Building Landscape Narratives: The material and visual culture of bridge construction in Montreal, 1854-1930

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Abstract:

This is a study of the cultural landscape of Montreal, Canada, in the nineteenth and twentieth centuries, as interpreted from the material and visual culture of bridge construction. The three bridges under study are the Victoria Bridge (constructed 1854-1860), the Saint-Laurent Bridge (constructed 1886-1887), and the Jacques Cartier Bridge (constructed 1926-1930) that cross over the St. Lawrence River at Montreal. At the time they were built, all were regarded as essential for the development of the city and country. Each was the most technically advanced of its kind and brought new material and construction methods to Montreal and Canada. As evidence of the importance of these structures, engineers, bridge manufacturing companies, and promoters produced generous construction records, each record offering a similar yet different perspective on the project.

This research brings a new understanding of bridge architecture in Montreal by connecting a wide variety of construction records and reading them against one another. The study synthesizes and contrasts technical literature, such as construction reports, with visual material, like souvenir books and personalized albums, to show the ways in which both types of sources construct and reproduce their histories. At times, these histories overlap by centring on the perspective of the engineer, and at other times they reveal discrepancies, for example, around the work of Indigenous populations. The intertextual approach to reading the texts and examining the visual imagery demonstrates the ways in which different sources control different narratives and views of the construction projects. The sources reveal the interconnectedness of Montreal bridge builders and how the construction site was a space for social interactions. The study exposes the spatial, temporal, and ecological characteristics of bridge construction in an exceptional cultural landscape along the St. Lawrence River during the period 1854-1930.

Resumé

Ce document étudie le paysage culturel de Montréal (Canada), aux 19^{e} et 20^{e} siècles, via l'interprétation d'éléments culturels, visuels et matériels, reliés à la construction de ponts. Sont ici étudiés les ponts Victoria (construit de 1854 à 1860), Saint-Laurent (1886 à 1887) et Jacques-Cartier (1926 à 1930) qui enjambent le fleuve Saint-Laurent à Montréal. Du temps de leur construction, ils étaient considérés comme essentiels au développement de la ville et du pays. Chacun d'eux était un chef-d'œuvre technologique de son époque, apportant ainsi de tout nouveaux matériaux et techniques de construction à Montréal et au Canada. Pour témoigner de la grande importance de ces nouvelles structures, ingénieurs, entreprises de fabrication de ponts et promoteurs ont alors produit quantité de documents autour de ces constructions – chacune de ces archives nous offre aujourd'hui une perspective similaire, mais toutefois différente, sur le projet dans son ensemble.

Ce travail de recherche nous apporte une nouvelle compréhension de l'architecture des ponts à Montréal par la mise en relation d'une grande quantité de documents liés à leur construction, et de références croisées entre ces différentes lectures. Ainsi, cette étude synthétise et met en contraste la littérature technique et les rapports de construction avec des documents visuels (par exemple, des livres de souvenirs ou des albums personnalisés) afin de démontrer la manière dont chaque source construisait et reproduisait sa propre narration. Par moments, ces cheminements narratifs se recoupent lorsqu'ils sont centrés sur le point de vue de l'ingénieur; à d'autres moments ils sont plutôt révélateurs de divergences, par exemple lorsqu'il s'agit du travail des populations autochtones. L'approche intertextuelle de ces lectures croisées avec l'examen de l'imagerie visuelle démontre la manière dont ces différentes sources témoignent de narrations parfois contradictoires, ou de visions uniques des projets de construction. Ces sources nous révèlent ainsi comment les différentes parties prenantes liées à la construction des ponts de Montréal étaient fortement interconnectées, et la complexité des interactions sociales qui prenaient place sur le chantier. Cette étude révèle les caractéristiques spatiales, temporelles et écologiques de la construction de ponts dans un paysage culturel exceptionnel, autour du fleuve Saint-Laurent durant une période qui s’étend de 1854 à 1930.

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Abbreviations

Libraries and Archives

CSTM	Canada Science and Technology Museum
CCA	Canadian Centre for Architecture
LAC	Library and Archives Canada
MM	McCord Museum
MRBSC	McGill Rare Books and Special Collections Library
NGC	National Gallery of Canada
VM	Ville de Montréal

Other Abbreviations

A&NWR	Atlantic and North West Railway
CPR	Canadian Pacific Railway
CSCE	Canadian Society of Civil Engineers
DBC	Dominion Bridge Company
DIA	Department of Indian Affairs
GTR	Grand Trunk Railway
ICR	Intercolonial Railway
LSL&PL	Lake St. Louis and Province Line
MHC	Montreal Harbour Commission
QMO&OR	Quebec, Montreal, Ottawa, and Occidental Railway
STS	Science and technology studies
WIBC	Wrought Iron Bridge Company

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Preface

My life experiences have shaped this research project. Shortly after finishing my undergraduate studies in 1998, I joined a volunteer project, deep in the rainforest, in Guyana, South America. The three-month project involved building a bridge over a swamp to connect an Indigenous community divided by a change in water levels. Historically, residents had crossed the swamp over a makeshift bridge between home and school or home and work. Even when rice farmers successfully lobbied the government to dam a nearby river, water still rose, and the makeshift crossing disappeared beneath it. The bridge responded to changing economic priorities and was designed to enable those inadvertently impacted by the flooding.

Community Elders guided the project, and early on, my volunteer group watched while three chainsaw operators felled and milled timber for the bridge. As we acclimatized to the tropical conditions, the group participated by carrying the dense wood to the construction site, hand-drilling the components, and driving piles atop rickety scaffolding. Building the bridge was a community project. The volunteers learned from their leaders about the exotic flora and fauna, community politics, and how to spy alligators lurking at the water's edge. When several volunteers became infected by parasites after spending too long in the alluvial waters, an Elder led them deep into the forest, searching for vines to cut and then let the vines "cry" into their eyes. The parasites were vanquished, and the volunteers consequently learned about more than building a bridge.

The bridge building experience had an immediate and lasting impact on me; I sketched, wrote postcards, and took photographs of these everyday experiences with my Pentax ME Super 35 mm camera. Upon returning home, I processed over three hundred pictures and compiled them into two heavy albums. The albums represented a personal documentation—the natural and cultural history, politics, and materials—through the experience of building a bridge.

In undertaking this dissertation, I discovered an album of photographs, echoing my bridge building experience in Guyana. The photographs—dating from the late nineteenth century but now in the Dominion Bridge Company *fonds* at the Library and Archives Canada—were of a bridge in Montreal. The album's similarities to my photographic compilations were striking. Although dusty and worn with age, the archived album was once a cherished possession, and its contents imparted an everyday connection to the land and the people who helped shape it. My awareness of the distinctiveness of the Montreal albums grows out of my experience collecting and arranging photographs of a bridge building project. Although it is the Montreal bridge constructions whose narratives underlie the research reported here, I owe a great debt of gratitude to my Guyanese bridge building mentors and fellow volunteers for inspiring parts of this study.

Introduction

This study explores the landscape history that emerged by comparing bridge construction reports and previously unexamined photograph albums that offer different interpretations of the building of three Montreal bridges. Using construction reports, newspaper articles, and construction logs, along with souvenir booklets and photographic albums, this study explores the interpretive potential of artifacts produced during the construction of the Victoria Bridge (1854-1860), the Saint-Laurent Bridge (1886-1887), and the Jacques Cartier Bridge (1926-1930) in Montreal. The research shows that the reports and souvenir albums from the construction site are symbolic and meaningful cultural artifacts that reflect diverse ideologies and politics and evolving cultural and professional agendas in relation to building projects.

This study produces a layered understanding of the city by exploring the process of building and its representations. The research situates the bridges in landscape history by examining the interwoven natural, social, and symbolic relationships documented and recorded during the building process. It considers the abiotic factors, or the non-living parts of the fluvial ecosystem, that shape the banks of the St. Lawrence River and create a unique set of constraints for building. The research observes the growing community of engineers in Montreal and their increasing use of photography to capture advances on the construction site. The study also acknowledges the lives brought together in meaningful places as a result of the construction projects.

Like architectural history, landscape history is concerned with interpreting the historical context for significant projects, including the design and material forms. However, landscape history uniquely focuses on the human process of shaping the entire cultural landscape. Engineers and construction workers are among those that play a significant role in reshaping the physical landscape and, as with other established work in landscape history, this research acknowledges their contributions.[1] Yet, rather than emphasizing the decision-making process of these men, the landscape history framework is concerned with understanding "multiple modes of perception" and the circumstances through which perception is interpreted.[2] To take the definition put forth by landscape historian Dianne Harris, landscape history is "constructed by scholars who study human interactions with external nature within a broadly interdisciplinary framework [and] it is specific and particular, revealing new aspects of human history that are not elsewhere available."[3] This research contributes to a new understanding of Montreal's grand era of bridge building through a detailed study and intense layering of engineering reports and souvenirs from the construction site.

Both architectural and landscape history intersect with engineering history through the production of construction-related sources—all three underlying fields communicated with visual tools such as maps, plans, sections, elevations, and photographs. To varying degrees, these fields also draw on geological and hydrological reports, transportation planning and expropriation documents, and corporate records in the design, construction, and dissemination of their projects. To "bridge" the disparate and often contradictory descriptions of the construction processes, this study examines technical accounts of the process of shaping the land alongside photographic collections and souvenirs that depict the qualitative aspects of these construction sites. This study distinguishes itself by using reports to describe the technical material and

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[1] For example, see Dolores Hayden, *The Power of Place: Urban Landscapes as Public History* (Cambridge, MA: MIT Press, 1995); Katherine Wentworth Rinne, *The Waters of Rome: Aqueducts, Fountains, and the Birth of the Baroque City* (New Haven: Yale University Press, 2011).

[2] Dell Upton, "Architectural History or Landscape History?," *Journal of Architectural Education (1984-)* 44, no. 4 (1991): 198, https://doi.org/10.2307/1425140.

[3] Dianne Harris, "The Postmodernization of Landscape: A Critical Historiography," *Journal of the Society of Architectural Historians* 58, no. 3 (September 1, 1999): 438, https://doi.org/10.2307/991537.

documents to encompass the qualitative material.[4] Layering and testing the two classes of artifacts reveals a dynamic cultural ecology in the bridge building process. The textual and visual sources trace the creative, ideological, and technical processes that humans engage with in transforming an idea into a material reality.

The three bridges under study were the first of ten crossings over (or under) the St. Lawrence River at Montreal.[5] The bridges share the challenge of building in a fast-flowing and seasonally disruptive river caused by the region's specific geographical conditions. Thus, an expanded understanding of the bridges' construction records necessarily includes context about the river and its banks. Both the region's abiotic and biotic factors establish common building challenges and play a role in the decision-making process. Each bridge was considered the most technologically advanced of its time and construction was heavily documented. The day-to-day records of construction are held in reports, diaries, corporate records, and material logs and are detailed such that one could conceivably rebuild any of the bridges in the present day. The technical sources also describe material flows and human resource matters and reveal a community of engineers and photographers. The archival and print sources, including journals, newspapers, and scrapbooks of newspaper clippings of construction curated by the engineers, reveal recurring themes and reflect the concerns of the engineers.

Each bridge also has a photographic record. During construction, promoters, manufacturers, and engineers hired one or more photographers to record these monumental building projects.

[4] Ian Hodder, "The Interpretation of Documents and Material Culture," in *Sage Biographical Research*, ed. John Goodwin, vol. 1: Biographic Research-Starting Points, Debates and Approaches (California: Sage Publications, 2012), 172.

[5] The ten Montreal—South Shore bridges in order of construction are: Victoria Bridge (1860), Saint-Laurent Railway Bridge (1886), Jacques Cartier Bridge (1930), Honoré Mercier Bridge (1934), Champlain Bridge (1962), Champlain Bridge Ice Structure (1964), Pont de la Concorde et Pont des Îles (1965), Montreal Metro Tunnel (1966), Louis-Hippolyte Lafontaine Bridge-Tunnel (1967), Samuel de Champlain Bridge (2019).

Near completion of the structure and before the bridges opened to the public, photographers compiled and gifted engineers with souvenirs of the projects. These albums and commemorative booklets substantiate the engineering records that document the immense effort necessary to move the earth and water to construct the foundation of each bridge. The imagery in the albums reveals the dangerous working conditions; it also captures the routine activities of building a bridge. This study finds that the photographs provide multiple views on a single landscape. In their arrangement, the souvenirs replicate the experience of moving through the construction site symbolic relationships not available elsewhere.

The photographic albums present open-ended stories about the bridge construction and the reshaping of the landscape. Landscape narratives, write landscape scholars Matthew Potteiger and Jamie Purinton, "intersect with sites, accumulate as layers of history, organize sequences, and inhere in the materials and processes of the landscape."[6] The Montreal bridge albums begin their narrative part-way into the construction project, and they end before the bridges are complete. In this way, the photographs are not tied to the process of building, and, tellingly, they are archived separately from the legal reports. In contrast, they represent movement through time and space, and they hold the memories of those who participated. For photographic historian Martha Langford, snapshot collections are a performance whereby "the story-telling nature of an album constitutes *lived* experience (real and imagined) that neither erases nor cancels sites of longing, but continuously revisits them in a moving present."[7] The albums engage with a process of discovery—as it is ongoing—that includes multiple contributors and open-ended analyses.

[6] Matthew Potteiger and Jamie Purinton, "Beginnings," in *Landscape Narratives: Design Practices for Telling Stories* (New York; Toronto: J. Wiley, 1998), 5.

[7] Martha Langford, "Speaking the Album: An Application of the Oral-Photographic Framework," in *Locating Memory: Photographic Acts*, ed. Annette Kuhn and Kirsten Emiko McAllister (New York: Berghahn Books, 2006), 61.

The significance of this study is that it contributes to the field of landscape history through an examination of two modes of representations of bridge construction in Montreal. The intertextual reading of construction narratives reveals how the projects are recounted materially, temporally, and spatially by each set of records. When combined with the technical documents, the visual records challenge the known history, based on how the viewer is positioned, selective presentation, framing and screening (carefully placed greenery), and perspective manipulations. The study approaches the examination of photographic albums by putting non-traditional sources together.

The literature review, found in Chapter One, examines the meaning of landscape, the ways in which scholars from architecture, science and technology studies (STS), cultural geography, and visual studies approach technical and visual sources methodologically. It establishes what is known about the ways Canadian engineers conceive, operate on and represent the landscape. The review begins by assessing approaches to interpreting landscape history, with a focus on representation techniques. The review examines the ways in which engineers and technicians represent their work and, by extension, landscape. This study groups the materials into four categories: technical drawings and reports, historical maps, printed material, and photographic collections. However, some of the materials fall into more than one category, and interdisciplinary approaches to scholarship can blur disciplinary boundaries. Still, the literature review develops an understanding of how researchers in architecture, engineering, cultural geography, and landscape engage with technical reports and the visual culture of engineers. The review touches on only a portion of the research available to demonstrate the interdisciplinary potential of the study and the importance of considering multiple perspectives. The literature review also assesses what is known about engineering practices in Montreal at the time of construction of the three bridges in question and the corresponding traditions of visually representing the landscape.

The following research questions guide the study:

1. In what ways do souvenir albums containing images of the construction of three Montreal bridges help to interpret the landscape history of that time and place with greater insight than is possible from just reading the construction reports?
2. In what ways do the technical reports and souvenir collections work together to support the creation of a new understanding of the bridge construction?
3. What does a landscape history approach reveal about what is represented in each set of documents? What is included, what is in the margins, what is out of place, and what is out of order? What are the pieces that do not appear to fit in the construction stories?

The theoretical framework places these sources in the purview of landscape history. It aims to expand the field by adding photographic collections to the cross-section of sources already used by landscape historians to interpret the ways that humans have shaped and occupied the land. The study approached the sources through what is a fundamentally comparative methodology. The variety of sources demanded a flexible method and the researcher returned to the data with new questions as new information became available in an iterative process. The analysis, therefore, includes a comparative study and close, or intertextual, reading of the text and imagery, and engages with narrative approaches to interpreting the landscape. The combined readings underpinning this work highlight the expansive landscape, including details about the local climate, cultural relationships, and material flows that may be overlooked in other histories.

Previous histories of the Victoria, Saint-Laurent, and Jacques Cartier bridges have been written exclusively in English, reflecting the British Colonial period in the city's history. In

1763, the Treaty of Paris ended the Seven Years War between France and Britain, and, at that time, Britain began its reign over North American territories.[8] Prior to this, the French had inhabited the St. Lawrence lowlands, beginning around 1534, when they began appropriating land from Indigenous populations. First Nations peoples inhabited Turtle Island, or North America, long before European explorers made claims on the land. The island and city of Montreal "is situated on the traditional territory of the Kanien'kehà:ka, a place which has long served as a site of meeting and exchange amongst many First Nations, including the Kanien'kehá:ka of the Haudenosaunee Confederacy, the Huron/Wendat, the Abenaki, and the Anishinaabeg. [This study] recognize[s] and respect[s] the Kanien'kehà:ka as the traditional custodians of the lands and waters on which [the research is based]."[9]

Chapter one, "Literature Review, Theoretical Framework, and Methodology," examines the literature that frames landscape studies and builds an argument for an analysis of engineering records and documents through a landscape lens. The review establishes the necessity for looking at the bridge from two or more perspectives, such as the engineer and the photographer. It engages with ways in which scholars have studied engineering and the ways engineers and their agents imagine, operate on, and represent the landscape. The review addresses the different approaches to reading technical records and visual documentation. Some of these scholarly publications fall under categories such as cultural landscape studies, architectural photography, and STS. The framework builds on established concepts in landscape history that draw from semiotic and linguistic theories that emphasize context, postcolonial theories that highlight

[8] Richard Cole Harris, *The Seigneurial System in Early Canada; A Geographical Study.* (Madison: University of Wisconsin Press, 1966).

[9] "Land Acknowledgement," Cultural and Indigenous Research in Counselling Psychology (CIRC), accessed January 20, 2021, https://www.mcgill.ca/circ/land-acknowledgement.

oppressed voices, and relativism that acknowledges the value of situated knowledge.[10] Moreover, this study addresses the inherent storytelling nature of landscapes by adopting mixed methods—including landscape narrative, microanalysis, and intertextual reading of visual and material culture—from allied fields such as architecture and cultural geography.

Chapter two, "Bridging the River," introduces the context for each of the three bridges and their infrastructural networks. The chapter describes the impetus for each bridge and questions the technical sources to reveal biases, shortfalls in reporting, and inherent power struggles. Some prominent sources include construction reports, journal articles, newspaper articles, agendas, travel diaries, and material logs. The chapter discusses each bridge in turn.

Chapter three, "Souvenirs from the Construction Site," presents the different types of visual records produced during the construction of each bridge. It describes the photographic collections and their use in promotion, as well as souvenir books, albums, and booklets. The chapter draws associations among engineers and photographers, rural locations, and construction materials and methods. The chapter illuminates what makes these sources valuable for interpreting the history of these three bridges. It sets the stage for a comparison of the reports and documents.

Chapter four, "Landscape Narratives," offers a comparative analysis of the primary source material to showcase what is made visible through the engineering reports, promotional materials, and souvenirs from the construction site. At times, the visual documents support the technical information, and at other times, they expose tension in what is understood about the bridges. The chapter explores the perspective of the engineer as a colonial tourist and a scientific expert. It examines movement through space and investigates the power of a single viewpoint.

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[10] Dianne Harris, "The Postmodernization of Landscape," 434–43; Jan Kenneth Birksted, "Landscape History and Theory: From Subject Matter to Analytic Tool," *Landscape Review* 8, no. 2 (2003): 4–28.

Overall, the chapter finds new meaning in the bridge construction projects by considering the ecological processes acting upon the bridge and the social structure that are apparent by reading the reports and documents.

The “Conclusion” reviews the importance of the commemorative books and albums, as well as their usefulness in establishing a layered landscape history of Montreal. The conclusion underlines the advantages of the comparative method and reiterates the contributions and significance of this study. The concluding chapter acknowledges the presence of missing voices, such as those from Indigenous history, and makes recommendations for future engagement with this extraordinary landscape.

Chapter One: Literature Review, Theoretical Framework, and Methodology

Chapter Overview

This first chapter, “Literature Review, Theoretical Framework, and Methodology” introduces the overall approach to the research. The Literature Review section establishes what cultural landscape studies and landscape history bring to this study. The review assesses what is known about the ways in which engineers in Canada conceive, operate on, and represent the landscape. The literature review includes an assessment of the ways in which scholars from science and technology studies (STS), architectural studies, and cultural geography engage with textual and visual sources produced by and for engineers. The Theoretical Framework identifies vital concepts, including the meaning of landscape adopted for this study, the primary and secondary observers addressed in the research, and the difference between constructing and construing landscape. The Methodology section describes the investigation approach and justifies specific chosen methods.

Literature Review

The erection of the Victoria Bridge, the Saint-Laurent Bridge, and the Jacques Cartier Bridge attest to specific periods of industrial and political growth. During this period, Montreal and its vast hinterland transitioned from a British colony to a Dominion with political autonomy. Researchers have explored the economic and political impact of these infrastructural networks,[11]

[11] See for example, Donald Creighton, *The Empire of the St. Lawrence: A Study in Commerce and Politics*, The Canada 150 Collection (Toronto: University of Toronto Press, [1937] 2017); Harold Innis, *Essays in Canadian Economic History*, ed. Mary Q. Innis (Toronto: University of Toronto Press, [1956] 2017); Pierre Berton, *The*

and the men who made the projects happen.[12] More recent studies have focused on the architecture of the Canadian Pacific Railway[13] and the social and environmental impact of the Canadian Pacific Railway's bridge at Montreal.[14] However, little scholarship has examined the landscape history of the area or the ways in which bridge engineers working in Montreal represented their projects.

Approaches to landscape history began to emerge and evolve throughout the first half of the twentieth century. In 1925, German-born American geographer Carl Sauer introduced the concept of cultural landscape to the United States. Sauer's approach to humanistic cultural ecology recognized that "culture is the agent, the natural area is the medium, the cultural landscape is the result."[15] While opponents criticized Sauer's concepts for seeing the landscape as an objective by-product of human action, his work laid the foundations for cultural landscape studies in the English-speaking world.[16]

National Dream: The Great Railway, 1871-1881 (Toronto: McClelland and Stewart, 1970); Pierre Berton and Norman Friedman, *The Last Spike: The Great Railway 1881-1885.* (Toronto: McClelland and Stewart, 1971); Christopher Andreae, "Railways," in *Building Canada: A History of Public Works*, ed. Norman R Ball (Toronto: University of Toronto Press, 1988); A. A. den Otter, *The Philosophy of Railways: The Transcontinental Railway Idea in British North America* (Toronto: University of Toronto Press, 1997).

[12] G. R. Stevens, *History of the Canadian National Railways*, Railroads of America (New York: Macmillan, 1973); Gerald J. J. Tulchinsky, *The River Barons: Montreal Businessmen and the Growth of Industry and Transportation, 1837-53* (Toronto ; Buffalo, Toronto: University of Toronto Press, 1977); Andrew Smith and J. Andrew Ross, *Canada's Entrepreneurs: From the Fur Trade to the 1929 Stock Market Crash: Portraits from the Dictionary of Canadian Biography Under the Direction of John English and Réal Bélanger* (Toronto: University of Toronto Press, 2011).

[13] Elsa Lam, "Wilderness Nation: Building Canada's Railway Landscapes, 1885-1929," (PhD dissertation, Ann Arbor, Columbia University, 2011).

[14] Daniel Rueck, "When Bridges Become Barriers," in *Metropolitan Natures: Environmental Histories of Montréal*, ed. Stéphane Castonguay and Michèle Dagenais (Pittsburgh: University of Pittsburgh Press, 2011), 228–45.

[15] Carl O. Sauer, "The Morphology of Landscape," *University of California Publications in Geography* 2, no. 2 (1925): 46.

[16] Lester B. Rowntree, "The Cultural Landscape Concept in American Human Geography," in *Concepts in Human Geography*, ed. Earle Carville, Kent Mathewson, and Martin S. Kenzer (Lanham: Rowman & Littlefield Publishers, 1996), 128.

In the decades following World War II, cultural geographers furthered historical approaches and developed interpretive methods for studying the landscape. In the United States, J. B. (John Brinkerhoff) Jackson's contributions were enormous. Jackson borrowed from material culturalists[17] to develop an exceptional approach to writing about the everyday landscape. Jackson studied the ordinary, day-to-day arenas of life. He maintains that landscape is "a composition of man-made or man-modified spaces to serve as infrastructure or background for our collective existence."[18] For Jackson, "background" means the ideologies and successional spatial occupation of the land that shape the history. Unlike other scholars who trace the etymology of landscape through Latin, Greek, and Germanic languages of the word, Jackson focused on landscape as inhabited and occupied by humans. Elsewhere, he expands on the concept to emphasizes that landscape is a direct engagement with and shared sensory experience that "make us recall it [landscape] with emotion."[19] The present study adopts Jackson's understanding of landscape as a physical space that holds meaning for those who experience it.

Jackson's "unique capacity to interpret landscapes iconographically and intelligently while remaining true to the everyday experience of landscape" deeply influenced cultural geographer Denis Cosgrove's research and writings.[20] Cosgrove theorized "the *idea* of landscape within a broadly Marxian understanding of culture and society" in which "landscape represents a way of seeing—a way in which some Europeans have represented to themselves and to other the world

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[17] Henry H. Glassie, *Material Culture* (Indiana: Indiana University Press, 1999); Clifford Geertz, *Local Knowledge: Further Essays in Interpretive Anthropology* (New York: Basic Books, 1983).

[18] John Brinckerhoff Jackson, "The Vernacular Landscape" in Penning-Rowsell, E.C., and Lowenthall, D. (eds), *Landscape Meaning and Values* (London: Allen & Unwin, 1986) reprinted in John Brinckerhoff Jackson, "The Word Itself," in *Discovering the Vernacular Landscape* (New York: Yale University Press, 1986), 8.

[19] John Brinckerhoff Jackson, *The Necessity for Ruins, and Other Topics* (Amherst: University of Massachusetts Press, 1980), 17.

[20] Denis E. Cosgrove, *Social Formation and Symbolic Landscape* (Wisconsin; London: University of Wisconsin Press, 1998), xi.

about them and their relationship with it."[21] Whereas Jackson studied landscapes, Cosgrove argues that landscape represents objective knowledge and visual authority.[22] Congruent with Cosgrove's argument, this study of the Montreal bridges sees landscape as inseparable from social and political contexts and that landscapes can be studied through visual material.

Cosgrove and fellow cultural geographer Stephen Daniels furthered this way of seeing by introducing iconographic methods in art history to cultural landscape studies.[23] Central to their argument is the concept of landscape as a cultural image, a representation. "To understand a built landscape," they write, "it is usually necessary to understand written and verbal representation of it […] as constituent images of its meaning or meanings."[24] Cosgrove and Daniels draw on the scholarship and methodologies of art historians to develop their "way of seeing"; they examine iconographical methods that merge Renaissance art history and anthropology,[25] Victorian biblical exegesis and Marxist aesthetics,[26] and employ literature and visual studies.[27] Taking a post-modern intertextual approach to reading landscape, Cosgrove and Daniels insist "every culture weaves its world out of image and symbol [and] the iconographic method remains central to the cultural enquiry."[28] While cultural geographers widely accept Cosgrove's and Daniels'

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[21] Author's italics. Cosgrove, xiii–xiv.

[22] Denis Cosgrove, "Prospect, Perspective and the Evolution of the Landscape Idea," *Transactions of the Institute of British Geographers* 10, no. 1 (January 1, 1985): 45–62, https://doi.org/10.2307/622249.

[23] Denis E. Cosgrove and Stephen Daniels, *The Iconography of Landscape: Essays on the Symbolic Representation, Design, and Use of Past Environments* (Cambridge [England]; New York: Cambridge University Press, 1988).

[24] Denis E. Cosgrove and Stephen Daniels, "Introduction: Iconography and Landscape," in *The Iconography of Landscape: Essays on the Symbolic Representation, Design, and Use of Past Environments*, ed. Denis E. Cosgrove and Stephen Daniels (Cambridge [England]; New York: Cambridge University Press, 1988).

[25] Erwin Panofsky, *Studies in Iconology: Humanistic Themes in the Art of the Renaissance* (New York: Harper & Row, 1972); Clifford Geertz, "Thick Description: Toward an Interpretive Theory of Culture," in *The Interpretation of Cultures: Selected Essays* (New York: Basic Books, 1973).

[26] John Ruskin and Jan Morris, *The Stones of Venice* (Boston: Little, Brown, 1981); John Berger, *Ways of Seeing* (New York: Viking Press, 1973).

