Fixing Niagara Falls

Environment, Energy, and Engineers at the World's Most Famous Waterfall

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FOREWORD BY GRAEME WYNN

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INTRODUCTION

Characterizing Niagara

If you wish to see this place in its grandeur, hasten. If you delay, your Niagara will have been spoiled for you. Already the forest round about is being cleared. The Romans are putting steeples on the Pantheon. I don't give the Americans ten years to establish a saw or flour mill at the base of the Cataract.

Alexis de Tocqueville, 1831

My first experience at Niagara Falls was on the return leg of a long family vacation. It was the summer before my last year of high school. I don't remember most of that trip to Niagara, aside from a few foggy snippets. I vaguely recall going on the *Maid of the Mist,* though perhaps I am confusing photographs with memories. But I definitely remember experiencing a general sense of awe. Niagara Falls obviously made enough of an impression on me that I was like fertile soil when, in the course of doing research on other aspects of the Great Lakes–St. Lawrence system more than a decade after that family excursion, I discovered that Niagara Falls had been heavily manipulated.

In fact, one could almost say that Niagara Falls is *fake.*

It might be jarring to hear such a statement. After all, Niagara Falls is the world's most famous waterfall. Niagara was *the* epitome of the natural sublime. Though the meaning of "the sublime" has changed over time, it was classically defined by Edmund Burke in a 1757 treatise as natural features that combined beauty, awe, and terror. "Sublime" was a favourite word in eighteenth- and nineteenth-century accounts of visiting the Falls. Though Niagara is no longer the quintessential example of the sublime, it still has ineffable qualities and persists as an icon – or cliché – that has attained the status of a common reference point. We compare things to Niagara Falls to convey a sense of size, magnitude, and grandeur. Though it is neither the tallest, widest, nor largest waterfall by volume, it

is the only cataract that combines all three elements in such impressive proportions.[1]

Furthermore, until the middle of the nineteenth century, Niagara was *thought* to be the largest waterfall in the world. Its location, along with the fact that Niagara Falls has been so heavily marketed over the years, further helps explain its hold on the world's imagination. Indeed, other notable waterfalls – Victoria, Iguazu, Angel, and so on – are not nearly as close to large population centres or so easily accessible (tourists don't even need to get out of their cars to see Niagara Falls). Most of the world's other large waterfalls aren't in the northern hemisphere and, unlike Niagara, don't turn into an icy wonderland in the winter.[2] Reading between the lines, what further distinguished Niagara Falls for many was racial and cultural chauvinism: the waterfall came to be controlled by cultures that believed they knew how best to appreciate and appropriate its liquid wealth so that it wasn't squandered by simply running to the sea.

The *genius loci* of Niagara Falls is widely recognized. It became a symbol of an entire continent and an entire cultural inheritance, in a way that isn't true of any other waterfall.[3] Some have speculated that, among the various artistic media, including prints, paintings, lithographs, maps, aquatints, engravings, and photographs, Niagara was the most commonly represented image from the American continent during the nineteenth century.[4] Though the waterfall is split between two nations, and the more spectacular Horseshoe Falls is predominantly in Canada, until the twentieth century Niagara was more prominently associated with the United States. The waterfall fed the fledgling republic's conception of its abundance, strength, and limitless possibilities. The perceived taming of Niagara's might gave the nation an exuberant confidence in its energy supplies, power over nature, and manifest destiny. Consequently, Niagara Falls is often cited as the birthplace of hydro power. While this role has been exaggerated, Niagara Falls is inextricably linked to the birth of hydroelectric generation and distribution on a large scale. The availability of energy made the Niagara frontier the ideal host for the Aluminum Company of America (ALCOA) and many important chemical industries, as well as the victim of the environmental impacts of all these industries, such as the toxic pollution of Love Canal (Niagara Falls is of course linked with the word "love" in other ways: it was one of the most well-known honeymoon destinations in North America). Despite its association with untamed nature, Niagara is the most industrialized and commercialized of the globe's tourist waterfalls.

Arguments and Approaches

Many excellent books have been written about Niagara Falls.[5] A number of studies consider its status as the repository of the sublime, and the fading of this sublimity, from cultural, social, and artistic perspectives.[6] Then there is the long legacy of preservation, park developments, and landscape design: New York's State Reservation at Niagara is the oldest state park in the United States, while the Queen Victoria Park in Ontario is one of the most famous public parks in Canada.[7] Several studies consider imagined utopias at Niagara Falls.[8] Many look at Niagara as a cultural touchstone, as a site of the carnivalesque and kitsch – from barrels to tightropes to wax museums – including tourism and honeymooners.[9] Given its geographic and spatial location, Niagara has attracted its share of scholars interested in borderlands.[10] Others examine it as a site of technological prowess, from its bridges to electricity generation to transmission networks.[11] Still others delve into the industrial and chemical factories that took advantage of the cheap power – the flip side of which is the Niagara frontier as a space of deindustrialization, rust belt, and toxins.[12]

Why the need for this book then? My answer is that little attention has been paid to the waterfall itself, especially in the post–First World War era. Scholars have addressed in some detail what transpired between the 1870s and the 1910s but have largely ignored the rest of the twentieth century, which is precisely the period on which this book concentrates. It was a time when massive public and state-sponsored hydro-power plants were built at Niagara Falls, and when both Canada and the United States sought to remake the waterfall in order to preserve tourism while accommodating power developments. Most existing studies treat the Niagara torrents either as a backdrop, in front of which impressive things were built, or a blank screen on which social and cultural mores are projected, much like the coloured lights that shine on the waterfall at night. This book seeks to foreground the waterfall while showing that it is a tangled blend of nature and culture. In the process, the terms "waterscape" and "fallscape" are used to refer to the interface of the fluid, terrestrial, and infrastructural elements that together constitute the defined space, or microgeography, which we call "Niagara Falls" (see Figure 0.2).

Above all else, most previous works about the history of Niagara Falls seem unaware of – or, if they are aware, then unconcerned with – the radical reshaping of the physical contours of the waterfall that occurred in the twentieth century.[13] The Niagara Falls of today bears only a partial

resemblance to its former self: it is smaller, it has a different shape and location, and much less water plunges over its lip. There is a good chance that the Falls used to feel and sound, maybe even smell, different from how they do today. The physical manipulation of the waterfall, including the politics and diplomacy that enabled engineering alterations, is the chief concern of this book. Niagara's modern history is defined by the tension, or contradiction, between power and beauty.[14] The 1950 Niagara Diversion Treaty between the United States and Canada is the hinge on which this study pivots. As a result of this treaty, between half and three-quarters of the water that would otherwise plunge over Niagara Falls is instead sent through huge tunnels that feed enormous hydroelectric stations some five miles downstream. To visually mask the impact of diverting all that water, the United States and Canada cooperatively reengineered the cataracts, particularly the Horseshoe Falls. The two governments sought to improve, rationalize, preserve, and enhance the waterfall – that is, they sought to *fix* Niagara Falls, to rectify those aspects of this border waterway that, from an anthropocentric perspective, were not efficient.

