious to visitors. After traveling next to the Androscoggin, a tourist wrote to Gov. Edmund S. Muskie, complaining that major improvements were necessary for Maine to "advertise itself as Vacationland."[45] As the second largest industry, residents began to recognize the importance of tourism to Maine's future. Especially as manufacturing jobs continued to leave the state, there was a growing sentiment that the future of Maine's economic progress depended on reducing environmental degradation.

Initially, Lawrance had hoped that technological changes at the mills could provide the desired improvement in the Androscoggin. When those technological changes failed to materialize and the foul odors persisted, he eventually required stricter discharge limits in 1955. After the mills recognized that these limits would restrict their ability to continue with business as usual, mill executives did invest in technological improvements. In 1960 mill executives decided to convert to the more expensive Kraft process. The Kraft process, engineers hoped, would not only reduce pollution and eliminate sulfite liquor waste, it would also create a stronger paper that postwar consumers demanded. By 1965 the last sulfite mill closed in Jay, Maine. When Lawrance began his tenure as rivermaster in 1948, there were 2480 tons of sulfite liquor entering the Androscoggin every week.

The elimination of sulfite liquor waste appeared to be a major accomplishment.[46]

The Pollution Problem

Just as Lawrance eliminated sulfite waste liquor and its obnoxious odors, he discovered that the Kraft process, which was supposed to fix the problem, created its own odors. Unlike sulfite liquor, Lawrance did not have the power to limit Kraft waste. When the Maine Supreme Court granted Lawrance the right to control sulfite waste discharges in 1948, the vast majority of the pollution load entering the river came from the mills' sulfite liquor discharges. A 1955 Army Corps of Engineers report said, "the pulp and paper plants in the Androscoggin Valley dump 91% of the pollution load carried by the water .... 92% of this waste is due to sulphite liquor alone."[47] Lawrance's legal right to limit sulfite waste, potentially limiting production, represented a major accomplishment for residents along the Androscoggin. Although odors and pollution persisted, by the time sulfite waste discharges ended in 1965, the Maine Supreme Court lacked the impetus to give Lawrance the power to control the large amounts of Kraft waste that were now entering the river.

While Lawrance continued to work toward a cleaner river, he did not think that pure water constituted an appropriate goal. In 1963 Lawrance said that he wanted further cleanup efforts, but "that now is not the time. The purpose of cleaning up the river is to get a higher grade of water. But, what are we going to do with this high grade water once we have it? ... Are we going to drink it?"[48] By making his case against drinking river water, Lawrance ignored the tourism industry's needs for environmental amenities, but he also forgot what many residents remembered: before the twentieth century, the twin cities had used the Androscoggin for drinking water. Lawrance's belief was consistent with the principles of the progressive conservation movement that had sought efficient industrial uses for resources. But with dissolved oxygen levels hovering below 5 ppm in much of the river, this view revealed Lawrance's continued ignorance of ecology's emphasis on healthy ecosystems.

Other scientists working on Maine's waters, such as fisheries biologist Richard Anderson, better understood the role of ecology in improving the environment. At Sebago Lake, the headwaters of the Presumpscot River adjacent to the Androscoggin River, Anderson discovered a link between DDT spraying and the lake's declining salmon population. After Anderson shared his findings with the press in the early 1960s, he noted, "there was never another drop of DDT sprayed at Sebago Lake." Unlike Lawrance, Anderson understood that the science of ecology not only viewed the environment from a

more holistic perspective, it also helped to inspire the environmental values of the residents who disagreed with Lawrance's policies.[49]

From the late 1950s to the late 1960s, coverage of environmental issues in newspapers and magazines increased over 300 percent. Lawrance's yearly reports grew thicker and thicker with articles on the Androscoggin problem, water pollution, and even air pollution. In 1971 he noted, "Intense nation-wide public interest in pollution resulted in a record amount of space devoted to this subject in the local press."[50] The federal government also noticed the growth of environmental values and started taking a more active role in encouraging states to clean their waterways. In 1962 Lawrance and all of Maine's water pollution representatives created a public spectacle after walking out on a conference on the conditions of Maine's waterways held in Portland by the US Department of Health, Education, and Welfare (HEW). While HEW representatives responded to the environmental movement by arguing much worked remained on the Androscoggin, Lawrance said "the major problem" had been solved.[51]