[27] Raymond Williams, *The Country and the City* (New York: Oxford University Press, 1975); W. J. T Mitchell, *Iconology: Image, Text, Ideology* (Chicago: University of Chicago Press, 1986).

[28] Cosgrove and Daniels, "Introduction: Iconography and Landscape," 8.

approach, they limit their framework to the viewer's understanding of landscape of an image. Consequently, landscape studies shifted to address this shortfall.

Since Cosgrove and Daniels, researchers have adopted a more active interpretation of landscape. In the introduction to an edited collection of essays, *Landscape and Power,* W. J. T. Mitchell proposes transforming landscape from a noun to verb to "think of landscape, not as an object to be seen or a text to be read, but as a process by which social and subjective identities are formed."[29] Exploring landscape as a verb involves expressing landscape in terms of action and performance. As a direct reflection on this proposal, the study that follows engages with materials that record and document a physical reshaping of the landscape—a tangible action—and the ways in which the engineers and their agents represent the projects, or how they wish the projects to be viewed and want themselves to be seen by other.

Mitchell's argument sees landscape through process and movement. "Landscape is a dynamic medium," he writes, "in which we 'live and move and have our being,' but also a medium that is itself in motion from one place or time to another."[30] The Montreal bridges are lasting material forms that hold the value systems of their makers. Similarly, the reports and documents they produce reiterate the ideologies beyond the time and place of construction.

Mitchell sees space and place as fundamental categories of analysis and approaches them through phenomenological and experiential traditions. "What we have done and are doing to our environment," Mitchell writes, "what the environment in turn does to us, how we naturalize what we do to each other, how these "doings" are enacted in the media of representation we call "landscape" are the subjects of his—and this—research.[31] Mitchell builds on spatial theories—of

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[29] W. J. T. Mitchell, ed., *Landscape and Power,* Second (Chicago: University of Chicago Press, 2002), 1.
[30] Mitchell, 2.
[31] Mitchell, 2.

Gaston Bachelard and Martin Heidegger and those of Henri Lefebvre, Michel de Certeau, and Michel Foucault—to define place as a specific location, space as a practiced place, and landscape as a medium, or a site encountered as an image. “Landscape circulates as a medium of exchange, a site of visual appropriation, a focus for the formation of identity.”[32] The ways in which the photographers and promoters represent the Montreal engineers, reflects how the engineers wanted to be viewed by others. With that in mind, the sources reflect the establishment of their cultural identity.

Mitchell’s approach to the study of landscape is in reading its multiple narrative tracts. This research examines documents and reports produced by different people involved in the construction projects. Each source adds a perspective on the project and is read in context with its making and in context with the other primary sources.

Still, there are limitations to reading landscapes. Both Cosgrove and Mitchell emphasize the Western-centric nature of landscape.[33] Landscape historian Dianne Harris notes, landscape histories “focus on elite and elite culture […] since archives are structured and preserved by wealthy and powerful members of society.”[34] In her 1999 review of the state of the field, Harris looked to sociologists for research that expanded landscape history to include the “stories of users, laborers, neighborhood groups, gardeners, engineers, merchants, politicians, and ethnic minorities.”[35] Harris argues that landscape is “a physical framework that structures social life and is, in turn, shaped by it.” For Harris, landscape constitutes a range of voices and contributors.

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[32] Ibid.

[33] Cosgrove, *Social Formation and Symbolic Landscape*, xi; W. J. T. Mitchell, “Imperial Landscape,” in *Landscape and Power*, ed. W. J. T. Mitchell, Second (Chicago: University of Chicago Press, 2002), 5.

[34] Harris, “The Postmodernization of Landscape,” 348.

[35] Ibid.

A decade later, Harris furthered this place-based research to argue for landscape as a site for understanding "the operations of authority, the flow of capital, the manipulation of environmental resources for specific ends, the creation of social hierarchies,"[36] gender, and race. She suggests that researchers ask how difference is constructed by studying power relations as expressed through language and spatial composition. Harris writes, "who is left in, who is left out, and look carefully at what's visible, but also what is erased or consciously rendered invisible and for what purposes."[37] Reading the Montreal bridge reports and documents against one another draws attention to, and from, the engineer. For example, the photographer adds a second perspective, and the photographer's ability to capture aspects of the entire cultural landscape evokes a sense of difference.

Harris proposes landscape studies involve analyzing that which is concealed by reading visual and material artifacts against one another to understand how power operates in and through landscape. Harris demonstrates this potential of landscape in her book, *The Nature of Authority,* by scrutinizing the "visual and material culture [of] a particular place and time [to offer] a spatial history, one that emphasizes the physical framework of space […] as the setting for and an agent in the development of […] culture."[38] Montreal bridge construction reports and documents capture the process of change and set the foundation for interpreting what is exposed and what is concealed. Drawing on a wide variety of maps, paintings, and prints of eighteenth-century Lombardy, Italy, Harris finds that the visual artifacts represent material wealth, prestige, and "academic knowledge of and participation in a variety of fields that allowed cultural

[36] Dianne Harris, "Self and Landscape," in *Landscape Theory*, ed. Rachael Ziady DeLue and James Elkins, vol. 6, The Art Seminar (New York: Routledge, 2008), 190.

[37] Ibid.

[38] Dianne Harris, *The Nature of Authority: Villa Culture, Landscape, and Representation in Eighteenth-Century Lombardy*, Buildings, Landscapes, and Societies Series; 1 (University Park, Pa.: Pennsylvania State University Press, 2003), 1.

distinction."[39] The quantity and quality of materials produced during the construction of the Montreal bridges expose the esteem in which the engineers held their work.

The visualizations also reflect how the engineers viewed natural elements and cultural groups involved in the projects. In his essay, "Eidetic Operations and New Landscapes," landscape architect James Corner asserts that "landscape and image are inseparable" and acknowledges that landscape architects are prone to "reshaping large area of land according to *priori* imaging."[40] Imagery, including engineering drawings, illustrations, and photographs, make ideas about landscape possible and can influence the ways in which landscape architects, architects, or engineers design the land. Understanding how and why images are made can help researchers assess the broad range of influence acting upon landscape.

Each one of the Montreal bridge construction sites in the study that follows is an arena for political power and professional authority. Relentlessly trying to shake the Victorian stigma of being laborious and ordinary workers, mid- to late-nineteenth-century engineers sought to redefine their role in a society that honoured learned professions, such as medicine, law, and the clergy.[41] Engineers lacked a popular identity, and an engineer could be anything from a train driver to a plumber to the public; they suffered from a British aristocratic stigma toward manual labour.[42] Historian Rodney J. Millard writes, "the ordinary citizen, engineers complained, saw no romance in such commonplace necessities as sewers and soon took them [sewers], and engineers, for granted."[43] Engineers worked for large corporations and had little individual

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[39] Ibid., 4–5.

[40] James Corner, "Edietic Operations and New Landscapes," in *Recovering Landscape: Essays in Contemporary Landscape Architecture*, ed. James Corner (New York: Princeton Architectural Press, 1999), 153.

[41] J. Rodney Millard, *The Master Spirit of the Age: Canadian Engineers and the Politics of Professionalism, 1887-1922* (Toronto: University of Toronto Press, 1988), 8.

[42] Ibid.

[43] Ibid., 9.

power to influence general impressions or protect the public from substandard work.[44] This study engages with construction reports and documents to establish the ways in which engineers distinguish themselves as a cultural group within a rapidly industrializing landscape.

The Montreal bridge construction sites brought together engineers that would form the Canadian Society of Civil Engineers (CSCE), in 1887. This association moved to elevate the profession by legally protecting the title of engineer.[45] The engineers further distinguished themselves by marketing themselves through their projects. For urban and art historian Claude Baillargeon, construction photographs are a form of commodity production that complies with its commissioning agency's requirements. In other words, the photographer takes direction from different stakeholders and produces images that reflect their agenda(s). While none of the Montreal bridge photograph contracts are accessible, this study reveals that the photographers (album compliers and book editors) use various devices to control or manipulate vision. Baillargeon traces the tradition of construction photography as propaganda as it evolved in the 1850s to prove that promoters came to value construction photographs. He demonstrates how a practical solution to an engineering communication problem "quickly proved beneficial as a powerful agent of self-promotion."[46] As will be shown, the Montreal engineers adopt photography as a marketing tool.

[44] Richard White, *Gentlemen Engineers the Working Lives of Frank and Walter Shanly* (Toronto: University of Toronto Press, 1999), http://site.ebrary.com/id/10218774.

[45] To become a member, CSCE candidates needed to be at least thirty years old, with ten years of combined work and educational experience, and five years in charge of projects. Candidates also needed to be upstanding citizens, and they entered by vote of recommendation from others. Finally, candidates received mentorship under experienced engineers, such as Bob Fleming and Reid, before undergoing peer review. Norman R. Ball, *"Mind, Heart, and Vision": Professional Engineering in Canada 1887 to 1987* (Ottawa: National Museum of Science and Technology, National Museums of Canada, in cooperation with the Engineering Centennial Board, 1987), 23.

[46] Claude Baillargeon, "Religious Fervor and Photographic Propaganda: Durandelle's Anatomical Studies of the Sacré-Coeur de Montmartre" (Ph.D., California, University of California, Santa Barbara, 2002), p. 17.

A distinct understanding of architecture and engineering developed in 1750[47] and advance one century later alongside photography. “The almost simultaneous acts of shaping and depicting the city,” writes urban historian Eric Sandweiss, “are both, in essence, ways of laying claim to space, of beginning to take note of the distinct forms that add up to a single, identifiable whole.”[48] The topographical photograph captures one slice of the city at one moment in time, and the viewer is left to fill in the picture. Meanwhile, as Sandweiss notes, the city keeps changing.

With the development of engineering as a modern profession,[49] serialized construction documentation became a familiar genre of architectural and engineering representation. “From the middle of the nineteenth century,” write architectural historians Eve Blau and Edward Kaufman, an “untold numbers of bridges [and other structures] have taken shape before the camera, and through such depictions, the drama of their construction has been inscribed upon the finished form.”[50] Like Sandweiss, these authors find that construction photographs arrest the bridge mid-construction, and Blau and Kaufman add that it imbues a sense of longing for the past and hope for a better future. Photographs evoke the architectural imagination.

Urban and architectural historians, like Sean Weiss and Peter Sealy, study similar phenomena in their studies of photographic collections. For example, Weiss traces the movement of photographs from a communication tool on the construction site to a teaching tool in the

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[47] For more on the autonomy of architects and engineers as professionals , see Peter Collins, *Changing Ideals in Modern Architecture, 1750-1950*, Second (Montreal: McGill-Queen’s University Press, 1998).

[48] Eric Sandweiss, “Claiming the Urban Landscape: The Improbable Rise of an Inevitable City,” in *Eadweard Muybridge and the Photographic Panorama of San Francisco, 1850–1880*, ed. David Harris (Montreal: CCA, 1993), 19.

[49] Collins, *Changing Ideals in Modern Architecture,* 185–97.

[50] Eve Blau and Edward Kaufman, eds., *Architecture and Its Image: Four Centuries of Architectural Representation: Works from the Collection of the Canadian Centre for Architecture* (Montreal: Canadian Centre for Architecture, 1989), 216.

classroom and a marketing tool in publications, the press, and expositions. He argues that Paris became modern through its mid-nineteenth century physical transformations, which is inseparable from the new modes of publicity available to the state-run engineering department. Otherwise stated, Weiss finds the photographs work to modernize the city through many iterations of its image.[51] Comparably, Sealy finds the photographic record evokes the architectural imagination in the mid-to late-nineteenth century. Sealy traces the likeness of photographs in lithographs representing new architectural forms and space and their use in the French architectural press.[52] Both authors demonstrate the reciprocal relationship between the rationalization of architectural materials and building campaigns and photography.

Urban and architectural scholars demonstrate the value of photographs for interpreting meaning in the development of the city and the many ways of approaching them as a source. Blau and Kaufmann examine the arrangement and rearrangement of large collections, Baillargeon and Sealy place emphasis on the reproductive processes, and Weiss investigates the meaning of photographs as they move between uses. Overall, these scholars pay close attention to what American art critic Rosalind Krauss describes as the photograph's discursive space.[53] For Krauss, historians, curators, and institutions play a role in exhibiting a photograph and, the function of a photograph changes depending on its situation in the world. In other words, photographs must be placed in context with their time, place, contributors, and function. The

[51] Sean R. Weiss, "Engineering, Photography, and the Construction of Modern Paris, 1857-1911" (Ph.D., United States -- New York, City University of New York, 2013).

[52] Peter Sealy, "After a Photograph, before Photography (Takes Command)," *The Journal of Architecture* 21, no. 6 (August 17, 2016): 911–37, https://doi.org/10.1080/13602365.2016.1220970; Peter Sealy, "From Object to Field: The Uses of Photography by Nineteenth-Century Architects," in *Companion to the History of Architecture*, ed. Martin Bressani and Christina Contandriopoulos, vol. III, Nineteenth-Century Architecture (Digital Editions: John Wiley & Sons, 2017), 1–21, https://doi.org/10.1002/9781118887226.wbcha097.

[53] Rosalind Krauss, "Photography's Discursive Spaces: Landscape/View," *Art Journal* 42, no. 4 (December 1, 1982): 311–19, https://doi.org/10.2307/776691.

study that follows searches for the interpretive potential of photographs by comparing them with other forms of communications in engineering.

Architects are among the specialists who draw on the material and visual culture of engineers. Architectural historian Carl W. Condit finds that anonymous monthly construction updates hold the potential to infuse the architectural imagination. In his 1959 article, “Sullivan's Skyscrapers as the Expression of Nineteenth Century Technology,” Condit proclaims Louis Sullivan as “the first great modern architect, the first to create a new and powerful vocabulary of forms derived from the major cultural determinants of his age.”[54] James B. Eads and his triple arch bridge across the Mississippi at St. Louis (1867-1874) and C. Shaler Smith and his cantilever bridge across the Kentucky River for the Cincinnati Southern Railroad (1873-1877) inspired Sullivan. He “followed their construction in the pages of the *Railway Gazette* and watched them grow,” writes Condit, “he followed each, with the intensity of personal identification, to the finale of each. Every difficulty he encountered, he felt to be his own; every expedient, every device, he shared in.”[55] The brief, anonymous updates on construction inspired Sullivan and possibly an entire generation of builders.

In his seminal work, *The Rise of the Skyscraper,* Condit expands on the importance of the weekly or monthly building news. He writes,

> It was the engineers who first pointed the way which a new structural art would have to take […] nineteenth-century industrialization made repeated demands on the builder for structural forms which had no precedent behind them. […] The recorders of building progress in Chicago [drew an awareness to] the unique success of the local architects. The best evidence of this understanding lies in the pages of Industrial Chicago, whose anonymous

[54] Carl W. Condit, “Sullivan’s Skyscrapers as the Expression of Nineteenth Century Technology,” *Technology and Culture* 1, no. 1 (Winter 1959): 79.
[55] Ibid, 83.

> authors were tireless in their praise of the originality and intrinsic greatness of 'Chicago construction.'[56]

Twentieth-century construction reports—printed in trade magazines and engineering and architecture journals—brought allied fields together. These reports provided readers with updates on aesthetic trends and technological advances that mutually benefited all parties.

The phenomena of sharing ideas within the British engineering community emerged during the middle of the nineteenth century. Until then, British railway engineers learned *in situ* and kept their trade secrets close at hand, a phenomenon that historian of science Derek de Solla Price calls the "papyrophobic nature of engineers."[57] The construction and dissemination of Robert Stephenson's Conwy and Britannia tubular bridges, argue STS scholars Nathan Rosenberg and Walter G. Vincenti, radically changed engineering communications.[58] Famed railway bridge architect Robert Stephenson, ironmaster William Fairbairn, and mathematician Eaton Hodgkinson tested the strength of structural iron. They generated knowledge that provided the scientific basis for the systematic use of wrought iron in bridges, ships, buildings, cranes, machinery and other engineering structures.[59] Fairbairn's and Clark's published reports on the projects marked a new application of scientific theory to engineering practice and a turning point in disseminating technical information. British engineers began publishing their trade secrets. As

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[56] Carl W. Condit, *The Rise of the Skyscraper* (Chicago: University of Chicago Press, 1952), 4–9.

[57] Nathan Rosenberg and Walter G. Vincenti, *The Britannia Bridge: The Generation and Diffusion of Technical Knowledge* (Cambridge, MA: MIT Press, 1978), 46.

[58] Ibid.

[59] William Fairbairn, "Conway Tubular Bridge, Experiments on the Completed Structure," *Civil Engineer and Architect's Journal* XI (1848); William Fairbairn, *An Account of the Construction of the Britannia and Conway Tubular Bridges: With a Complete History of Their Progress from the Conception of the Original Idea, to the Conclusion of the Elaborate Experiments Which Determined the Exact Form and Mode of Construction Ultimately Adopted* (London; New York: John Weale; Putnam, 1849), https://archive.org/stream/anaccountconstr00fairgoog#page/n72/mode/2up; Edwin Clark, *The Britannia and Conway Tubular Bridges, with General Inquiries on Beams and on the Properties* (London: J. Weale, 1850), http://archive.org/details/britanniaandcon00clargoog.

a direct precedent for the design and construction of the Victoria Bridge, the Conwy and Britannia bridge reports set an example for communications on Stephenson's projects.

The reports on Stephenson's bridges established a common vocabulary or language, making the engineers' findings accessible to other disciplines. When scientific and engineering records circulate beyond one institution or a cultural group for science and technology scholar Bruno Latour, they take on new meaning. Latour argues scientific and technological facts—investigations and test results—convey information, not facts, when they leave their controlled setting.[60] "Diagrams, lists, formulae, archives, engineering drawings, files, equations, dictionaries, collections, and so on, depending on the way they are put into focus," writes Latour, "may explain almost everything or almost nothing at all."[61] These artifacts—that Latour sums up as paperwork—may assume a visual consistency with their source. Still, when reshuffled and recombined, they take on a new meaning. Therefore, the artifacts studied in the chapters that follow are considered in the context of their technical use(s) and as souvenirs from the construction site.

For example, monthly construction updates on the Victoria Bridge appeared in the *Civil Engineer and Architect's Journal*.[62] The articles are text-based, and there is no indication of the source of the information or the author. A similar transcript appears in *The Construction of the Great Victoria Bridge in Canada.*[63] The book attributes the text to the lead construction engineer, James Hodges. While these two accounts of the Victoria Bridge construction have textual

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[60] Bruno Latour, "Visualization and Cognition: Thinking with Eyes and Hands," in *Knowledge and Society: Studies in the Sociology of Culture Past and Present*, ed. Elizabeth Long and Henrika Kuklick, vol. 6 (London: JAI, 1986), 1–40.

[61] Ibid, 4.

[62] "The Victoria Bridge, Montreal," *The Civil Engineer and Architect's Journal* 23 (June 1860): 157–58.

[63] James Hodges, *Construction of the Great Victoria Bridge in Canada* (London: J. Weale, 1860).

similarities when reshuffled and recombined, the documents take on, as Latour suggests, different meanings for different groups.

Drawings, artwork, and photographic representations support Hodges's text and increase the interpretive potential. STS scholar Susan Leigh Star examines collaborative work environments and the objects (or knowledge) that moves among cultural groups. She advances awareness of how technical knowledge transfers. For Star and others, the artifacts are "boundary objects [that] have different meanings in different social worlds, but their structure is common enough to more than one world to make them recognizable, a means of translation."[64] In this study, the scientific observations of a geologist are incorporated by an engineer into the design of a bridge and rendered in by an artist before being published. Each contributor adds a layer of information that is revealed, using Star's methodology, by looking for patterns like "the special language used in the location, metaphors, *mots justes*, turns of phrases, private codes used by one group and not another" as well as anomalies in the patterns across all contributors.[65] The project's scientific, technical, and artistic iterations reveal new information about the landscape when assessed with different contributors and audiences in mind.

Students and instructors are among the many contributors and audiences of technical and landscape knowledge. Historian of architecture and technology Antoine Picon examines engineering students' assignments to expose a change in how French engineers conceived of the world from Enlightenment to the Industrial Revolution (1747-1851). Picon uses the archive at the French state-run *École des Ponts et Chausées* to trace over a century of student drawings and

[64] Susan Leigh Star and James R. Griesemer, "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39," *Social Studies of Science* 19, no. 3 (1989): 393.

[65] Susan Leigh Star, "This Is Not a Boundary Object: Reflections on the Origin of a Concept," *Science, Technology, & Human Values* 35, no. 5 (2010): 609.

competitions[66] and the pedagogical approaches put forth by the school's directors.[67] His study finds that the engineers went from seeing the natural and artificial world as static to recognizing its dynamic force. The new dynamic model of thinking, argues Picon, fused the "form and process of construction [such that] work was put on the same footing as material."[68] In one drawing, the students represented both the process and the final product.

The engineers' drawings also depicted natural forces acting upon engineering works, demonstrating conflict alongside the process. Picon maintains that the aesthetics of the sublime appeared in the student work—exciting impressions of danger or pain—and became part of the visual language of engineering in France.[69] For example, the Eddystone Lighthouse drawings encompass the force of the water and a deadly "struggle against the treacherous sea."[70] Raging waters and dangerous gorges activated the technical drawings.

Like Picon's work, the study that follows finds that British and Canadian engineers, artists, and photographers represent the bridges with forces acting upon them. However, the Canadian projects assume a romantic or pastoral aesthetic. The difference may be explained by the British and American influences on Canadian engineering; it shares more similarities with British and American traditions than French.[71] In *A History of Engineering Drawings*, British engineer and technology drawing historian Peter J. Booker demonstrates that all four nations produce different projection points. Booker is concerned with three-dimensional communications between

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[66] Antoine Picon, *L'Invention de l'ingénieur moderne: L'École des Ponts et Chaussées, 1747-1851* (Paris: Presses de l'Écone Nationale des Ponts et Chaussées, 1992).

[67] Antoine Picon, *French Architects and Engineers in the Age of Enlightenment* (Cambridge [England]; New York: Cambridge University Press, 1992).

[68] Ibid., 167.

[69] Ibid., 231–32.

[70] Ibid., 232.

[71] Norman R. Ball, *"Mind, Heart, and Vision": Professional Engineering in Canada 1887 to 1987* (Ottawa: National Museum of Science and Technology, National Museums of Canada, in cooperation with the Engineering Centennial Board, 1987).

designers and builders and finds British and European drawings differ from American and Canadian drawings.[72] Booker establishes that Canadian engineers develop a unique style of representation. He also illustrates what art historians establish as “visual culture” in engineering from a science and technology perspective.[73]

In her ground-breaking work on visual culture, *The Art of Describing: Dutch Art in the Seventeenth Century,* Svetlana Alpers emphasizes the importance of situating works of art “through a consideration of their place, role, and presence in the broader culture.”[74] Alpers investigates the circumstance in which the specific pieces and collections of art emerge, which “involves questions of pictorial mode as well as questions of social function.”[75] Alpers echoes in art historical terms what Booker exposed from an STS perspective; different cultures have different ways of seeing.

Engineering drawings and technical reports are (generally speaking) produced by members of the engineering community. In her study on the visual culture of engineers, STS scholar Kathryn Henderson maintains that engineering communications are based on a set of standards and, yet, they embody a form of tacit knowledge. Engineers follow drafting conventions; however, each person adjusts their drafting table (or AutoCAD shortcuts) to suit their needs. Similarly, when conducting a report on construction, there are steps to follow. Each person develops her or his way of achieving the inspection and producing their report. Henderson argues

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[72] Peter Jeffrey Booker, *A History of Engineering Drawing* (London: Northgate Publishing Co., [1963] 1979).

[73] For subsequent a study on the unique professional cultures of engineers in Great Britain and the United States, se:. John K. Brown, “Design Plans, Working Drawings, National Styles: Engineering Practice in Great Britain and the United States, 1775-1945,” *Technology and Culture* 41, no. 2 (2000): 195–238.

[74] Alpers pays tribute to the writings of Michel Foucault in distinguishing between a “seventeenth-century emphasis on seeing and representation and the Renaissance emphasis on reading and interpretation.” Svetlana Alpers, *The Art of Describing: Dutch Art in the Seventeenth Century* (Chicago: The University of Chicago Press, 1984), xxiv.

[75] Ibid., xxvi.

that engineering communications are a situated practice. She writes, “Constant exposure and interaction with a ‘way of seeing’ develops skills in visual reading analogous to verbal reading and writing literacy.”[76] One generation of engineers may influence the next, like Picon demonstrates; however, individuals can also generate their way of seeing and representing the landscape change. In other words, there may be anomalies across broad studies.

In his now-classic book, *The American Technological Sublime,* STS scholar David Nye traces the ways in which nineteenth-century American society sees technology and the integration of those technologies into the fabric of social life. Nye finds that society constructions new and sublime views on each technological age; the dynamic sublime of the railways, the geometrical sublime of the bridges and skyscrapers, the industrial sublime of the factory, and the electric sublime. Authors, painters, and photographers established symbolic associations between technology and society to shape how the public understood the rapid change in the built environment.[77] The public is continually awed by new technology and normalizes older technologies that awed them once before. Notably, the amount of material produced during the construction of the Victoria Bridge is proportionally higher than the two subsequent bridge projects. Nye might attribute this imbalance to changing public perceptions of what is sublime.

Unlike the archive of student work in Picon’s study, Nye demonstrates that libraries, museums, and galleries hold the visual material that took hold of the public imagination and continued to push the symbolic connections between technology and society long after the

[76] Kathryn Henderson, “The Visual Culture of Engineers,” *The Sociological Review* 42, no. S1 (1994): 211, https://doi.org/10.1111/j.1467-954X.1994.tb03417.x.

[77] Leo Marx, *The Machine in the Garden: Technology and the Pastoral Ideal in America* (New York: Oxford University Press, 2000); Barbara Novak, *Nature And Culture: American Landscape And Painting, 1825-1875* (New York: Oxford University Press, 2007); Alan. Trachtenberg, *Reading American Photographs: Images as History, Mathew Brady to Walker Evans* (New York: Hill and Wang, 1989).

bridges opened to the public. "The volume of printed material about the Brooklyn Bridge," writes cultural geographer Pierce F. Lewis, "must equal that of the bridge itself," establishing a cultural ecology of the structure.[78] Indeed, the list of artifacts produced in conjunction with the Montreal bridges is extensive (a selection of which are described in Chapter Three) to such an extent that Montreal-area museums have engaged with the subject of bridge construction more than once.[79] Illustrated books are among the material forms that capture the construction of these events in perpetuity and are valuable sources for reading the landscape. Rare books are written, writes Lewis, "by a perceptive person who has looked intently at a landscape and discovered what it means."[80] For Lewis and others,[81] landscape history is found in what is already known about the city and in studying the lesser-known participants and everyday places found in books and libraries.

In addition to photographs, illustrated print, and technical drawings, this study engages with historical maps. One of the foremost authorities on reading maps as a "thick" text is J. B. Harley,[82] who seeks to find out the ways in which scholars can "make maps 'speak' about the

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[78] For cultural and material studies on the Brooklyn Bridge see: David G. McCullough, *The Great Bridge: The Epic Story of the Building of the Brooklyn Bridge* (New York: Simon and Schuster, 2001); Alan Trachtenberg, "Brooklyn Bridge as a Cultural Text," *Annals of the New York Academy of Sciences* 424, no. 1 (1984): 213–24; Alan Trachtenberg, *Brooklyn Bridge: Fact and Symbol* (Chicago: University of Chicago Press, 1979); Carl W Condit, *American Building Art: The Nineteenth Century* (New York: Oxford University Press, 1960); Kiel Moe, *Empire, State & Building* (New York: Actar, 2017). Pierce F. Lewis, "Axioms for Reading the Landscape: Some Guides to the American Scene," in *The Interpretation of Ordinary Landscapes: Geographical Essays*, ed. D. W. Meinig (New York: Oxford University Press, 1979), 31.

[79] Stanley Triggs et al., *Le Pont Victoria: Un Lien Vital / Victoria Bridge: The Vital Link* (Montreal: McCord Museum of Canadian History, 1992); Francine Lelièvre et al., *Montréal, by Bridge and Crossing* (Montreal: Pointe-à-Callière, Montréal Museum of Archaeology and History, 1999).

[80] Lewis, "Axioms for Reading the Landscape," 22.

[81] Grady Clay, *Close-up: How to Read the American City* (Chicago: University of Chicago Press, 1980).