Since various governments were responsible for the remaking of Niagara Falls – two federal, one state, one provincial, and multiple municipal and binational institutions – I am primarily interested in the public hydroelectric generating stations and the remedial works constructed by governmental bodies or agencies. Therefore, relatively little time is spent discussing privately developed hydro-power works, all but one of which were out of operation or publicly controlled by the later 1950s anyway. The role of the state is stressed because the combination of governments and industrial capitalism was the prime historical manipulator of Niagara's landscape and non-human nature; these were the agents that determined that the highest uses of Niagara were energy and tourism.[15] That said, it is important to recognize that there were differences of opinion and conflicts not only between, but within, the different levels of government in both nations.[16]

This book blends environmental and technological history, an approach commonly called *envirotech,* with an emphasis on water and energy history. Since the deepest channel of the Niagara River demarcates the international boundary between the United States and Canada, this is an inherently transborder book, as well as a contribution to international, political, and borderlands history. I pay equal attention to both sides of Niagara Falls: the United States and Canada, the state of New York and the province of Ontario. In order to do so, I examined archival files from many governmental bodies and institutions in both Canada and the United States:

FIGURE 0.2 Niagara Waterscape. *Created by Rajiv Rawat and Anders Sandberg, based on a map by Daniel Macfarlane*

various branches of the two federal governments and diplomatic services, presidential libraries and archives, local Niagara libraries and collections, and the relevant Province of Ontario and State of New York holdings. I was able to access the records of the bilateral International Joint Commission, which may have been the most revealing of the archives I consulted. I also received access to some archival sources from the two public power entities that develop electricity at Niagara Falls: the Power Authority of the State of New York (PASNY), which is now known as the New York Power Authority (NYPA), and the Hydro-Electric Power Commission of Ontario (HEPCO). In this book I will refer to HEPCO as "Ontario Hydro," the long-standing nickname that was adopted as the commission's official title in the 1970s.[17]

I was fortunate to be able to draw on an extremely deep global literature on water, rivers, and hydroelectricity. Underpinning this study is the notion that nature and the infrastructures we create by blending nature and technologies exhibit types of agency and historical causation.[18] Rivers and waterfalls are historical actors. Rivers are shaped by humans, but they also shape human history. Water provides both opportunities and constraints; it opens up many possibilities while simultaneously limiting many others; it inspires dreams and frustrates ambitions; it provides life and takes life. A river can serve as a major power source, transportation corridor, nurturing source for agriculture, quenching font of drinking water, sustainer of fish and fowl, artistic inspiration, and nationalist or regional repository of identity. But it is also a receptacle of waste and pollution, wrecker of ships, conduit of disease, and flood hazard. The embedded energy in water, which humans try to capture in various forms, thwarts as many plans as it enables.

Various debates about what are deemed to be the greatest public goods run like threads through the history of Niagara Falls. Though statist developments and regulations were often undertaken in the name of the collective good, they also raised concerns among the general populace that taxpayers were subsidizing cheap electricity for industrialists and the infrastructure necessary for private profit. Such concerns were well-founded. Although the availability of cheap electricity helped revolutionize modern living standards in North America, it did not usher in the democratic utopia predicted by many, and only some of the savings trickled down to the average person. Most of the electricity produced from Niagara water on the New York side was sold in bulk to industry rather than to local domestic consumers (granted, Ontario's Niagara power was added to the province-wide electricity grid).

As this book will show, the "preservation" of Niagara had multivalent and sometimes contradictory meanings. Ironically, the act of preserving Niagara Falls usually seemed to be synonymous with changing it. This book will show that, though widely considered to be one of the continent's natural icons, Niagara Falls is in fact quite *un*natural.[19] The Falls are as artificial as they are natural – a type of "organic machine" in the now-classic formulation.[20] The Niagara waterscape has become a part of the built environment, an exemplar of the technological sublime.[21] Technocrats concealed the industrialization of Niagara's waterscape by helping the Falls continue to resemble their past appearance – a process labelled here as *disguised design* – so as to maintain and boost tourism levels. In the minds of those diverting water and designing remedial works, they were merely protecting Niagara Falls from itself. These "remedial works" – a term that encompassed the suite of various engineering interventions and control structures that included excavations, fills, reclamations, weirs, and dams – were labelled as such precisely because they were meant to correct something considered faulty. Instead of a messy, receding waterfall, an idealized and synthetic version was sculpted and frozen in place. The copious technical discussions and engineering specifications in the archival records serve as a sort of black box from which I can tease out the technopolitics of disguised design – for example, how Niagara experts dealt with uncertainty and politics, came to rely on hydraulic scale models, and sought to reconcile qualitative and quantitative factors.[22]

The growth and reach of infrastructure is a defining feature of modern life, and Niagara Falls is no exception. After 1945, the North American electrical grid tied Niagara to most of the continent energy-wise. Given that the utility and actual shape of Niagara Falls have been predicated on energy considerations, I suggest that the Falls are profitably understood as an energy landscape or sacrifice zone (even if it seems anathema to lump such a picturesque landmark in with the likes of denuded tar sands or strip-mined coal mountains). Niagara Falls was also linked to another wide-ranging and geographically diffuse envirotechnical system: diversions in and out of the Great Lakes basin hundreds of miles to the west affected water levels in the Niagara River and thus production at Niagara generating stations. In a way, this meant that the entire Great Lakes–St. Lawrence basin – as well as other major watersheds, such as the Mississippi and Hudson Bay, whose levels were affected by these same diversions – became a scaled-up and interconnected infrastructural system to develop Niagara hydroelectricity.

But Niagara Falls itself also became infrastructure. Thomas Zeller helpfully defines infrastructure as "large, state-sponsored, transformationist

projects which mobilise environmental and technological resources for the attainment of specific goals."[23] Indeed, one of the central claims advanced in this book is that the Niagara waterfall and river were purposefully transformed into principal parts of a larger terraqueous infrastructure, a hybrid envirotechnical system that was submerged and concealed by a flowing facade.[24] Even the seemingly natural features that constitute Niagara Falls (water, ice, rock, and weeds) were intentionally enrolled as working parts of the infrastructure.[25]

While the American and Canadian nation-states were busy shaping Niagara Falls, they were themselves being shaped by the Falls. Numerous scholars have addressed how states and societies have been structured and changed by the ways they relate to water resources, such as Donald Worster's "hydraulic society" in the western United States.[26] At Niagara, government control of water as well as hydro power profoundly influenced North American state-building and socio-democratic politics. The *idea* of Niagara Falls was politically potent, especially for the ways in which Niagara fostered socio-technical imaginaries of perpetual economic growth and abundance. In more tangible ways, Niagara Falls was central to the evolution of federal and state/provincial policies in a number of areas, such as conservation and parkland, federalism, water rights, and electricity regulation. And its policy influence stretched beyond domestic issues: Niagara Falls was one of the foremost issues in the environmental and energy diplomacy that underpins so much of the modern Canada-US relationship.[27] For example, it was a key factor in the creation of the 1909 Boundary Waters Treaty and the International Joint Commission, as well as in the evolution of continental electricity exports and imports, while Niagara negotiations in the mid-twentieth century involved some of the earliest examples of North American subnational diplomacy.[28]

Though Niagara Falls is an important shared cultural landscape, it has different cultural meanings and hydrosocial relations on each side of the border.[29] Both countries evinced distinct forms of hydraulic nationalism, which springs from the juxtaposition of national identity, technology, and major water basins.[30] In Ontario, and in Canada as a whole, hydroelectricity has been intimately intertwined with political identity to a much greater extent than in the United States, in large part due to Niagara.[31] As one engineering journal put it in 1953, Canada is "hydro-conscious."[32] Hydroelectric development was so attractive in Canada not only because the country was amply endowed with viable sites but because "white coal" reduced Canadian reliance on American sources of energy.[33] Residents of

Figure 0.3 Aerial view of Niagara Falls in 2018

Ontario and several other Canadian provinces today still refer to their domestic electricity invoice as a "hydro bill."

