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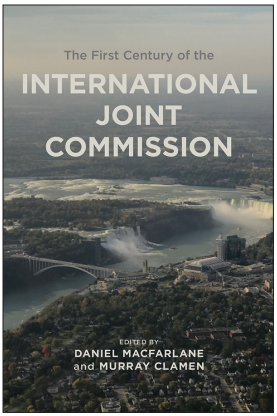

THE FIRST CENTURY OF THE INTERNATIONAL JOINT COMMISSION

Edited by Daniel Macfarlane and Murray Clemen

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The International Joint Commission and Water Quality in the Bacterial Age

Jamie Benidickson

Nineteenth-century belief in the capacity of running water to purify itself largely alleviated contemporary anxiety about the detrimental impacts from municipal sewage discharges. This comforting misconception persisted as an obstacle to reform when the International Joint Commission (IJC) conducted its first major pollution inquiry between 1912 and 1918.[1] As the new institution explored its innovative mandate, efforts to enhance water quality were thus significantly hampered by the perception that sewage was essentially a local nuisance or inconvenience accompanying vital municipal waste-water removal. Yet while water-based displacement of untreated municipal sewage substantially improved the living conditions of upstream residents, epidemics remained rampant as the nineteenth century drew to a close,[2] prompting no less a figure than former US president Theodore Roosevelt to argue in 1910 that "civilized people should be able to dispose of sewage in a better way than by putting it into drinking water."[3] To move beyond the rhetoric of "a better way," however, would require new and affordable treatment methodologies capable of securing institutional approval and ideally backstopped by an effective framework for enforcement. The search for that cluster of supporting conditions constituted Docket No. 4 of the IJC's official agenda. Although the IJC's first

boundary waters pollution reference (1912–18) did not resolve the water quality challenges of the early twentieth century, this bilateral initiative contributed significantly to greater awareness of bacterial contamination and potential responses. It did so on the basis of a substantial investigative effort involving extensive institutional collaboration and widespread community involvement along much of the Canada–United States border and beyond.

The Bacteriological Background

Ground-breaking scientific advances—notably bacteriological insights derived after the 1870s from the work of Louis Pasteur and Robert Koch—conferred substantial authority on public health officials, who were quick to question reassuring assumptions derived from the work of their forerunners in chemistry. As the new bacteriological era got underway, health officials set out to advance a water quality agenda consistent with the contagionist theory of the transmission of disease, even attempting to reshape local legal environments through new forms of regulation. These interventions, by no means welcomed by municipal leaders, involved a vigorous campaign to eliminate untreated discharges of civic wastes. The effort intermittently transferred debate from the local to the state, provincial, or national level. By the era of the First World War, senior public health officials on both sides of the Canada–United States border even spearheaded an ultimately unsuccessful international initiative to safeguard communities around the Great Lakes and along boundary waters.

By the late nineteenth century, popular and professional opinion in Europe and North America had begun to associate water quality in some way with disease, and public agencies were frequently established to assume responsibility for municipal water supplies. Yet, with the bacteriological transmission of disease still not well understood, linkages remained speculative.

The efforts of newly empowered public health officials focused on the vaguely characterized realm of "nuisance." One Canadian official, for example, circulated a questionnaire concerning nuisances attributed to industrial activity in 1886. Dr. Peter Bryce, who had previously investigated the public health implications of sawdust, now inquired into the number

and extent of slaughterhouses, dairies, and cheese factories, as well as piggeries. Breweries and distilleries were also to be tallied up, and special attention paid to cattle byres in the vicinity of the distilleries. Moreover, Bryce asked: "Are any of your streams polluted by town or city sewage; and if so, what is the extent of this pollution?"[4] But he could offer no guidance as to any standard relevant to the assessment.

In the same year, a Massachusetts State Health Commission, having examined the condition of inland waters, advocated a permanent body to assume responsibility. The designated state guardians of inland waters would be expected to familiarize themselves with the actual conditions bearing upon the relationship of water pollution and purity to public health. They were to address all remediable pollution and, through advice to cities, towns, and manufacturing concerns, to "use every means in their power to prevent further vitiation." In sum, the agency's function would be "to guard the public interest and the public health in its relation with water, whether pure or defiled." The ultimate goal, "which must never be abandoned," was that means might eventually be found to redeem and preserve all the waters of the state.[5] The shift away from the wishful thinking of such comparatively rudimentary investigation and exhortation came quickly in the wake of important discoveries regarding the transmission of typhoid.

Traceable to one home upstream from Plymouth, Pennsylvania, typhoid had led in 1885 to the deaths of 114 of the town's 8,000 inhabitants. Nearly a thousand more experienced but survived the disease.[6] Newark, Jersey City, Louisville, Cincinnati, and Philadelphia were among other American cities to encounter first-hand the ravages of late-nineteenth-century typhoid, whose transmission was facilitated by bacteria-contaminated sewerage and misunderstanding. For North Americans, much learning was derived from the experience along the Merrimack River, one of the three major waterways that Massachusetts legislators had chosen to exempt from pollution control measures in the 1870s.

Contemporary professional opinion had supported the decision to exempt the Merrimack. Health officials calculated—or assumed—that, by virtue of dilution and distance, the river would purify itself between points of waste-water discharge and water intake sites. Indeed, they embraced an even more mischievous doctrine—the notion of beneficial

contamination—whereby certain industrial wastes actually accelerated natural processes: "The sewage of Lowell is diluted with from 600 to 1,000 times its volume of water, and then flows a dozen miles to Lawrence, much of the refuse from the mills acting as a precipitant and disinfectant to it."[7] However comforting it must have been to imagine mill refuse as an antidote to the effects of sewage, beneficial contamination was a mirage. In little more than a decade, deaths from typhoid spiked dramatically in communities along the Merrimack. First in Lowell and shortly thereafter in Lawrence, whose water intake was nine miles downstream from the former community's sewage discharge, the toll of victims mounted. Investigation of the higher rates of illness and death along unprotected rivers produced "remarkably conclusive evidence of the river water supply being the direct cause of the epidemics."[8]

William Thompson Sedgwick, recently appointed as the first head of biology at the Massachusetts Institute of Technology, was recruited to investigate.[9] Sedgwick's meticulous observations established the point of origin for the outbreak in the privies of the neighbouring community of North Chelmsford, and traced the passage of the typhoid bacillus "down the river and over the falls" along the Merrimack into Lowell's water supply.[10] His report on Lowell was unequivocal about sewage practices and disease. Lowell and Lawrence, he declared, "have constantly distributed to their citizens water, unpurified, drawn from a stream originally pure but now grossly polluted with the crude sewage of several large cities and towns."[11]