[82] J. B. Harley, "Deconstructing the Map," *Cartographica* 26, no. 2 (1989): 1–20; J. B. Harley, "Cartography, Ethics and Social Theory," *Cartographica* 27, no. 2 (1990): 1–23.

social worlds of the past."[83] Maps are a socially constructed form of knowledge and need to be treated as subjective images. Harley reads the political power written into maps by mixing methods from semiotics, iconography, and sociology. Borrowing from literary criticism and "cartographic discourse," Harley researches the production of maps. He questions "those aspects of a text which are apprehensive, evaluative, persuasive, or rhetorical, as opposed to those which simply name, locate, and recount."[84] Harley tests the making of maps against their symbolic meaning by using, like Cosgrove and Daniels, Panofsky's formulation of iconology.[85] Harley's methods include establishing "the circumstances in which maps were made and used [which involves a] reconstruction of the physical and social settings for the production and consumption of maps, the events leading up to these actions, the identity of map-makers in a socially constructed world."[86] The symbolism can reveal the motivation, effects, and significance of the information that maps communicate.

Harley's third assessment is built upon the sociology of knowledge proposed by Michel Foucault in *Discipline and Punishment.* For Harley and others, Foucault's critique of historiography specifies, "the quest for truth was not an objective and neutral activity but was intimately related to the "will to power" of the truth-seeker. Knowledge was thus a form of power, a way of presenting one's values in the guise of scientific disinterestedness."[87] Harley writes, "Whether a map is produced under the banner of cartographic science – as most official maps have been – or whether it is an overt propaganda exercise, it cannot escape involvement in

[83] J. B. Harley, "Maps, Knowledge, and Power," in *The Iconography of Landscape: Essays on the Symbolic Representation, Design, and Use of Past Environments*, ed. Denis E. Cosgrove and Stephen Daniels (Cambridge [England]; New York: Cambridge University Press, 1988), 277.

[84] Ibid., 278.

[85] Panofsky, *Studies in Iconology*.

[86] Harley, "Maps, Knowledge, and Power," 281.

[87] Mark Poster, "Foucault and History," *Social Research* 49 (1982): 118–19 in Ibid., 278.

the processes by which power is deployed."[88] English-speaking cartographers, surveyors, and engineers produced most of the historical maps used in this study which reflect the position of power of British map makers at the time.

The Victorians were great collectors, and albums were among the many objects they coveted. Art historians have explored the many different types of albums and their evolution, attesting to the broad use of collections in the Victorian era.[89] Art historian Stephan Bann sees the album as a cultural accumulator, one that stores the energy of the past. He writes, "the unprecedented facility of combining photographic and textual elements became the means of releasing new charges of energy and so of empowering significant shifts in the operation of art and its institution that could hardly have been envisioned before."[90] The study that follows sees great potential in the previously unexamined Montreal bridge photographs and challenges them against the reports and technical literature.

Like studies in STS and art history, recent research in architecture has examined the flow of ideas (facts and information) and finds "new surges of energy" in historical projects by tracing construction materials' movement from their point of processing to their material form. Scholars like Anthony King, Lucia Juarez, and Kiel Moe are among those studying the movement of ideas and materials across time and place to establish the interconnectedness of buildings and ideologies.[91] Landscape studies are also increasingly engaging with the built environment's

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[88] Ibid., 279.

[89] See, for example, Anthony Hamber, "Facsimile, Scholarship, and Commerce: Aspects of the Photographically Illustrated Art Book (1839–1880)," in Bann, *Art and the Early Photographic Album*, 123–49.

[90] Stephen Bann, "The Photographic Album as a Cultural Accumulator," in *Art and the Early Photographic Album*, ed. Stephen Bann (Washington [D.C.]; New Haven [Conn.]: National Gallery of Art; Distributed by Yale University Press, 2011), 9.

[91] Anthony D. King, *Spaces of Global Cultures: Architecture, Urbanism, Identity* (London; New York: Routledge, 2004); Lucia Juarez, "Scottish Cast Iron in Argentina: Its Role in the British Informal Imperial System," in *Function and Fantasy: Iron Architecture in the Long Nineteenth Century*, ed. Paul Dobraszczyk and Peter Sealy (Brookfield: Taylor & Francis Group, 2016), 141–62; Kiel Moe, *Empire, State & Building* (New York: Actar, 2017).

social, political, and ecological entanglement.[92] The Montreal bridges hold the knowledge and doctrines of their makers. As will be demonstrated, the reports and documents provide evidence toward the movement of ideas and materials and the relationships between finished projects and the people who built them.

Throughout time, engineers have played a significant role in reshaping the land and have infused the public imagination with notions of a better future. Beginning in the nineteenth century, engineers in Canada made an impact. “No other group,” writes historian J. Rodney Millard, “was in such direct and constant contact with the physical evidence of substantial material improvements as engineers.”[93] In his book, *The Master Spirit of the Age: Canadian Engineers and the Political of Professionalism, 1887-1922*, Millard argues that engineers were part of a growing middle-class and saw themselves as society’s natural leaders. As corporate employees, however, they had little professional standing or unity. Millard writes, “Engineers were not a clearly defined and cohesive group […] they were ambitious, fiercely competitive, and largely insensitive to the professional welfare and livelihood of fellow engineers.”[94] They were scattered across a vast territory and “torn by the conflicting demands of business and science.”[95] For Millard, their divisions slowed their ability to develop a professional identity, and the engineers overlooked community importance. He writes, “To win public recognition, engineers must be more than technically competent; they must see their work in its context and develop a broad social consciousness. Engineers must become truly altruistic.”[96] Millard demonstrates that Canadian engineers had a vision of society and their role in it.

[92] Jane Hutton, *Reciprocal Landscapes: Stories of Material Movements* (Routledge, 2019).
[93] Millard, *The Master Spirit of the Age*, 13.
[94] Ibid., 86.
[95] Ibid.
[96] Ibid., 87.

Millard establishes that professionalization—the Canadian Society of Civil Engineers (CSCE)—helped engineers overcome challenges through collective action. The timeframe of the three Montreal bridges' construction was a formative period for engineering in Canada. The construction site's temporary nature makes it an uncommon area of study for landscape—engineering and architectural—history. The reports and documents evidence the ways in which the engineers present on the Montreal bridge construction projects viewed the landscape in Canada.

Canadian engineers worked across the country, and each province or territory has its sub-culture. The years leading up to the CSCE creation marked a rise in formal engineering education in Canada. Yet, the schools were as diverse as the provinces or territories where they were.[97] Differences in core values argue historians Yakov M. Rabkin and J. Ann Lévi-Lloyd in "Technology and Two Cultures: One Hundred Years of Engineering Education in Montreal," developed across schools within the same city. In Montreal, French and English engineering education developed with different value systems. Technical education in the province of Quebec extends nearly three centuries, however in the mid-nineteenth century, the difference in ideological values prevalent at degree-granting universities became evident. McGill University suspended its engineering programs in 1863 due to a lack of funding. "In the wake of enthusiasm for the rail link between Montreal and Toronto," write Rabkin and Lévi-Lloyd, "Principal John [sic] Dawson, a geologist, worked for the reorientation of McGill […] towards more practical

[97] For descriptions of post-World War II schools and education systems, see: George Richardson, "Engineering Education in Canada, Part 1," *Engineering Journal* 45, no. 9 (September 1962): 60–71; George Richardson, "Engineering Education in Canada, Part 2," *Engineering Journal* 46, no. 1 (January 1863): 42–49; Glenn A. Morris, "Engineering Education in Canada: The Early Years," *Canadian Journal of Civil Engineering* 13, no. 1 (February 1, 1986): 25–32, https://doi.org/10.1139/l86-004.

pursuits suited to the problem of a sparsely populated country with vast natural resources."[98] Dawson reinstated engineering programs at McGill with substantial private and corporate donations.[99]

By contrast, the city's French institutions developed through the Catholic School board and benefited from government funding. In 1873, French-born American soap maker Charles Pfister designed the École Polytechnique's first scientific and industrial course. For decades, the church kept French students from enrolling at the Protestant-led McGill University.

Enrollment in the CSCE was predominantly English until after World War II. As Rabkin and Lévi-Lloyd demonstrate, state, church, and corporate funding influenced graduates from Montreal's engineering programs, which likely guided their approaches to practice. Canadian engineering in Canada changed in the interwar period. The CSCE was renamed the Engineering Institute of Canada to reflect the diversity of engineering across the country.

Millard and Rabkin and Lévi-Lloyd establish that—at least until the beginning of World War II—Canadian civil engineers were scattered across the country, educated at autonomous institutions, and employed by corporations. Their records are also scattered among archives across the country. It is necessary to look at other Western groups of engineers to assess how Canadian engineers conceive, operate on, and represent the landscape. Rather than discussing the engineering tradition in other countries by region, this review organized itself around the types of materials produced by engineers and the movement of ideas across time, space, and material form.

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[98] Yakov Rabkin and J. Ann Lévi-Lloyd, "Technology and Two Cultures: One Hundred Years of Engineering Education in Montreal," *Minerva* 22, no. 1 (1984): 68.

[99] Ibid., 70.

Thus far, the literature demonstrates that engineering reports and technical drawings are a valuable source of research in STS and allied fields. Meanwhile, architectural scholars show how construction materials and photographic representations carry with them the ideologies of designers and builders. All artifacts must be taken as subjective and placed in context with their time and place of making, their primary and secondary uses, the messages they convey, and additional layers of information they gather as they move from one social group to another. The extent to which Canadian engineering contributed to reshaping landscape views, however, is less understood. Further, they are divided by differing pedagogical opinions within a single city, not to mention across the country. Canadian engineering reports and drawings are likely in corporate archives; therefore, they represent the ideologies of a corporation before that of the engineering community and, again, need to be taken into context. However, the alignment of the Montreal bridge constructions with the formation of an engineering society suggests that engineers in Montreal shared a standard set of values. Appreciating that each group of engineers brings an implicit way of knowing the world indicates the Montreal bridge reports and technical drawings are a valuable source of study in understanding how the bridge builders understood and represented the banks of the St. Lawrence River.

Theoretical framework: Landscape History

Montreal's history is well established across many disciplines, but the history of the city's landscape is sparse. In part, landscape history is relatively new, and it is often confusing or ill-defined. As a framework, landscape history can be challenging to use because it is interdisciplinary; it imports and applies methodologies from various other disciplines. For example, Harris writes, "landscape analysis has started to appear with increasing frequency in the works of scholars who define themselves as art, architectural, and environmental historians, or as literary citric, anthropologists, archaeologist and scholars of material culture."[100] These groups of scholars engage with the cultural landscape as a dynamic power that is continuously acted upon by natural and cultural forces. Yet, as landscape historian Jan Birksted notes, "it lacks a "widespread, popular cultural influence and authority."[101] Thus, a study of landscape involves studying the experience of space through the movement (including vision) of the people who shape or inhabit it.

Landscape history is an approach to studying how, why, and by whom landscapes are created, built, and represented and how they relate to broader cultural contexts. It is similar to garden history[102] and architectural history.[103] Landscape history traces changes to built form through a study of people, places, and the material forms that emerge. Like visual culture studies, landscape history emphasizes multiple modes of perception and exploring context or relationships for different perspectives.[104] And landscape history shares an interest in the everyday with cultural geography.[105] Landscape history also draws on spatial theory[106] in the ways in which it is concerned with the myth and memory of natural and cultural processes.[107] Landscape history is a challenging framework but not impossible to use. Overcoming the challenges of landscape history requires establishing a time and place of study, identifying the

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[100] Dianne Harris, "The Postmodernization of Landscape," 434.

[101] Birksted, "Landscape History and Theory," 4–28.

[102] James Elkins, "On the Conceptual Analysis of Gardens," *The Journal of Garden History* 13, no. 4 (December 1, 1993): 189–98, https://doi.org/10.1080/01445170.1993.10412487.

[103] Upton, "Architectural History or Landscape History?"

[104] Mitchell, *Landscape and Power*.

[105] Jackson, *Discovering the Vernacular Landscape*.

[106] Henri Lefebvre, *The Production of Space*, translated by Donald Nicholson-Smith (Oxford, UK; Cambridge, MA: Blackwell, 1991); Michel de Certeau, *The Practice of Everyday Life*, translated by Steven Rendall, Third (Berkeley: University of California Press, 2011).

[107] Simon Schama, *Landscape and Memory* (New York: Vintage Books, 1995); Cosgrove, *Social Formation and Symbolic Landscape*.

different cultural groups that act upon a landscape, analyzing their perspectives, and contrasting it with other points of view.

A bridge's construction begins with an idea, a concept, or a dream and ends with a new material form. The envisioning process involves many people; some imagine change long before the engineers take their soundings or produce a concept diagram. They can be viewed as promoters. This study defines promoters as entrepreneurs, politicians, and bridge manufacturing company owners who envisioned improved mobility in the colony, and later the country, and backed each new crossing over the seasonally disruptive river long before it became a material reality. The promoters typically raise capital or market the project upon completion and provide an imaginative perspective on the project. The engineers and builders are the designers and labourers who take the ideas and transform them into a material reality. Their attitude is founded on science and practical experience. Photographers and book editors (along with the builders and the promoters) are considered co-producers of these historical accounts: their perceptive gazes and artful editing transform documentary photographs into visual narratives.

This study tests the perspective of the promoters and the engineers with that of the photographers and book editors, depending on the artifacts. For Dell Upton, this means "construing" and not just "constructing" the human experience of landscape.[108] The study's framework is based on methods established in art history and literature studies and adapted in cultural geography and architecture, with an end to identify the perspectives and the layer upon layer of context that informs those perspectives. The approach engages with a wide variety of sources to show that there are some fascinating aspects of the landscape overlooked and understudied that mean everything and nothing at all. They gain momentum in the areas where

[108] Upton, "Architectural History or Landscape History?," 198.

they overlap and conflict. This landscape history approach is an interdisciplinary way of looking at spaces both shaped and occupied by humans.

Research process

This dissertation takes a comparative approach to building a new understanding of the cultural landscape. It does so by observing patterns in reports and documents produced during significant construction projects of three Montreal bridges. This object-based approach "hypothesizes the more improbable sort of documentation as being [a] potentially richer" source of study to demonstrate "that any social structure is […] a fabric that can only be reconstituted from close observation."[109] The "more improbable" documents are the most obscure, the more anecdotal, or the least expected and are used alongside common forms of construction reporting to interpret a micro-history of the landscape of the St. Lawrence River at Montreal during the construction of three bridges. As a method, it is inductive and reiterative; it involves collecting, comparing, analyzing, and re-analyzing material multiple times. The three-step iterative process is described below.

Data collection

The first step in this research project was to identify materials and locate them in different archives. The most significant number of sources come from the Dominion Bridge Company (DBC) *fonds* —MG28-III100—held in Ottawa at Library and Archives Canada (LAC).[110] In 1882, the DBC established a shop along the Lachine Canal in anticipation of its first formal

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[109] Carlo Ginzburg, John Tedeschi, and Anne C. Tedeschi, "Microhistory: Two or Three Things That I Know about It," *Critical Inquiry* 20, no. 1 (1993): 33.

[110] In the 1970s and 1980s, the DBC donated over forty-six thousand photographs, 4,500 architectural drawings, and 10.85 metres of textual records, along with other visual artworks and audiovisual recordings, to the National Archives of Canada, now the LAC. The finding aid is found at http://data2.archives.ca/pdf/pdf001/p000000325.pdf.

commission, the Saint-Laurent Bridge (St. Lawrence Bridge and Lachine Bridge in early documents), for the Canadian Pacific Railway Company (CPR).[111] There is little scholarship on the company, the collection, or its impact on engineering, architecture, or landscape architecture; in this research, however, only a tiny fraction of the holdings is examined, and the study lays the foundation for future investigations.

The archival search extended to other Montreal and Ottawa regional archive, like the Canada Science and Technology Museum in Ottawa (CSTM) and Exporail – Le musée ferroviaire canadien, hold a wide variety of material on the development of transportation in Canada, among many other collections. The Canadian Centre for Architecture (CCA) has a vast array, including a hard copy of a (nearly) complete set of *Civil Engineer and Architect's Journal* from John Weale's Architectural Library in London. The CCA also holds many of Weale's technical *Rudimentary Series* books and copies of the publisher's rarer and high-end books. The McCord Museum (MM), the National Gallery of Canada (NGC), and the McGill Rare and Special Collections, Osler, Art, and Archives (ROAAR) hold significant photographic collections, including bridge construction photographs. The library archives at the Ontario Tech University (formerly the University of Ontario Institute of Technology) have a growing collection of private papers of individual engineers.

While research at some of these archives was surprisingly fruitful, others like the CPR were disappointing. In 1996, the CPR relocated its headquarters from Montreal to Calgary, and in 2009, the company sold Windsor Station, the former Montreal headquarters, and archival

[111] For a company overview, see George Fetherling, *Vision in Steel: 1882–1982: One Hundred Years of Growth, Dominion Bridge to AMCA International* (Montreal: AMCA International, 1982).

location. At that time, the archival materials moved to Calgary and the company has no plans to make the collection public.[112]

	A	B	C	D	E	F	G
1	**Dominion Bridge Company**						
2	**LIBRARY AND ARCHIVES CANADA (LAC)**						
3	UPDATED	14-Mar-14					
4							
5	Researcher:		Heather Braiden				
6	**Date Visited**	**ARCHIVE**	**RECALL INFORMATION**	**Barcode**	**NO. PAGES**	**DOCUMENT TYPE**	**Document Title**
7		**LAC**	**Special Collections**				
8	14-Mar-14	*LAC*	Box 27 Acc' 1976-72 SC 0027	2000611055	multi	Box of Photos -	
9	14-Mar-14	*LAC*	Box 27 Acc' 1976-72 SC 0027	2000611055	1	Photo - PA-117228	Steel Bridge on the Ca pacific Railway over th lawrence River, at lac near Montreal, Provin Quebec, Canada
10	14-Mar-14	*LAC*	Box 27 Acc' 1976-72 SC 0027	2000611055	1	Photo - PA-117231	Dominion Bridge Com Limited, montreal, F
11	14-Mar-14	*LAC*	Dominion Bridge Co. Acc' 1976-072 207 44	2000797302	many	Photo Albums for Jacques Cartier Bridge	

Figure 1.1: *Tracking Sheet, Dominion Bridge Company fonds.* Heather Braiden.

At each archive, I consulted with archivists and ordered materials based on their knowledge of the collections. I logged information to help me recall the materials; date visited, archive, location in the archive, document type, title, and description, along with some notes about the document's relevance to this study (See Figure 1.1). The logs quantify the materials available in each company's archival collection and help establish what to look for across each case. These archival notes serve as prompts for future research.

[112] Personal email correspondence with Larry McNally, March 5, 2015.

Categorization

The preliminary searches revealed an abundance of material available for studying the cultural landscape throughout the construction of three Montreal bridges. The next step in the research process identified the relevant sources and categorized them. The materials reviewed are all communication tools of engineers and represent different stages of design and construction and different internal and external modes of communication. The range of material is quite broad, from hand-written notes to corporate publications and reports to technical. The artifacts have equally broad distribution patterns, from internal memos to international periodicals.

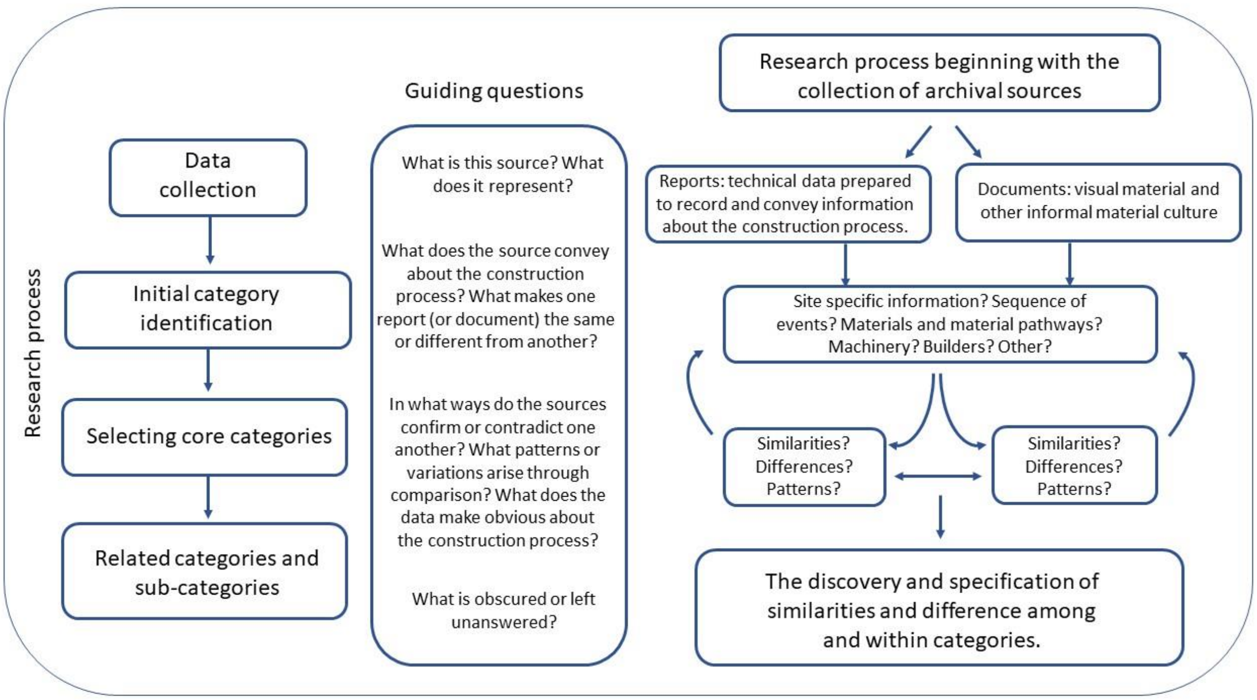

Figure 1.2: *Research process diagram.* Heather Braiden.

The initial review subdivided the sources into "technical reports" and "documents" categories. The technical report category encompasses documents and records produced by engineers and technicians for other administrators, engineers, technical audiences, and allied fields. Meanwhile, documents include visual and other material prepared for personal or non-official reasons, like diaries, field notes, and photographs (See Figure 1.2). While the report tended to have a clear audience, the documents were harder to categorize; for this study, the documents are a mix of visual material—historical maps, illustrated prints, and photographic collections—and other informal drawings that are directly related to the construction projects or that demonstrate the relationship between the river and the city. Printing houses published some of the visual material, while others appear to be unique gifts for the engineers. For Langford, the private album is organized to preserve "visual memory in a framework of oral consciousness."[113] While the engineers who received the souvenirs and the photographers who complied them are no longer alive to recount the stories, the albums' content both preserves and provokes the dominant narrative.

Even though the materials studied are all held in archives, they were not always identified in search engines or clearly organized. For example, much of the DBC photographic collection (over fifteen thousand photographs on North American bridge construction alone) is held in bankers' boxes. Maintained this way, the photographs are stripped of their narrative ability. Thus, the research limited its study to those photographs taken of each bridge during construction and strayed only to explore a larger body of work by one photographer or another. Their place in an institutional archive, however, implies they hold the values of that institution.[114] Thus, a closer inspection revealed that the boxes appeared to be roughly organized by region, project, and general timeframe, with many of the photographs appearing under different categories. The bankers' boxes demonstrate that the copies of the bridge photographs, arranged in different categories, held multiple narratives for the companies.

[113] Martha Langford, "Speaking the Album: An Application of the Oral-Photographic Framework," in *Locating Memory: Photographic Acts*, ed. Annette Kuhn and Kirsten Emiko McAllister (New York: Berghahn Books, 2006), 277.

[114] Gillian Rose, "Discourse Analysis I: Text, Intertextuality and Context," in *Visual Methodologies: An Introduction to the Interpretation of Visual Materials*, Fourth (London: Sage, 2016), 186–219.

Through an extensive search and, with help from several archivists, more actively curated collections particular to the dissertation case studies surfaced: a scrapbook and an album of the Lachine Bridge construction photographs and eight unnamed indexical albums related to the Jacques Cartier Bridge. Photographic albums are "exceptionally valuable," writes art historian Michael Charlesworth, "selecting from and organizing the mass of contemporary photographs into more manageable groups and providing […] historical testimony."[115] Locating the albums helped triage the overall quantity of visual material by furnishing a manageable sample of primary sources for the second and third bridges.

The DBC collection has over three hundred photographs of the Jacques Cartier Bridge arranged in reverse chronology in eight albums. Based on the album numbering system, an additional eight albums existed at one point. The repository offered few clues to the purpose of the images. However, the photographs appear in a commemorative booklet and a scientific journal article, copies of which are at the Canadian Centre for Architecture (CCA).

None of the contracts for the photograph or books exist. The secondary sources are crucial in understanding the motivation behind these photographic collections. While at the different archives, I also surveyed comparable books and albums of other notable bridges to understand the genre and different reporting styles. Notably, I examined the CCA's entire collection of John Weale's publications and as many copies of Hodges's book on the Victoria Bridge. The book may have been a precedent for other bridge-building stories, including the reports of James B. Eads, Casimir S. Gzowski (who included a chapter on ice), and C. M. Woodward on other

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[115] Michael Charlesworth, "India: The 1890 Album and the Canon of Mughal Architecture," in Bann, *Art and the Early Photographic Album*, 241.

notable bridges in North America.[116] These precedents, antecedents, and journal articles helped distinguish between photographic collections meant for public audiences and those designed as private keepsakes.

Interpretation

While at the archives, I used my iPhone 6 to scan PDF copies of reports and photograph the documents. As a result, some of the images used in this study are blurred and serve as placeholders until the archives reopen, post-Covid-19, to the public, and I can rescan the material. I transformed the PDFs into searchable documents and (for the most part) assessed them in digital form. From the textual records, I pieced together site surveys to understand how the engineers saw the river. I noted critical moments in the construction process, like the arrival of equipment or the completion of a pier, and the appearance of inspectors or special guests. The reports provided information about the material pathways and the relationship of industries beyond the construction site. News paper articles filled in some missing pieces, and where parts of the construction stories were still unclear, I went back to the archive to fill the gaps.

In contrast, I printed copies of the photographic albums on a standard black and white photocopier.[117] The copies gave me the freedom to observe the content from different perspectives, and the tacit knowledge I gained by handling the photographs was invaluable.[118] I

[116] James B. Eads, *Report of the Chief Engineer: The Illinois and St. Louis Bridge* (St. Louis: Missouri Democrat Book and Job Printing House, 1871); Casimir Stanislaus Gzowski, *Description of the International Bridge: Constructed over the Niagara River, near Fort Erie, Canada, and Buffalo, U.S. of America* (Toronto: Copp, Clark, 1873); and C. M. Woodward, *A History of the St. Louis Bridge: Containing a Full Account of Every Step in Its Construction and Erection, and Including the Theory of the Ribbed Arch and the Tests of Materials. Illustrated by Numerous Wood-Cuts and Fifty Full-Page Lithographs and Artotypes* (St. Louis: G. I. Jones, 1881).

[117] See, Martha Langford, *Suspended Conversations: The Afterlife of Memory in Photographic Albums* (Montreal: McGill-Queen’s Press, 2001).

[118] Gillian Rose, “Practising Photography: An Archive, a Study, Some Photographs and a Researcher,” *Journal of Historical Geography* 26, no. 4 (October 2000): 555–71, https://doi.org/10.1006/jhge.2000.0247.

was able to position and reposition myself within a project and see the project from many different angles. I laid the images out on a library desk in the exact order they appeared in the albums (See Figure 1.3) and established the intermediate coding categories. I looked more closely at timelines, camera position or vantage point, and the content, including people, equipment, and materials.