Setting the Stage

To help situate the reader, I would like to provide an outline of both the rest of this book and Niagara's geophysical properties. First, let us turn to

the Niagara River, whose green waters are the by-product of dissolved salts and "rock flour," primarily limestone (an estimated sixty tons of dissolved minerals are swept over Niagara Falls every minute).[34] Carrying the flow and energy of the upper Great Lakes basin, these waters hydrologically connect Lake Erie to Lake Ontario. The Great Lakes–St. Lawrence basin holds about 84 percent of North American – and over 90 percent of American – surface freshwater, and the Niagara is one of the ten largest rivers by volume on the continent. Measured by discharge, the Niagara River is the second-biggest river in both New York State and Ontario. In fact, the volume of the Niagara River is roughly ten times greater than that of New York State's most prominent river, the Hudson. But the Niagara is only thirty-six miles long, which is not very lengthy compared with other large continental waterways. It has a watershed of approximately 264,000 square miles but few tributaries. As a result, the Niagara River can be considered a "strait."

The river drops 326 feet in total, most of that in an eight-mile span between Chippawa and Queenston, Ontario. About half of that drop is at Niagara Falls proper, with a fall of another 140 feet in the rapids above and below the Falls. The mean flow of the Niagara River at the waterfalls, without any diversions, is officially 202,000 cubic feet per second (cfs), the equivalent of roughly 13,000 bathtubs of water. It appears that this volume was much higher prior to the twentieth century, though without question some of the difference was the result of varying natural causes and rudimentary measurement techniques and technologies. To illustrate, an 1841 estimate pegged the flow of the river at 374,000 cfs, while New York State engineer and surveyor John Bogart estimated in 1890 that its flow was 275,000 cfs.[35] Nonetheless, compared with mountain- or precipitation-fed rivers, the flow is very uniform and steady within a given year. The Niagara River's volume does fluctuate from year to year, tied to oscillations in Great Lakes water levels driven by natural precipitation, ice cover, and evaporation, as well as anthropogenic interventions such as diversions and engineering works. The Great Lake that most directly determines the flow in the Niagara River is of course Erie, with an underwater rock ledge at the head of the Niagara River influencing the rate of water inflow.

After beginning at Buffalo, the Niagara River widens out, moving relatively slowly between low banks for eighteen miles to the head of the rapids (or cascades) above the Falls and splitting into two channels to go around Grand Island and Navy Island. The four miles of river from the lower end of Grand Island to the head of the cascades, opposite the southern end of Goat Island, is known as the Chippawa–Grass Island Pool. This

Figure 0.4 Historical erosion at the Horseshoe Falls (lines indicate crestline at a given year; aerial image is from 2017). *Map by Jason Glatz (Western Michigan University Libraries) and Daniel Macfarlane*

pool transitions into the upper rapids – a drop of about fifty feet over a distance of one mile.

Niagara Falls consists of three cataracts (see Figure 0.3). The American Falls carries about 10 percent of the river's flow. The minuscule Bridal Veil Falls – which could be considered part of the American Falls – drops between Luna Island and Goat Island. Roughly 90 percent of the Niagara River's water goes over the magnificent Horseshoe Falls (also known as the Canadian Falls), which straddles the international boundary. The *horseshoe* moniker is apt not only because of this waterfall's shape but since, like the hydro power from the flowing water, it evokes notions of brute force – horsepower – that just need to be harnessed. The American Falls, entirely in US territory along with the Bridal Veil Falls and Goat Island, has a much smaller crestline but is taller (by approximately ten feet) than the Horseshoe Falls; the fallen boulders (talus) at the base of the American Falls, however, reduce the sheer drop by roughly half. The cross-section of the bed of the river here is not horizontal: the Niagara River slopes gradually toward the western (Canadian) side, which results in gravity sending water toward the Horseshoe Falls.

The famous drop of Niagara Falls comes from the level change of the Niagara Escarpment, or "the mountain," as it is colloquially called by locals. The escarpment is a distinct topographical feature running through the Great Lakes basin. The location where the Niagara River originally plunged over the escarpment was the birthplace of Niagara Falls. The waterway has relentlessly eroded its way more than seven miles south since glacial ice receded about 12,500 years ago (note that this book will generally employ the imperial system of measurements since that is what was used for the majority of the time period covered). That is, the feature that we call "Niagara Falls" – the place where the water drops dramatically from the upper river to the lower river – is constantly migrating (see Figure 0.4). As the waterfall slowly worked its way back, it cut down through much older sedimentary rock layers – the product of clay, mud, sand, and shell sediments left behind by saltwater seas – compressed by earth's geomorphic processes. Looking at the sides of the Niagara Gorge downstream from the Falls, these different types of sedimentary rock form visually apparent bands, a sort of geological layer cake.[36] These various types of rock and shale react differently to the erosive force of water, depending on variables such as composition, thickness, fracture lines, and hydrostatic pressure.

The American, Bridal Veil, and Horseshoe Falls plunge dramatically into the narrow but elongated Maid of the Mist Pool. The pool leads to the first stretch of the perilous lower river rapids. In the Whirlpool Rapids, the water reaches speeds of over thirty miles per hour, making it one of the fastest rivers in North America. The rocky bottom produces phalanxes of standing waves. The river trends northwest until it arrives at the Whirlpool, where it performs a counter-clockwise rotation then exits, making a hard northeast turn. The channel runs through another chasm and some smaller rapids, past the enormous hydro-power stations and a gap in the imposing cliff of the Niagara Escarpment. The Niagara River then widens, settles, and slows, almost as if it is catching its breath, spent and exhausted from its journey up to this point. For the rest of its course, there are no rapids, gorges, or islands. At its mouth, the river deposits sand and sediment as it debouches into Lake Ontario.

The escarpment is responsible for the region's different microclimates: the fruit belt running to Lake Ontario and a snow belt to the south. The Niagara Peninsula is part of the Carolinian life zone and its sylvan biodiversity, particularly at that latitude, was renowned: the father of North American botany, Asa Gray, declared that Goat Island contained the greatest variety of plant species on the continent.[37] It should be noted,

however, that nineteenth-century pronouncements about this rich biodiversity may have been exaggerated.[38] Contemporary ecologists are therefore unsure about the proper baselines with which to evaluate long-term changes to the biodiversity of the area, though clearly that diversity has been adversely affected by human activities.

Chapter 1 of this book begins with a selective history of the Niagara region, running from the deep past up to the early twentieth century. Readers well versed in Niagara lore will find little on tightrope walkers, barrels, and bazaars, but when it comes to those events, processes, and innovations connected to this book's central themes, my discussion becomes more detailed and nuanced. It includes the growth of industry directly at and along the margins of the waterfall, as well as the ensuing public outcry about the visual impact on the Niagara landscape that eventually led to the creation of Niagara parks in the late nineteenth century. We then turn to the fin-de-siècle diversions and hydroelectric complexes that followed hot on the heels of the preservation movement. Chapters 2 and 3 cover the first half of the twentieth century. By the early twentieth century, hydroelectric plants dotted both the New York and Ontario shorelines above and below the Falls, and alterations to the cataracts had already been made to facilitate diversions. The proliferating and sometimes contradictory calls for further preservation of Niagara Falls found expression in various types of legislation and international agreements, which are detailed in Chapter 2. During the interwar years, covered in Chapter 3, Canada and the United States undertook binational studies on Niagara remedial works, as well as some failed international agreements, in attempts to mitigate the scenic impact of the continually increasing water diversions. Seeking to legally enshrine higher diversion levels, the United States and Canada signed the Niagara Diversion Treaty in 1950.