Experimental work at Lawrence then helped to reveal how sewage might be purified.[12] The essential conditions, as explained to the Massachusetts State Board of Health, involved "very slow motion of very thin films of liquid over the surface of particles having spaces between them sufficient to allow air to be continually in contact with the films of liquid." Here, bacteria did their work, with the consequence that during an experiment conducted over several months, the intermittent filtration process over gravel stones removed 97 per cent of the organic nitrogenous matter, a large part of which was in solution, as well as 99 per cent of the bacteria. These organic matters were oxidized or burned, so that the resulting effluent contained only 3 per cent of the decomposable organic matter of the sewage.[13] By the early 1900s, twenty-three Massachusetts

towns and cities had adopted intermittent filtration sewage treatment plants to encourage bacterial decomposition.[14]

The importance of supplementing traditional chemical analysis of water with bacterial research had been firmly placed on the agenda by the pioneering bacteriological inquiries of Louis Pasteur and the subsequent investigations of Robert Koch. The former's microbial studies in the context of beer, wine, and vinegar production were soon followed in 1883 by Koch's investigation of a possible linkage between a distinctive "comma shaped" organism and the spread of cholera.[15] Very shortly thereafter, the etiology of typhoid and its relationship to sewage in waterways was more clearly understood: coliform bacteria, prevalent in human and animal feces, though not ordinarily found in water, signalled fecal pollution and indicated the possible presence of pathogenic organisms.[16] New biological insights, gathering support from the 1880s onwards, led to the recognition that germs, rather than noxious smells, putrefaction, or miasmas, were responsible for many diseases. Nonetheless, miasmas and their cousin, sewer gas, retained their status as treacherous foes for many years.[17]

Even where the new contagionist principles were acknowledged, the implications encountered resistance. A number of US courts had shown a singular reluctance to impose preventive obligations on private water supply companies. In 1891, for example, Pennsylvania water companies were relieved of the obligation to respond to new knowledge even though the court recognized that typhoid fever was "produced by a specific typhoid germ existing in the excreta of a person sick with that disease, which, being deposited in a stream, multiplies so that it contaminates the body of the water and reproduces the disease in the persons who drink it." A few years earlier, another Pennsylvania court had sharply lowered the performance bar: "Even comparatively pure water is hard to be obtained in large quantities, for in populous sections of the country where waterworks are most needed, neither rivers nor small streams can be kept entirely free of sewage." To the court, these were matters of "common observation" requiring no substantiation from experts; "purity" would thus be interpreted pragmatically to mean "wholesome, ordinarily pure." To put its dismissal of specialist opinion still more bluntly, the court emphasized: "We must use [pure] as it is used by the world at large and not in the abstract or chemical sense." In no other way would it be possible to attain the

court's chosen outcome of ensuring that a water company charter would remain "economically valuable."[18] But alongside economic considerations and financial constraints, sewage treatment faced governmental and institutional obstacles.

State Policy, Local Funding, and Someone Else's Health

As one early twentieth-century summary of governmental responsibilities for waste management commented: "The interest of the city is to get rid of its waste; the state sees to it that one municipality does not commit a nuisance upon others."[19] Following the Massachusetts example, state and provincial boards of health dominated by medical practitioners and public health professionals began to emerge.[20] National health organizations sprang up: the American Public Health Association in 1872, followed within a decade by the short-lived US National Board of Health, a response of the federal government to yellow fever devastating Memphis, New Orleans, and the Mississippi Valley. In Britain, the Public Health Act of 1875, with its requirements for local boards of health, represented a pivotal accomplishment. Equivalent institutions appeared in Canada.

Yet both in Britain and North America, controversy persisted about the appropriate location of responsibility for water quality. In 1882 a legislative committee in Ontario determined that the water supply was being polluted by privies in three-quarters of the eighty municipalities that responded to its inquiries. Remedial efforts were virtually non-existent and disease was widespread. The committee called for a provincially appointed board of health.[21] This body repeatedly encountered municipal penny-pinching in its efforts to persuade local councils to act systematically and methodically in dealing with the sewage of their burgeoning populations. In Toronto, where health officials had responsibility for sanitary conditions affecting nearly a hundred thousand people, civic leaders allocated a mere five hundred dollars to the local board of health.[22] The situation was not unlike that in Massachusetts a few years earlier, when nuisances such as polluted water and contaminated food were also accepted as the responsibility of town and city governments whose commitment was at best uneven.[23]

Yet as health officials assumed the role of the public "conscience" for water quality, their efforts remained grounded in the common law of nuisance. Law offered a few gratifying successes, but was equally a source of frustration, thanks to its preoccupation with property rights and procedural preconditions. Legislation greatly extended—indeed, formally created—the authority that health officials exercised over water. Simultaneously, it constrained that authority within broader norms.

Ontario health officials were initially encouraged by successes in the courts. In 1884 they reported enthusiastically: "The reading of the law has been so clear that verdicts against offenders have been obtained and remedies have been effected."[24] But early successes were short-lived. Waves of individual offenders were dishearteningly common in certain communities, and public health professionals soon grew sceptical of the legal process. It seemed excruciatingly difficult to establish nuisance at trial—"not only whether this or that condition is *injurious to the public health*, but whether it is *materially offensive to the senses*, or interferes with the *enjoyment of life and property*." Health officials lost confidence in the capacity of juries to reach decisions that they—as experts—would consider appropriate: "To make the question of whether a man with senses rendered obtuse is or is not nauseated by a smell a criterion of the existence or absence of a nuisance is as crude as was trial by fire in old Saxon times, since the guilt or innocence of the accused was tested by his power to endure pain."[25]

In reviewing American law on inland water pollution for the United States Geological Survey in 1905, Edwin B. Goodell found that despite uneven levels of "public enlightenment as to the deleterious effects of water pollution" there was no shortage of statutory initiatives to alleviate the problem.[26] These he presented in three rough categories. In the first, represented by seventeen states, Goodell could ascertain "no sense of the general desirability of pure natural waters, but only a desire to prevent certain acts recognized as criminal in intent or as likely to injure special groups of persons whom the legislature desires to protect."[27] These jurisdictions had simply enacted prohibitions, albeit often accompanied by the threat of imprisonment, for wrongs related to the offence of knowingly or wilfully depositing noxious, poisonous, or offensive matter in or near water supplies, springs, wells, or reservoirs. Judging from the frequency

with which specific prohibitions appear, dead animals were particularly adept at finding their way into the sources of water supply.

A further twenty states had gone somewhat further in protecting their water supplies. In this second grouping, prohibitions similar to those in Goodell's first category were often supplemented by greater detail—concern about contamination of ice supplies, for example. In addition, a number of these states had conferred modest regulatory authority over water pollution on boards of health, occasionally funding enforcement actions or the operation of laboratory facilities. A few states required permits for the discharge of waste water, some even insisting that sewage be treated before effluent could be released.