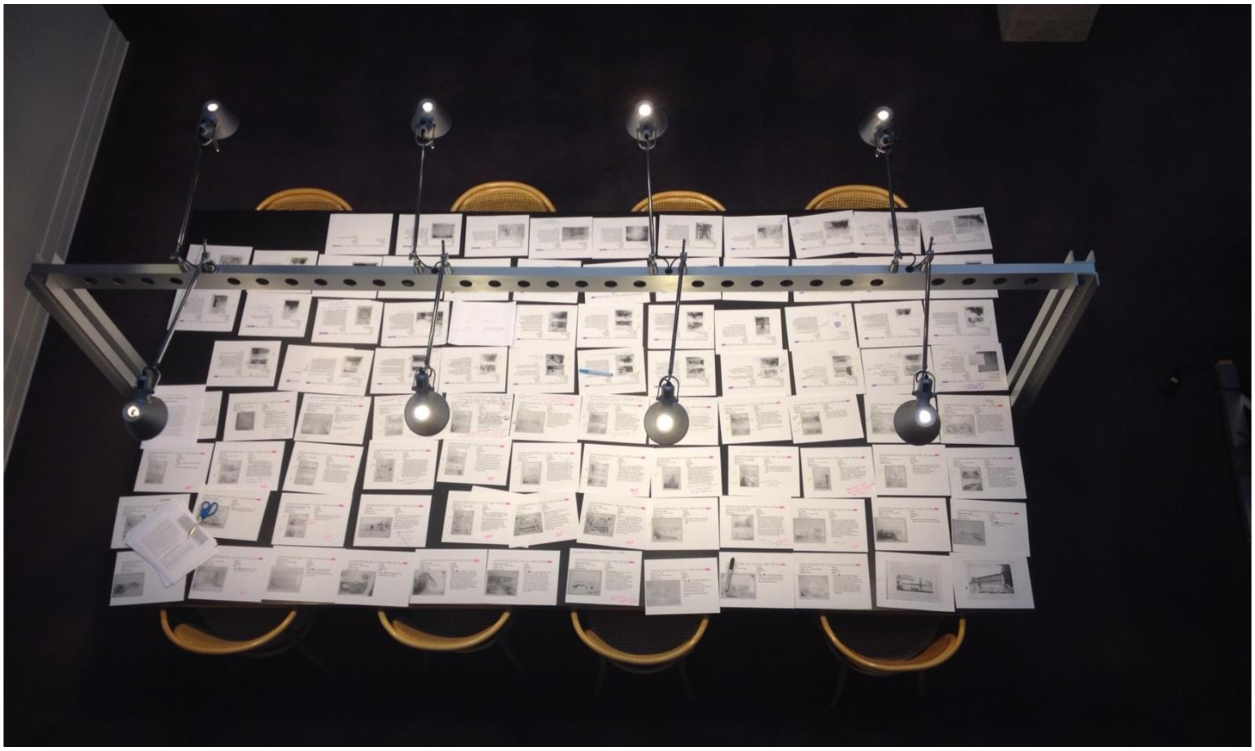
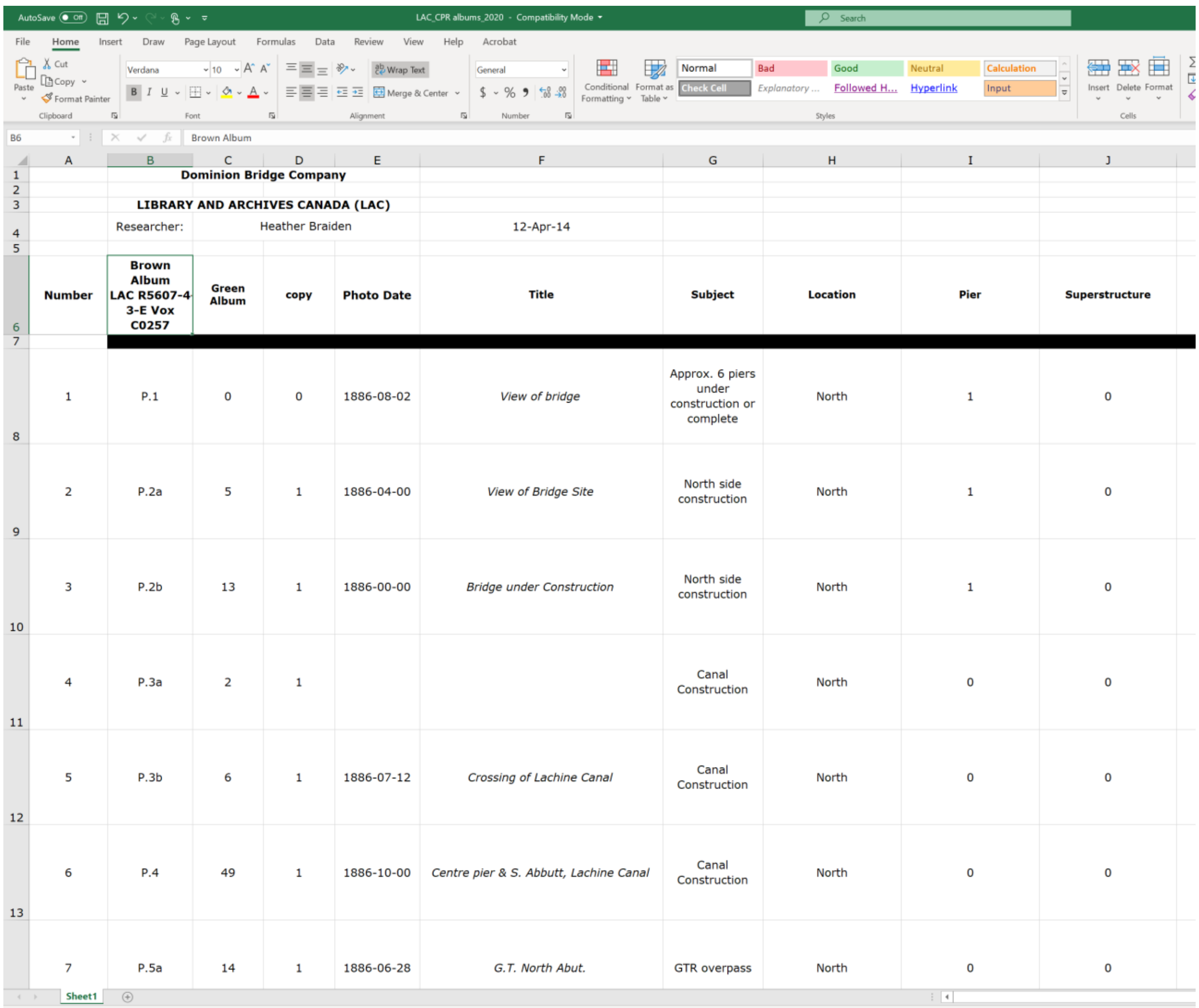


Figure 1.3*: Copies of album photographs laid out on a table at the CCA,* Heather Braiden, July 6, 2014

I cross-referenced the dates of the photographs with newspaper and journal reports, as well as diaries and old calendars to determine if the pictures were taken at construction milestones or during visits by officials. I found little to demonstrate that the photographer was present for a special event, except for a few stereographs where Notman noted such details in the caption. I corroborated names, dates, and locations in the newspapers and journals with the contractors' construction logs and associated the names of individuals present during construction, material costs, and supply chains with the project. I then plotted these references on maps and compared them with the photographs. Some of the historical maps have long titles, and these are included in the figure captions unless I modified the map to draw my reader's attention to one element in the map. In such cases, I included the map's full name in the reference. The cross-referencing exercise furthered my sense of the construction process and added minute details missing from the reports, like how and when materials arrived at the site and how the challenges of materials circulation arose.[119] Reading across the reports and documents also offered the masonry contractor's perspective and not just the engineer.



Dominion Bridge Company

LIBRARY AND ARCHIVES CANADA (LAC)

Researcher: Heather Braiden 12-Apr-14

Number	Brown Album LAC R5607-4-3-E Vox C0257	Green Album	copy	Photo Date	Title	Subject	Location	Pier	Superstructure
1	P.1	0	0	1886-08-02	*View of bridge*	Approx. 6 piers under construction or complete	North	1	0
2	P.2a	5	1	1886-04-00	*View of Bridge Site*	North side construction	North	1	0
3	P.2b	13	1	1886-00-00	*Bridge under Construction*	North side construction	North	1	0
4	P.3a	2	1			Canal Construction	North	0	0
5	P.3b	6	1	1886-07-12	*Crossing of Lachine Canal*	Canal Construction	North	0	0
6	P.4	49	1	1886-10-00	*Centre pier & S. Abbutt, Lachine Canal*	Canal Construction	North	0	0
7	P.5a	14	1	1886-06-28	*G.T. North Abut.*	GTR overpass	North	0	0

Figure 1.4: *Tracking Sheet, CPR albums,* Heather Braiden.

[119] The construction log is introduced as the "Commercial Diary" later in the chapter. Sandford Fleming, "Sir Sandford Fleming's Date Book," 1886, MG29 B 1 82, Sandford Fleming Fonds, LAC.

To familiarize myself with the images' content, I built a spreadsheet and logged the primary and secondary subject matter of each photograph (See Figure 1.4). I counted the frequency of particular visual elements and analyzed the frequencies.[120] I began with general categories like equipment and horses, workers and other people, bridge components and other references to the built environment. The categories shifted as I moved back and forth between the reports, documents, and additional sources, like historical maps and online archives. The equipment category narrowed to boats, and I was able to track the purchase and delivery of a tugboat used during the construction of the Saint-Laurent Bridge. The exercise gave me insight into the spatial arrangement, and implicit movement ascertained through the albums, and it proved helpful in determining the originality and meaning of the albums (vs. scrapbook).

The spreadsheets made the subject matter of photographs observable. They made it possible to review patterns and variations in the content matter. In combination with the mapping exercise, it was possible to determine pictures taken outside the presumed boundaries of the construction site and assess for meaning in the outliers: the mapping exercises made visible land use patterns and emerging spatial priorities. The location and sequence of different photographs helped establish a landscape history by setting the time and place for the events.

Some of the albums were anonymous so connecting them to the individuals who compiled or received them was valuable in uncovering their relevance. However, finding associations took some detective work and consequently, the results for the Saint-Laurent Bridge album and scrapbook are more successful. Montreal commercial and landscape photographer Alexander Henderson took a series of promotional photographs for the DBC during the erection of the Saint-Laurent Bridge (See Figure 1.5). These photographs were altered in their reproduction and

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[120] Gillian Rose, "Content Analysis and Cultural Analytics: Finding Patterns in What You See," in *Visual Methodologies: An Introduction to the Interpretation of Visual Materials*, Fourth (London: Sage, 2016).

by connecting with a footnote in a journal article, I drew my first association. The article's author, J. W. Schaub notes, "The photograph […] had been reversed in the negative, and the error was not discovered until the drawing was complete," he continues, "To see the bridge correctly, it should be looked at through the paper from the back side, holding the leaf up to the light."[121] The "correct" viewing of the photographs draws resemblance to the photograph in the album, *Photographs C. P. R. St. Lawrence Bridge 1886*, and I believed them to be test-shots for the campaign.

Figure 1.5: Left: *Steel Bridge on the Canadian Pacific Railway: Centre Staging*, Alexander Henderson [LAC: 1976.72 SC 0027 PA-117233]; Right: Cantilever from the South Shore [LAC: C-256 Accession 1987-161, Box 2 #3, Image 58].

I also met with archivists and retired engineers to discuss the bridge-building process and the albums' arrangement. At the McCord Museum, former archivist Nora Hague explained Henderson's writing captions and compiling albums. She began by talking about Notman's practice of carefully writing the name, date, or place of the photograph on the negative when it was taken. Notman scratched the information directly onto the place, which resulted in dark lettering. By contrast, Henderson would write or paint on his plates, blocking the light from

[121] J. W. Schaub, "The Superstructure for the St. Lawrence Bridge," *Engineering News and American Contract Journal* 18 (October 1, 1887): 238.

passing through, with a white set of lettering on the print. Both options required writing on the negative in reverse to expose a positive or forward-facing text.

Knowing the practices of the two photographers gave me confidence in speaking of the Saint-Laurent Bridge photographs as Henderson's work. I compared Saint-Laurent Bridge photographs attributed to Henderson with other known photographs and determined some patterns in his captions. I noticed two sets of handwriting scratched into the photographs in the Saint-Laurent Bridge scrapbook, which establishes that more than one photographer was present during the construction of that bridge. Throughout the dissertation, I use the caption found on the photographs in the title of each figure, unless I modified the photograph or want to draw attention to one aspect, in which case I include the caption title with the reference.

To understand Henderson's practice of making professional and personalized albums, I consulted secondary sources on the photographer's "Snow and Flood After the Great Storms of 1869"[122] albums and accessed copies of his "Canadian Views and Studies"[123] and "Phoenixville Bridge Company Album"[124] at the Notman Photographic Archives at the McCord Museum (MM), in Montreal and the National Gallery of Canada (NGC), in Ottawa. The secondary literature establishes Henderson as a visual storyteller; in her reading of Henderson's album *Snow and Flood After Great Storms of 1869* historian of photography Elizabeth Cavaliere writes:

[122] David Harris, "Alexander Henderson's 'Snow and Flood after Great Storms of 1869,'" *RACAR: Revue d'art Canadienne / Canadian Art Review* 16, no. 2 (1989): 155–272; Elizabeth Anne Cavaliere, "Flood Watch: Construction and Evaluation of Meaning in an Alexander Henderson's 'Snow and Flood After the Great Storms of 1869,'" in *The Photograph and the Collection*, ed. Graeme Farnell (Edinburgh: Museums Etc, 2013), 244–67.

[123] Alexander Henderson, "Canadian Views and Studies by an Amateur - Copy 1" (Photographic Album, Montreal, 1865), Box 5/5 MP 1468, Fonds Alexander Henderson, MM; Alexander Henderson, "Canadian Views and Studies by an Amateur - Copy 2" (Photographic Album, Montreal, 1865), Box 5/5 MP 308, Fonds Alexander Henderson, MM; Alexander Henderson, "Canadian Views and Studies" (Alexander Henderson, n.d.), Photograph Collection, National Gallery of Canada, accessed April 12, 2014.

[124] Charles G. Auerbach, "Album of Photographs of Wrought Iron Railroad Bridges Constructed and Erected for the Government of the Dominion of Canada on the Line of the Quebec, Montreal, Ottawa & Occidental Railway." (Phoenixville Bridge Works, 1879), PSC71:003:1-24, Photograph Collection, NGC.

> Henderson does not provide photographs of working-class neighborhoods affected by the flood, instead focusing on the business districts of Montreal. The people in his photographs are calm and composed as though the natural disaster that surrounds them is nothing that they can't handle. Business in Montreal continues as usual. As a commercial and political powerhouse in Canada during the Victorian period, such representations of the city and its people may be Henderson's attempt to indicate that nothing can stop Montreal, not even nature.[125]

Thus, Henderson builds a narrative about the flood and downplays the impact of the flood on poor neighbourhoods in attempts to attract buyers. I approach his and other albums with an interpretive lens of landscape narrative. "Narratives intersect with sites," write landscape historians Matthew Potteiger and Jamie Purinton, and "accumulate as layers of history, organize sequences and inhere in the very materials and processes of the landscape. […] The term 'landscape narrative' designates the interplay and mutual relationship between story and place."[126] The landscape narrative offers a cross-section of how the landscape is represented, the many different contributors and valuable for interpreting new knowledge about the natural and cultural landscape.

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125 Cavaliere, "Flood Watch," 252.

126 Matthew Potteiger and Jamie Purinton, *Landscape Narratives: Design Practices for Telling Stories* (New York: J. Wiley, 1998), 136.

Chapter Two: Bridging the River

This chapter, "Bridging the River," introduces the three bridges with a brief and straightforward presentation of each, along with its infrastructural context. The chapter begins with an overview of the river, a unique geographical setting with the extraordinary seasonal phenomenon that influenced the decision(s) to bridge the river. Maps and geological reports are the foundation for understanding the geographical context and the mid-nineteenth-century ice phenomena. Historical maps provide a visual context and demonstrate how British surveyors and engineers visualized the relationship between the river and the city. The second part of the chapter relates a technical history of the bridges. Secondary sources develop the infrastructural context and technical reports, corporate records, construction diaries, newspaper and journal articles glean the design and construction processes. The chapter presents the designers and contractors, the design and construction challenges, and the material pathways and machinery employed during construction. These details provide insight into the ways in which engineers and their agents conceived, operated on, and represented the landscape.

Geographical setting

Long before the French and other explorers arrived, First Nations people inhabited *Tiohtiake* (the region of Montreal) and travelled by canoe through a system of rivers and lakes across *Tewakhwishenhelon* (Turtle Island or North America).[127] From its headwaters at the near centre of the continent, the St. Lawrence River flows east and slightly north, marking part of the

[127] The Island of Montreal crosses many territorial boundaries, Indigenous traditional territory: Haudenosaunee (around Lake Ontario); Huron-Wendat (north of the river, from about Georgian Bay to the Gulf of the St. Lawrence); Mohawk (northern boundary of their territory, south along Richelieu) ; St. Lawrence Iroquoians (both sides of the river, from Lake Ontario to the Gulf of the St. Lawrence) (see www.native-land.ca)

present-day political boundary between Canada and the United States. *Tsi Tetsionitiotiakon* (the Island of Montreal) is the traditional meeting place of these Indigenous communities and the meeting place of significant river systems. The St. Lawrence River converges with the Ottawa River at the western tip of the Island of Montreal and the Richelieu River to the east before continuing east to the Atlantic Ocean.

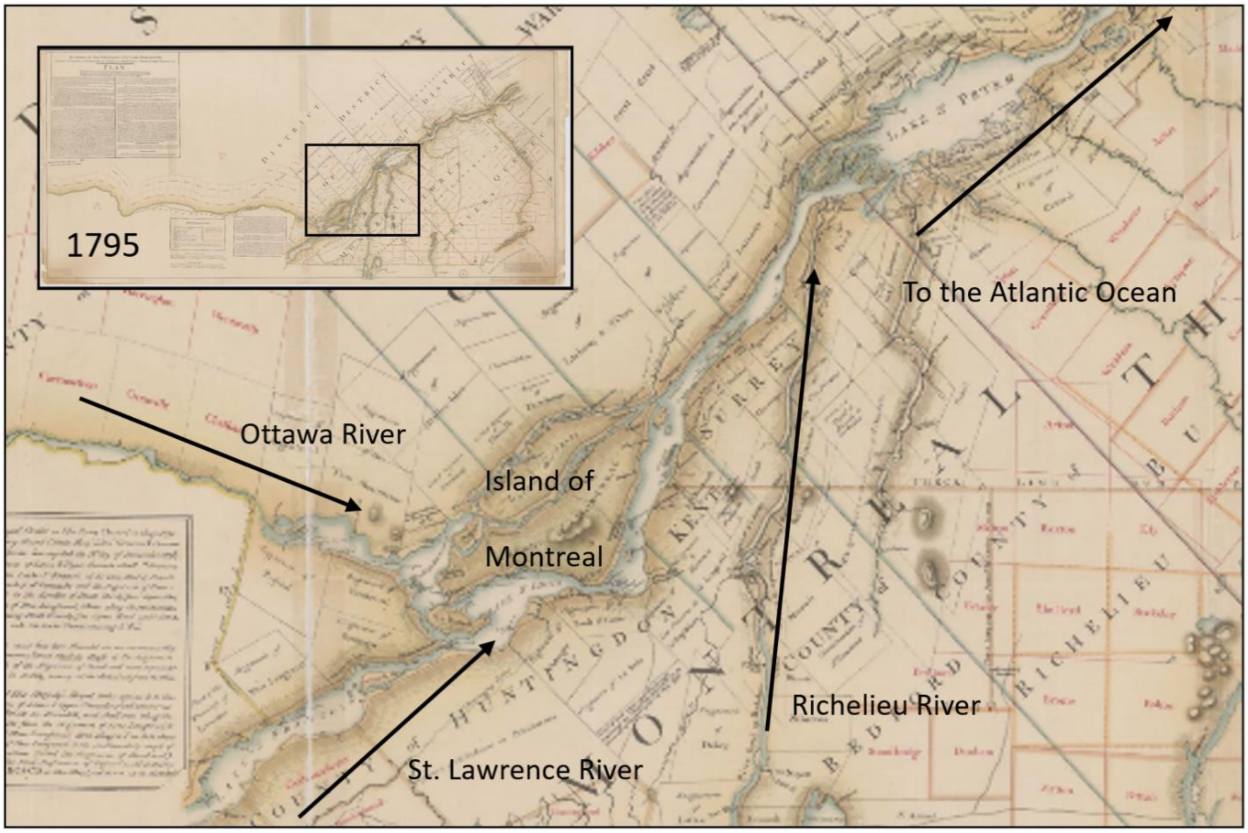

Figure 2.0: *Map showing how the rivers meet at the Island of Montreal*. [Map by Samuel Gale and John B. Duberger, *Plan of part of the province of Lower Canada containing the country from the river Montmorency near Quebec upwards as far as any surveys have been hitherto made, that is to St. Regis on the Rr. St. Lawrence, and to the township of Buckingham on the Rr. Ottawa*, Province of Quebec, [s.n.] 1795, BANQ: https://collections.banq.qc.ca/ark:/52327/2244029].

One of the earliest measured surveys of the lakes and rivers surrounding the Island of Montreal is a combination of nine older British surveys[128] of the region (See Figure 2.0). The

[128] The surveys are listed as: Samuel Holland, *Survey of Part of the River St. Laurence*, 1765; James Peachy, *A survey of the River Jesus, the Northeasterly Shore of the Lake of the Two Mountains, and part of the Ottawa River as far as the upper end of the Seigneurie of Argenteuil*, 1795; Patrick McNiff, *A Survey of part of the Ottawa River fronting the Township of Chatham, Grenville, Carmarthen, Norfolk, Suffolk, and Buckingham*, 1788; Guy and

map conveys little detail about the land cover beyond the shores of the rivers. Its focus is on the river and the existing primary roads running parallel to the river. Notably, the cartographer superimposed the names of English counties over the French seigneurial land system.[129] Red ink indicates the potential boundaries of new townships, but according to the map-maker's notes the lines are yet to be "run out in the fields."[130] "As much as guns and warships," writes cultural geographer J. B. Harley, "maps have been the weapons of imperialism […] used in colonial promotion and land claims that may or may not have come true, […] maps anticipated empire."[131] The red lines and English names are part of an imagined landscape and the new territorial layout emphasizes the importance of waterways as connectors. The waterways, however, are represented without pertinent information about the natural conditions of the St. Lawrence River, its flow, elevation changes, and depth. The condition of the river heavily impeded circulation and served as the impetus for bridge construction in Montreal.

Garnier, *A Survey of part of the tongue of land between the Rover Ottawa and St. Laurence,* 1789-1790; Simon Z. Watson, *A Survey of the River Richelieu (or Sorel),* 1792; Theodore Depenciere, *A Survey of part of the River Yamaska from its mouth to the Upper end of the Seigneurie of St. Hyacinthe,* 1792-1793; Joseph Kilborne, *A Survey of the River St. François and Lake Memphramagog, the Lower part from the mouth of the river to the long point and the western shore of the Lake Memphramagogue,* 1792; James McDonell, *A Survey of part of the River Beccancourt and Nicolet,* 1792; and Jeremiah McCarthy, *A Survey of the River Chaudiere and Lakes Magantic,* 1792.

[129] For more on the French territorial formation, see: Geoffrey J. Matthews, *Historical Atlas of Canada* (University of Toronto Press, 1987); Jean-Claude Robert, *Atlas Historique de Montréal* (Montreal: Art global, 1994).

[130] Samuel Gale and John B. Duberger, *Plan of Part of the Province of Lower Canada Containing the Country from the River Montmorency near Quebec Upwards as Far as Any Surveys Have Been Hitherto Made, That Is to St. Regis on the Rr. St. Lawrence, and to the Township of Buckingham on the Rr. Ottawa* (Province of Quebec, 1795).

[131] Harley, "Maps, Knowledge, and Power," 282.

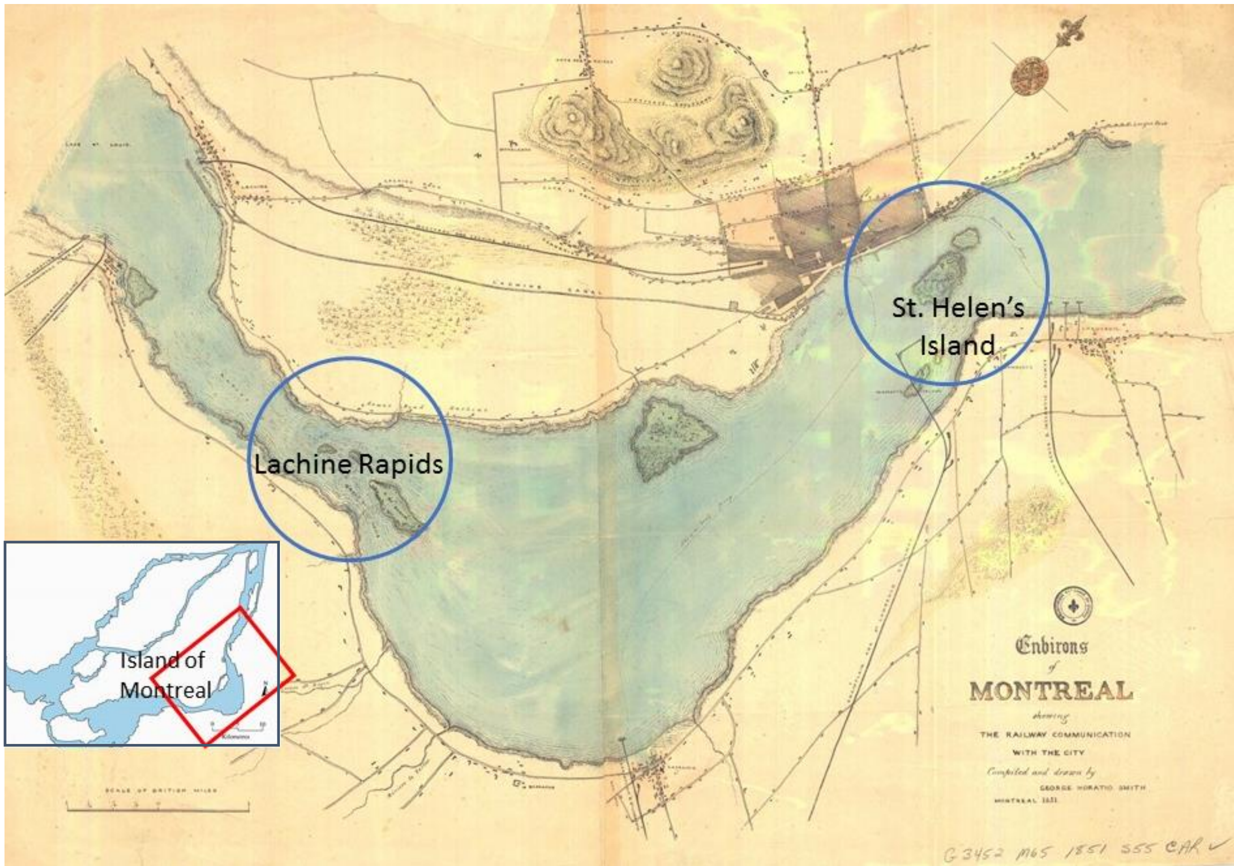

Figure 2.1: *Map showing where the St. Lawrence River is pinched as it passes between the Island of Montreal and the south shore.* [Map by George Horatio Smith, *Environs of Montreal, Shewing the Railway Communication with the City, Montreal,* [s.n.] 1851 BANQ: http://collections.banq.qc.ca/ark:/52327/2244051].

The St. Lawrence River pinches twice along the southern edge of the island—at the Lachine Rapids and St. Helen's Island—before and after the waters pass the urban centre and the Port of Montreal (See Figure 2.1). The Lachine Rapids are a nearly three-metre (ten-foot) drop in elevation over a five-kilometre (three-mile) run of rocky and turbulent waters; dangerous for the unskilled river pilot. The second pinch is located between the Island of Montreal and St. Helen's Island, below the harbour. "The greatest disadvantage to this harbour," wrote British surveyor Joseph Bouchette in 1815, "is the rapid of the St. Mary about a mile below it." [132] Without a wind, notes Bouchette, the current could keep ships for up to two weeks from reaching the port.

[132] William Henry Atherton, *History of the Harbour Front of Montreal since Its Discovery by Jacques Cartier in 1535: Showing the Growth of the Harbour, Its Improvements, Its Shipping and Its Sailor Services* (Montreal: City Improvement League, 1935), 4.

Indigenous communities circumvented the rapids along the path of the now disappeared St. Pierre River. Seventeenth- and eighteenth-century European settlers followed the same trail until engineers devised a cost-effective technical solution to the detour. The Lachine Canal, built in 1821-1825, improved circulation in the warmer months; however, the bypass did little to overcome winter challenges. The fast-flowing river disrupted the city twice a year when enormous ice shoves blocked water flow at the two pinch points and inundated low-lying areas. The ice made approaching the banks and crossing the river dangerous. As a result, industrialists, politicians, and others rallied at different points to bridge the river and keep resources flowing through the city all year round.

A key component to the successful development of the colony was n understanding the river. In Figure 2.0, cartographers Gale and Duberger orient the map using the cardinal directions, depicting the river as it moves past the south-western tip of the island to the north-east; the river flows north. By contrast, the orientation in Figure 2.1 is rotated 45º to align the island on an imagined north-south axis and the river on an east-west axis. The reorientation is typical maps of Montreal. The map emphasises roads and railways in relationship to the environs, however, only the urban areas, the mountain, and the lowlands are rendered. The emphasis is, like the Gale and Duberger map, on the river and the deep navigation channel drawn along the centreline of the river. The textures applied to the water's surface at the Lachine Rapids and St. Helen’s Island represent a form of turbidity, where the current is fast and dangerous.