Chapter 4 focuses on the construction of the massive public hydroelectric stations built at Niagara Falls after the Second World War. The first of these was the Sir Adam Beck Generating Station No. 2, completed by Ontario Hydro in the early 1950s not far from the Niagara Escarpment. After much delay, in 1961 the Power Authority of the State of New York opened its own hydro megaproject across the gorge, the Robert Moses Niagara Power Plant. In addition to detailing the creation of these generating plants, Chapter 4 addresses the larger infrastructures they required around the region, including diversion works and reservoirs. Chapter 5 covers the international implementation of the 1950 treaty. Remedial works, built by Ontario Hydro and the US Army Corps of Engineers, involved the installation of structures and a range of physical reconfigurations to

the river and waterfall. Engineers sought to produce a pleasing "curtain of water" over an unbroken crestline, with the appropriate colour and, in response to tourist complaints about getting wet, not too much spray or mist. The overarching goal was to achieve a sufficient "impression of volume" to captivate tourists and obscure the fact that at least half the water, which would otherwise have gone over the waterfall, was diverted for power production. The International Control Structure, a gated dam that is part of the International Niagara Control Works, was built above the Falls to apportion the flow of water, and it was extended in the early 1960s. Chapter 6 explains the 1965–75 campaign to preserve and enhance the American Falls. Concerned about rockfalls and the resulting talus at the base of the smaller of the two main Niagara waterfalls, local interests pushed higher-level governments and the International Joint Commission to examine whether this talus could be removed and the American Falls improved. However, the experts eventually decided, with public support, to let nature take its course and not significantly re-engineer the American Falls.

The Conclusion offers some final thoughts about Niagara's modern history. Other major hydroelectric projects of the twentieth century obliterated and dominated the rivers they remade, but Niagara was an exception: as Niagara Falls was turned into a tap, it was being changed to have it appear more like its past self. Measuring by water volume, since the 1950s the real waterfall has been downstream in the penstocks of the enormous hydro-power stations. Since Niagara Falls has been so extensively manipulated, it can be thought of as a simulacrum: an imitation of something that existed in the past.

1
Harnessing Niagara: Developments up to the Twentieth Century

Among the many natural curiosities which this country affords, the cataract of Niagara is infinitely the greatest.

Andrew Elicott, 1789

The Edward Dean Adams Power Plant, opened in 1895 on the New York side of Niagara Falls, was an electricity pioneer. Despite its heritage significance, when the Robert Moses Niagara Power Plant came online in the early 1960s, the buildings that made up the Adams station, which by that time had long been redundant and outdated, were mostly torn down. Today, all that is left standing of this historic plant, the symbol of fin-de-siècle American progress, is one building: the transformer station. The impressive archway from the entrance to generating station no. 1 of the Adams plant still exists, albeit in a disembodied form: it was taken apart and reassembled on Goat Island, towering over a walkway that leads from the main parking lot to the Cave of the Winds tour, framing a statue of Nikola Tesla. Built in the Beaux Arts fashion with locally quarried and rough-finished limestone, like the two generating stations that flanked it, the Adams Power Plant Transformer House is registered as a US National Historic Landmark (see Figure 1.1). According to a 1978 landmark designation document, "this 1½ story building is presently utilized by a local chemical firm to house its frequency converters. It is well maintained."[1]

But when I went to photograph this last vestige of the Adams plant, "well maintained" was not the first adjective that came to mind. The transformer station is in a nondescript location just off Buffalo Avenue, a brisk walk from the waterfall. Surrounded by other industrial buildings and a municipal wastewater treatment plant, it is now privately owned

Figure 1.1 Adams Power Plant Transformer House today

and, as of early 2020, was for sale. There appears to be a dump or junkyard out back, and the last time I visited, an RV had been added to the menagerie of abandoned vehicles. The roof has seen better days. The inlet canal that brought water from the Niagara River to the generating stations, and then into the discharge tunnel, was filled in – and in its place seems to be some sort of water treatment lagoon. It is a poor monument to a complex that was hailed as enabling one of the greatest advances in electricity. In a profound way, however, it symbolizes how much of the history of Niagara Falls is hidden beneath the surface.

Many Niagara scholars have analyzed the late nineteenth-century period, and more has been written about the history of Niagara Falls during the Progressive Era than any other epoch. In this chapter, I first provide some backstory on the pre-twentieth-century human history of the Niagara frontier, highlighting aspects that will help readers better understand subsequent chapters. We then turn to the earliest hydroelectric stations built at Niagara Falls. I survey the rapid pace of technological change, political and diplomatic developments, and societal ferment in these decades, delving into more detail when necessary for establishing the context in which public hydro-power projects developed. Weeding through the various power stations and their often misleading names can be tricky, and though entire books have been written about these individual stations, this chapter provides a selective history that foregrounds those aspects that are most relevant to the themes of this book.

Onguiaahra

First Peoples began occupying the Niagara region around 9,000 BCE. The Niagara River was a trading crossroads and the Falls were an important spiritual and physical resource that supported Indigenous lifeways. In addition to fish, meat was gathered from animals that went over the Falls. Oral and archaeological evidence indicates that Haudenosaunee (Iroquoian) groups developed agricultural villages nearby that featured palisaded longhouses.[2] By the early seventeenth century, the Neutrals were the predominant Indigenous group in the area, though there is evidence that their habitation of the region went back further.[3]

Early European explorers, such as Jacques Cartier and Samuel de Champlain, were told about the Falls. The latter relayed that it was called *Onguiaahra* or some variation thereof, which may have referred to the Neutrals, or may have meant "thunder of the waters" or "neck" in reference to the river as a strait connecting two lakes. At any rate, various understandings of this word came to be interpreted as *Niagara.* By the middle of the seventeenth century, the Neutrals had been almost completely wiped out by disease and conflict; the Seneca and Mississauga nations, and then the Tuscarora, eventually occupied the Niagara frontier. Though several other Europeans had made it close to Niagara Falls, the first to produce a record of seeing the waterfall was Father Louis Hennepin, who witnessed the Falls in 1678 as part of an exploratory party. Hennepin distorted and exaggerated the scale of the waterfall, and in the following decades his depictions spread around Europe and the world. Niagara Falls became a symbol of – a sort of stand-in for – all of North America and its wilderness.

Forts were built. French and British settlers trickled into the area. Around the midpoint of the eighteenth century, the first recorded use of the Falls for power took place: a small ditch was dug to power a sawmill.[4] Travel accounts by first-time visitors to the Falls usually commented on its size – many taking issue with Hennepin's assertions – and often noted that the mist and the thunder of the waterfall could be apprehended from miles away. Other common concerns in such travelogues included debates over whether birds could survive flying near the Falls, whether it was rarefied or condensed air that made it hard to breathe behind the waterfall, and whether congealed spray or foam created white rock-like substances.[5] The US-British treaties in the aftermath of the American Revolution established the Niagara River as the international boundary line. The First

Nations groups in the area were forced to leave or sell most of their territory. Niagara then became a focal point in the War of 1812: the British/neo-Canadians and their various Native allies held off the Americans, and the Treaty of Ghent, along with subsequent agreements, established the international boundary as cutting through the Horseshoe Falls.

Thus, force and the power of the state imposed a process of settler colonialism by which the Indigenous inhabitants of the region were moved or disenfranchised so that European settlers could appropriate the land for their purposes.[6] The Niagara Corridor was at first valuable as a transportation and portage route, and the Falls offered many nascent economic development possibilities. For this reason, moving local peoples away from the river margins was one of the first priorities of settling the area and developing agriculture, and then tourism and industry. Leaving Niagara Falls to Indigenous Peoples was considered the same as letting its waters pour unfettered over the precipice – in either case, the potential power was squandered. Indigenous conceptions of Niagara Falls, and their embodied ways of knowing its water and ice, needed to be replaced by quantifiable notions of Niagara Falls as a commodity that could be properly exploited by an industrializing society in which private property rights were sacrosanct. Much of this was done "legally" – though these are legal fictions when they are structurally designed to extinguish Indigenous claims, rights, and modes of living.