Eight states—New York, Minnesota, and Pennsylvania alongside the Great Lakes, plus Connecticut, Massachusetts, New Hampshire, New Jersey, and Vermont—constituted Goodell's third category. He credited these jurisdictions with "stringent methods to enforce the right of their citizens to unpolluted natural waters."[28] Their enactments, he anticipated, would control pollution so as "eventually to prevent all danger to public health." Refinements adopted in these states served to encourage regular water quality investigation and reporting. Authorizations to enter premises subject to public health regulations or considered possible sources of pollution were also commonly granted. Some states—New Jersey, for example—provided for sewerage districts or boards with supervisory responsibility over permits, treatment facilities, and the means of financing the costs of infrastructure. Remedial measures and the prevention of pollution were also addressed.[29]

For its part, in 1906 Ontario promulgated a more sternly worded general prohibition on a province-wide basis: "No garbage, excreta, manure, vegetable or animal matter or filth shall be discharged into or be deposited in any of the lakes, rivers, streams or other waters in Ontario, or on the shores or banks thereof."[30] In a later revision of the Public Health Act (PHA) that further fortified the public health arsenal, officials were empowered to develop regulations for preventing pollution in the province's lakes, rivers, streams, and other inland waters.[31] Perhaps most significantly, for purposes of the PHA, "nuisance" was redefined to pertain to more than inconvenience or aesthetic sensibilities: "any condition . . . which is

or may become injurious to health or prevent or hinder in any manner the suppression of disease."[32]

Regulatory measures against those whose actions threatened public welfare was undoubtedly an important alternative to the procedural and financial pitfalls of private litigation—or to formal criminal prosecutions in which technical and evidentiary requirements might prove insurmountable. But, as public health officials increasingly recognized, prohibitions against pollution were no more self-enforcing than the Ten Commandments. Indeed, the paradoxical coexistence of permissive regulations alongside prohibitions risked undermining the authority of the latter. As judges and other officials considered prohibitions and regulations on the front lines in local communities, the practical and symbolic significance of legislative measures were publicly tested, and anomalies in enforcement exposed.

Other incidents more positively suggested the potential of a determined environmental and public health bureaucracy to pursue its objectives—when supported by the judiciary and the legislature. In 1914, Dr. John W. S. McCullough, who was by this time actively associated with research for the IJC, put Ontario residents on notice that anyone contravening the pollution provisions of the *PHA* would be "prosecuted to the full extent of the law."[33]

Frederick A. Dallyn, sanitary engineer for the Public Board of Health (PBH), believed the time was ripe for the province to suggest collaborative ways for municipalities to handle their sewage as well as improve their water supply. Smaller municipalities were "keenly concerned" about the situation, he urged, but, as they lacked local engineers, could take no steps to assess the practicality of remedial alternatives. Assuming that the province would take some initiative, Dallyn outlined further issues to be considered. Would the PBH be content to discuss generalities and ultimately to generate a little business for consulting engineers, or would it wish to furnish each municipality with a plan and a general cost estimate, either at no charge or on the basis of some formula for cost recovery? Given provincial support, Dallyn argued, the engineering department might (without waiting for civic initiatives) collaborate with local health officers to campaign for improved sewers, treatment facilities, the extension of water

supply systems, and water purification processes—especially in smaller municipalities.

Unwillingness to address the challenge of treating sewage was not confined to smaller communities. Many major centres had a less than sterling record when it came to dealing responsibly with residential, commercial, and industrial wastes.[34] Nor was it entirely clear that local public health administrators could actually influence or accomplish sewage treatment to the degree that sanitary officials might have wished. The challenges were quickly compounded on a scale that affected entire watersheds in North America, including the Great Lakes and boundary waters, although the magnitude of the public health and environmental challenge to international watersheds was not yet widely recognized or acknowledged. Indeed, influential commentators occasionally even denied the need for intervention.

Wastes Unlimited in Boundary Waters

Allen Hazen, a prominent and experienced engineering consultant, dismissed sewage treatment in 1914 as a viable contributor to public health: "The Great Lakes are so large, and the dilution and time intervals and exposure to sun and air are so great that there is no chance of infection being carried from one of the great cities to another."[35] The sewage of Detroit, he categorically insisted, was harmless to Cleveland, while sewage from Cleveland posed no threat whatsoever to Buffalo. Perhaps Hazen was unaware of the extent to which the Detroit and Niagara Rivers were being exploited for waste disposal purposes in the late nineteenth century. Perhaps he had not heard of the barges of municipal waste that were being towed out by the Detroit Sanitation Company for dumping near Amherstburg, Ontario, emboldening Canadian customs officials to arrest the perpetrators. With a similar approach to waste management by Buffalo meeting the same fate,[36] mounting expressions of concern from both sides of the border encouraged the United States and Canadian governments to contemplate water supply and sewage treatment on a bilateral basis.

When it was finally assigned to the IJC, the public health challenge presented by bacterial water contamination was continental in scope and without any obvious means of resolution. The challenge was evident

enough in comparative typhoid mortality rates. These exposed a sharp contrast between the overall incidence in Canada and the United States (35.5 and 46.0 per 100,000, respectively) and the vastly more satisfactory results then being achieved in much of Europe. Even the worst European experience, in Hungary (28.3) and Italy (35.2), was better than the North American record. In the assessment of George Whipple, author of *The Microscopy of Drinking Water*, the overall situation in the United States as of 1907 saw cities with "reasonably good water supplies" reach a typhoid fever death rate of around 20 per 100,000. In communities whose supplies were "more or less contaminated" the rate rose up to 40 or 60.[37] A good many communities around the Great Lakes suffered substantially higher rates.

Powerful voices were being raised against the flood of sewage. Charles Evans Hughes, New York State's influential governor, had risen to prominence through his exposure of malpractice in gas utilities and insurance companies. Turning his energies to water quality, Hughes proclaimed in 1909—the date of the Boundary Waters Treaty—that the state could "no longer afford to permit the sewage of our cities and our industrial wastes to be poured into our watercourses." Roosevelt's previously quoted remarks pursued the same theme as he emphasized before a Buffalo audience the importance of protecting the quality of the Great Lakes. His prescription was directly linked to imperatives of public health when he proclaimed that "We must keep the water supply unpolluted and to do that you must see that it is not polluted in the source."[38] An American expert similarly questioned presumptions about the security of water supplies in the bacteriological era: "He who says that a polluted river will purify itself in the course of several miles reckons with an unknown force which will probably fail him at the critical time."[39] The Canadian equivalent was represented in a series of articles by T. Aird Murray, a Canadian civil engineer who endeavoured to call attention to the extent of the public health crisis attributable to contaminated water supplies.[40]

Against rapidly evolving scientific opinion, Canada and the United States took advantage of the newly created IJC to put water pollution on the international agenda. In 1912 the neighbouring countries specifically asked the newly established commission to investigate the location, extent, and causes of boundary water pollution that was injurious to public

health and rendered the affected waters unfit for domestic or other uses. Remedies were requested, whether involving the construction and operation of suitable drainage canals or treatment plants. The inquiry also encompassed potential preventive measures to make the waters of the Great Lakes sanitary and suitable for domestic and other uses, so as to fulfill treaty obligations. The parties had agreed that boundary waters and waters flowing across the boundary would not be polluted on either side to the injury of health or property on the other. Although the original terms of reference appeared to invite "an investigation of all boundary waters as … defined in the treaty without regard to the present or future transboundary effect of their pollution on either side," the two national governments subsequently determined to confine the scope of the inquiry to transboundary pollution. Either way, this was a tall order, the scale of which was perhaps not fully realized even after the eventual completion of the inquiry's work in 1918.