Early nineteenth-century engineers who lived and worked in Montreal regarded the river with some contempt. Railway philosopher and promoter Thomas C. Keefer, for example, lamented the river in his *Philosophy of Railways.* “Old winter is once more upon us,” he wrote, “and our inland seas are ‘dreary and inhospitable wastes.’” Keefer yearned for the sound of the railway’s steam whistle and the day that technology would overcome the seasonal ice blockades; Keefer, along with other entrepreneurs and politicians, called for permanent communication lines. They insisted on a railway and a bridge over the St. Lawrence River to connect Montreal’s island and city, the British colonies of North America, and Britain. In their view, the railways would unite the independent colonies and help build a new nation.[133] The population of Montreal rose to between sixty and seventy thousand nearing the middle of the nineteenth century, and many considered it “the most important city of all the British possessions in America.”[134] Montreal engineers and businessmen played a prominent role in establishing a vision, raising capital, and designing the project.

Montreal is positioned by Keefer, local entrepreneurs, and British investors as the centre of a vast pool of resources. Yet, as Figures 2.0 and 2.1 demonstrate, the island and city are drawn without context. The omission is typical and reflective of the types of histories that are written about the region. Environmental historian Stephan Castonguay notes scholars have overlooked Quebec’s hinterland, “ridiculous as it might seem,” he writes, “cows are simply absent from the history of the dairy industry.”[135] As will become apparent, the geographical context for the three Montreal bridges is a preoccupation of the engineers but missing from their plans and technical drawings.

[133] Thomas C. Keefer and H. V. Nelles, *Philosophy of Railroads, and Other Essays.* (Toronto; Buffalo: University of Toronto Press, 1972), p.3.

[134] “The Victoria Jubilee Bridge,” *The Railway and Shipping World*, October 1900, 313.

[135] Stéphane Castonguay, “Society, Territory and Ecology in Québec: A Historiographic Review,” in *Positioning Québec in Global Environmental History*, ed. Stéphane Castonguay, Richard Judd, and Stephen J. Pyne, New Perspectives in Québec Studies (Montreal: Éditions Nota bene, 2007), 47, https://www.erudit.org/en/books/new-perspectives-in-quebec-studies/positioning-quebec-in-global-environmental-history--978-2-89518-279-5/003046co/.

Technological Feats

In Montreal, each major bridge construction project is a milestone in developing the country, the city, and engineering institutions. The narratives that emerge before, during, and after construction influence the perception of the impetus, the value of the precedents for each bridge, and the legacy of each project. The remaining sections of this chapter are organized around three construction stories. The Victoria Bridge, the Saint-Laurent Bridge, and the Jacques Cartier Bridge are considered in turn, with a description of the motivation for building each, the design and construction processes, and the photographs that documented each construction. The organization of this text emphasizes the timeframe of each construction rather than a continuous, comprehensive look at the history of Montreal. The focus is on introducing each bridge as reported by the engineers and draws upon newspaper clippings, construction reports and diaries, material quantity logs, and secondary sources. The following descriptions offer insight into the perspectives of the bridge builders.

The Victoria Bridge (Erected 1854-1860)

In 1854, engineers of the Grand Trunk Railway completed two railway bridges over the Ottawa River and, that same year, they began construction on the Victoria Bridge (1854-1860). It measured over two-and-a-half kilometres (a mile and three-quarters) and upon completion, the Victoria Bridge was the world's longest tubular bridge.[136] The bridge designers imported construction knowledge and (newly improved) material standards from Britain.[137] The construction engineers set the tubular structure on solid masonry foundations, many of which are

[136]Hodges, *Construction of the Great Victoria Bridge*, 4.

[137] Edwin Clark, *The Britannia and Conway Tubular Bridges, with General Inquiries on Beams and on the Properties* (London: J. Weale, 1850), http://archive.org/details/britanniaandcon00clargoog.

still in use today. The bridge was considered a success before it opened to traffic. The bridge took six years to erect, and on completion, the demand for crossing exceeded the single track's capacity.[138]

The successful design and construction narrative of the Victoria Bridge has held strong for over 160 years. In part, the books and albums commemorating the construction make technical details about the bridge available to lay audiences and are detailed such that anyone wishing to reconstruct the bridge in the present day could almost do so. In the section below, I use secondary sources alongside construction reports and other documentation written by engineers to present a detailed history of the bridge construction and its expansive landscape.

The Need to Navigate the River

At the turn of the nineteenth century, two natural conditions impeded smooth navigation on the river beyond Montreal. The first impediment was the Lachine Rapids, a nearly three-metre (ten-foot) drop in elevation over a five-kilometre (three-mile) run of rocky and turbulent waters located on the south shore of the Island of Montreal, between its west end and the harbour. Starting in 1821, the Lachine Canal allowed large, flat-bottomed "Durham" boats to circumvent the rapids. On a tour of the colonies after the 1837–1838 rebellions in Upper and Lower Canada, Lord Durham encouraged the British Parliament to invest in communication lines, including a widening of the canal to resolve "nature's slight imperfections."[139] Expansions to the canal (in

[138] "Rebuilding of the Victoria Bridge 1897-1899," *Canadian Rail, The Magazine of Canada's Railway History*, June 1999, 469.

[139] Charles Prestwood Lucas, Charles Buller, and John George Lambton, *Report on the Affairs of British North America from the Earl of Durham, Her Majesty's High Commissioner* (Oxford: Clarendon Press, 1912), 314, http://archive.org/details/reportonaffairso02durhuoft.

1842 and 1874) and the development of a network of waterways to the Great Lakes gave industrialists access to resources at the centre of the continent.[140]

Short-track railways first opened in the vicinity in 1836 to replace the portages and bypass the canals.[141] Locomotives carried heavy loads from the hinterland through Montreal and supplies from Britain to the interior. These railways were small victories as the growth and stability of the economy faced two significant political challenges. The first was the American Drawbacks Act, 1845-1846, which allowed Canadian trade to pass through America "in bond" and exempt it from American tariffs.[142] The agreement meant that there was no added cost to ship through the United States. Second, the end of Colonial Preference in the British Market meant that there were no financial incentives for farmers in the western part of the continent to ship through Montreal. They started taking advantage of cheaper "ocean freight rates" available through New York City.[143] Montreal risked losing commission on goods that moved from the Great Lakes through the Erie Canal on the continent's American side to New York or Boston's harbours without a competitive plan.

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[140] For more on the industrial development of the canal, see Gerald J. J. Tulchinsky, "The Construction of the First Lachine Canal, 1815–1826" (Master's thesis, McGill University, 1960); Jean Bélisle et al., *An Industrial Landscape Observed: The Lachine Canal, 14 July to 25 October 1992* (Montreal: CCA, 1992); Yvon Desloges and Alain Gelly, *The Lachine Canal: Riding the Waves of Industrial and Urban Development, 1860–1950* (Montreal: Les éditions du Septentrion, 2002); Desmond Bliek and Pierre Gauthier, "Understanding the Built Form of Industrialization along the Lachine Canal in Montreal," *Urban History Review / Revue d'histoire urbaine* 35, no. 1 (Fall 2006): 3–17, https://doi.org/10.7202/1015990ar; and Nik Luka and Heather Braiden, "Montreal: Blue Collars, Green Corridors, Post-Industrial Waterways," in *Third Coast Atlas: Prelude to a Plan*, ed. Daniel Ibañez et al. (New York: Actar, 2017), 176–81.

[141] For more on the construction of railways in Montreal, see Christopher Andreae, *Lines of Country: An Atlas of Railway and Waterway History in Canada* (Toronto: Boston Mills Press, 1996).

[142] Robert Passfield, "Construction of the Victoria Tubular Bridge." In *Canal History and Technology Proceedings*, 20:5–52. Easton, PA: Canal History and Technology Press, 2001. p.7

[143] Ibid., p.7

Montreal entrepreneurs, politicians, and promoters devised a plan to control merchandise and profits by shipping Canadian goods from Montreal through Portland, Maine.[144] The project received little financial support until the price of grain dropped on two occasions before the winter of 1847.[145] With fears spreading of being unable to ship perishable products during the winter, merchants and local politicians again rallied for improved rail lines. Existing east-west lines between Toronto and Montreal and north-south routes between New York and Montreal terminated at the river.[146]

By 1847, there was little doubt that Montreal needed a bridge.[147] The city was fighting to maintain its position as a leading port of entry. The economy depended on the movement of goods between the continental interior and Europe. Even with the construction of the Lachine Canal, Montreal merchants struggled to keep up with American trade. To retain its importance as the economic centre of the British Colonies of North America, the city needed access to a year-round Atlantic port.

The Grand Trunk Railway (GTR) was formed in 1851 to build a railway between Toronto and Montreal, and before long, the charter extended west to Sarnia and east to Portland, Maine. The company took over the management of several existing short tracks between Montreal and Kingston. It developed the line eastward to connect industrial centres, like Detroit, Buffalo, and Toronto, to the Port of Montreal (See Figure 2.2). Port operations spanned seven to eight months

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[144] Gerald J.J. Tulchinsky and Brian J. Young. "Biography – YOUNG, JOHN (1811-78) – Volume X (1871-1880) – Dictionary of Canadian Biography." Accessed October 1, 2019. http://www.biographi.ca/en/bio/young_john_1811_78_10E.html

[145] A.W. Currie, *The Grand Trunk Railway of Canada*. Toronto: University of Toronto Press, 1957.

[146] For a timeline of railways, see Andreae, *Lines of Country*.

[147] Robert R. Brown, "Crossing the River: The Story of the Construction of the Victoria Bridge at Montreal 1854-1860," *Canadian Rail, The Magazine of Canada's Railway History*, no. 443 December 1994, pp.208-221.

a year, depending on when the ice formed in the fall and broke in the spring.[148] Before a permanent link over the St. Lawrence River, railway companies ferried goods and people across the river during the summer. They laid temporary tracks on the solid ice cover in the winter.[149] However, in the shoulder seasons, the ice packed and piled up to twelve to fifteen metres (forty to fifty feet) in height along the banks and halted all circulation.

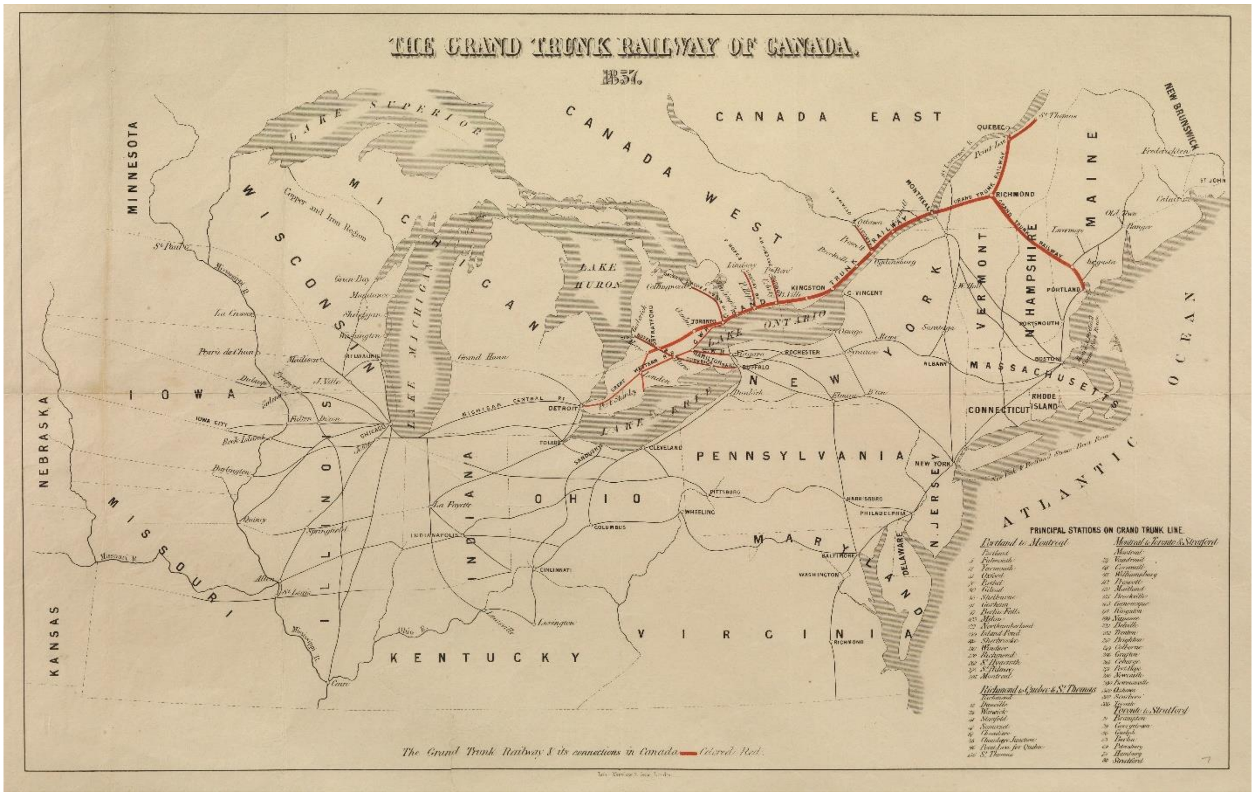

Figure 2.2: *The Grand Trunk Railway of Canada, Lithography. Waterlow & Sons, London,* 1857 [The Baring Archive of Risk and Reward: No. 65, HC5.15.3 and 4 HC5.15.3 http://www.risksandrewards.org.uk/library/1202/0000/0056/HC5.15.3__Grand_Trunk_Railway_Map_2.jpg]

The GTR map provides little context for the ice or political boundaries. The map is of the waterways and the railways, the primary means of circulation in 1857. The striated lines give form to significant water bodies, while the thin black lines represent the railways. The GTR line

[148] John Kennedy, "Appendix No. 28 to Report of the Montreal Harbour Commissioners on the Deepening of the Channel between Montreal and Quebec," December 8, 1886, https://books.google.ca/books?id=LRMUAAAAYAAJ& .

[149] For more on Montreal's ice bridge, see Brown, "Crossing the River," 208-220.

is drawn thicker and in red; the line gives prominence to the international line that crosses the St. Lawrence River at Montreal with the completion of the Victoria Bridge. The map makes no distinction between Canada West and Canada East; the viewer visualizes the Ottawa River as its dividing line. The American state boundary lines are also missing from the map, inferring that the GTR railway overcomes the political divides. Yet, the portion of the line situated in British North America followed British railway standards. At the same time, American standards guided the construction of the American section.[150] The two populations divided the railway by their inability to rationalize the track gauges.

The Ice Phenomena

The second natural obstruction was seasonal and unimaginable in Britain. Unlike English tidal waters, this freshwater river flowed during the summer but froze in the winter. Sir William E. Logan, the provincial geologist of the British colonies in Canada and the first director of the Geological Survey of Canada, was the first to observe and publish papers on the phenomena.

In his 1842 paper to the Royal Geological Society of London, Logan described the ice phenomena in straightforward terms that learned societies and the public would understand.[151] His descriptive observations circulated for decades and gained the attention of engineers, architects, and naturalists alike.[152] Logan's theory is significant because he conceptualized the

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[150] Gilles Lauzon, "The Impact," in *Victoria Bridge: The Vital Link/Le Pont Victoria: Un Lien Vital* (Montreal: McGill-Queen's University Press, 1992), 99.

[151] William E. Logan, "On the Packing of Ice in the River Saint Lawrence," *Proceedings of the Geological Society of London* 3 (1842): 766–70.

[152] For other papers, see William E. Logan, "On the Packing of the Ice in the River St. Lawrence; the Occurrence of Landslips in the Modern Deposits of Its Valley; and the Existence of Marine Shells in Them and on the Mountain of Montreal," *Quarterly Journal of the Geological Society* 2, no. 1–2 (January 1846), 422–32, https://doi.org/10.1144/GSL.JGS.1846.002.01-02.61; William E. Logan, "Effects of Ice on the St. Lawrence (from a Paper by W. E. Logan, of Montreal Read before the Geological Society of London)," *Civil Engineer and Architect's Journal* 16 (1853): 245–47; William E. Logan, "On the Packing of the Ice in the River St. Lawrence," *The Canadian Naturalist and Quarterly Journal of Science with the Proceedings of the Natural History Society of Montreal* 3, no. 1 (1858): 115–21; and Bernard J. Harrington and John W. Dawson, "Logan on Packing of Ice," in *Life of Sir*

river and topography as a single system. He developed his theory on the packing of ice from the river's form: where it narrows, widens, and converges with other rivers.

Logan described how, with the first autumnal frost, ice forms in calm, shallow water and how daytime temperatures warm the shores and release the ice. Nearing the end of December, the shorter days and colder nights mean that larger chunks of ice form, release, and dam the narrows. Logan called the process the "packing and piling" of ice. He wrote, "Standing for hours together upon the bank overlooking St. Mary's current, I have seen league after league of ice crushed and broken against the barrier lower down and there submerged and crammed beneath."[153] The volatile release and violent packing of ice that accumulates as much as twelve to fifteen metres (forty to fifty feet) in height along the banks made circulation to and from the island dangerous. The cycle repeats until the river's force carves an opening through the ice dam, slightly below St. Helen's Island. Then, the floods diminish, and the winter ice bridge opens to restore circulation.[154] The phenomenon repeated in reverse in the spring and cut the island off until the summer heat cleared the ice.

Each cycle of packing and piling inundated the city with water, and the ice flattened everything in its path. The naturally sloping riverbanks guided ice—from ten metres (thirty feet) to upward of sixty metres (two hundred feet) inland—inland with a force that could topple an unprotected five-storey stone building, wrote Logan, "like a house of cards."[155] In the 1840s, engineers built a stone revetment wall to protect Montreal from floodwaters and ice. Logan noted how builders used locally sourced limestone to a height of seven metres (twenty-three feet)

William E. Logan, Kt., LL.D., F.R.S., F.G.S., &c: First Director of the Geological Survey of Canada (London: S. Low, Marston, Searle, and Rivington, 1883), 88–92.

[153] Bernard J. Harrington, *Life of Sir William E. Logan, Kt., LL.D., F.R.S., F.G.S., &c: First Director of the Geological Survey of Canada* (Montreal: Dawson Bros., 1883), 88.

[154] For more on the ice bridge, see Brown, "Crossing the River," July 15, 1960.

[155] Logan, "On the Packing of Ice in the River Saint Lawrence," 766.

above summer water levels. Moreover, the merchants used an assortment of oak piles set at an angle less than forty-five degrees to deflect the ice. The piles protected buildings located along the river; the incline lifted, shattered, or threw the ice away from the building, creating a rampart. Altogether, the height of the wall and strength of the locally sourced limestone offered protection for the city, as did the angle of the wooden piles for individual buildings. Logan's observations—at the intersection of the built and natural environment—enlightened engineers who appropriated the incline and the use of limestone in railway bridge pier designs.

The Design

The Victoria Bridge needed to withstand the impact of ten metre (thirty-foot) ice shoves. Its designers combined local knowledge of the river and the ice in their plans for the bridge's solid masonry piers. They imported iron and iron bridge construction methods from Britain to overcome the seasonally disruptive freeze-thaw phenomena. When the project seemed destined to fail, the construction managers persevered. The result was a significant contribution to the advancement of engineering and an economic benefit to the city and colonies.

The Honorable John Young, Cabinet Minister and Chief Commissioner of Public Works hired Thomas C. Keefer, engineer and author of *The Philosophy of Railways,* to prepare a bridge proposal. Keefer was the fourth engineer in less than five years to survey the river for a potential bridge location.[156] His report is notable for several reasons. First, it quotes Logan's paper almost in its entirety. Keefer adapted Logan's observation on the strength of local limestone as a construction material and the benefits of angled oak piles in deflecting the ice in a unique

[156] Surveys included one in 1846 by A. C. Morton, then chief engineer of the St. Lawrence and Atlantic Railway, one in 1847 by Edward F. Gay of the Columbia and Philadelphia Railway Company (or of the St. Lawrence and Atlantic Railway, depending on sources), one in 1849 by Casimir S. Gzowski, a contractor also with the St. Lawrence and Atlantic Railway, and one in 1851 by Keefer, who was with the Montreal and Kingston Railway. Frederick N. Boxer, *Hunter's Handbook of the Victoria Bridge, Illustrated with Wood-Cuts* (Montreal: Hunter and Pickup, 1860), 15–19.

proposal for the bridge piers. Second, Keefer recommended locating the bridge crossing very close to the eventual site. The engineer argued that the ease of building in the shallow waters at a wide crossing would outweigh the difficulties of building in deeper water at a shorter crossing. Critics argued that Keefer's proposal of long abutments extending in the shallows put the bridge at a greater risk of being swept away by the ice, and Keefer (rightly) countered that the ice would get swept into the swift-moving current of the navigation channel and leave the bridge untouched.[157]

Notably, Keefer proposed using the winter ice to lay out the bridge and build the structure over the navigation channel. For Keefer, the main hindrance to the construction of the bridge was also its most significant advantage. Keefer was, writes engineering historian Alister MacKenzie, "well in tune with the particular conditions affecting construction work in the St. Lawrence, especially during the winter."[158] Fourth, Keefer recommended a wooden structure, except for the segment over the navigation channel. He recommended a tubular structure at the deepest and fastest flowing part of the river, like those built in Wales by railway entrepreneur and bridge architect Robert Stephenson. Keefer considered a suspension bridge, like the one completed in 1854 by John A. Roebling over the Niagara Gorge; however, Keefer argued for a rigid structure. Finally, Keefer's report is significant because his design premise was carried through in principle, even though Keefer and his role in the project ended with the report.[159]

As Keefer was adding the final details to his report, the railway project changed hands. Between 1851 and 1854, Sir Francis Hincks (then Co-Premier of the Province of Canada)

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[157] Keefer, *Report on a Survey*.

[158] Overall, Keefer drew attention to prevention or security measures to protect against the ice and included Logan's full paper in his report. Alistair MacKenzie, "Case Study in Engineering History Education: Robert Stephenson's 'Last Great Work'—The Victoria Bridge in Montréal," *Journal of Professional Issues in Engineering Education and Practice* 131, no. 1 (January 2005): 34.

[159] John Young, *The Origin of the Victoria Bridge* (Montreal: D. Bentley, 1876).

repeatedly lobbied parliament on behalf of the British railway construction company Peto, Brassey and Betts to develop and expand railway lines from Lake Ontario along the north shore of the St. Lawrence river to Montreal under the name of the Grand Trunk Railway (GTR). In a complex and controversial takeover, the British railway firm released Keefer from his duties and pursued other design avenues.[160] The contract left Keefer unpaid for his report,[161] and he was improperly cited or ignored in the British account of the bridge.[162]

Instead, the GTR consulted with Stephenson directly. They engaged the British engineer to review drawings by the newly appointed Chief Engineer of the Grand Trunk Railway, Alexander Mackenzie Ross.[163] Ross had a long career building railways in Britain and France and supervised the construction of the bridge piers on Stephenson's Conwy Tubular Bridge in Wales.[164] Stephenson was one of the most celebrated Victorian engineers and insisted on being appointed joint chief with Ross. Both men's names appeared carved in stone above the north entrance to the bridge when it first opened.

Stephenson designed his first tubular structures to overcome the challenges of building long-span bridges strong enough to support locomotives and railway cars' weight. The design was based on the hull of a ship and looked like an iron cage for trains. Stephenson engaged William Fairbairn, an experienced shipbuilder, and Eton Hodgkinson, a mathematician, to test materials

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160 John Malcolm Trout and Edward Trout, *The Railways of Canada for 1870–1: Shewing the Progress, Mileage, Cost of Construction, the Stocks, Bonds, Traffic, Earning, Expenses, and Organization of the Railways of the Dominion* (Toronto: Office of the Monetary Times, 1871), 69.

161 MacKenzie, "Case Study," 34.

162 One article misspelled his name as "J. C. Keepe," and another left him out entirely. "Book Review: The Construction of the Great Victoria Bridge in Canada," 310; and James Silk Buckingham et al., *The Athenaeum* (London: J. Francis, 1860). Also see early and contemporary accounts defending the concept for the bridge in Boxer, *Hunter's Handbook*; Young, *Origin of the Victoria Bridge*; and MacKenzie, "Case Study."

163 Passfield, "Construction of the Victoria Tubular Bridge,"14–15.

164 MacKenzie, "Case Study," 34.

and different forms.[165] Ross adopted Stephenson's proportions, five by six metres (sixteen by twenty feet) sections and adapted Keefer's proposed spacing, from twenty-two to twenty-four spans in the design. Neither Keefer nor Ross received full credit for their involvement in the design.[166] Instead, popular accounts reported that Stephenson designed the whole of the ironwork at his office in Great George Street, Westminster, and "the execution of it was carried out at the Canada Works, Birkenhead."[167] Stephenson worked until his untimely passing in the fall of 1859, a few short months before the bridge opened to traffic.

Stephenson and Ross completed their design of the bridge in 1854 and, the same year, a rendering of the design appeared in the *London Illustrated News* (See Figure 2.3). The viewer is placed above the river but below the bridge, offering a mix of perspectives, having authority over the river, yet being humbled by the bridge. The tubular structure cuts horizontally across the length of the image, and the image places the bridge at a crossroads of past and present. The ships in the foreground are traditional raft-boats used in the colonies and sailing ships that, because of the height of the mast, will not fit under the bridge. The sailing ship's fly British colonial and American flags, showing the imagined union, made accessible by the bridge. Behind the tube are the signs of industrialization, one or more steamboats with smoke coming out. "Railroads, river barges […], and a horizon of smoke-puffing chimneys all symbolize [the city's] role as a great industrial center."[168] The background features the City of Montreal at the

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[165] Edwin Clark, *The Britannia and Conway Tubular Bridges* (London: Published for the author, by John Weale High Holborn, 1850).

[166] *The Victoria Bridge, at Montreal, Canada, Who Is Entitled to the Credit of Its Conception?: Or, A Short History of Its Origin* (John King & Company, 1860).

[167] Henry Peto, *Sir Morton Peto, a Memorial Sketch* (London: Elliot Stock, 1893), 19, http://archive.org/details/sirmortonpetoam00bargoog.

[168] John William Reps, *Bird's Eye Views: Historic Lithographs of North American Cities* (New York: Princeton Architectural Press, 1998), 38.

foot of Mount Royal. The heaviness of Stephenson's tubular design is rendered delicate in comparison with the weight given to the design of Ross's heavy masonry piers.

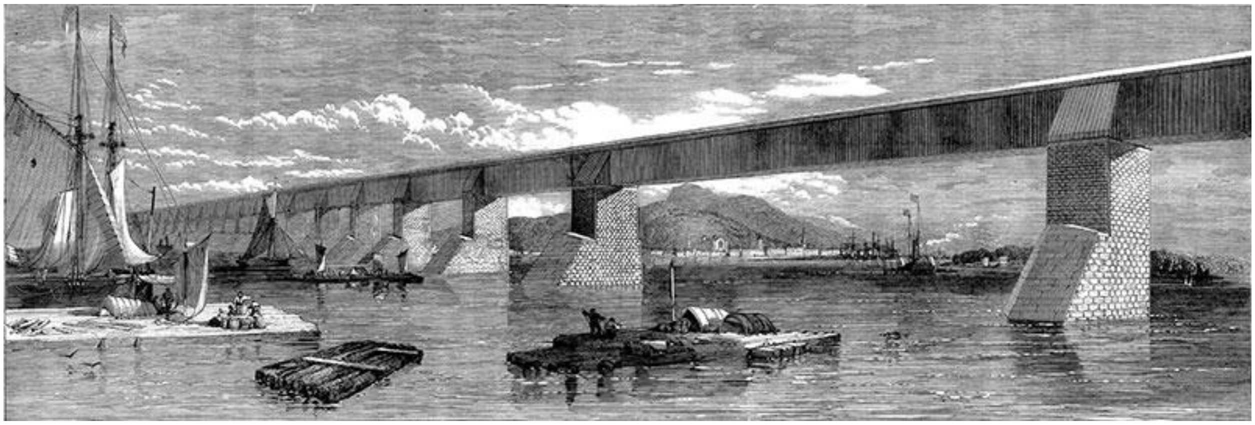

Figure 2.3: *Artist's rendering of the Victoria Bridge,* lithograph based on a watercolour painting by S. Russell, 1854 in *London Illustrated News,* February. 19, 1859, p.8.

Ross incorporated the lessons learned from Logan, through Keefer, in his original design for the piers. He integrated an upward sloping face directly into a heavy masonry design and faced the masonry with an iron place. Like the shipbuilding lessons used in the tubular structure design, the piers applied the same principles as the icebreaker found on vessels. From the riverbed up, each piece of stone fit together like a giant puzzle (See Figure 2.4). The first row levelled out any unevenness in the ground plane and was attached to the riverbed with long pins. The subsequent rows were made of roughly dressed masonry that diminished in size as they rose above summer and winter water levels. Some of these pieces weighed as much as fifteen tons.[169] The interior rows were locked together and pinned for extra support. More importantly, each pier front was arranged with a forty-five-degree batter to take the brunt of approaching ice shoves and finished to receive a protective metal armour. Each pier was thus unique, depending on the river bottom and the height required to form the superstructure's base. The drawing shows high and

[169] Hodges, *Construction of the Great Victoria Bridge,* 38.

low water levels but is missing an opportunity to establish the relationship between the bridge and the ice.