From a settler perspective, however, the displacement of Indigenous Peoples brought peace and borders, which brought stability, which in turn brought commerce and transportation improvements: the Erie and Welland Canals to circumvent Niagara Falls, then later railways. The Erie and Oswego Canals were key links in, and became key attractions along, the fashionable "Northern Tour" to Niagara. The number of visitors to the Falls rose significantly in the mid-nineteenth century. The first tourist spectacles soon followed. Establishments catering to tourism cropped up on both sides of the river, and Niagara enjoyed an extended period as the prime tourist landmark on the continent.

Communities near Niagara Falls developed in both New York State and Ontario, connected by ferry and then bridges (see Figures 1.2 and 1.3).[7] Not long afterward, Frederick Church crafted his famous portrait of Niagara Falls, and soon the Falls were illuminated by lights for the first time.[8] Daredevils such as the Great Blondin crossed the gorge by tightrope or challenged the rapids in different contraptions. About 40,000 people visited annually. As Karen Dubinsky puts it, "Niagara became famous for being famous."[9] In a case of what has been termed "allowably indigenous" –

Figure 1.2 View from the American side in the nineteenth century

Figure 1.3 Bird's-eye view of Niagara Falls in 1882. *Niagara Falls Public Library, New York*

in reference to those enriching aspects of Native cultures that settler society permits to be visible – First Peoples were part of the mythical Niagara histories peddled to tourists, since they represented untamed wilderness.[10] Entrepreneurs in both countries – Canada became a nation in 1867 – built stairs and ladders to take curious onlookers to the base of the Falls and behind. Although the strip of land along the Falls and the gorge was supposed to be government-controlled, private interests installed fences and obstacles so that curious onlookers would have to pay to use their facilities (see Figure 1.4).

At the start of the nineteenth century, New York State had auctioned off a strip of land bordering the Niagara River. This strip included the riverbed and riparian rights to the water. Niagara offered hydraulic power opportunities that exceeded the capability of the imagination. At this point, hydraulic power was obtained along the shoreline of the upper river just by utilizing the drop of the rapids above the Falls.[11] Various factories and industries congregated at these rapids, constructing an intersecting network of diversion works, dams, canals, and millraces. These industries later spread to the downstream gorge, which was traversed by a number

Figure 1.4 At Prospect Point in the late nineteenth century. *Niagara Falls Public Library, New York*

of new bridges that associated Niagara with pushing the technological envelope.[12] In the 1840s, developers had purchased property for a hydraulic canal, although digging would not begin until the following decade. The scheme fell into insolvency but was resurrected. In 1861, a hydraulic canal was completed, taking water from above the cataract to the High Bank area downstream from the American Falls, where the declivity was 210 feet to the lower Niagara River. This canal initially attracted few users, but things changed when Jacob Schoellkopf's Niagara Falls Hydraulic Power and Manufacturing Company purchased the canal in 1879. Within a few years, seven mills were taking hydraulic power from the canal.

Free Niagara

New developments began to divert water from the upper river rapids and return it to the lower river gorge. This was more easily achieved on the east (New York) side of the waterway since the river turns sharply to the northeast after the waterfall, making for a short diversion route from the American Falls rapids to the east bank of the river below the Falls. By the late 1870s, the American side of the Niagara River was in an "advanced stage of visual blight."[13] In the words of author Archer Butler Hulbert, "the spectator ... cannot help seeing this mass of incongruous and ugly structures extending along the whole course of the Rapids and to the brink of the Falls. Of course, under these circumstances the Rapids are degraded into a mill race, and the Fall itself seems to be lacking a water-wheel."[14] The tailraces of the many mills and factories poured mini-torrents down the gorge face, forming a wall of small waterfalls (see Figures 1.5 and 1.6). Above the Falls, the shoreline and islands in the channel leading to the American Falls were thick with sundry commercial buildings, warehouses, icehouses, mills, hotels, and so on. At the waterfall proper, there was a jumble of vendors, carts, and confidence men, and visitors had to pay proprietors just for the privilege of viewing the falling water. In reference to all the fees and gratuities, one tourist lamented: "I could hardly divest my mind of the idea that I was not 'doing' Niagara, but that Niagara was 'doing' me."[15]

Niagara's reputation as the top resort destination was in decided decline, and its status as the icon of American nature was being surpassed.[16] A preservationist movement to "free Niagara" by creating parkland arose on both sides of the border. But it was noticeably stronger to the south, where a wide-ranging alliance of middle-class and elite reformers sought public

Figure 1.5 Industry along the High Bank in the nineteenth century. *Niagara Falls Public Library, New York*

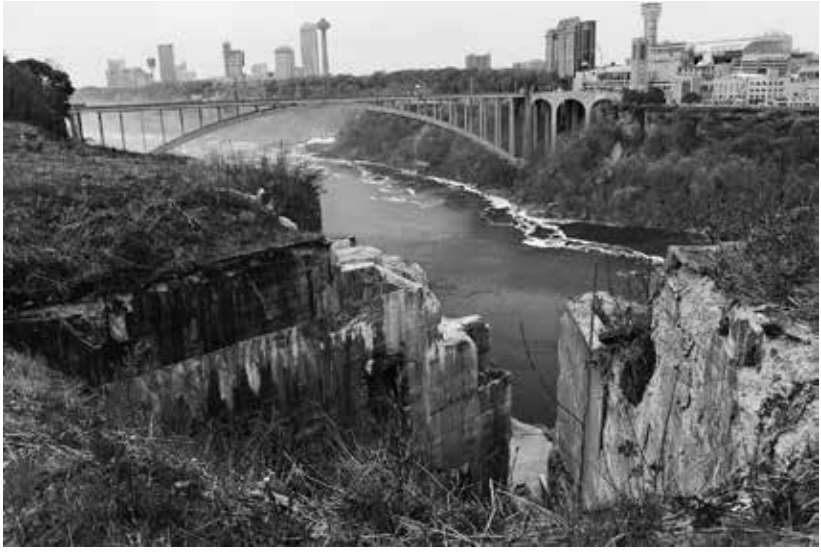

Figure 1.6 Industrial ruins along the High Bank today

ownership of Niagara Falls. While most participants in the "free Niagara" movement wanted to protect the cataract from rapacious industrialists and ugly encroachments, these sorts of preservationist anxieties were also, consciously or not, bound up in efforts to combat hostile forces that threatened not just the waterfall but the ideals and goals of white North America, particularly those of the upper classes.[17] Governments on both sides of the border cracked down on tourism purveyors considered to be crooks and rip-off artists.[18] Certainly many were. But the ethnicity of some of the tourism operators (e.g., Jews and African Americans) motivated at least some of the charlatan characterizations. Thus, preserving Niagara was a discursive framing that partly relied on mobilizing racial and class fears: Niagara was not so much "freed" but rather "simply placed in different, more culturally acceptable hands."[19]

Even claiming that Niagara Falls should be publicly controlled was not as altruistic as it might appear. Creating some sort of Niagara preserve that was free for everyone essentially subsidized the cost of visiting Niagara Falls for those who could actually afford to vacation there – at the time, these were mostly those with financial means. For the hoi polloi who could partake, the experience was paternalistically meant to be a civilizing lesson of sorts. And this preservationist movement was even more directly colonial in the sense that it continued long-standing assumptions about what constituted the appropriate and efficient uses of the setting, and whom these uses were intended to benefit (i.e., industry and tourism took precedence over other uses and cultures).