A preparatory conference in Buffalo, held on 17 December 1912, brought together representatives of the Canadian and US federal governments, as well as provincial and state officials from Ontario, Quebec, Illinois, Minnesota, New York, and Ohio. The Buffalo gathering identified a research agenda, which Dr. Allan J. McLaughlin of the United States Public Health Service would oversee as chief sanitary expert and director of fieldwork. Among the Canadian participants, Dr. J. W. S. McCullough and Dr. John A. Amyot of the Ontario Board of Public Health were named as consultants to the undertaking. By September 1913, the scope of the investigation had been determined, and arrangements formulated to examine the Niagara River; the Detroit River and connecting waterways from Lake Huron to Lake Erie; the St. Mary's River; the St. Lawrence River from Lake Ontario to the point where it departs from the boundary; and a portion of the St. John River.[41]

At this point, more than seven million people lived along the boundary waters, from Lake of the Woods between Ontario and Minnesota on the west, to the St. John River flowing between New Brunswick and Maine in the east. Extensive pollution, signalled by the presence of certain micro-organisms in water samples, was common in centres of population.[42]

The research program involved analysis of about 18,000 samples taken from 1,500 locations and reviews of the historic incidence of certain

diseases, accompanied by an elaborate program of interviews and correspondence. In concluding what they described as the most extensive investigation and bacteriological examination ever made in the world, the commissioners presented their preliminary findings in 1914. In the absence of comprehensive information establishing historic baselines, the report's authors made comparative references to conditions in other jurisdictions. However, the use of these horizontal benchmarks—perhaps the best or most persuasive indicators that might have been obtained—had the effect of establishing standards already far removed from pre-industrial conditions on the lakes. Pollution was therefore being defined against a baseline or norm that appeared already to take for granted a significant level of contamination from human activity.

Addressing the effects of pollution on public health, the commissioners indicated that—apart from public water supplies—the sanitary and climatic conditions of cities and towns around the Great Lakes were much better than national averages, and infinitely better than those pertaining in the filthy, overcrowded, and often impoverished cities of Europe. Yet despite such advantages, excessive rates of typhoid fever persisted in Great Lakes communities. The explosive epidemics sometimes seen in the region were said to be without parallel in the European context. While death rates attributed to typhoid fever averaged less than 5 per 100,000 in the large cities of Northern Europe, where water supplies—often underground—enjoyed better protection, the Great Lakes inquiry revealed disturbingly high impacts in many North American communities. Between 1910 and 1912, the death rate per 100,000 ranged from 15 in Detroit to well over 100 in many centres, and it skyrocketed to over 300 in Ashland, Wisconsin.[43] As generalized in the context of the IJC's final report in 1918, "the intolerable condition of boundary waters from a sanitary standpoint"[44] was widely acknowledged. The situation was "generally chaotic, everywhere perilous and in some cases disgraceful."[45]

The IJC's advisors advanced a straightforward explanation directly implicating untreated sewage in the public health crisis: "The greatest single factor in this avoidable and remediable pollution is the sewage discharged without restriction or treatment of any kind by the municipalities situated on the boundary waters."[46] The situation at the Niagara River illustrated this crucial finding. On the American side, a population of roughly 615,000

(including 100,000 rural residents and more than 500,000 in the cities of Lackawanna, Buffalo, Tonawanda, North Tonawanda, and Niagara Falls), occupying approximately 2,000 square miles, discharged raw sewage directly into the river above the Falls.[47] The waters below the Falls were dangerously polluted, affecting municipalities on both the Canadian and American sides. Buffalo, a city of 460,000 people, was the most important contributor to Niagara River pollution. This city discharged all its sewage in an untreated state into the river above the intakes of the public water supplies of all the downstream communities.[48] The researchers' analysis of this popular tourist mecca was clear in its assessment of the implications: they rejected the popular impression that the action of the Falls purified sewage. "It simply mixes it more thoroughly with the water; it does not remove it or its danger. The pollution below the Falls is gross."[49]

The Canadian situation had yet to be addressed in detail by sanitary experts, but at Niagara-on-the-Lake researchers reported "the injurious effects of the pollution from the upper cities on the river have been seriously felt." These findings were in marked contrast to the assessment gratuitously offered by British engineer James Mansergh in an 1896 report on Toronto's water supply. Mansergh had quoted the highly regarded Dr. Edward Frankland on the quality of the Niagara River at the entrance to Lake Ontario: "The water of the Niagara River as it enters Lake Ontario is of excellent quality, for, although it has received the sewage of Buffalo and other places, the immense volume of water with which this is mixed renders its effect upon the chemical, as distinguished from the bacteriological character of the water, inappreciable." Yet Mansergh had added an essential caution that was taking some time to register with municipal officials around the Great Lakes: "The bacteriological condition of the water intended for dietetic purposes is probably of greater importance than its chemical composition."[50]

There was no particular reason apart from size to single out individual municipalities for critical comment, since the expert investigators had quite categorically concluded that "Every municipality, without exception, in the area investigated of the Great Lakes and their connecting rivers, avails itself of the opportunity to discharge its sewage untreated into these international waterways. This is the largest factor in their pollution."[51] For purposes of the final report to the national governments, the IJC explained

that "The present international situation is not the result of any desire on the part of the inhabitants of either country to ignore international obligations either of comity or of law, but is the outcome of the failure on the part of the urban communities in each country, respectively, to recognize from a sanitary standpoint any right in other communities to river waters, especially communities on their own side of the boundary line."[52] In general terms, therefore, the problem confronting the IJC involved finding ways to alter long-established and accepted practices whose unintended adverse consequences were largely experienced by others.

As early as its interim report, the IJC offered up success stories as examples for other communities to follow: Cleveland saw its typhoid death rate fall to single digits—7 per 100,000 after 1912—while Erie, Pennsylvania, recorded equally positive improvements. The interim report then advanced a finding with immense and continuing significance for future water-quality management: rather than treating sewage—the outflow—communities such as Erie and Cleveland had taken advantage of new chemical or mechanical procedures to treat water prior to consumption. These means would increasingly expose a gulf between the protection of human health and the preservation of the natural environment.[53]

Dr. McLaughlin, in his advisory capacity, expressed the opinion that a sewage-oriented campaign would be futile: "The source of Detroit's water supply is polluted," he declared, "and the attempt to purify is ineffectual."[54] The Tonawandas and Lockport suffered an even more intemperate dressing-down: the residents of Tonawanda and North Tonawanda "still drink sewage-polluted water, expending their energies in a fruitless effort to improve sewerage conditions in the Upper Niagara River instead of protecting themselves by treating their own water supplies." The town of Lockport drew water from the same source, and, "in spite of repeated warnings and advice," followed the same course as the Tonawandas. In forty-eight hours and at a cost of under a thousand dollars, Dr. McLaughlin insisted, a plant could be installed to treat the water supply with hypochlorite of lime. Treatment costs would be less than fifty cents per million gallons. Even if it were later decided to construct a filtration plant, temporary arrangements of this nature were vital to save lives in the interim: "There is no excuse for delay in making the temporary installation."[55]

The priority accorded human health in these circumstances was by no means surprising, and where modest expenditures would allow civic officials to deal quickly and effectively with the threat of typhoid—after several promptings in the case of the Tonawandas—McLaughlin's rebuke was well-deserved. But emphasis on remedial water treatment in the immediate interests of human health, rather than a comprehensive preventive alternative, also signalled official acknowledgement within much of the medical community that, despite Roosevelt's vision of civilization, the flushing of untreated municipal wastes would not readily be curtailed at the start of the twentieth century.