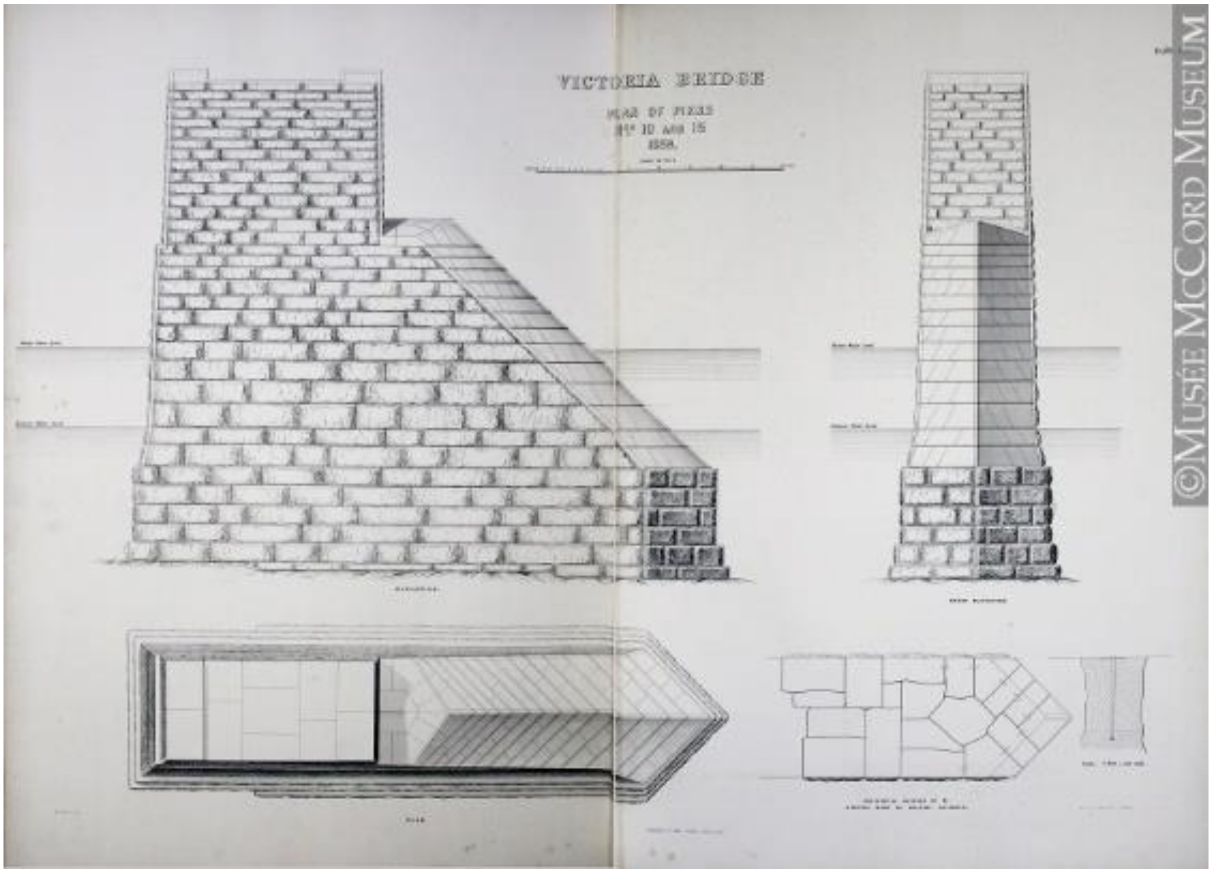

Figure 2.4*: Plan of Piers Nos. 10 and 15,* 1859, W. O. Gooding, in Hodges, *Construction of the Great Victoria Bridge,* 1860. [MM: M15934.84].

Ross remained in Montreal throughout the construction. However, Peto, Brassey, Jackson[170] and Betts chose another trusted employee, James Hodges, to oversee the day-to-day operations on the construction of the Victoria Bridge project. Upon arrival, Hodges consulted with Logan and the Commission of Public Works, Samuel Keefer (brother of Thomas), before settling in for what would be a six-year undertaking. During his tenure, Hodges would become familiar with the local stone and seasonal conditions of the river.

[170] William Jackson partnered with Peto, Brassey, and Betts for parts of the GTR. "Grace's Guide to British Industrial History: Peto, Brassey and Betts," accessed April 28, 2019, https://www.gracesguide.co.uk/Peto,_Brassey_and_Betts.

The Construction

Construction engineer James Hodges had a successful career working on British railways and was settling into his retirement when, circa 1853, his former employers convinced him to return to duty, although this time in Canada.[171] In his early twenties, as resident engineer of the South Eastern Railway, Hodges was responsible for heavy blasting at construction sites: "he deposited every ounce of gunpowder with his own hands."[172] From an early age, Hodges proved his capability.

In addition to the daily construction activities, Hodges was charged with finding suitable stone for the project. He assessed stone at a quarry in Pointe-Claire, twenty-six kilometres (sixteen miles) northwest of the bridge's north abutment, and two sites south of the south abutment, one in the Indigenous territory of Kahnawake and another almost one-hundred kilometres (sixty miles) south on Isle La Motte in Vermont.[173] The selected quarries employed two hundred labourers, and Hodges ensured the workers blasted, lifted, and loaded the stone without delay.[174] Similar to his British experience, Hodges had his hand in every aspect of construction. The main difference between this project and those in Britain was the climate.

When it came time to build the bridge, crews used the frozen river to measure and lay out the piers. In the winter of 1853, the exact location and the final position was measured over a

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[171] W. H. Maw and J. Dredge, eds., "The Late Mr. James Hodges," *Engineering: An Illustrated Weekly Journal* 28 (July-December 1879): 78.

[172] Henry James Morgan, *Sketches of Celebrated Canadians: And Persons Connected with Canada, from the Earliest Period in the History of the Province Down to the Present Time* (Quebec City: Hunter, Rose, 1862), 707.

[173] For more on the evolution of these sites, see Brian Richard Matthews, *A Century of Golf: Club de Golf Beaconsfield Inc* (Quebec City: Brianor, 2003); and Zadock Thompson, *Appendix to the History of Vermont, Natural, Civil and Statistical 1853*. Burlington, VT: Z. Thompson, 1853.

[174] The American quarry workers were paid more than their Canadian counterparts. For more on the quarries, see: J. Willis, "Rural Industrialization and the Great Lower Canadian Tourtiere: The Montreal Region and the Seigneury of Argenteuil, circa 1800 to 1851" (PhD diss., Université Laval, 1999); Edward Hitchcock et al., *Report on the Geology of Vermont: Descriptive, Theoretical, Economical, and Scenographical* (Proctorsville, VT: Claremont, 1861); and Albert David Hager and Elkanah Billings, *Report on the Economical Geology, Physical Geography and Scenery of Vermont* (Proctorsville, VT: Claremont, 1862), 49.

two- to three-metre- (eight- to ten-foot-) thick covering of ice.[175] Workers shovelled a straight ice road from shore to shore, laid out the pier positions, and boreholes through the ice at each pier location. The men dropped iron rods into the water through the ice, securing them by drilling into the riverbed and marking them with buoys, indicating the centre of each pier, for work to begin.[176]

From the last ice shove in April, May, or June to the first sign of frost in October, the working season was short. Crews needed to tow and sink cribs and cofferdams, pump them dry, and seal the foundations. Preparing the river for each pier took several weeks (upward of two months), depending on the current, river bottom conditions, and unwanted boulders. In locations where the river bottom comprised a fine shale, crews could sink the cofferdams, put up the ribbing and start pumping immediately. Challenges arose when boulders covered the bottom, and divers had to locate and secure the boulders before moving them out of the way. Furthermore, in cases with sand, silt, or clay covering the shale, crews used machinery to scrape the bottom to establish a tight seal.

On one occasion, while scraping the bottom, crews knocked open a geyser, and a thick black liquid escaped from below the riverbed. Hodges explained that "a blow of the pick, within a few feet of the centre of the dam, tapped a spring of thick black water, which at first produced a fountain about as large as a man's finger. […] It increased in volume so rapidly that in a few minutes, they [the workers] had to run for their lives, and in a quarter of an hour, the dam was full."[177] Ultimately, the sinking of the dams was not a precise science. The goal was to create

175 Hodges, *Construction of the Great Victoria Bridge*, 16.
176 Ibid., 17–18.
177 Ibid., 49.

direct contact with the solid ground and to form an impermeable seal so that crews could pump the dams dry and begin work on the piers.

Preparing the riverbed was one of the steps in laying the piers. At the height of the season, the workers placed massive quantities of stone every day: in the summer of 1856, more than one thousand tons per day. From the Pointe-Claire quarry, the stone was blasted from an open cliff face and placed on railcars. It moved on a temporary track by locomotive to a newly built wharf on Lake St. Louis. From the wharf, workers loaded the stone on one of twenty-five newly built barges towed by one of two new steam tugs through the Lachine Canal locks.[178] At the end of the journey, the stone was either floated upstream against an eleven-kilometre-per-hour (seven-mile-per-hour) current or unloaded at the canal basin, for future use.

The stone was loaded onto barges from Isle La Motte and carried across Lake Champlain to Saint-Jean-sur-Richelieu, where workers reloaded it onto rail cars. Stone was unloaded at the end of this trip and left to weep—allowing the quarry water to seep out—before being used.[179] Since there was no space at the base of a pier, the organization of stone took place in those fields,[180] and each piece of stone passed through workers' hands at six different locations—quarry, train, wharf, canal, field, boat, and caisson—before it was placed. Preparing and orchestrating the stone took efforts equal to those necessary to sink the cofferdams.

Hodges noted how important it was to have the pieces arrive intact—that no stone fell overboard—and in the correct order. He wrote, "The cost, loss of time, and vexation caused by such an accident, can only be understood by those who know and have experienced the shortness

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[178] The barges were made of white oak and tamarack, and they were designed to carry one hundred tons of stone at a time. Ibid., 12.

[179] Willis, "Rural Industrialization," 309.

[180] "Book Review: The Construction of the Great Victoria Bridge," 343.

of a Canadian working season."[181] Each subsequent stone had to arrive at the pier in the order it was placed; otherwise, it was problematic for Hodges. He draws attention to the importance of getting each pier done before winter.

When the ice finished packing on January 24, 1859, crews moved quickly.[182] The ice gave a solid footing directly below the centre tube, space inaccessible when the water was flowing. Hodges and his crews knew they had two to four months to complete the centre tube. Gangs shovelled roads on the ice to carry materials to Pier 12, the newest temporary construction site. Carpenters built the staging, and before long, timber framework occupied the space between Piers 12 and 13—complete with ramp and lifting cranes—to support the tube.

Iron bridge components arrived from the shops in Birkenhead.[183] The shops owned by Peto, Brassey, Betts, and Jackson, known as Canada Works, formed the metal and loaded it onto ships waiting at the nearby slip called Brassey and Logan's Cut.[184] The shipments likely arrived at Montreal's harbour, ahead of the winter season and the ice's embargo. The GTR owned storage sheds near the canal, and it is reasonable to believe that the sheds held the iron until the ice bridge opened, at which point sleds moved the materials to where they were needed.

The winter workshop, like all sites under Hodges's supervision, was well orchestrated. Stacks of iron plates and tubing arrived pre-punched and numbered from England. Of the 10,309 pieces and nearly 500,000 holes, Hodges noted that none were miscut or mislabelled.[185] The iron

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[181] Hodges, *Construction of the Great Victoria Bridge*, 39.

[182] Chapter 12 of Hodges's book covers the entire last year of works. Ibid., 57–73.

[183] The shops employed 3,281 men to manufacture the iron. Hager and Billings, *Report on the Economical Geology*, 49.

[184] The pier name suggests ties to Thomas Brassey, who convinced Hodges to work on the bridge, and provincial geologist William Logan. These place names are removed from contemporary maps of Birkenhead's West Float. John F. Ward, "Canada Works," *The Industrial Railway Record* 54 (June 1974): 264–70, http://www.irsociety.co.uk/Archives/54/Letters%2054.htm.

[185] Hodges thanked George Harris, manager at Birkenhead Works & Co., and Harris's two assistants, Alex and Heaps, for their attention to detail. Hodges, *Construction of the Great Victoria Bridge*, 62.

arrived by sled from the storage sheds along the canal and was lifted by crane into trucks and hoisted up by chain—pulled by a steam engine—over the rollers to the top of the staging. Hodges tracked the amount of iron used and noted how satisfying it was to monitor a diminishing mountain of metal: “It was not uninteresting to watch the gradual diminution of the pile of iron [...] and eventually to see the last piece taken to fill up some out-of-the-way hole or corner, and then to hear for certain that the tube was complete.”[186] Materials for the superstructure, like the stone for the piers, were in motion, and the winter workshop took on a different form daily.

After years of monitoring the ice, Hodges knew the ice bridge could crack at any time. Gangs worked diligently, day and night, to assemble the iron components. Work stopped only when the thermometer dropped below −30°C (−20°F), that is, when the wind made it feel that cold or when vapour lifting off the open water covered the men in icicles.[187] The workers proceeded until late March when Hodges heard the now familiar sounds of the ice breaking. He waited until the spring shoves subsided and ensured the centre tube’s stability before calling the winter’s work a success.

Winter work was challenging as workers risked exposure to the elements. With cold, short days and colder, longer nights, the workers needed protection. The men covered nearly every inch of their bodies against the cold. They wore thick gloves, heavy coats, fur caps to cover their ears, and thick scarves over their faces to avoid frostbite. One worker wore a layering of tights and trousers and colourful wool and flannel shirts under his topcoat.[188]

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[186] Ibid., 55.
[187] Ibid., 58.
[188] Triggs et al., *Le Pont Victoria*, 49.

With scaffolding and steam lifts in place, workers started with the bottom plate of the tube. For ten days straight, gangs of rimmers, upward of forty men, roughly placed the iron. They ensured the pre-punched holes aligned and were ready for permanent assembly. The riveting gangs followed close behind. Boys, aged eight to twelve years, heated the rivets over portable forges.[189] They then tossed the red-hot rivets up to the "holder-up" on the platform above, who caught the hot metal in a cone-shaped pot. The boys were adept at using tongs to throw the rivets in glowing arcs high into the air—to the left or right, as needed. A second holder placed each hot rivet into a hole, pre-drilled at the shops in Birkenhead, and held a heavyweight against it. At the same time, the two riveters on the other side of the plate hammered the rivet's narrow end until it too formed a head, holding the heavy iron plates together.

The descriptions of the ice provided by Hodges render the ice into a sublime nature. It is both beautiful and dangerous; it is both helpful and destructive. Hodges portrays the ice, and the construction project in general, with emotion. In his study of eighteenth-century engineering students at the *École des Ponts et Chausées,* Picon found that the students rendered their drawings with feeling. The student works intuitively "assumed a heroic and sublime character," but, Picon writes, "Burke's work probably did not exert any direct influence upon French engineers of the Age of Enlightenment."[190] The French engineers were using artistic effects that evoked a sense of pleasure and pain, or danger,[191] and Picon finds that they incorporated their struggles against nature, like the violent currents and a (sometimes deadly) struggle with a

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[189] Stanley Triggs, "The Bridge," in *Le Pont Victoria: Un Lien Vital / Victoria Bridge: The Vital Link* (Montreal: McCord Museum of Canadian History, 1992), 49.

[190] Picon, *French Architects and Engineers in the Age of Enlightenment*, 231.

[191] For more on the beautiful and sublime, see Edmund Burke, *A Philosophical Enquiry into the Origin of Our Ideas of the Sublime and Beautiful* (London: Rand J. Dodsley, 1757), Eighteenth Century Collections Online (McGill); Immanuel Kant, *Observations on the Feeling of the Beautiful and Sublime*, translated by John T. Goldthwait, 2nd ed. (Berkeley: University of California Press, 2003).

treacherous sea, into their drawings.[192] The engineers applied the aesthetic of the sublime and engaged the imagination. "A bridge," Picon continues, "strikes the imagination through its defiance of gravity and of the impetuousness of the water, rather than by its actual dimensions."[193] The sublime rendering entails context, the territory in which the bridge is inserted.

In contrast to Hodges's descriptions, images included in his account depict the ice as non-threatening. Its imposing size represents the grandeur of the ice, however, when rendered static, the ice appears harmless (See Figure 2.5). Picon also finds that by the end of the eighteenth century, student assignments and competitions referencing bridges lost their "anguished character." Instead, students adopted more pleasant pairings found in the increasingly popular style of the picturesque. Picon critiques, "In contrast to the sublime, the picturesque did not constitute a definite aesthetic category, but rather a register of effects and of sensations which were applied primarily to gardens, landscapes and voyages, and then to architecture."[194] For Picon, the picturesque aesthetic produced less dramatic drawings[195] , and indeed the onlookers in Figure 2.5 are not afraid of the ice piled up next to the wharf at Montreal.

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[192] Picon, *French Architects and Engineers in the Age of Enlightenment*, 131–32.
[193] Ibid., 235.
[194] Ibid., 235–36.
[195] Ibid., 136–39.

Figure 2.5: *Shoving of ice upon wharves in front of Montreal,* Anonymous, *Construction of the Great Victoria Bridge,* 1860. [MM: M15934.18].

After more than five years of work, the Victoria Bridge was completed on December 17, 1859. The bridge, 2,751 metres (9,025 feet) long, with a wrought iron structure 2,009 metres (6,592 feet) long set out over twenty-four solid masonry piers was "the largest bridge ever attempted anywhere in the world at that time."[196] Workers built a memorial, a gigantic boulder set on a cut-stone platform, to commemorate the bodies of immigrants who died from ship fever that was discovered during construction. Heir to the British throne, His Royal Highness Edward Prince of Wales officially opened the bridge the following August, and the bridge was celebrated around the world for overcoming numerous construction challenges.

[196] MacKenzie, "Case Study," 32.

The bridge was, however, limited. It had a single track, and its tube-size matched locomotives and cars' size and capacity. The smoke-filled tube made for an unpleasant passenger experience, and the tracks left no room for vehicles or pedestrians to use. Additionally, the sulphuric fumes and dripping brine from refrigerator cars corroded and structurally weakened the ironwork over time. While the superstructure was rebuilt before the turn of the century (1897-1899), the piers and the images of the first Victoria Bridge remain intact.[197]

The Saint-Laurent Bridge (Erected 1886-1887)

Nearly three decades later, the Canadian Pacific Railway (CPR) erected the second crossing over the St. Lawrence River at Montreal. The CPR project fulfilled an 1871 promise to the colony of British Columbia for a transportation link to the rest of the newly formed Dominion of Canada.[198] Construction preparations began in December 1885 for the Lachine Bridge (1885-1887)[199] and the project opened to circulation a short nineteen months later in July 1887. The project marked one of the final physical links between Upper and Lower, Pacific, and Atlantic Canada. The construction attracted little attention even though it employed new materials and building techniques. The designers learned from the Victoria Bridge and incorporated its form and materials in the piers; it was the first to use concrete as a levelling device for the piers in the St. Lawrence River.[200] The superstructure employed cantilever principles—even though a central pier supported the span—that seamlessly transitioned the trough into a deck-bridge. The detail

[197] "Rebuilding of the Victoria Bridge 1897-1899," 63.

[198] In June 1871, the colony of British Columbia became the sixth province to join Canada.

[199] At the time of its erection, the bridge was commonly known as the "Saint-Lawrence Bridge at Montreal" or the "Lachine Bridge." After opening to rail traffic in July 1887, it underwent two major modifications: the first to double the track and accommodate increases (1911–13) and the second to span the Saint Lawrence Seaway (1954). Today it is owned and operated exclusively by the Canadian Pacific Corporation—formerly known as the CPR.

[200] S. D. Werry, "Rails across the River: The Story of the St. Lawrence Bridge (1881-1915)," *Canadian Journal of Civil Engineering* 24, no. 3 (June 1997): 480–88, https://doi.org/10.1139/l96-131.

added an aesthetically pleasing s-curve while giving clearance over the deep navigation channel below.[201] Upon completion, it was the world's longest four-span truss bridge.[202]

Figure 2.6: *Map of the Canadian Pacific Railway, and its connections,* Copp, Clark & Co., 1887, [Toronto Public Library: Baldwin Collection, 912.71 C58.11 https://www.torontopubliclibrary.ca/detail.jsp?Entt=RDMDC-912-71-C58-11-SMALL&R=DC-912-71-C58-11-SMALL]

In his opposition to common perceptions about the transcontinental railway, author A. A. den Otter postulates four myths have dominated public understandings of the railway: 1) a struggle for centralized political power, backed by greedy railway investors; 2) a struggle for control over economic resources and a contest to succeed before the Americans; 3) a romantic struggle to overcome the wilderness, yet realistic in terms of the span of proposed works in an unruly climate; 4) a struggle to build a national identity as a sovereign state, breaking colonial ties and remaining autonomous of America. American technology used in railway building, den Otter concludes, brought Canada closer to America, even though one objective was to distance itself.[203]

The *Map of the Canadian Pacific Railway* adheres to the myths observed by den Otter (See Figure 2.6). The railway appears to be the continental dividing line when the border is due south of the railway line. The international border roughly follows the St. Lawrence River watershed

[201] Ibid, 480.
[202] Ibid., 482.
[203] den Otter, *The Philosophy of Railways,* 3-12.

from the Atlantic Ocean to the Great Lakes, and the 49th parallel west of the Great Lakes, through the Rocky Mountains to the Pacific Ocean. In addition to absent international borders, the map shows no provincial, territorial, or colonial boundaries. The territory appears to be one country when the territories between British Columbia and present-day Ontario did not join the Dominion until the late-nineteenth- and the early-twentieth-century. The lack of distinction assumes the zone, and the resources contained within, are part of the Dominion. Finally, the Rocky Mountains are represented as a physical obstacle; the topographical detail presents a physical barrier or "a romantic struggle" to overcome wilderness.[204] Harley asserts that maps are, "used as an aggressive complement to the rhetoric of speeches, newspapers, and written texts, or to the histories and popular songs extolling the virtues of empire."[205] Indeed, the CPR map exemplifies the myths set forth by den Otter.

In contrast to the well-known histories of the need and influence of the CPR, little is written about the impact of the railway at the local scale. The Saint-Laurent Bridge is one example of how a detailed account of landscape change of a local area can bring insight to a much larger project. There is little written about the bridge or the company that built it. One notable exception is a paper by a retired army officer, S. D. Werry, who engages with archival material—plans, sections, and photographs—from the CPR archive to tell the construction story. Werry credits "Reid & Flemming" with the construction of the masonry works, however Sir Robert G. Reid and Sir Sanford Fleming are the contractors. With the correct spelling, the study of the Saint-Laurent Bridge construction took a turn. This section uses material from Fleming's *fond* at LAC to build on what Werry established in his paper. Specifically, the story of

[204] Ibid., 7.
[205] Harley, "Maps, Knowledge, and Power," 282.

construction is enhanced by examining Fleming's sketchbooks, weekly agenda, and travel records.

The masonry contractors for the second bridge over the St. Lawrence River, Reid and Fleming, agreed to the job with a short deadline of eighteen months. The duo risked a penalty of $40,000 for delays.[206] One year into the contract, Sir John Maxwell and Sir Malcolm Stewart visited the contractors and wanted to bet five-to-one that the bridge would not be finished in time. Reid countered with a bet of $50,000 that it would, and Bob Fleming noted, "They refused!"[207] Sir Robert Gillespie Reid, it seems, was teaching the son of Sir Sandford Fleming how to manage a construction site and the naysayers at the same time. The contractors finished eighteen days ahead of their deadline,[208] and the new bridge at Montreal opened a new era in railway communications.

In the two decades following Confederation, a new bridge over the St. Lawrence River promised a new railway transportation era between Canada and the United States. The Grand Trunk Railway owned the only other crossing, the Victoria Bridge, and the company was taking advantage of its monopoly. The GTR charged other railway companies a toll of five dollars a car each way for passenger cars.[209] The bridge proposed by the Canadian Pacific Railway promised an alternative.

[206] "The Big Bridge at Lachine," *New York Times*, November 12, 1885.

[207] Bob Fleming, "Collins' Commercial Diary," June 8, 1886, MG B 1 82, Sandford Fleming Fonds, LAC.

[208] "Lachine Bridge, Canadian Pacific Railway," *Engineering News and American Contract Journal* 18 (October 15, 1887): 270.

[209] "A New Bridge over the St. Lawrence," *Engineering News and American Contract Journal*, August 12, 1882, 233.

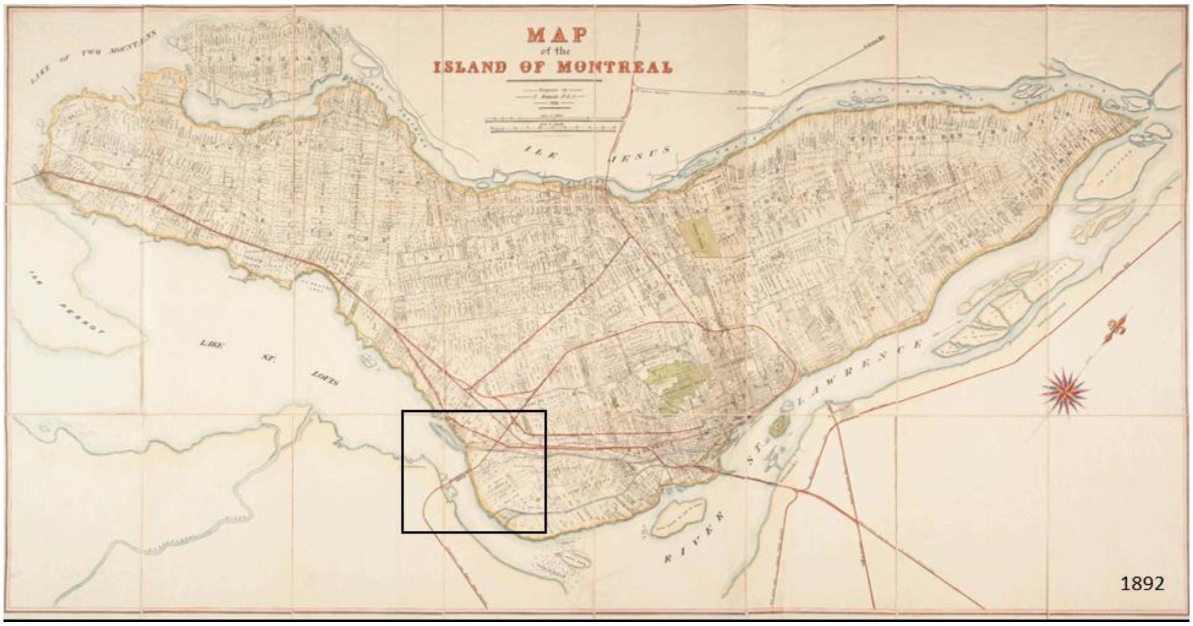

Figure 2.7: Site location plan of the Saint-Laurent Bridge [J. Rielle, *Map of the Island of Montreal,*1892 (MRBSC: G3452 M65 1892 R54)].

Despite its prominent masonry contractors and important place in the history of railway transportation in Canada, this bridge's story is commonly overlooked. Ask a current resident of Montreal to locate the bridge on a map, and they may hesitate; the name of the bridge is unremarkable. Late nineteenth-century engineering journals referred to it as the Lachine Bridge[210] or the St. Lawrence River Bridge,[211] and occasionally as the Saint-Laurent Railway Bridge. The latter two refer to the name of the river, in English and French, respectively, while the earlier name calls attention to the former village of Lachine. The name Saint-Laurent Bridge is adopted in this study to avoid confusion. The village of Lachine municipal boundaries shifted over time, and, in the present, the bridge crosses through the borough of LaSalle to Kahnawake Mohawk Territory, a First Nation's reserve of the Mohawks of Kahnawá:ke on the south shore. The bridge is part of the Canadian Pacific Railway, and the Réseau de transport métropolitain

[210] "The Big Bridge at Lachine"; "Lachine Bridge, Canadian Pacific Railway."

[211] "A New Bridge over the St. Lawrence"; "A Canadian Bridge," *Engineering News and American Contract Journal* 9 (July 22, 1884): 256; P. Alex Peterson, "St. Lawrence River Bridge: General Specification for the Construction of the St. Lawrence Bridge and Approaches," *Engineering News and American Contract Journal* 14 (September 16, 1885): 225–28; Schaub, "The Superstructure for the St. Lawrence Bridge."