A group of American cultural elites seized on the idea of a public park. They were led by Frederick Church, the Hudson River School painter who had given Niagara its most famous artistic rendering, and Frederick Law Olmsted. The "free Niagara" campaign grew quickly, channelled through a Niagara Falls Association composed of prominent citizens and backed by widespread popular sentiments. This included a petition that, in Pierre Berton's estimation, featured the signatures of more "illustrious and distinguished persons" than any other comparable effort.[20] Within a decade, the campaign achieved stunning success.

Other early state and national parks were often leftover lands that had little economic or agricultural value until railways ran nearby. By comparison, Niagara was already a veritable American shrine. By no means, however, were all Americans disenchanted with what was happening at the Falls. Visitors to Niagara were almost as likely to praise the harnessing of Niagara and to call for further development as they were to lament its

despoilment. Some industrial capital sectors supported the preservation of Niagara Falls because they saw an opportunity to further their economic interests and investments. Many thought that Niagara would be *most* attractive when all of its water was put toward producing power. For example, Sir William Thomson, later Lord Kelvin, remarked that

> a long while must elapse before the whole of the volume of water now passing over Niagara Falls could possibly be utilized for the production of power, but if the whole of the water were so utilized and if the lofty cliffs over which the waters now tumble, were bare, think what would then be their aspect! The face of the precipice would be covered with aquatic plants giving in summer a splendor of color which with all their watery magnificence the Falls do not now possess, while the pool below would have a quiet beauty instead of its present turbulence.[21]

Despite considerably less industrial development, the Canadian side was not in a much better state than its cross-river counterpart when the "free Niagara" movement got underway. The chain reserve kept a strip sixty-six feet wide in the hands of the Crown. This precluded the types of industrial development that flourished in New York, as did much of the topography (for example, a ridge runs along the Canadian side, set back a bit from the waterfall, and much of this area was cedar swamp). However, hotel operators and other tourist purveyors had long encroached on the chain reserve, with or without permission, creating a carnival atmosphere of con artists, extortionists, and low-brow attractions. Moreover, upriver from the Falls, mills occupied parts of the river bank and various nearshore islands.

Members of the "free Niagara" entourage met with Governor General Lord Dufferin to get Canadian cooperation. They sought his help because of his central role in saving heritage landscapes in Quebec City. Dufferin became the first to officially propose the creation of an international Niagara park, which attracted many powerful proponents in North America and abroad. In New York State, a survey of the prospective Niagara parkland was quickly authorized and undertaken: it recommended a small, publicly owned reservation around the cataract. But gubernatorial changes and resistance from other quarters in the state led to several years of unsuccessful efforts in the New York legislature.[22] Finally, in 1883, with the Niagara Falls Association as the motive force and supported by a massive letter-writing campaign, a bill was passed to create a state reservation at Niagara.

Opponents fought a rearguard action, however, and it took until 1885 for the legislature to appropriate the necessary funds for Niagara land acquisition. In the end, the state spent $1.4 million to acquire the requisite property through eminent domain. The new reserve totalled 412 acres, three-quarters of which was underwater. The unsubmerged portion took the form of a mile-long strip, ranging in width from 100 to 800 feet, along the Niagara River, as well as Goat Island and other islands in the American Falls channel. On July 15, 1885, some 75,000 people gathered to celebrate New York's State Reservation at Niagara, as it was officially titled.[23] This was the first time that an American state "had used public money to expropriate property purely for aesthetic reasons."[24] Testifying to the blurring of the lines between a "reservation" and a "park," it eventually inherited the title of the country's oldest state park. But the actual reservation still needed to be created. There was considerable debate about its form and appearance: Should it evoke sylvan wilderness, or be in the English garden tradition? Or should it be a park replete with modern amenities? Regardless, the first step was to remove all the existing industry and related buildings, a procedure that left the land constituting the new reservation disfigured and denuded.

It was not until 1887 that the reservation commissioners hired Frederick Law Olmsted and his partner, Calvert Vaux, to design the area. The pair aspired to "restore the primacy of nature" while simultaneously accommodating throngs of tourists.[25] Olmsted wished to avoid emphasizing the terror and awe associated with Niagara's sublime past, aiming instead to evince spiritual regeneration and moral uplift to the visitor through verdant peacefulness. He favoured the upper rapids and was apprehensive about the waterfall drawing too much attention away from the "picturesque" surroundings he planned to create. Drawing on their past projects, such as Central Park in New York City and parks in nearby Buffalo, the reservation was intended to look as natural as possible and free of obvious human intrusions such as buildings and monuments. But it was also a manufactured naturalness that needed constant maintenance, and the reservation operators would later introduce park and commercial features that seemed incongruous with a reserve or preserve. Nonetheless, when completed, the State Reservation was widely acclaimed and gave Niagara a new lease on life as a prime place to see and be seen.

The genesis of the Canadian Niagara park has for many years been told "as a case of the virtuous people and the wise political leaders successfully overcoming the social abuses of commercial and corporate interests."[26] As in the American preservationist push, however, there were mixed motives

at play. Gerald Killan has shown that, though the Canadian park movement did originate in concerns about preserving or restoring the natural state of the Falls, "the initial impetus of the nature lovers soon gave way to the influence of private park promoters. These businessmen viewed Niagara Falls as a resource to be conserved and wisely exploited as a tourist attraction for their personal profit."[27]

As early as 1880, the Canadian federal government had passed an act allowing it to expropriate land for the park, but questions about whether the provincial government had jurisdiction over the chain reserve stalled matters for several years, with each level of government trying to get the other to take responsibility. Entrepreneurs spurred on by potential profit opportunities, particularly railroad interests, helped bring matters to a head.[28] After several different commissions and inquiries and suggestions of a privately funded park, in 1885 the Ontario government passed an act to create a parks commission that would investigate and make recommendations for the future of the prospective park.

The commission endorsed provincial control of the park, which should include land between the the ridge and river. This included the edge of the Horseshoe Falls and the territory running from the Dufferin Islands to a spot close to today's Rainbow Bridge, as well as several islands – a total of 154 acres above water and 317 acres below. In 1887, the Ontario legislature, led by Premier Oliver Mowat, half-heartedly passed another act formally instituting the Queen Victoria Niagara Falls Park along the recommended lines. The new parks commission began the process of acquiring the necessary property and removing most of the existing buildings along the front while other new facilities were installed.[29] Park officials undertook landscaping, though there was little effort to naturalize the area compared with New York's State Reservation at Niagara. Be that as it may, when the new Queen Victoria Niagara Falls Park was officially opened in 1888, it was considered the "first expressly 'natural' park in British North America."[30]

Both of the new park systems were free to the public, a major change from the days of paying for the privilege of a view of the waterfall. The public responded by visiting in record numbers. Within a decade, the Queen Victoria Niagara Falls Park had expanded several times, to about 675 acres.[31] The State Reservation could not easily do the same, hemmed in as it was by industry. But it had an important advantage: it received operating funds from the state government, whereas its Ontario counterpart had to raise its own financial support in order to be self-sustaining. The result was that, in order to fund itself without charging entrance fees, the Queen Victoria

Niagara Falls Park allowed commercial concerns and hydroelectric franchises within the park boundaries in exchange for annual rental fees.[32] New York's State Reservation did not allow any power developers within its boundaries. This was a reversal of sorts, for it would now be Canadian, rather than American, powerhouses in tourist sightlines.