A notable exception to the investigation's initial recommendation to forsake sewage discharge controls in favour of drinking water treatment—and a direct rejoinder to Allen Hazen's broad assurance that the water supplies of Great Lakes communities were entirely secure from each other's sewage—concerned vessels plying the Great Lakes. The scale of the phenomenon and its potential contribution to the contamination of the Great Lakes was apparent from the fact that in 1912 alone twenty-six thousand vessels passed through the Detroit River. These and other vessels navigating the Great Lakes and connecting waterways annually transported a population of at least fifteen million. The sewage these vessels discharged indiscriminately along their routes—and in harbours—contributed materially to pollution in both countries.[56] Even ballast was problematic, since some vessels took on water ballast before leaving port and discharged it just before entering the port of destination. There was therefore a danger of polluted water being discharged near the intake of a city water supply in an otherwise uncontaminated harbour.[57] And, of course, passengers themselves were at risk, for even though lake vessels were supposed to fill their drinking tanks in mid-lake—ostensibly far removed from sources of pollution—the distance that pollution travelled from shore made it difficult to find unpolluted areas. "There is excellent evidence," the commissioners noted, "to show that vessels frequently fill their tanks from polluted sources."[58] Officials on the American side conducted a survey of lake vessels to determine whether any were equipped with holding tanks or other retaining devices. Without exception they were not so equipped; the sewage outlet pipes from these lake vessels discharged directly into the water.[59]

As chief sanitary officer of the 1912 international investigation, Dr. McLaughlin had perhaps not entirely abandoned sewage treatment as a public health measure, but rather recognized that it would not likely come about through the ad hoc initiatives of individual communities. He argued, as British and Canadian authorities were also inclined to observe, that a more encompassing authority was essential: "The problem of pollution of interstate and international waters is so broad and affects so many interests that it necessitates for its equitable and efficient handling a central directing authority independent of local influences and prejudices."[60] The 1918 final report built upon this insight in its recommendation for institutional reform, a proposal—ultimately unsuccessful—for the IJC itself to receive authority to make the required "rules, regulations, directions and orders."[61]

It was becoming increasingly urgent on both sides of the Canada-US border to ascertain which level of government was most suited to respond effectively to the distinctive and growing challenges of controlling water pollution. Each of the existing options—local, national, or the intermediate-level jurisdictions of state or provincial governments—had plausible claims. Local governments have always asserted a degree of responsiveness to community sentiment greater than state, regional, or provincial jurisdictions might offer, while the latter have tended to insist that the remoteness of national institutions disqualifies them from involvement in activities and services intimately associated with the preferences and well-being of individual communities. From the perspective of problem-solving and effectiveness, however, the calibre of personnel and access to financial resources—purse-string politics—have sometimes favoured national-level initiatives.

Whereas in the United Kingdom tension between local and national institutions was perpetuated in philosophical considerations and deeply rooted traditions, in the North American federations the potential for inter-jurisdictional controversy and uncertainty was embedded in constitutional documents. As a new generation of public health issues came to prominence, national governments were forced to reflect on their potential contributions and responsibilities, and the jurisdictional basis for any actions they might contemplate. When pollution concerns of the Progressive Era coincided with the formation of the US Public Health

Service in 1912, Congress authorized the new institution to study the problem. The PHS established a Center for Pollution Studies in Cincinnati, although its mandate was congressionally confined to navigable waters. Despite the absence of any powers to compel abatement, the PHS enjoyed considerable success persuading state and local authorities to adopt water treatment along uniform standards.[62] Thus it came about that interstate transport provided the leverage on which federal regulation of drinking water quality oriented around bacterial standards was introduced in the United States.[63]

Navigable waters and transportation also grounded federal water quality initiatives in Canada, where the public health implications of sewage discharges were widely apparent. Within a decade of the first US federal drinking water quality standards, the Canadian government followed suit with bacterial quality standards for drinking water and water used for culinary purposes on vessels engaged in inter-provincial and international transport.[64] Yet authority over navigable waters was ultimately too limited a basis on which to proceed against the ever-increasing volume of sewage and industrial waste pouring into Canadian waterways.

The IJC's wartime quest for a satisfactory resolution of the uncertain local-state-national allocation of will and capacity in relation to sewage pollution resulted in an array of sophisticated diplomatic suggestions designed to safeguard public health at a cost that would appear affordable and without ruffling municipal feathers. Accordingly, it was recommended that all sewage destined for boundary waters should receive some purification, "and [that] the degree of such treatment is to be determined in a large measure by the limits of safe loading of a water-purification plant."[65] In the commission's words, "to the extent that is consistent with a proper degree of autonomy by the urban communities interested, all boundary waters should be subject to regulations prescribed by . . . some authority clothed with the necessary power."[66] From a cost perspective, though, "sewage treatment requirements must not be made so excessive and unreasonable as to involve the cities and towns along these waters in an expenditure entirely unjustifiable."[67]

The strength and persistence of reservations against sewage treatment contributed to the eventual abandonment of the IJC's early anti-pollution initiative.[68] It is noteworthy nonetheless that the 1912–18 pollution

reference—notably its formulation of scientific guidance—stimulated both binational and multi-level intergovernmental exchange, a precedent if not a model for subsequent water quality protection initiatives.

National Default and International Failure

Campaigns for national action against sewage contamination were intermittently underway on both sides of the border alongside the IJC inquiry. In 1910, as President Roosevelt was calling for action in the United States, Canadian senator Napoléon Belcourt, an Ottawa resident, called on Parliament to declare that "our noble rivers shall no longer be made the receptacles of the raw sewage of the country."[69] His proposal was diverted to Canada's newly created Commission of Conservation, which recommended a modified version. Although passed by the Senate, the measure—a prohibition against contaminating navigable water in Canada, subject to specifically authorized exemptions—was not considered in the House of Commons because of the unexpected dissolution of Parliament.