(RTM) leases the tracks for its commuter trains. The bridge is limited to rail traffic and is located near the busy automobile bridge, Honoré Mercier Bridge (erected 1932-34).

The 1892 map of Montreal is insightful (See Figure 2.7). It is one of a few maps that shows the municipal and property boundaries and establishes the extent of the project and location of the overpasses and cut and fill operations. The map shows places missing from contemporary maps, like the Rockfield Station, a stop on the GTR built in about 1880[212] and the original location of the Blue Bonnets Racetrack, established in 1872. The map is set at 45º, locally known as the "Montreal North" and, like the maps in the first section, the hinterland is missing. Notably, the map shows property (and, by extension, property rights) on the island but not on the north or south shore. The CPR impacted both shores, but the bridge had a significant impact on Kahnawake, cutting through the territory.[213] The map represents a social order perceived by the Canadian government.

The Design

The same month—November 1885—that railway builder Sir William Cornelius Van Horne ceremoniously drove the "last spike" into the first Canadian transcontinental railway in Creighleigh, BC, the Canadian government awarded a contract to build a bridge at Montreal. Preparation had begun nearly one decade earlier when, in 1879, Canadian Pacific Railway President and General Manager George Stephen founded the Atlantic and North West Railway (A & NWR). Stephen had the express interest in building a bridge over the St. Lawrence River at Montreal. Two years later, the CPR president appointed P. Alex Peterson as the Chief

[212] Robert R. Brown, "Montreal and Lachine Rail Road 1847-1947," *The Railway and Locomotive Historical Society Bulletin*, no. 71 (1947): 34.

[213] Daniel Rueck, "Commons, Enclosure, and Resistance in Kahnawá:Ke Mohawk Territory, 1850–1900," *The Canadian Historical Review* 95, no. 3 (2014): 352–81, https://doi.org/10.3138/chr.2556.

Engineer.[214] Stephen tasked Peterson with the project's design and tender, including the bridge over the river, a significant amount of earthworks, and several secondary crossings. The project included substantial cut and fill operations north of the bridge, an overpass at the Grand Trunk Railway and the Lachine Canal, along with elevated abutments on either side of the bridge (Figure 2.8). Overall, the project measured a linear space of nearly seven kilometres (4.25 miles).

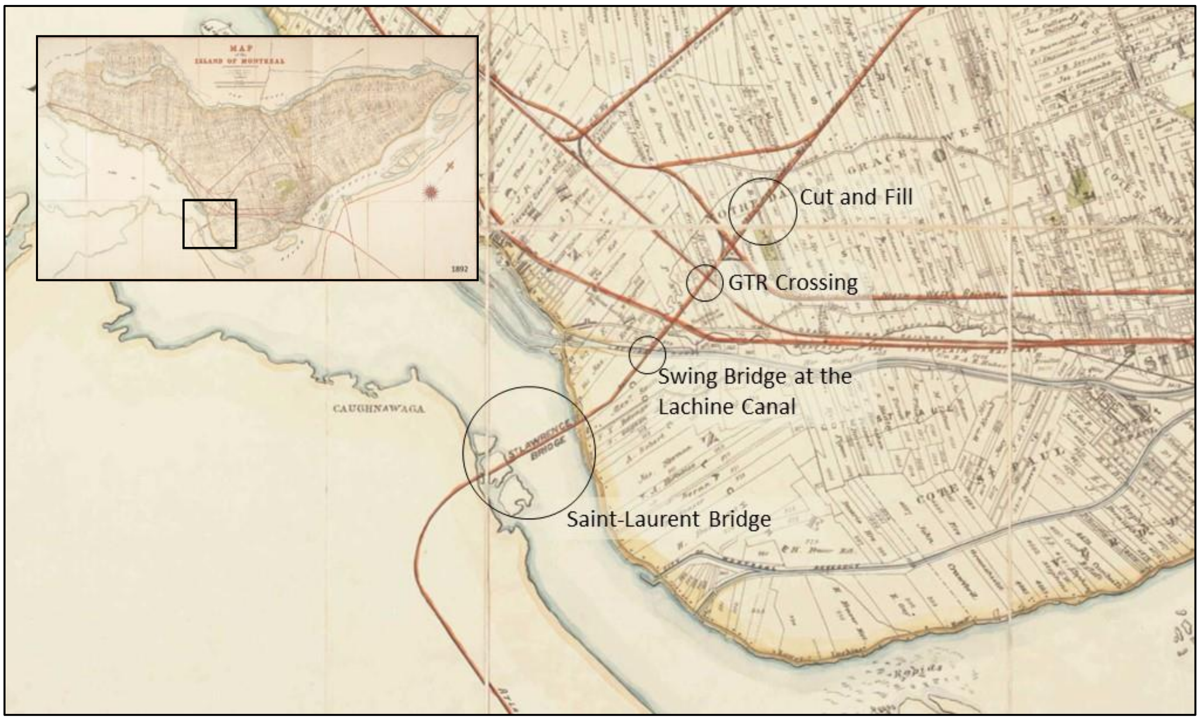

Figure 2.8: *Diagram showing works associated with the construction of the Saint-Lawrence Bridge overlaid on an 1892 map of the city* [J. Rielle, *Map of the Island of Montreal* 1892 (MRBSC: G3452 M65 1892 R54)].

In the fall of 1881, Peterson conducted three surveys before making a recommendation on the bridge's location. The engineer considered the length of the crossing and the water's depth and speed at both high and low water levels. Peterson also felt the best fit alignment with existing railway lines and concluded that a crossing located above the Lachine Rapids between the village of Lachine to Kahnawake (then Caughnawaga) was the shortest (and least costly) location.

[214] Werry, "Rails across the River," 480.

In his preliminary design proposal, Peterson considered water flow, the free navigation of timber rafts, and ice jams. Between 1882 and 1884, Peterson and Charles Shaler Smith, a renowned American railway bridge builder[215] and consultant to the CPR, critiqued each other's proposals. The final design incorporated elements proposed by both engineers, a compact continuous truss with a raised central portion to keep the channel free from obstruction.

The contract for this simple iron-girded, 3,300 ft. long truss bridge was awarded to the Dominion Bridge Company (DBC) for $1,250,000.[216] Reid and Fleming won the contract for the substructure. Peterson was appointed the chief engineer of the project, Smith continued his consulting role, and G. H. Massy was charged with the design and construction management of the substructure.

Key features of the construction were the embankments, as high as ten metres (thirty feet) and as long as 1.6 kilometres (one mile), which were graded into farmland north of the bridge to level out the approach. Peterson laid out the specifications in the call for tenders that read, "the whole of the grading must be carefully formed to the levels given, and the roadway both in cutting and embankment must be carefully rounded and left six inches higher at the center than at the sides."[217] The earthworks followed a general slope of "1 ½ horizontal to 1 perpendicular," as needed to allow for settlement, and they included catchwater ditches at the top for drainage.[218] Locomotives pulling heavy cargo were restricted to inclines of 1.5:3, the slopes and their

[215] Francis E. Griggs, "C. Shaler Smith," *Journal of Bridge Engineering* 15, no. 2 (March 1, 2010): 196–209, https://doi.org/10.1061/(ASCE)BE.1943-5592.0000033.

[216] "The Big Bridge at Lachine."

[217] Peterson, "St. Lawrence River Bridge," 225.

[218] The call for tender indicated that the chief engineer would be the sole judge of materials and workmanship and that "all questions of dispute, with regard to the work or material, or as to the meaning or interpretation for the plans or specifications is to be considered final and binding on all parties." Ibid., 228.

drainage needed to be precise. The design included a backfilled trestle to meet the height of the bridge on the south shore. The cut-and-fill operations were thus highly sculpted landforms.

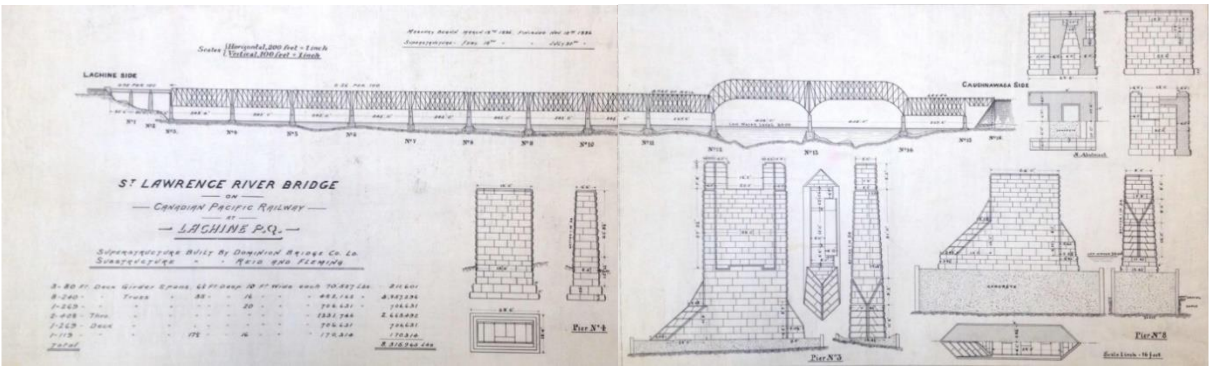

Figure 2.9: *St. Lawrence River Bridge Elevation*, [LAC: Dominion Bridge Co. *fonds*, 86703115, Contract No. 109 #71].

An elevation of the Saint-Laurent Bridge presents several detailed views of the underwater topography and several views of the deep-water piers. The elevations are likely based upon soundings taken by surveyors. The drawing, however, provides little detail about how the bridge is connected to the railway line and specifically how the abutments and earthworks leading up to the bridge intersect with the existing topography and built environment. The bridge, like the maps of the greater CPR infrastructure network, is represented without context. The photographs are an alternative for reading the hinterland and the expansive landscape.

Before reaching the river, the new line needed to cross three existing railway lines and the Lachine Canal.[219] The CPR engineers designed a solid masonry wall and a twenty-four-metre (eighty-foot) through-girder bridge over the GTR to give both companies a precise right of way. The approach to the other two railway crossings is unexplained in the newspaper reports. Over the canal, engineers designed a swing bridge with a triangular pattern known in Smith's office as the "Menomonee" type.[220] In addition to meeting height and weight conditions, the designers needed to consider existing land use patterns and the delivery of materials to these remote sites.

[219] Schaub, "The Superstructure for the St. Lawrence Bridge," 236.
[220] Ibid.

Massive stones arrived from at least four different quarries, located on and off the island. Carters delivered it at a rate of nine to twenty carloads per day and unloaded it at the GTR overpass base.[221] Due to competition, the stone probably did not travel on the GTR tracks. As early as 1882, the CPR began preparing for stone delivery by grading and building a double-track loop from the Mile End[222] to transport stone from north of the island.[223] Horses and carters carried stone short distances to the railways, and, on at least one occasion (February 2, 1886), a horse moving materials from Pointe-Claire fell through the ice and died. The movement of materials was at the mercy of existing routes and the stability of existing infrastructure.

As early as the 1830s, the size of timber rafts entering the canal was restricted to reduce damage to the canal walls.[224] During the 1840s enlargement, the most extended section of the canal, between Lachine and Côte-St.-Paul, was laid out with an embankment. Excavators used the stones from the canal bottom to build up the rock walls for this canal section, earning the section of the canal the name "Rock Fields."[225] The small stones used to reinforce the wall proved susceptible to freeze-thaw cycles and crumbled—a challenge that would not find resolution until the use of reinforced concrete in the 1930s. High levels of foot and horse traffic—necessary to guide non-motorized boats along this high-maintenance section of the canal—necessitated at least some reinforcement or structural support along the walls to protect the new bridge.

[221] For more on provincial stone and its applicability to building construction and location, see W. A. Parks, *Report on the Building and Ornamental Stones of Canada. Volume 3, Province of Quebec* (Ottawa: Canada Department of Mines, 1913), 31; and Gerald F. Reid, *Kahnawá:Ke: Factionalism, Traditionalism, and Nationalism in a Mohawk Community* (Lincoln: University of Nebraska Press, 2004), 24.

[222] The Mile End is a neighbourhood located approximately one mile north of the historical walled city to the intersection of (present day) St. Laurent Boulevard and Avenue Mont Royal.

[223] "A Canadian Bridge," *Engineering News and American Contract Journal* 9 (July 1882): 256.

[224] Rafts had to be 8.5 × 97.5 metres, divided into two section of 8.5 × 48.75 metres each. Desloges and Gelly, *The Lachine Canal*, 71.

[225] Ibid., 48.

Except for the navigation channel, where depths reach thirty metres (ninety feet), the river at the crossing location was shallow. The water fluctuated by approximately two metres (six feet) between high-winter and low-summer levels.[226] Reid and Fleming needed to work quickly while they contended with moving oversized boulders in the shallows.[227]

Summer water levels, along with spring and winter ice, shortened the working season, which required advanced planning to deliver wood for caissons and cement and stone for piers. It also required carefully sourced equipment: chains to lift the materials, a dredge bucket to level the riverbed and a tug to tow and power the operations, all before the water dropped below a tugboat's ability to operate.

Until the last quarter of the nineteenth century, cement was reliably inconsistent—of low and uneven quality—and generally unsuitable for bridge piers. It could not withstand the effects of frost and was expensive. For example, Fleming was purchasing one thousand pounds at a time and was quoted $2 per barrel in February and $0.12 per pound in May.[228] With so few precedents for its, it is no wonder that engineers were reluctant to use it. Due to a "lack of experience with the material in Canada," writes STS scholar Norman Ball, engineers "resisted its use because of the poor and uneven quality of the cement available to them."[229] Toward the end of the nineteenth century, as material standards improved in general, higher-quality cement became available, including long-living hydraulic cement set in water. The Saint-Laurent Bridge was the first bridge across the St. Lawrence to use any form of cement.[230]

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[226] G. H. Massy, "Foundations of the St. Lawrence Bridge," in *Transactions of the Canadian Society of Civil Engineers*, vol. 1 (Montreal: Canadian Society of Civil Engineers., 1887), 40.

[227] Fleming, "Collins' Commercial Diary," June 4, 1886.

[228] Fleming, "Collins' Commercial Diary," February 10, and May 8, 1886.

[229] Ball, *Mind, Heart, and Vision*, 53.

[230] Early attempts at establishing a cement industry failed, but by 1909, Montreal manufacturers were supplying material for most of the country. In 1907, Vulcan Portland Cement Co Ltd. bought two small Montreal

The Construction Process

In preparation for construction, engineers surveyed the river bottom. Between 1881 and 1885, Peterson measured the depths on at least three occasions. Each time, his crews took three to fifteen soundings by floating a boat over up and down-stream of the required measurements.[231] At a given signal from a man at the lead line, the boat's exact position was fixed using two onshore transits. Crews numbered each sounding to avoid confusion or mistakes; the man on the boat held up a card with the sounding unit figure, so both transit men and the man in the boat checked the number each time. Crews moored a scow boat over the site of the piers to sample the riverbed. They bored into the ground with an ordinary steel rod affixed with a 1.5-inch diameter screw bit. The tests revealed that there was primarily hard rock near the north shore and that near the centre, the bottom was covered with several feet of gravel and hardpan. The bedrock was mainly composed of Utica shale interspersed with veins and floors of trap and blue limestone near the south shore.[232] Based on this, Massy was able to specify exact pier locations and heights.

Peterson's specifications for the masonry work called for exact materials and artistry. The stone had to be "sound and durable," free from visible imperfection and able to withstand the harsh climate.[233] The stone was also to have a "neat" finish and was to be prepared and installed

operations. This company, along with two others in Hull and Point-aux-Trembles, had a total capacity of 2,000 barrels per day. By 1909, the Canada Cement Co. Ltd controlled 100% of Quebec cement manufacturing and 40%–50% of all Canadian production. Marc Vallières et al., Des mines et des hommes: histoire de l'industrie mínerale Québécoise: des orgines au début des années 1980 (Québec: Publications du Québec, 1989), 111. For more on the cement industry in Montreal, see Arthur Charles Tagge, *The Cement Industry in Canada* (Montreal: Canada Cement Co., 1924).

231 Massy, "Foundations of the St. Lawrence Bridge," 37.

232 Massy, 37.

233 Spread over three pages comprising three columns of print, the Lachine Bridge bid proposal was detailed, specifying materials, testing, construction methods, and mandatory inspections. For the full specification, see P. Alex Peterson, "St. Lawrence River Bridge: General Specification for the Construction of the St. Lawrence Bridge and Approaches," *Engineering News and American Contract Journal* 14 (September 1885): 225–28.

by qualified masons. Peterson wrote that "all workmanship must be strictly first-class, and not what is commonly termed 'merchantable' work," and the quality was subject to "the entire satisfaction of the chief engineer."[234] Peterson, as Bob Fleming noted, was in regular communication with the masonry contractors.[235]

The Lachine Bridge masonry contract and earthworks went to famed railway bridge builders Sir Robert Gillespie Reid[236] and Sir Sandford Fleming,[237] apparently without their having to submit a tender because of their high standards for railway construction.[238] Notably, Fleming surveyed potential routes for the CPR with his eldest son, Frank Andrew, and the Reverend George Monro Grant.[239] By the time the Saint-Laurent Bridge at Montreal was under construction, Fleming was busy in his role as director of both the CPR and the Hudson's Bay Company,[240] and left his second son, Sandford Hall ("Bob" or "Bobby") Fleming (hereafter, Bob Fleming), in charge of daily activities on the bridge.[241]

Reid and Bob Fleming set up an office in Lachine. On January 1, 1886, they recorded daily temperatures ranging from mild with rain to freezing and −24° in an agenda, marked *Collins Commercial Diary*.[242] Records also show the order and delivery of timber, cement, and stone; the

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[234] Ibid., 228.

[235] Fleming, "Collins' Commercial Diary," January 27, March 19, 27, April 7, 8, and 10, 1886.

[236] Peter D. Locke, "Czar of Newfoundland: A Profile of Sir Robert Gillespie Reid," *Canadian Rail* 419, no. November-December (1990): 183–93.

[237] Mario Creet, "Fleming, Sir Sandford - Volume XIV (1911-1920)," Dictionary of Canadian Biography, accessed July 24, 2016, http://www.biographi.ca/en/bio/fleming_sandford_14E.html.

[238] Smith and Ross, *Canada's Entrepreneurs*, 337.

[239] See, George Monro Grant and W. L. Grant, *Ocean to Ocean. Sandford Fleming*'s *Expedition through Canada in 1872* (Toronto: Radisson Society of Canada, 1925).

[240] Early in his career, Fleming kept detailed notes of his experiences in diaries, and later on, he kept his travel schedule in a date book. Fleming, "Sir Sandford Fleming's Date Book"; and Jean Murray Cole, *Sir Sandford Fleming: His Early Diaries, 1845–1853* (Toronto: Natural Heritage, 2009).

[241] Reid may have collaborated directly with Bob Fleming. Currently, there is no way to substantiate this aspect due to the inaccessible CPR archive.

[242] The diary entry gives no indication of whether the temperature was measured in Fahrenheit or Celsius. Bob Fleming, "Collins' Commercial Diary," January 1, 1886.

purchase of horses, at $60–92 each; and the search for equipment. As early as January 8, 1886, the men ordered a derrick to the quarry in Terrebonne and a telephone between the two locations and a line from the office to Montreal.[243] Records also confirm and leave traces relating to locally sourced material supplies from Terrebonne and Pointe-Claire quarries and their coordination efforts to have stone arrive at the GTR overpass, the Lachine Canal or the "Swing Bridge," and each pier in a timely fashion.

The masonry contractors managed the project wisely and prepared for the 1886 construction season over the winter of 1885–1886, ordering cut stone for masonry, broken stone for concrete, and building caissons and scows for the spring.[244] Reports indicated that near the end of 1885, blacksmiths and carpenters set up their shops on the "north bank of the river below Lachine village" and that enormous quantities of stone began to arrive from Terrebonne, St. Martin, Pointe-Claire, and other locations. [245]

Stone began arriving at the Swing Bridge in December 1885, before the river and canal froze and the contractors had a small window of time to prepare and execute their work. Traffic on the canal likely slowed when the harbour closed on December 7 and stayed calm until April 24, 1886, when it reopened.[246] Although they had had plans in hand since February 8, 1886,[247] the contractors only began work on the Swing Bridge foundation on April 15, 1886. In part, they were at the mercy of ice movement on the river, which determined when the weirs to drain the water from the canal could open or close. On April 12, Fleming noted how the ice was not

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[243] Ibid.

[244] Massy, "Foundations of the St. Lawrence Bridge," 37.

[245] "The St. Lawrence Bridge," *Engineering News and American Contract Journal* 14 (December 1885): 367.

[246] The harbour closed on December 7, 1885, and reopened on April 24, 1886. Ministry of Public Works, *Annual Report of the Minister of Public Works for the Fiscal Year 1885–1886 on the Works under His Control* (Ottawa: Maclean, Roger, 1886), 148, https://books.google.ca/books?id=LRMUAAAAYAAJ&.

[247] Fleming writes, "Got plan of centre pier for Swing Bridge in Canal." Fleming, "Collins' Commercial Diary," February 8, 1886.

moving, and it caused delays because the water was still standing in the canal. Two days later, the ice moved, and the weirs opened, but by the end of the day, "not all water [was] out of the canal."[248] Then, at 6 p.m. on April 15, with the water still "about three feet deep," they began "taking out the sides of the canal"[249] to stabilize the "rockfield" construction and install the piers.

The seventy-three metre (240 feet) "Menomonee" type Swing Bridge pivoted on a central pier and was supported by two other supporting piers in both open and closed positions, for a total of five piers. The supporting piers are rectangular, and their roughly dressed stone with sawn edges taper from bottom to top. The central pier differed; it was conical, flared at its top and bottom, and built with smaller cut stone rows. It held a "rim-bearing" table turning on thirty-four wheels set in a circular track operated by hand or steam power.[250] The turning mechanism reduced the area exposed to wind pressure and was favoured in longer spans.[251] However, the bridge sat nine metres (thirty feet) over the summer water levels and, being so high, it "opened very seldom."[252]

While Fleming and Reid waited for the ice to move and the water to drain from the canal, they prepared for work on the GTR overpass. At this site, too, Fleming reported delays. On March 29, 1886, Fleming wrote to Van Horne and Peterson that stone "has been delivered for some time."[253] He and his crews were ready to begin work but were waiting for the construction drawings. The chief engineer expedited the process and delivered Fleming a sketch of the abutment position two days later, with no explanation for the delay.[254] Construction on the

[248] Ibid.
[249] Ibid.
[250] Schaub, "Superstructure for the St. Lawrence Bridge," 238.
[251] Ibid.
[252] "New Canadian Bridge," *Engineering News and American Contract Record* 9 (July 1882): 256.
[253] Fleming, "Collins' Commercial Diary," March 29, 1886.
[254] Ibid.

simple twenty-four metre (80 foot) long deck plate girder began on April 6, 1886, one week ahead of the swing bridge.

On May 4, 1886, crews set the first caisson for pier number four. It took immense effort to place each of the deep-water cribs. Two powerful tugs dragged the caisson and lined it up at right angles with the centreline of the bridge, an acute angle to the river's flow. The caissons were prefabricated on land with timber members, 30.5 × 30.5 centimetres (twelve by twelve inches), spiked together, braced, and caulked before being towed upstream and sunk in place with heavy anchors. As records show, the uneven and muddy riverbed made it challenging to form a seal. Dredge buckets removed excess mud, and divers fastened chains around oversized boulders so that tugboats could move them out of the way.[255]

To expedite the process, Reid and Bob Fleming ran many wet construction sites at once. The parallel projects required multiple sets of equipment: boats, dredge buckets, and chains. During the summer, when masonry work began, the Montreal Harbour Commission (MHC) undertook a significant deepening of the harbour between Montreal and Quebec. The project employed seven elevator dredges, two to three spoon dredges, two stone lifters, seven screw tugs, five barges, fifteen hopper-bottom scows, and four flat scows.[256] Thus, the harbour project occupied a large portion of the MHC-owned equipment. Fleming travelled to Buffalo to purchase a tug, *the Nellie Reid*, exclusively for the towing and sinking caissons and delivering equipment and material to each caisson.[257]

To seal the bottom, divers spiked sheet piles of 7.6 centimetres (three-inch) planks all around the bow and fastened a canvas curtain on the inside. A caisson's interior permitted for 1.5

[255] Massy, "Foundations of the St. Lawrence Bridge," 38.
[256] Ministry of Public Works, *Annual Report of the Minister of Public Works*, 345–47.
[257] Fleming, "Collins' Commercial Diary," May 16-23, 1886; Fleming, "Sir Sandford Fleming's Date Book," 1886.

metres (five feet) of movement around the piers but only allowed for about a 15.25-centimetre (six-inch) placement tolerance.[258] Two crews worked day and night to mix and lower concrete in an iron box—2.3 metres (2.5 yards) at a time—to the bottom of the caisson until approximately seventy-three metres (eighty yards) filled the space. They used stone broken to pass a ten-centimetre (2.5 inch) ring, and for every three portions of stone, the workers mixed one part cement and one part sand. Workers waited two to three days for the concrete to set and then began pumping water out of the caissons.[259] Work on the piers advanced relatively quickly and, as mentioned, works finished eighteen days ahead of the November 30, 1886 masonry deadline.

Four American and one Canadian company submitted tenders for the superstructure,[260] and the DBC won with the lowest bid. The company had three advantages over their competition; the company was in Montreal. They had access to high-quality Scottish steel, and the company owners had experience building prefabricated bridges in America. The DBC's Scottish connections[261] gave the company access to materials from the Steel Company of Scotland[262] that, according to J. W. Schaub, "disarmed criticism" and set a "valuable precedent on this Continent" of using high-quality metals in railway bridge building.[263]

The company revolutionized building in Canada thanks to the combined knowledge and experience of founding members Job and Ira Abbott. The brothers trained as railway engineers,

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[258] Massy, "Foundations of the St. Lawrence Bridge," 38.

[259] Ibid., 39.

[260] Bids included the Union Bridge Company of New York, the Phoenixville Bridge Company of Ohio, Bridge Co. of Delaware, the Keystone Bridge Company of Pennsylvania, and the DBC of Lachine. "The Lachine Bridge – Montreal," *Engineering News and American Contract Record* 14 (November 1885): 158.

[261] The Scottish board members were James K. Stewart and Reid Stewart of Glasgow. "Board of Directors minutes 1882–1889," MG28-III100 Vol. 1 File 1-7, LAC.

[262] Larry McNally, "Job Abbott," in *Dictionary of Canadian Biography*, 1891-1900, accessed July 19, 2016, http://www.biographi.ca/en/bio/abbott_job_12E.html.

[263] Schaub, "Superstructure for the St. Lawrence Bridge," 56.

and Job earned credentials as a patent lawyer in Canton, Ohio.[264] Ira Abbott's attention to detail likely earned him the shop manager's role, where he supervised the pre-testing of Lachine Bridge components.[265] Job Abbott brought his knowledge of the patents with him to the DBC. The design employed an innovative truss system that enabled engineers to prefabricate and test the bridge components in the shops.

The bridge opened to traffic in July 1887 and, as mentioned, received little attention from journalists. The DBC *fonds* hold many artifacts that draw attention to the structure, and its collection is invaluable for interpreting aspects of the construction previously unexplored in the literature. Among the company's many achievements is the third, record-breaking bridge to cross the St. Lawrence River at Montreal, the Jacques Cartier Bridge.

The Jacques Cartier Bridge (Erected 1924-1930)

Then called the Montreal Harbour or the South Shore Bridge, the bridge was a response to urban growth. In the first three decades of the twentieth century, the city's population quadrupled as rural populations and immigrants moved to the city, searching for work.[266] Members of the Montreal Harbour Commission lobbied for the bridge as part of a new vision for a regional metropolis. The bridge offered an opportunity to expand industrial and residential development to the south shore district and increase access to park space by providing access to St. Helen's

[264] Lehigh University Library and Technology Services, "Illustrated Pamphlet of Wrought Iron Bridges Built by Wrought Iron Bridge Company, Canton, Ohio," accessed October 15, 2014, http://digital.lib.lehigh.edu/cdm4/bridges_viewer.php?DMTHUMB=&CISOPTR=363&ptr=391.

[265] Job or Ira Abbott, "Untitled Scrapbook" (Scrapbook, Unknown, 1880 1872), Box 62, MG28-III100, Fonds Dominion Bridge, LAC.

[266] In three decades (1900–30), the city's population went from 200,000 to 1,000,000. Paul André Linteau, *Histoire de Montréal depuis la Confédération*, 2nd ed. (Montreal: Boréal, 2000), 188.

Island.[267] The bridge marked a shift in transportation priorities, as the automobile and highways revolutionized the transportation patterns and preferences.