Lawrance responded to the environmental movement's popular ascendance by doing what he knew best; he used technology to help clean the river. Unable to limit discharges from Kraft mills, Lawrance worked on improving water quality along a part of the river that had chronically low oxygen levels. Just upstream from the Lewiston-Auburn area, the section of the river known as Gulf Island Pond suffered from large amounts of organic pollution; impoundment behind the dam further increased the potential for oxygen levels to hover close to zero. Rather than dump more chemicals in the river, Lawrance decided to increase oxygen levels by mimicking natural re-aeration in the Androscoggin. In cooperation with the National Council for Stream Improvement, a research group funded by US paper companies, Lawrance persuaded the paper mills to pay for the design and installation of three aerators during the summer of 1969.[52]

Unlike his earlier work with sodium nitrate, Lawrance never claimed that the aerators were a temporary solution. Comparing the Androscoggin to a sickly patient, a reporter for the *Lewiston Evening Journal* commented on the desperation of Lawrance's work: "The photo of aerators working feverishly, but futilely, at Gulf Island Pond could only remind one of the hospital patient, being kept alive solely by mechanical and medical devices."[53] As awareness of the environment as a living system increased, people expected technology to transform their environment and not simply to control a nuisance in an ecosystem that was essentially dead, lacking enough oxygen for most fish to survive. A 1970 *Newsweek* article on pollution summed up this frustration, explaining how "a belief in the ability of technology to solve almost any problem . . . leads people to expect a solution where none is possible."[54] Technology clearly had a role in solving

Figure 5: Using mechanical aerators on the Androscoggin's Gulf Island Pond, Lawrance attempted to re-create the natural oxygenation that the river's many impounded falls had once provided. Credit: Androscoggin River Studies Annual Report 1969, 102. Walter A. Lawrance papers. Edmund S. Muskie Archives and Special Collections Library, Bates College.

America's pollution problem; use of the best available technology represented a critical part of the Clean Water Act. What worried people was that scientists like Lawrance might use a technological approach to deny the pressing moral and political questions surrounding pollution and the health of America's waterways.[55]

This search for a solution took on a new urgency in Maine politics in the late 1960s. In stark contrast to the 1955 legislative session, the session of 1969 proved far more successful with almost half of the sixty-plus conservation bills passing in the legislature. The following year, Maine governor Kenneth Curtis created the Department of Environmental Protection, which had significant powers of enforcement and actively sought to ensure that polluters were in compliance with regulations. Increased power also came from the federal government following the passage of the Water Quality Act of 1965 that required states to set minimum water quality standards. The act gave states less discretion over pollution control but ultimately augmented the power of state agencies to enforce their mandates. While the Department of Environmental Protection continued to rely on the expertise of scientists like Lawrance, Maine residents hoped that these experts would carry out the environmental movement's explicit demands for cleaner water.[56]

Both the reform movements of the 1960s and a growing environmental consciousness culminated in Earth Day, what Gaylord Nelson called "a demonstration of the public will."[57] More Americans

participated in the 1970 event than any of the civil rights and antiwar marches of the 1960s, but in many ways its roots could be traced back to a single scientist. In 1962 Rachel Carson had published *Silent Spring* and showed millions of people the grave consequences of widespread DDT applications, a chemical whose original purpose had been to improve quality of life through increased farm yields. Carson not only articulated a growing concern over the costs of pollution, but she also galvanized skepticism toward certain types of scientific research and the inadvertent consequences of technological fixes such as Lawrance's nitrate program. Describing America's pollution crisis in dire terms, Carson wrote, "For the first time in the history of the world, every human being is now subjected to contact with dangerous chemicals, from the moment of conception until death."[58] Carson's fears came to life for Maine residents when they discovered that the Oxford Paper Company had been dumping mercury into the Androscoggin. Lawrance, barraged by the public, now found himself answering questions about mercury levels in Lake Auburn, the source of the twin cities' water but unconnected to the Androscoggin.[59]