Over the years, Belcourt's advocacy of national anti-pollution measures was vigorous and wide-ranging. He turned to history, and Roman law in particular, for the principle that water "is a natural commodity provided by the law of creation for the use of man." "Consequently," Belcourt argued, putting his claim on a very high plane, "the individual and the public as well, have an inalienable and indefeasible right to pure water."[70] But the senator's proposition never became a rallying cry.[71] Belcourt furnished evidence that stringent legislative provisions had been implemented to this effect in European jurisdictions. And, lest apprehension about the practical challenges deter action, he offered a brief inventory of successful—ostensibly even profitable—sewage treatment procedures.[72]

Outside Parliament, Aird Murray promoted government action along the lines of Belcourt's initiatives. Murray voiced the concern that isolated provincial actions would never achieve more than localized responses based on local interests, and that many aspects of the pollution problem would be ignored: "For example the province of Ontario may have the most stringent laws relative to water pollution, and after putting its house in order would be yet dependent upon the action taken by the province of Quebec relative to the pollution of the Ottawa river whose banks are

interprovincial."[73] Similarly, referring to the United States, he wrote, "while one state may have drastic laws with reference to river pollution, the adjoining state may have none."[74] Action at the national level, on the other hand, offered attractions: standardized information could be assembled, neglected problems of interprovincial pollution could be addressed, and the array of questions associated with Canada-US boundary waters could be effectively confronted.[75]

Despite the apparent attractions, critics showed no hesitation. Senator McSweeney voiced a strong reservation, inquiring on behalf of the city of Moncton, New Brunswick, whether that community would be put to great expense by the far-ranging proposal. Moncton was by then well accustomed to discharging its sewage into the Petitcodiac River, confident in the capacity of this tidal waterway to flush municipal waste thirty miles into the Bay of Fundy, whence it would be swept into the ocean.[76] Exemptions were available under the proposed amendment, Belcourt assured his senatorial colleagues, but the expression of doubt was underway. Other senators queried the constitutional authority of the federal government to enact the proposed measure, imagining it to fall more appropriately within provincial jurisdiction. The suggestion was made that the criminal law, statutorily codified in Canada in 1892, was a more suitable location for a prohibition of the sort envisaged. But it was the measure's practical implications that occasioned the most doubt.

Perhaps established communities could be spared, one senator reflected, if the proposed measure could be confined to new localities. Having satisfied himself that Montreal could not possibly prevent its own sewage from accumulating along the St. Lawrence waterfront, Senator Casgrain advanced the self-interested proposition that "it would be a great improvement if in all the new places being constantly established above Montreal such a system were adopted."[77] The *Sanitary Review* was thus fully vindicated in its assessment of Montreal as "a hygienic disgrace to civilization."[78]

A former Canadian prime minister, Sir Mackenzie Bowell, expressed the opinion that the Belcourt proposal as drafted was too wide in its implications to be carried out. By way of example he described the circumstances of his own community on the Moira River, which flowed to Lake Ontario's Bay of Quinte. The Moira, he explained, extended some

hundreds of miles to the north along a course into which twenty or more villages of various sizes emptied their sewage. Numerous other communities along tributary creeks and branches similarly discharged wastes that descended the Moira to the very navigable Bay of Quinte. The proposed legislation, Bowell protested, "provides that if a dead horse is thrown into the river a hundred miles north of its outlet, or sewage from any of the towns or villages upstream is deposited in the waters running into the Bay of Quinte, then the operation of this law could be invoked, because the River Moira empties into the Bay of Quinte."[79] The former prime minister thus emerges as a stalwart defender of the right to throw dead horses and discharge sewage into rivers against the inalienable right to pure water championed by Belcourt. To this end Bowell invoked "scientific treatises" purportedly establishing "very clearly that once sewage is emptied into a running stream, after it has travelled a certain distance it purifies itself."[80]

Belcourt had at least one strong ally in the person of Senator James Lougheed, who seems to have appreciated both the promise and the limitations of his colleague's proposal. While by no means a panacea, Belcourt's measure struck Lougheed as an initiative that had "set public opinion in motion." Something useful might result to address a tragic state of affairs, he said: "all our public streams, provincial and inter-provincial are becoming practically the great sewers of the Dominion." Municipalities, he observed, find it cheaper in their attempts to avoid indebtedness, "to empty their sewers into the streams which run by their doors, than to adopt some scientific method which possibly will cost more, for the purpose of cremating or otherwise destroying the sewage of that community." Concerted national action, Lougheed concluded, was essential to confront the intolerable situation that had developed: "We seem to have concluded that nature has placed those streams by our doors to carry off our sewage, and notwithstanding the fact that the community requires pure water, yet we will reject the best methods of purification and take the consequences. It seems to me we have reached that stage."[81]

Napoléon Belcourt's campaign against pollution of navigable waters during the 1912–15 period coincided with work on the IJC reference, and it encountered comparable obstacles. Municipalities resisted expenditures on sewage treatment where the benefits seemed to accrue to the neighbours. Other municipal critics, notably in coastal communities blessed with the

apparent infinity of the undrinkable oceans, rejected national sewage treatment measures as irrelevant to their circumstances, and found amenable parliamentary allies. Constitutional reservations persisted, while the boldness of the flushing constituency reached new heights: Montreal senator Henry Cloran maintained that Canada's geography provided "rivers and lakes large enough to contain all the refuse that the inhabitants of the country could discharge into them, without danger of contagion to the people."[82] A blessed country indeed.

To the extent that Belcourt's proposal had actually secured a sufficient number of allies, even including government supporters, to sustain active interest in Canadian pollution legislation applicable to navigable waters, that pressure dissipated with anticipation of the IJC's final report on boundary water pollution. The desire to avoid inconsistent action, the virtues of being more fully informed, and the significance of simple courtesy or respect for the commission's efforts all counselled delay. Unfortunately, the IJC did not report in 1915 as expected, nor in 1916, nor the year after that. Only in September 1918 did the product of over half a decade of scientific and engineering research, public consultations, and vigorous deliberations emerge from the IJC.[83]

Whether a sincere interest in receiving the findings of the IJC's work, as opposed to the availability of a convenient source of delay, had caused Canadian authorities to set aside the Belcourt initiative is of some interest. Evidently the commission considered the delay unnecessary or merely opportunistic, for it cited the disinclination of governmental authorities at all levels to take responsible action as grounds for endowing yet another jurisdiction with authority over Great Lakes waters and effluent quality, and would have assigned that responsibility to itself.[84]

In relatively short order—that is, by March 1919—the two national governments agreed to call upon the IJC to formulate a convention or to draft concurrent legislation for the purpose of conferring such authority as would be necessary to remedy existing pollution problems. In completing this assignment the following year, the commission proposed a draft treaty that would allow it to investigate sources of pollution on its own initiative while leaving enforcement matters to be addressed on the basis of national legislation.[85] That the fledgling IJC was prepared to assert this level of autonomy over its own potential mandate was indeed remarkable.