War of the Currents

The last decades of the nineteenth century were a period of incredible technological ferment and cultural anxiety concerning the continent's most recognizable natural icon. Those preoccupied by the landscape of the future focused their attention on the seemingly limitless energy of Niagara. Some plans were rational and realistic and, enabled by a rapid succession of socio-technological advancements, led to the proliferation of hydroelectric stations and industrial enterprises. Other schemes were, as both William Irwin and Patrick McGreevy have discussed, much more utopian.[33] Such unfinished undertakings were not benign, however. Although razor blade tycoon King Camp Gillette's envisioned Metropolis at Niagara, for example, never came to pass, a canal started but then abandoned by one William T. Love would later become the site of America's most famous toxic crisis. Technological advancements also stoked dystopian anxieties: Would the sacred waterfall be completely drained and commercialized?

Many businessmen had supported the creation of the State Reservation at Niagara. Some did so for "enlightened" reasons, in the parlance of the times, while some seemed to sense that the creation of the parkland might be, from an industrialist's perspective, a sort of reverse sacrifice zone: a small area near the cataract would be protected in exchange for the right to develop the surrounding area. With industry shunted to the margins of the Niagara tourist zone, the waterfall was preserved for tourists, while locals would come to bear the cost of living in a toxic landscape.

Although the State of New York had created the reservation, it seemingly had no compunction about authorizing developments that extracted water from the Niagara River. The year after creating the reservation, the state legislature was already granting charters to multiple companies that allowed them to divert water right outside the park boundaries. By 1894, eight companies had power charters on the American side. The state charged the companies nothing, and most had no restrictions on the amount of water they could divert, save for technological and capacity

limits. There were rumors that the existing franchises, both real and on paper, could cumulatively deplete the entire river.[34]

These franchises generally took advantage of the new power form, hydroelectricity, which had been emerging as a viable alternative to hydraulic power while the State Reservation was in the process of being legally established. Hydro-power innovations, and electricity in general, were prime contributors to what has been termed the second industrial revolution.[35] Niagara's first hydroelectric generator – and one of the first in the world – was installed in 1881 by Jakob Schoellkopf, owner of the Niagara Falls Hydraulic Power and Manufacturing Company. The generator was housed in one of the mills at the High Bank taking water from the hydraulic canal, and produced direct current with one of Charles Brush's dynamos. Schoellkopf built another generating station close to the first installation, this one at the base of the gorge below the High Bank. Up to that point, other turbines and water wheels had not been able to use the full drop of water down the gorge wall, but the technology had advanced enough that Schoellkopf could take advantage of the head from the forebay of the hydraulic canal.

Other interests had also explored water conduits and power station configurations. Thomas Evershed, a New York engineer, developed a plan for a tunnel that would take water from above the American Falls and discharge it at the gorge.[36] However, this was initially intended to be a hydraulic, not a hydro-power, enterprise, featuring many small intakes for factories. Formed in 1886, the Niagara Falls Power Company took over the Evershed tunnel idea. This company was the engineering arm of the Cataract Construction Company, a holding firm that had big-name financial backers such as J.P. Morgan and John Jacob Astor. It was a model of Gilded Age interlocking directorships, conflicts of interest, and vertical integration that would have made John D. Rockefeller proud and trust-busting reformers furious.

By the early 1890s, the tunnel was well advanced and a central station design (rather than the multiple intakes and wheel pits in the original Evershed tunnel scheme) had been adopted. The company was still not absolutely certain about what generation and distribution form to choose for this new development – in addition to electricity, mechanical power and compressed air were options on the table. To attract the requisite technology, and attempt to get it as cheaply as possible, the Niagara Falls Power Company formed the International Niagara Falls Commission to hold an international competition. This commission was headed by Lord

Kelvin, arguably the world's most eminent theoretical physicist and the mind responsible for the absolute temperature scale and the second law of thermodynamics. The commission consulted with experts around the world, and toured water control facilities in far-flung places such as Switzerland.[37] A range of entries were submitted to the competition in various categories, including alternating current (AC) and direct current (DC) proposals, as well as non-electrical methods. Some prizes were awarded, but none provided a complete and workable power production and distribution method that satisfied the contest organizers.

As the types of entries suggest, this competition coincided with the so-called war of the currents between AC and DC. That battle has, of course, been well documented, and we need not rehash it at length here.[38] Thomas Edison, who had created a DC distribution station in New York City in 1882, followed by a number of other stations in other locales, was the major advocate of that form. But the new developers were banking on the need to send power a longer distance (such as to Buffalo) to make it profitable, since it was reasonably, though ultimately incorrectly, believed that Niagara Falls could not attract enough industrial customers.[39] DC could not be distributed long distances, which, along with being cheaper, was the advantage of polyphase AC induction motors whose voltage could be stepped up and down. After seeing Nikola Tesla and George Westinghouse's display of polyphase AC at the World's Columbian Exposition in Chicago in 1893, and in light of the fact that a polyphase generation and transmission system was installed in California that same year, the International Niagara Falls Commission recommended its method. (Steven Lubar argues that the decision to use AC was based as much on cultural criteria as material: that the technology used at the Falls should match their natural grandeur.[40]) Westinghouse was awarded the contract for the generators. The generating station was named after Edward D. Adams, president of the Cataract Construction Company.[41]

Polyphase AC combined with the revolutionary central station model meant that all the power would be produced at one location by large generators and then transmitted at high voltage over longer distances to multiple recipients. The design of the Adams plant would divert water about 1.5 miles above the American Falls, through a 1,200-foot intake canal at Port Day that served as a reservoir. From there, water would drop through penstocks to the bottom of a powerhouse, generating electrical energy. After leaving the turbines, the water would then flow northwest through the newly constructed 1.25-mile Evershed tunnel – itself heralded as a

Figure 1.7 Adams Power Plant under construction. *Niagara Falls Public Library, New York*

major achievement – under the City of Niagara Falls, pouring into the bottom of the gorge about one-quarter of a mile downstream from the American Falls.[42]

The first power came online in August 1895. When completed, the Adams plant's ten turbines produced 50,000 horsepower (around 37,000 kilowatts) of two-phase electricity, utilizing a head of 135 feet. It was the first large-scale AC generating and polyphase transmission plant in the United States, and it deployed technology that could transform high-voltage power into the various currents (including DC) needed by customers and sectors (such as industrial and lighting). Twenty-five-cycle frequency was selected as a compromise, and it became the electrical industry standard, though later 60-cycle frequency would be provided to domestic customers. In 1896, the Niagara Falls Power Company began sending three-phase AC (11,000 volts) the twenty-two miles to Buffalo, though most of the power remained in the local vicinity for industries like aluminum. All this, and the central station approach, made it an "electrical wonder of the world." The powerhouse and adjoining building were spared no expense and famed architect Stanford White gave them classical treatment (see Figures 1.7 and 1.8).[43] The Adams generating station soon became

FIGURE 1.8 Inside a generating station at the Adams Power Plant. *Niagara Falls Public Library, New York*

a regular stop for tourists. The company quickly added a second powerhouse, built between 1899 and 1904, doubling the plant's electrical power capacity.

Industry remained along the Niagara River, but outside the boundaries of the State Reservation, in two main areas. The first was at the High Bank downstream from the Falls. The second area was just upstream of the

American Falls in the Buffalo Avenue area, where Port Day took water out of the river. Though factories and mills no longer encroached so closely on the waterfall, these two areas grew to become some of the most concentrated industrial zones in the country, particularly in the electrochemical and electrometallurgical fields, which were well established before the First World War.[44] "Electro-chemistry is essentially a child of Niagara," proclaimed one commentator in 1912.[45] A bit further afield, in places like Buffalo and Lackawanna, heavy industry also set up, churning out products like steel and iron, as well as cereal, beer, and lumber. Cheap power was crucial, but so were factors such as easy transportation options and the path dependencies that resulted from initial investments (such as economies of scale, interdependencies, and vertical and horizontal integrations of processes, products, firms, and industries).