Harmful chemicals in the environment not only changed how residents perceived pollution; these toxic substances changed how people understood science. In the first half of the twentieth century, the public revered chemistry as a science with unlimited potential to improve the world. However, the negative consequences of pesticides and chemicals revealed a scientific/technological elite that had lost sight of its initial goal to improve the environment. From 1940 to 1970, the production of chemicals increased sixfold in the United States, and many of these chemicals were initially accepted because of the scientific uncertainty about their true impact on the environment. At the same time that scientific uncertainty allowed harmful chemicals into the environment, scientists like Lawrance sometimes used a double standard, arguing against the public's demands for cleaner water by noting that the scientific uncertainty of many pollution control methods prevented their widespread use. Judging by the magnitude of the backlash that Carson received from many chemists and "apostles of technology," her critique represented a threat to the authority of those scientists who refused to publicly recognize the limits of scientific expertise.[60]

On the eve of the 1972 Federal Clean Water Act, the Androscoggin appeared to reach its ecological and political breaking point. Lawrance found that "the public and local press were very critical," and to make matters worse, a chemical spill at the Oxford mill in Rumford, Maine, killed twenty thousand fish. Passage of the 1972 Clean Water Act showed that the federal government would not tolerate such egregious pollution in the Androscoggin. Edmund Muskie, who had sponsored the original bill and had grown up along the Androscoggin in

Rumford, considered pollution to be a life-or-death issue. His argument that pollution thrived under "half-hearted attempts to control it" fit the Androscoggin.[61] Throughout his tenure Lawrance never stopped looking for ways to eliminate nuisance conditions in the

Figure 6: The passage of the 1972 Clean Water Act did not immediately stop pollution from the pulp and paper industry. Credit: Charles Steinhacker, Brown Paper Company, Showing outfall into the Androscoggin River, 1973. National Archives and Records Administration.

Androscoggin, but except for a few hot days in the summer, Lawrance did nothing to reduce the pollution going into the river; instead he tried to control the river's response to that pollution load.

As the public debate continued, Lawrance reflected on the success of his efforts to decrease the Androscoggin's offensive odors. He wrote, "Public interest in the environment is evidenced by the space devoted to the subject in the local and national press. Due to the almost complete absence of objectionable odor in the Lewiston-Auburn area, the major topics are Solid Waste Disposal and the building of a domestic waste treatment system." Yet few residents agreed with his assessment. In a November 1971 letter to the *Lewiston Daily Sun*, a local duck hunter wrote, "If Mr. Lawrance feels the river is improving and the smell only sporadic it must be because he is living at least five miles from the river and checking it from an airplane." As early as 1951, residents disagreed with Lawrance's characterizations of low odor levels; one local citizen sarcastically wrote, "It may be that I haven't advanced, culturally, to the point where I can ignore my nose and smell only what is rationalized for me by helpful others."[62] When he dumped nitrates into the river, Lawrance revealed his own misunderstanding of the changing scientific attitudes of the public by ignoring the long-term ecological health of the river, and he only compounded residents' frustration by arguing that odors they considered offensive no longer existed.

Conclusion

Following the passage of the Clean Water Act in 1972, water quality initially improved rapidly on the Androscoggin. Treatment plants such as the Lewiston-Auburn sewage plant and the Androscoggin Mill's secondary treatment plant in Jay drastically reduced the amount of organic waste entering the river, and in 1975 Lawrance recorded the lowest pollution load on record.[63] By 1977 most sections of the river consistently had oxygen levels above 5 ppm, high enough to support fish life. Until his retirement at the age of eighty-three in 1978, Lawrance continued to manage the aerators on Gulf Island Pond, but he could take little credit for the swift changes brought about by political activism and the tens of millions of dollars provided by local, state, and federal coffers for waste treatment. The Androscoggin's revival shows how Lawrance failed to recognize that pollution in the river was more than a technical scientific problem; it was an economic, political, and moral issue. Yet even citizens' "emotional claims" did not exclude science as they pointed to the low dissolved oxygen levels, questioned the potential impact of dumping tons of fertilizer into the river, and denied Lawrance's claims of an odorless river.