Intermittent international negotiations throughout the twenties finally lapsed completely in 1929, to some degree in consequence of other preoccupations triggered by the Great Depression. At the end of the decade, though, health officials still imagined that some basic treatment standard would be adopted for international waters and that the example would inspire communities elsewhere to do the right thing. Only a collective initiative, it was now assumed (in a manner that foreshadowed twenty-first-century global climate policy), could overcome the natural inclination of communities to defer significant local measures in the interests of a wider constituency until they were confident that their efforts would be reciprocated. "So many of our municipalities are located on international waters where similar conditions exist on both sides that there is a distinct tendency to make no move until assurance is given that other offenders will follow the same course." A committee representing communities bordering on international waters had already been formed. It had agreed upon sedimentation as a minimum treatment at such time as treatment might be considered necessary. Ideally, such an example "should have an excellent effect on inland centres where conditions are generally more acute by lack of sufficient dilution water."[86] But time, as we know, then passed.

Conclusion

The IJC's early experience with pollution exhibited a number of notable features. Firstly, of course, the pollution reference addressed a subject whose innovative inclusion in the Boundary Waters Treaty had been something of a struggle. Agreement on the reference, thus, in and of itself, suggests some softening of previous resistance, possibly in the face of prominent calls from both sides of the border, for action. The pollution reference also coincided with important advances in scientific and professional understandings of the role of bacteria in public health. This experience foreshadows future examples of the transboundary influence of experts in fostering a shared outlook. The researchers, by all accounts, collaborated effectively and with a common purpose in mind and offered a valuable illustration of the potential for scientific deliberations to stimulate discussion, if not to resolve policy challenges.

Clearly, if the reference coincided with a new understanding of waterborne diseases, there was no comparable clarity in relation to potential solutions ranging from protecting natural water sources through treating public drinking water supplies. The latter approach ultimately carried the day. This in turn allows us to highlight another feature of the early pollution era, a period focused clearly on public health rather than environmental quality more generally. Later water quality considerations (addressed in several other chapters in this volume) were almost entirely absent from early twentieth-century deliberations apart from passing references to recreational enjoyment of boundary waters and to fishing.

The IJC's boldness or assertiveness in offering itself as a formal source of regulatory authority concerning standards is also notable. The attractions and the pitfalls of such a role are a further aspect of the legacy of the IJC's first water quality inquiry, and should be noted alongside important contributions to capacity-building that resulted from pioneering investigative work, the active exchange of comparative research findings, and the engagement of officials from all levels of government.

Notes

1 International Joint Commission, *Final Report of the International Joint Commission on the Pollution of Boundary Waters Reference* (Ottawa and Washington, DC: Government Printing Bureau, 1918), 27; hereafter "1918 Pollution Reference."

2 J. A. Hassan, "The Growth and Impact of the British Water Industry in the Nineteenth Century," *Economic History Review* 39 (2nd Series) (1983): 531 at 543.

3 Joel A. Tarr, Terrie Yosie, and James McCurley, "Disputes Over Water Quality Policy: Professional Cultures in Conflict, 1900–1917," *American Journal of Public Health* 70 (1980): 427. See also "Mr Roosevelt and the People," *Outlook* 96 (1910): 1, as quoted in Joel A. Tarr, "Environmental Risk in Historical Perspective," in *The Social and Cultural Construction of Risk: Essays on Risk Selection and Perception*, ed. Branden B. Johnson and Vincent T. Covello (Dordrecht, NL: D. Reidel, 1987), 317 at 320; "The Pollution of Lakes and Rivers," *Outlook* 96 (1910): 144–5.

4 Ontario Archives, Provincial Board of Health, RG62 Series B4, Scrapboooks, Item 32, 1884, "Sawdust Survey," PH Bryce, Secretary; Ontario Archives, RG 62B4, Scrapbooks, Item 56, 10 May 1886.

5 As quoted by C. -E. A. Winslow, "Pioneers of Sewage Disposal in New England," in *Modern Sewage Disposal*, ed. Langdon Pearse (New York: Federation of Sewage Works Associations, 1938), 276 at 279.

6 Donald J. Pisani, "Fish Culture and the Dawn of Concern over Water Pollution in the United States," *Environmental Review* 8, no. 2 (1984): 24.

7 Health Committee of the Massachusetts Board of Health, "Lunacy and Charity," quoted in Barbara Gutmann Rosenkrantz, *Public Health and the State* (Cambridge, MA: Harvard University Press, 1972), 81.

8 Ontario, Provincial Board of Health *Annual Report, 1892*, 50.

9 John Duffy, *The Sanitarians: A History of American Public Health* (Urbana and Chicago: University of Illinois Press, 1990) 176, 194, 201–2.

10 "Report of Sedgewick's presentation to the Lowell Water Board," 9 January 1891, available through the University of Massachusetts at Lowell, Center for Lowell History, available at https://uml.worldcat.org/title/report-upon-the-sanitary-condition-of-the-water-supply-of-lowell-mass-presented-to-the-water-board-of-lowell-april-10-1891/oclc/55483004?referer=di&ht=edition.

11 Quoted in Rosencrantz, *Public Health and the State*, 105.

12 Ibid.

13 Quoted in C. -E. A. Winslow and Earle B. Phelps, "The Purification of Boston Sewage," (Washington, DC: United States Geological Service, 1906), 37.

14 Ibid., 39.

15 Keith Vernon, "Pus, Sewage, Beer and Milk: Microbiology in Britain, 1870–1940," *History of Science* 28, no. 3 (1990): 289.

16 Joel A. Tarr, "Industrial Wastes and Public Health: Some Historical Notes, Part 1, 1876–1932," *American Journal of Public Health* 75, no. 9 (1985): 1059 at 1060.

17 Duffy, *The Sanitarians*, 129, 187.

18 Earl Finbar Murphy, *Water Purity: A Study in Legal Control of Natural Resources* (Madison: University of Wisconsin, 1961), 29–30.

19 Henry Bixby Hemenway, *Legal Principles of Public Health Administration* (Chicago: T. H. Flood, 1914), 684.

20 45 Vict. (1882), c. 29.

21 J. E. Hodgetts, *From Arm's Length to Hands-On: The Formative Years of Ontario's Public Service, 1867–1940*, (Toronto: University of Toronto Press for the Ontario Historical Studies Series, 1995), 20–1.

22 Ibid., 14.

23 Rosenkrantz, *Public Health and the State*, 52.

24 Ontario, Provincial Board of Health *Annual Report, 1884*, 15, 22, 26.

25 Ibid., 22.

26 Edwin B. Goodell, "A Review of the Laws Forbidding Pollution of Inland Waters in the United States" (Washington, DC: United States Geological Survey, Department of the Interior, Water-Supply and Irrigation Paper No. 152, 1905), 32.

27 Ibid., 33.

28 Ibid., 73.

29 Ibid., 107, 109.

30 Charges were laid under the Public Health Act 2 George V, c. 58, s. 91. The prohibition was introduced to Ontario law by the Statute Law Amendment Act, 1906 6 Edward VII S.O. c. 19, assented to 14 May 1906.