With the ideal sites for a hydro development on the New York side already snapped up, at least until there were further technological advances, American hydro financiers looked across the river for more opportunities. The Canadian Niagara Power Company had been granted the right to develop power in Ontario in 1892.[46] This American-controlled company failed to begin construction, however, in large part because the Adams plant design had so disrupted the industry. The International Railway Plant actually produced the first hydro power on the Canadian side in 1893.[47] This small plant conducted water through a canal just above the Falls and discharged the water through a tunnel that exited at the face of the cliff below the Horseshoe Falls. The electricity was used to operate the International Railway Company's trolley line, and power sent across the river for the trolley reputedly represented the world's first-ever international electricity interconnection. In 1898, the DeCew Falls hydroelectric station became operational. Taking water from the Welland Canal just west of Niagara Falls, it sent electricity thirty-five miles to Hamilton, Ontario.

Canadian Niagara Power's original charter was revoked in 1899, and the rights to develop power from water were divided between this company and several other concerns.[48] In the first decade of the twentieth century, Ontario's Niagara parks commission granted other charters. Three hydroelectric stations were subsequently completed on the Canadian side by the Electrical Development Company, Canadian Niagara Power, and the Ontario Power Company. The proliferation of hydroelectric companies was part and parcel of a larger continent-wide explosion in electricity: between 1902 and 1912 hydro-power generation mushroomed by 464 percent in the United States and supplied one-third of the output of central

electrical stations.[49] The Edward Dean Adams Power Plant alone was responsible for one-tenth of all the electrical power generated in the United States. This growth helped drive the shift from using electricity only for lighting to also powering machines. More widely available electricity in turn brought with it a transformation of both workplace and household labour, with the attendant range of social consequences.

The first large power station at Niagara Falls on the Ontario side was the Canadian Niagara Power Generating Station, later known as the Rankine Generating Station, which featured the largest generators in the world when it came online in 1905.[50] It was modelled on the Adams plant and was a subsidiary of the same parent concern, the Niagara Falls Power Company. This plant is near the brink of the Horseshoe Falls, and discharged its water to the lower river through a tunnel. As the company directors planned from the beginning, the bulk of the electricity was exported to the United States.[51] Another new station, the Ontario Power Plant, was owned by the Ontario Power Company; however, the name is misleading, for this was an American company and it signed export contracts to send the electricity across the river.[52] The Ontario Power Plant was placed in the gorge right below the Falls along the waterline, and brought water from the upper river via underground conduits. The Toronto Power Plant, owned by the Electrical Development Corporation (EDC), was sited along the upper cascades. The EDC was the only Canadian concern among the new plants on the Ontario side, though a group of Toronto robber barons controlled it and sent most of its power to that city.[53] The architecture of all these stations, like those on the American side, was along classical lines to project strength, solidity, and power.

Thus, within the span of only a decade, a spate of power stations had sprung up around Niagara Falls (see Figure 1.9). The various Niagara hydroelectric plants on both sides of the border could cumulatively produce well over half a million horsepower. While that may not seem like much by modern standards, or even by the standards of the mid-twentieth century, this figure dwarfed the hydraulic power available from places like Lowell, Massachusetts, which just a few decades earlier was seen as a revolutionary energy source because it could produce the equivalent of up to 20,000 horsepower. It is important to realize that, before certain technological and scale advances enabled industry to tap nearly the full potential of generating and dam sites, hydro power from Niagara was popularly perceived as inexhaustible. Niagara's hydropower was so attractive not only because it seemed limitless but because it was so clean compared with burning coal, oil, or biomass. According to historian H.V. Nelles,

Figure 1.9 View of the Horseshoe Falls in the early twentieth century (note the Rankine generating station in the upper left). *Niagara Falls Public Library, New York*

hydroelectricity "existed in harmony with the rational and the romantic world" and "could resolve the paradox of ugliness that had blighted nineteenth-century industrialism; it could create factories *and* natural beauty."[54] As a direct result of the new power and jobs, the sister cities of Niagara Falls expanded rapidly: between 1890 and 1910, the population on the Ontario side of the waterfall almost tripled, while the size of its New York counterpart grew sixfold.

Conclusion

Robert Belfield writes that the Niagara Falls Power Company had introduced a technological system – the universal electric power system, which means that the resulting power could be used at different voltages (AC and DC) and for different applications (lights, small motors, large motors, and so on) – that was so successful that earlier hydraulic power approaches at Niagara immediately became obsolete.[55] The Adams plant technology

was transferred to or imitated by subsequent power developments on both sides of Niagara and beyond.[56] The fascination with the new technology and energy form was further enhanced by the fact that it was derived from a place that still held a magical aura in the public consciousness. This was an exciting era when new electricity-related technology was developed or advanced every few years. However, the wide acceptance of hydroelectricity, and the central plant model, should not be taken as inevitable developments. As with all energy transitions, there were many contingencies, the supply preceded the demand, and infrastructures and technologies had to be provided or improved to convince producers and consumers that they should adopt the new source of power.[57]

Niagara became the synecdoche for a host of advances related to hydroelectricity, and the symbol of what electricity derived from water could offer. After all, by 1905, all of the generating stations in service at Niagara Falls on both sides of the border cumulatively produced the same amount of electrical energy as the rest of the United States put together. But Niagara's electrical "firstness" does get exaggerated. This is likely because of American technological exceptionalism narratives, but also the tendency when discussing the evolution of technologies to collapse inventions into oversimplified stories that privilege certain events, companies, and individuals (for example, framing Niagara Falls as the birthplace of hydroelectricity was good for Westinghouse and bad for General Electric), ignore the many necessary but incremental small advances, and then reify this narrative into concrete truth.

Niagara Falls and electricity became intertwined in the minds of so many because both were exemplars of unlimited power, danger, and utopian possibilities; quite simply, it makes for a compelling story if the greatest natural wonder of the world brought forth what some thought of as the greatest invention of modern times. Nonetheless, hundreds of places in Canada, the United States, and the United Kingdom produced hydro power before the Adams station. Nor did the Adams station involve the first transmission line, as both AC and DC electricity had already been transmitted various distances elsewhere.[58]

These qualifications need not reduce Niagara's importance to the evolution of hydrotechnology. In much the same way that Niagara's physical impressiveness stems not from being the biggest in the world by any one measurement but from the magnitude of its combination of numerous factors, so too does the history of Niagara as the cradle of hydroelectricity reflect its combination of several important advances on a larger scale, even if it cannot claim to have been the first in all of them. Niagara's first

AC station generated far more power than its predecessors and contemporaries. And because of its volume, and the technological capacity of late nineteenth-century generators, Niagara Falls was seen as a boundless source of energy close to urban centres and transportation networks. The Adams station had tapped only a portion of Niagara's potential, which far exceeded other water-power sites. To be sure, future generating stations at Niagara would be even larger, with several taking their turn at bearing the mantle of largest in the world.

Therefore, even though the story is more complicated and nuanced than is often presented, Niagara does deserve the title as the *main* locale where hydroelectric generation and transmission from a large central station was proven. Because of Niagara's potential, location, and symbolism, the establishment of power generation there "took on a larger-than-life role in the future of the country" and substantially conditioned North American attitudes toward electricity. Hydro power was an exceptional and "clean" energy source – compared with fossil fuels – that could be sent virtually anywhere and that represented a "utopian and progressive force for the future."[59] Looking back from the twenty-first century, it is difficult to appreciate how profound a psychological impact this energetic abundance had on North American society.

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