As Lawrance worked to assuage river residents' concerns, he also used his position to undermine their opinions as unscientific.

Scientific expertise adds an authoritative element to the debate over the environment even though scientists often disagree as to what constitutes scientific facts.[64] Without a clear path to navigate, Lawrance exercised his expertise as a chemist to manage pollution in the shifting currents of postwar politics. He used his scientific expertise in the same way that engineers, according to Linda Nash, use objective facts. Yet as Nash concludes, "taken to the extreme, the effort to eliminate all traces of subjective involvement leads, logically, to the rejection of all phenomenological data as potentially suspect."[65]

Lawrance initially framed the problem of pollution in the Androscoggin River as one that went beyond seemingly objective knowledge and the boundaries of chemistry. For example, he was unwilling to discount his sense of smell as a subjective response. By attempting to turn subjective odors into objective information, Lawrance hoped to provide a measure of progress against pollution that all stakeholders along the Androscoggin could accept, and by supporting his decisions with numbers, rather than qualitative data, Lawrance could give the appearance of impartiality.[66] Yet what was malodorous to one person was acceptable to another. Even in his own house, there were divergent reactions to the river odor: Lawrance said he was immune to the strong odors of 1941 while his wife was "nauseated at times and unable to eat." Like smell, pollution itself shifts and changes over time and space. It is both a human creation and the result of an ever-changing physical world. As a result, Lawrance never found the objective measure to achieve what everyone would accept as a clean and healthy Androscoggin.[67]

While Lawrance blurred the lines of science and emotion through his odor observations, he never embraced the discipline of ecology. The fourteen different locations at which Lawrance and his lab workers sampled for dissolved oxygen and oxygen-consuming bacteria levels, along with pH, turbidity, gas, floating sludge, and foam, suggests that Lawrance understood the complexity of the Androscoggin. His narrow focus on chemistry and odor emerged when he refused to acknowledge the uncertain significance of those variables. Whereas ecology placed value on a healthy ecosystem, Lawrance only cared about the relationship between dissolved oxygen levels and foul odor.

The scale of the Androscoggin's pollution problem meant that thousands of Maine residents could not ignore the failure of Lawrance's approach to managing the river. As residents' environmental consciousness grew, so did their definitions of nuisance, which Lawrance recognized but refused to publicly affirm. His denial of residents' requests for pure water was consistent with the conservation movement's emphasis on the efficient use of resources, but residents never forgot that Lawrance had been appointed to abate a specific nuisance.

In an era prior to concerted national environmental regulation, Lawrance had to create his own path to address the odiferous Androscoggin River. The result was a trans-science that melded his background in chemistry with his own sense of smell. Although Lawrance was appointed to control a specific nuisance, the era in which he worked, from the 1940s to the 1970s, was rapidly changing as people began to embrace ecology and environmental activism. Thus for many residents, dumping nitrate into the river, in defiance of their ecological principles, was itself a nuisance. Ironically, taking the ecological health of the river more seriously could have allowed Lawrance to better reduce odor levels as public sensitivity toward those odors only increased. Lawrance was not alone in turning a blind eye toward ecology. Indeed, even the title of rivermaster reveals how he was expected to master the Androscoggin rather than consider humans and industry as a connected part of the river.

Even after Lawrance's tenure, as more ecologists worked on the river, the problem of pollution persisted, and to this day aerators pump oxygen into the impounded Gulf Island Pond, suggesting that not even ecology can restore the river on its own. Likewise ecologists find themselves entering the same murky area that Lawrance attempted to navigate, of competing demands and of questions that cannot be answered by science alone.[68] This study shows how different fields of scientific thought, combining and colliding with each other, were influenced as much by the river itself, with its impounded ponds and potent odors, as by any scientific, legal, or political community.

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Notes

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