31 S.O. 1912 c.58 s.8(o).

32 S.O. 1912 c.58 s.73.

33 See, for example, *Re Waterloo Local Board of Health. Campbell's Case* (1918), 44 OLR 338.

34 Michele Dagenais, *Montreal et l'eau: une histoire environnementale* (Montreal: Boréal, 2011); Nancy B. Boucher and Ken Cruikshank, *The People and the Bay: a social and environmental history of Hamilton Harbour* (Vancouver: UBC Press, 2016).

35 Allen Hazen, *Clean Water and How to Get It*, 2nd ed. (New York: John Wiley, 1914), 31.

36 Margaret Beattie Bogue, *Fishing the Great Lakes: An Environmental History, 1783–1933*, (Madison: University of Wisconsin Press, 2000), 144–5.

37 George C. Whipple, *The Value of Pure Water* (New York: John Wiley and Sons, 1907), 36.

38 "Mr Roosevelt and the People," 1.

39 Marshall Ora Leighton, *Sewage Pollution in the Metropolitan Area near New York City and its Effect on Inland Water Resources* (Washington, DC: US Government Printing Office, 1902), 10.

40 T. Aird Murray, *The Prevention of the Pollution of Canadian Surface Waters* (Ottawa: Commission of Conservation, 1912). The three articles reproduced in this pamphlet originally appeared in the Toronto *Globe*, 30 December 1911 and early January 1912.

41 IJC, Progress Report of the IJC on the Reference by the United States and Canada in "The Pollution of Boundary Waters," 16 January 1914, 2–7; henceforth "1914 Progress Report."

42 For a description of the use of "indicator" organisms to detect contamination, see D. Krewski, J. Babus, D. Butler-Jones, C. Haas, J. Isaac-Renton, K. J. Roberts, and M. Sinclair, "Managing Heath Risks from Drinking Water," *Journal of Toxicology and Environmental Health* 65 (2002): 1635 at 1692–5.

43 IJC, 1914 Progress Report, 14. During at least one of the three years preceding the reference (1910–12), a death rate (per 100,000) of over 300 was registered in Ashland, Wisconsin; of 109 in Marquette, Michigan; of 196 in Port Huron, Michigan; of 194 in Niagara Falls, New York; of 190 in Erie, Pennsylvania; and above 50 in the Michigan communities of Alpena, Bay City, and Sault Ste. Marie, as well as in Duluth, Minnesota, and Sandusky, Ohio. The Ontario side produced equally alarming numbers—330 in Sault Ste. Marie; 179 in Port Arthur; 134 in Sarnia; 86 in Niagara Falls; 63 in Brockville; and 55 and 57 in Windsor and Walkerville, respectively. Even comparatively fortunate

Great Lakes cities such as Detroit, where the rate had never fallen below 15, and in 1913 had a rate of above 30, were operating at levels of typhoid that would not be tolerated in Europe.

44 IJC, 1918 Pollution Reference, 39.

45 Ibid., 31.

46 IJC, 1914 Progress Report, 12.

47 The exception was Lackawanna, which discharged its water through Smoke's Creek a mile and a half above the head of the river.

48 IJC, 1914 Progress Report, 8.

49 Ibid., 45.

50 James Mansergh, *The Water Supply of the City of Toronto, Canada* (Westminster, 1896), 19.

51 IJC, 1914 Progress Report, 21.

52 IJC, 1918 Pollution Reference, 48.

53 IJC, 1914 Progress Report, Appendix, 354.

54 Ibid., 353.

55 Ibid., 356.

56 Ibid., 3.

57 Ibid., 7–8.

58 Ibid., 12.

59 Jamie Benidickson, *The Culture of Flushing: A Social and Legal History of Sewage* (Vancouver: UBC Press, 2007).

60 Writing in the US Public Health Service Annual Report 41–41 (1913), as quoted in L. B. Dworsky, "Assessing North America's Management of its Transboundary Waters," *Natural Resources Journal* 33 (1993): 427.

61 IJC, 1918 Pollution Reference, 50, 52.

62 John Capper, Garrett Power, and Frank R. Shivers Jr., *Chesapeake Waters: Pollution, Public Health and Public Opinion, 1607–1972* (Centreville, MD: Tidewater Publishers, 1983), 97. See also William L. Andreen, "The Evolution of Water Pollution Control in the United States—State, Local and Federal Efforts, 1789–1972, Part II," *Stanford Environmental Law Journal* 22 (2003): 222–3; N. William Hines, "Nor Any Drop to Drink: Public Regulation of Water Quality, Part III: The Federal Effort," *Iowa Law Review* 52 (1967): 804–5.

63 The initial US Treasury Department standard specified a maximum limit of 2 B. coli per 100 c.c. George W Fuller, "Relations Between Sewage Disposal and Water Supply are Changing," *Engineering New-Record*, 5 April 1917, 12.

64 B. Grover and D. Zussman, *Safeguarding Canadian Drinking Water* (Ottawa: Inquiry on Federal Water Policy, Research Paper No. 4, 1985); Frank Quinn, "The Evolution of Federal Water Policy," *Canadian Water Resources Journal* 10 (1985): 21 at 25.

65 IJC, 1918, 36.

66 Ibid., 48.

67 Ibid., 36.

68 For a more comprehensive review of the challenges of introducing sewage treatment, see Benidickson, *The Culture of Flushing*.

69 Senate of Canada, Debates 2 March 1910, 349.

70 Senate of Canada, Debates 2 March 1910, 335.

71 The Boundary Waters Treaty had put domestic uses at the top of its hierarchy, and distinguished sanitation.

72 Senate of Canada, Debates 2 March 1910, 342.

73 Murray, *Pollution of Canadian Surface Waters*, 7.

74 Ibid., 8.

75 Ibid., 6.

76 Senate of Canada, Debates 2 March 1910, 341 (Senator McSweeney).

77 Senate of Canada, Debates, 3 March 1910, 352–3 (Senator Casgrain).

78 *Canadian Engineer* 16 (16 April 1909): 527.

79 Senate of Canada, Debates, 3 March 1901, 370.

80 Ibid.

81 Senate of Canada, Debates, 3 March 1910, 371–2.

82 Jennifer Read, "Water Pollution Management in the Great Lakes Basin, 1900–1930" (paper presented to Themes and Issues in North American Environmental History Conference, April 1998), 9. See also Jennifer Read, " 'A Sort of Destiny': The Multi-Jurisdictional Response to Sewage Pollution in the Great Lakes, 1900–1930," *Scientia canadensis* 55 (1999): 103–29.

83 *Final Report of the International Joint Commission on the Pollution of Boundary Waters Reference* (Ottawa and Washington, DC: Government Printing Bureau, 1918).

84 Read, "Water Pollution Management in the Great Lakes Basin," 14–15.

85 F. J. E. Jordan, "Great Lakes Pollution: A Framework for Action," *Ottawa Law Review* 5 (1971): 65 at 69.

86 Provincial Board of Health *Annual Report, 1929*, 49.