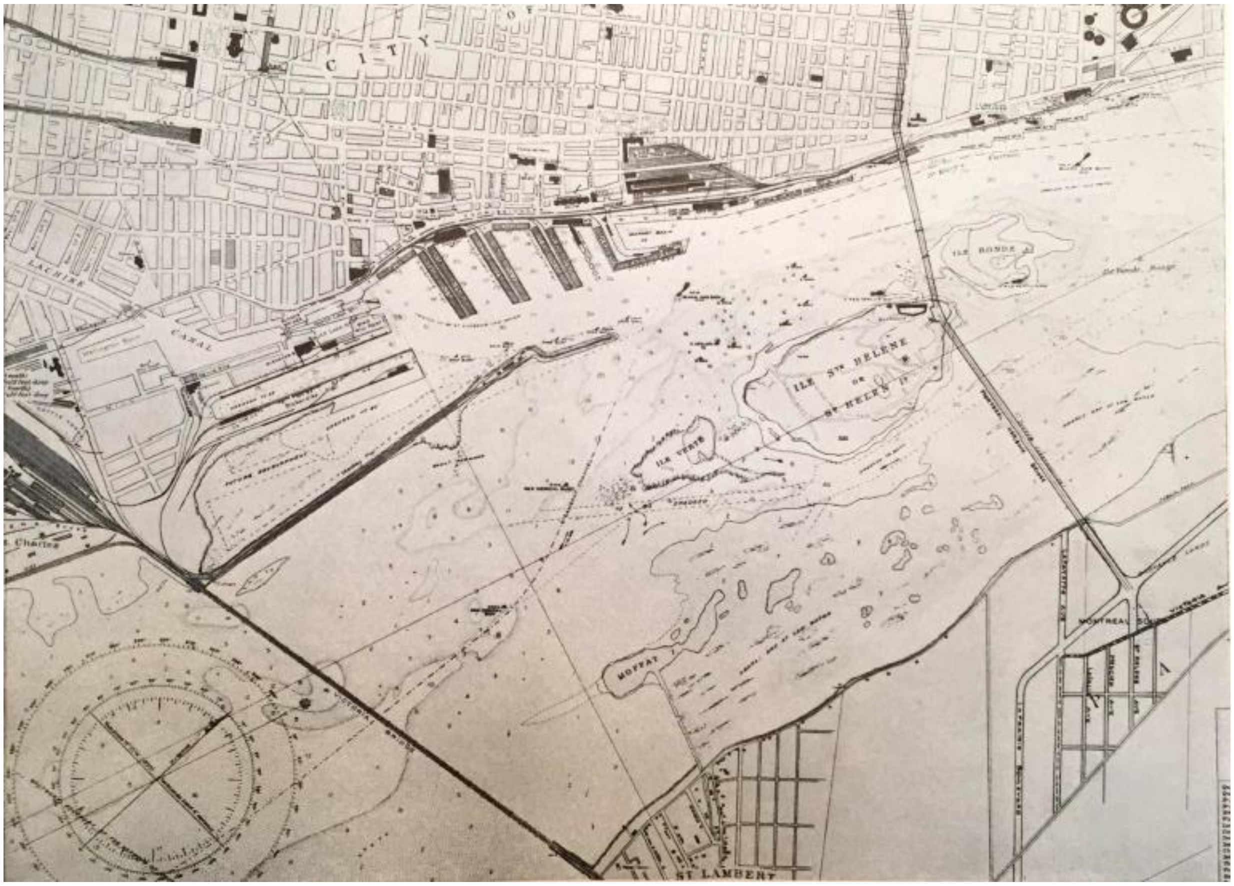

Figure 2.10: *Plan of the Montreal harbour, with the extant Victoria Bridge on the lower left-hand side and the proposed Jacques Cartier Bridge on the upper right-hand side*. [DBC, *Superstructure of Montreal Harbour Bridge*, 5].

The map used to represent the pre-construction bridge to the public provides details about the river, the Montreal Harbour Commission's holding, and the form of the city (See Figure 2.10). The river depths and navigation channel reflect successful attempts in deepening the harbour[268] and the shorelines reflect the infrastructure in place to keep the Montreal Harbour competitive in world markets. The Montreal Harbour Commission holdings are shaded in, providing an overview of their infrastructural assets such as the Victoria Bridge, grain silos,

[267] Dominion Bridge Company, *The Superstructure of Montreal Harbour Bridge over the St. Lawrence River* (Dominion Bridge Company Limited, 1930), 7.

[268] Richard White, "The Engineers' Engineer: Sir John Kennedy and the Port of Montreal," ed. Michael J. Eamon and Stéphane Castonguay, *Scientia Canadensis* 27 (2003): 5–26.

wharfs, buildings, and so on. The Jacques Cartier Bridge is drawn on the map but the north decent is cut off, and on the south shore, the decent dead-ends into a network of unbuilt roads. The plans call for connections to a provincial highway network, however at the time of construction, neither the highway or the connections to the bridge were designed.[269] When construction began on the bridge, the city had yet to expropriate lands for the decent onto the island. Thus, the bridge is drawn as an asset of the MHC, a federal operation, while the provincial highways and municipal roads are uneven in their representation. Additionally, the city streets are represented as negative space among a grid of dense urban development and the south shore the streets are the prominent features, and the buildings are dotted along the shore. The map interprets spatial hierarchies and difference.

The Jacques Cartier Bridge,[270] like the two bridges erected over the river before it, earned the title of "most advanced" bridge of its kind. The joint designing and consulting engineers, Charles Monserrat and Philip Pratley (with J.B. Strauss) pioneered reinforced concrete in Canadian bridge building by using poured-in-place concrete piers faced with limestone at the water level. "Pratley's career," writes historian Phyllis Rose, "captures and illustrates an important development in twentieth-century bridge building: the increasing importance of concrete."[271] The engineers used time- and money-saving devices to reuse local sand otherwise considered too impure for making concrete.[272] It was the world's fifth-longest span of any

[269] Alex Fraser, "A New Six-Lane Boulevard to Connect with the Montreal Harbor Bridge: Reconstruction of the Highway System of the South Shore Opposite Montreal," *Contract Record and Engineering Review* 44, no. 1 (January 1, 1930): 1–5.

[270] In 1934, the bridge changed names from the South Shore or Harbour Bridge to the Jacques Cartier Bridge in celebration of the 400th anniversary of Jacques Cartier's arrival at Montreal. It is owned and managed by the Jacques Cartier and Champlain Bridge Corporation.

[271] Phyllis Rose, "Bridges," in *Building Canada: A History of Public Works*, ed. Norman R Ball (Toronto: University of Toronto Press, 1988), 22.

[272] P. L. Pratley, "How They Concreted 19 Piers," *Concrete* 28, no. 5 (May 1926): 26–28.

cantilever bridge in the world and hailed "the most modern of the large cantilevers" in its use of material, design, and construction.[273] The bridge cantilevers over the busiest port in the country with a lightweight, K-Truss silicon steel[274] structure that spans more than three hundred metres (one thousand feet) over the river and fifty metres (163 feet) above the high-water levels at the navigation channel.

Engineers, industrialists, and politicians envisioned that each of these bridges would improve society. The projects all came to fruition through technological advances and evoked robust urban growth and development symbols. Consequently, engineers and bridge companies hired commercial photographers to document the process and capture these critical urban transformations. These men, or their agents, compiled the photographs, generally in the form of a commemorative book or album.

In his 1930 introduction to the DBC's commemorative booklet *The Superstructure of Montreal Harbour Bridge over the St. Lawrence River*, Wilfrid Laurier McDougald notes that the construction of the bridge marked the end of a seven-year process, whereby "the structure gradually emerged from first nebulous, then definite plans into the tangible thing that it is today."[275] McDougald, senator and president of the Board of Montreal Harbour Commissioners (MHC), wrote his introduction to the bridge ahead of the opening ceremonies and presented the bridge as though it were already a historical monument. He concludes, "my colleagues and myself shall ever hope, that we have produced, not alone "a thing of beauty" which shall be a "joy for ever," but that the existence of this great municipal and national utility will afford [...

[273] Robert W. Passfield, "Philip Louis Pratley (1884-1958): Bridge Design Engineer," Canadian Journal of Civil Engineering 34, no. 5 (May 1, 2007): 640, https://doi.org/10.1139/l06-130.

[274] Canadian mills supplied all materials, when possible. The lighter weight (and more expensive) silicon steel was manufactured by the United States Steel Corporation. Ibid., 28.

[275] DBC, *The Superstructure of Montreal Harbour Bridge over the St. Lawrence River* (Montreal: DBC, 1930), 7.

the] facility of transport and profit […] in the development and expansion of the City of Montreal."[276] The following overview of the Jacques Cartier Bridge builds on technical papers by engineers responsible for overseeing the construction of the piers and the superstructure, newspaper articles, corporate records, and the souvenir album (commemorative booklet) described above with an introduction by the Senator.

The Impetus for the Bridge

The significance of north-south routes between Canada and the United States grew after World War I. While Britain recuperated and rebuilt, Canadian trade shifted to the centre of the continent, whereby Canadian domestic manufacturing and an increase in imports from the United States strengthened trade on the continent.[277] Additionally, throughout the American Prohibition period, automobile tourism increased, and tourists flocked to Montreal.[278] The first Montreal–New York State highway opened in 1912, and by 1929 over four-and-a-half million vehicles crossed the border, generating over $400 million in local revenue.[279] There was, however, a limited number of routes for accessing the island-city.

By the turn of the twentieth century, the Victoria and Lachine Bridges no longer met the city's transportation needs. Starting in 1897, the Victoria Bridge's tubular structure was replaced by a pin-connected through trusses design. The new steel structure replaced the original single-track box girder with two rail tracks and a roadway and footpath cantilevered out on each side. It

[276] Dominion Bridge Company, 12.

[277] Montreal historian Paul-André Linteau argues the "First World War caused a rupture" in traditional trade patterns between Canada and Britain, whereby a shift toward domestic manufacturing and an increase in imports from the United States strengthened trade on the continent, rather than within the British Empire. David B. Hanna, "The Importance of Transportation Infrastructure," in *Montreal Metropolis, 1880-1930*, ed. Isabelle Gournay and France Vanaethem (Montréal: Stoddart / Canadian Centre for Architecture, 1998), 56.

[278] Woods, *Molson Saga*, 252.

[279] For more on the provincial and national highway system, see: Larry McNally, "Roads, Streets, and Highways," in *Building Canada: A History of Public Works*, 43; David W. Monaghan, "Canada's New Main Street, the Trans-Canada Highway as Idea and Reality, 1912–1956" (master's thesis, University of Ottawa, 1997).

was built on the same piers, and when it formally opened in 1901, the bridge was renamed the Victoria Jubilee Bridge. The Canadian Pacific Railway also doubled the capacity of the Saint-Laurent Bridge (1910-13) by adding a second railway track over the existing piers. The two major bridge modifications more than doubled the travel capacity between the Island of Montreal and its south shore, and still, traffic increased. In 1926 Montreal resident and bridge engineer Philip L. Pratley writes, "The congestion on the narrow and unsatisfactory roadway of the Victoria Bridge is already intolerable at peak periods," and with steadily rising vehicular, suburban, and tourism traffic, "impressed" the need for adequate facilities.[280] In 1920, a fire on the Victoria Jubilee Bridge had exasperated congestion and halted traffic for a week.[281] The congestion pushed the HMC to search for an alternative to accommodate the flows of traffic.

Urban growth played a role in the push for a new bridge. In the first three decades of the twentieth century, the number of inhabitants in Montreal quadrupled. The population went from 200,000 to 1,000,000 as rural populations moved to the city, searching for employment, and international immigration intensified.[282] The population boom forced architects, urban planners, and engineers to rethink the city's organization and urban limits.

Mobility had a significant impact on the shape of the city and growth outside the historical city boundaries. Urban historian David Hanna notes, "the combined draw of the new GTR and CPR terminals would have a powerful effect on the Central Business District, which until then centred in Old Montreal but soon shifted northward."[283] Manufacturing and industrial zones also exceeded their spatial capacity and leapfrogged over traditional industrial zone boundaries along

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[280] P. L. Pratley, "Montreal Harbor Bridge Sub-Structure," *The Canadian Engineer* 51 (November 26, 1926): 593.

[281] Fraser, "A New Six-Lane Boulevard," 2; and DBC, *Superstructure of Montreal Harbour Bridge*, 7.

[282] Paul André Linteau, *Histoire de Montréal depuis la Confédération*, 2nd ed. (Montreal: Boréal, 2000), 188.

[283] Hanna, "The Importance of Transportation Infrastructure," 47.

the Lachine Canal and in the Port of Montreal. The south shore became a focus for expansion.[284] Residential and industrial growth to the South Shore seemed a viable solution, and the MHC pushed for a new crossing.

During construction, the new bridge was called the South Shore Bridge and was named the Harbour Bridge on opening in 1930. The two names were used interchangeably in reports, journals, and newspapers by reporters, investors, and even the designers. In the discussion about a paper delivered at the Engineering Institute of Canada annual general meeting, one writer noted, "In using the names South Shore Bridge and Harbour Bridge alternately Mr. Pratley was participating in that popular but not particularly profound pastime, adopted by both public and press, of proposing an appropriate patronymic for this product of our prolific profession." [285] The search for a meaningful name continued until 1934, when the bridge changed names a final time in celebration of the 400th anniversary of Jacques Cartier's arrival at Montreal.[286]

Architectural historian Jean-Claude Marsan reports, "Jacques Cartier, Canada's discoverer, received the order from Francis I, "to discover certain islands and lands where it is said that a great quantity of gold, and other precious things, are to be found."[287] While post-colonial perspectives counter the "discovery" of North America, the renaming of the bridge to reflect the French heritage of the city, the island, and the province. Moreover, the renaming of the bridge addresses tensions between French and English communities in the city, an imbalance of French and English-speaking Harbour Commissioners and engineers working on the project, and the

[284] Anthony Sutcliffe, "Montreal Metropolis," in *Montreal Metropolis, 1880–1930*, ed. Isabelle Gournay and France Vanlaethem (Montreal: Stoddart/CCA, 1998), 18–23.

[285] P. L. Pratley, "Discussion of Paper on the Fabrication and Erection of the Superstructure of the Montreal–South Shore Bridge by L. R. Wilson, M.E.I.C.," *Transactions of the Engineering Institute of Canada*, 13 (December 1930): 323–24, https://archive.org/stream/transactionsofen13engi/transactionsofen13engi_djvu.txt.

[286] Éric Giroux, "Le Pont Jacques-Cartier," *Histoire Québec* 16, no. 2 (n.d.): 15.

[287] Jean-Claude Marsan, *Montreal in Evolution: Historical Analysis of the Development of Montreal's Architecture and Urban Environment* (Montreal: McGill-Queen's University Press, 1990), 3.

destruction of the Saint-Marie neighbourhood, a predominantly French (and poor) district at the foot of the bridge on the island.

The Commissioners concerned themselves with maintaining the national economy. In 1830, the Montreal Harbour Commission was formed, and two years later, the harbour was officially declared a port of entry; the same year, Montreal became a municipality.[288] In the century leading up to the Jacques Cartier Bridge construction, MHC invested in infrastructural assets to improve the circulation of ships, railway cars, and economic goods. Twentieth-century innovations, like deepening the harbour, [289] proved valuable as Montreal attempted to hold its position at the heart of the national economy and dominate transatlantic trade with Europe.[290]

In 1909, an Act of Parliament allowed the MHC to expropriate land and expand operations. By 1924, the MHC regulated thirteen kilometres (eight miles) of waterfront and a narrow, yet highly organized, commercial corridor from the Victoria Bridge to the Bout-de-l'Île (end of the island).[291] As an "avenue of civilization and the main artery of commerce," the river brought transatlantic vessels to Montreal, nearly a third of the way to the centre of the continent. The MHC commissioned several modifications, including deepening the channel between Montreal and Quebec City. By 1926, the "modern deep-draft wharf" extended another 1.5 kilometres (one mile) to accommodate up to one hundred large ocean steamships at any given time.[292] In 1926, Montreal was the second largest port in North America, and the harbour broke all previous

[288] The Montreal Harbour Commission formed under Act 10 and 11 George IV, Chapter 2, and the port of entry under king 1832 (Act 11 and 12 George IV, Chapter 28), the same year Montreal became a municipality. For more on the port's early history, see Gerald J. J. Tulchinsky, *The River Barons: Montreal Businessmen and the Growth of Industry and Transportation, 1837–53* (Toronto: University of Toronto Press, 1977).

[289] White, "The Engineers' Engineer," 5–8.

[290] The 1921 Commissioners' report boasts Montreal is the second largest port, next to New York, and geographically closer to the British port in Liverpool than any other in North America.

[291] Stephen Butler Leacock, *Montreal, Seaport and City* (Toronto: McClelland and Stewart, 1942), 242.

[292] W. L. McDougald, Emilien Daoust, and Milton L. Hersey, *The Growth of a Great Port* (Montreal: Harbour Commissioners of Montreal, 1927), 34.

shipping records that year.[293] It was the first fully electrified port in the world.[294] The commissioners saw the construction of a new bridge as an extension of the MHC's infrastructural investments.

Design Considerations

Between 1922 and 1924, the MHC conducted several background studies to submit a formal bridge proposal to the federal government. Their surveys, soundings, preliminary design plans, and budgets helped advance the project. In July 1924, the federal government granted the MHC the powers to proceed with the construction and management of the bridge.[295] The MHC studied several options before settling on a crossing at Section 28 of the harbour, at the foot of De Lorimier Avenue, to the village of Longueuil on the south shore.[296] The site offered several benefits, including a solid footing halfway across the river, at St. Helen's Island. The natural break provided an opportunity to address the unique condition on either side of the island.

The MHC accepted design proposals from several engineering firms and chose a design proposed by a local firm. The engineering team of Monserrat and Pratley, with J. B. Strauss of Chicago, were appointed as design and supervising engineers for the project. Charles N. Monserrat was a general consultant and oversaw out-of-town inspection at quarries and mills. Philip L. Pratley oversaw the administrative work, managing contractors, technical design, local inspection, and certificates. Strauss consulted on early works.[297]

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[293] The MHC annual report for 1926 boasted that "during the 1926 season of navigation, 1,421 ocean-going vessels, having a net registered tonnage of 4,221,730 tons, sailed from the Harbour of Montreal." Ships arrived and sailed to ports in Europe and North and South America. Ibid., 8.

[294] Ibid., 46.

[295] Parliament approved legislation (Act 14 and 15 George V, Chapter 58), which enabled the MHC to select the site and "proceed with the designing and erecting thereof, subject to approval of the site and of all plans by the Governor-in-Council." DBC, *Superstructure of Montreal Harbour Bridge*, 8–10.

[296] Other options included sites near the Jacques Cartier and Mackay Piers, the Canal Basin, and Black's Bridge. Ibid., 593.

[297] Pratley, "Montreal Harbor Bridge Sub-Structure," 599.

A decade earlier, Charles Monserrat and Philip Pratley consulted in different capacities on the twice-failed Quebec Bridge.[298] The Quebec project took more than thirty years (and eighty-eight lives) to compete after two failed attempts to bridge the St. Lawrence River at Quebec. Therefore, an advisory committee was put in place for the Jacques Cartier Bridge ahead of any design decisions or budget approvals. The role of the committee was to provide unbiased reporting on the integrity of the design and construction.[299] Nobody wanted to repeat the Quebec Bridge disaster.

Between St. Helen's Island and Longueuil, surveyors found that the underwater topography and the riverbed's soil conditions varied significantly. In response, the engineers designed each of the twenty piers to suit its unique location. Like those of the Victoria and Lachine Bridges, the Jacques Cartier Bridge's piers incorporate upstream-facing buttresses to protect it from the "irresistible ice pressures," and ice shoves of up to ten metres (thirty feet) high.[300] The south channel approach consists of a series of deck truss spans over concrete and masonry piers.

The bridge hinges at 10.5° over St. Helen's Island to align with the river's flow on either side. Until the bridge, access to the island and its amenities proved challenging.[301] The designers

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[298] In 1907, the Phoenixville Bridge Company was pushing new limits in an attempt to build the longest cantilever span in the world and in August of that year, the project failed, killing dozens of men. In 1911, the province signed a new contract with St. Lawrence Bridge Company (conglomerate of DBC and Canadian Bridge Company of Walkerville) but an attempt to raise the centre span failed on Sept. 11, 1916, killing more workers. Crews successfully inserted a new span on Sept. 21, 1917. For more on the Quebec Bridge and its administrative webs, see William D. Middleton, *The Bridge at Québec* (Bloomington: Indiana University Press, 2001); and Eda Kranakis, "Fixing the Blame: Organizational Culture and the Quebec Bridge Collapse," *Technology and Culture* 45, no. 3 (July 2004): 487–518.

[299] L. R. Wilson, *Montreal-South Shore Bridge: Fabrication and Erection of the Superstructure* (Montreal: DBC, 1930), 7.

[300] Pratley, "Discussion of Paper," 13.

[301] The Barons of Longueuil owned the island until, shortly after conquest, the British government bought it. In response to the War of 1812, the British military used it to defend the city. The Dominion government of Canada inherited the island and converted it to a public park. The city purchased the island in 1907 and planned for park improvements. Michèle Benoît and Roger Gratton, *Pignon Sur Rue: Les Quartiers de Montréal* (Montréal: Guérin, 1991), 104.

integrated the bridge's decks into the island's pavilion and included access ramps to the parkland below.[302] The park was one of three urban parks that offered leisurely space—green space, historic fortifications, and beaches—in the busy industrial city.[303]

The water flow and depth between St. Helen's Island and the Island of Montreal presented different challenges. The river is deep at that location, and the current is strong; St. Mary's Current flows between eight and eleven kilometres (five and seven miles) per hour. Thus, the current precluded construction of any deep-water piers. The site is also the principle shipping channel and access point for ocean steamboats to the harbour's docks, warehouses, grain elevators, and cold storage sheds. The design at this location considered a minimum of three-hundred metres (1000 foot) wide and fifty metres (160 foot) high clearance above high water levels.[304]

The engineers determined that a cantilever over the harbour was the best option to overcome these natural and economic constraints. The designers proposed a symmetrical cantilever over the navigation channel with an overall length of 590 metres (1,937 feet). The trusses have a K-design that considers a pleasing outline and economic proportions "to permit harmonious treatment of the web members."[305] The designers introduced a tapering effect in consideration of the appearance of the north channel section of the bridge.

The bridge is set on four towers (Piers 23-26) to meet the minimum height requirements. The north anchor arm spans over the navigation channel and meets Pier 26 at the edge of the

[302] "The artistic and solidly constructed pavilion," writes transportation engineer Alex Fraser, could accommodate fifteen- to twenty-thousand people for band concerts and other public events all year round. Fraser, "A New Six-Lane Boulevard," 3.

[303] Other parks included Parc Lafontaine and Mount Royal. Marsan, *Montreal in Evolution*, 297.

[304] Dominion Bridge Company, *The Superstructure of Montreal Harbour Bridge over the St. Lawrence River*, 9.

[305] Wilson, *South Shore Bridge*, 18.

wharf and the river. The pier marks a junction between the anchor arm and viaduct and signals a second bend in the bridge. The second pivot was a response to existing urban forms as the bridge's alignment was designed to make a gradual, four-percent descent along a viaduct and eventually meet the city grid. The bridge consequently steps over the harbour and creates a new layer in the overall circulation system. The viaduct descends approximately four percent over 700 metres (2,300 feet) from the junction of the main span to Saint-Catherine Street in Montreal.

World War I changed the economy of, and approaches to, engineering, including the standardization of materials and manufacturing.[306] For example, Canadian manufacturers produced parts for the war effort, and a nut made in Canada needed to fit a bolt made in Britain or elsewhere. A standard nut and bolt thread eliminated the time required to design new threads for each project and reduced manufacturing and maintenance costs by avoiding duplication and error. The international interchangeability of parts saved time in the design process and made more efficient use of materials. Furthermore, the price of steel rose after the war[307] and forced a further economy of materials to design and construct projects. The designers and construction engineers of the Jacques Cartier Bridge were aware of these changes and promoted material uniformity and manufacturing standards.

The engineers and contractors were also acutely aware of the value of human life during the interwar period. The two recent failures of the Quebec Bridge drew attention to bridge-building hazards,[308] and the number of war casualties increased the focus on human safety during construction. Nearly half of the Mohawks employed at the Quebec Bridge died when the bridge

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306 For more on the standardization of industrial components, see Millard, *Master Spirit of the Age*, 102; and Robert Ferguson Legget, Economic Council of Canada, and Science Council of Canada, *Standards in Canada* (Ottawa: Information Canada, 1971).

307 Rose, "Bridges," 20.

308 Wilson, *Montreal-South Shore Bridge*, 30–31.

collapsed on August 29, 1907. The loss left twenty-four women widowed and dozens of children fatherless.[309] As a result of the deaths, the community women resolved that men were to spread out over job sites to avoid a similar tragedy.[310] The construction supervisors provided flooring and scaffold as support for those working at all heights, and a gasoline rescue boat was on call near the base of Pier 25. Additionally, the manufacturers kept all machinery in high-performance repair and construction halted during winter months to ensure human safety.[311] Despite such safety measures in place, five men lost their lives during construction.[312]

The bridge is designed to carry highway, street tram, and pedestrian traffic only. Consequently, the structure had insufficient strength to accommodate locomotive trains and traditional railway-bridge building equipment. In considering a light-weight truss system, the designers also had to calculate the weight of the machines used to build the bridge and, in the end, the engineers developed special equipment.[313] The engineers found innovative solutions to building the piers and the superstructure *in situ.*

The Construction Process

As mentioned above, the pier design incorporated the same upstream slope used in the past to receive ice, but with one major exception: the Jacques Cartier Bridge piers are made of concrete instead of stone.[314] Concrete, explains architectural historian Adrian Forty, is a stone-like medium that requires a significant amount of human energy (and fossil fuel) to make it a

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[309] "Kahnawake Mohawks Mark 1907 Quebec Bridge Disaster | CBC News," CBC, August 30, 2006, accessed January 28, 2021.https://www.cbc.ca/news/canada/kahnawake-mohawks-mark-1907-quebec-bridge-disaster-1.623180.

[310] Blanchard, "High Steel," 49.

[311] Wilson, *Montreal-South Shore Bridge*, 58.

[312] DBC, *Superstructure of Montreal Harbour Bridge*, 12.

[313] Wilson, *South Shore Bridge*, 9.

[314] The piers were faced with an additional 36,000 tons of cut stone to protect against the ice. Ibid., 598.

viable building material.[315] It also requires an exact chemical reaction and the insertion of reinforcing steel before it is useful in contemporary construction. Pratley, who had significant experience working with the material, brought his expertise to the design and construction of the Jacques Cartier Bridge. Historian Phyllis Rose wrote that "Pratley's career captures and illustrates an important development in twentieth-century bridge-building: the increasing importance of concrete."[316] Pratley consequently mastered these requirements, pioneering concrete in Canadian bridge-building and wrote extensively about his findings.[317]

In his paper, "How They Concreted 19 Piers," Pratley described the process of obtaining uniform concrete.[318] He described innovations in technology developed on-site and economic approaches to materials and space. He explained how—without modification—sands taken from local riverbeds where logging operations occur are impure and unfit for making concrete. Contractors need large quantities of the aggregate to produce 84,125 metres (92,000 yards) of the stone-like medium. Therefore, the closer to the site contractors could source sand, the more economical it was to build with concrete, and Pratley calculated ways to reduce the distance between material sources and construction sites.

Construction began on May 25th, 1925, between Longueuil and St. Helen's Island with Piers 0–19.[319] Contractors used an inundator to wash away impurities, such as bark and wood chips, from local sand. The process gives the sand the consistent moisture content needed to produce a

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315 Forty described concrete as "stone-like" without being stone and considered concrete a process rather than a natural building material. Adrian Forty, *Concrete and Culture: A Material History* (London: Reaktion, 2012), 44.

316 Rose, "Bridges," 19.

317 Pratley won three writing awards and a medal recognizing his contributions to engineering consulting. In 1987, the CSCE recognized his lifetime achievements and contributions to the profession by instating the annual P. L. Pratley award for the best technical paper in the field of bridge engineering. For more on his awards, see Passfield, "Philip Louis Pratley," 648.

318 Pratley, "How They Concreted 19 Piers," 27.

319 Pratley, "Montreal Harbor Bridge Sub-Structure," 596.

chemical reaction with larger aggregates and cement. In this case, the science of making a viable building material lay in the hands of a single operator who, having established the quality of sand and quantity of water and aggregates (stone and cement), mixed all three ingredients in a hopper directly at the construction site.[320] As Adrian Forty pointed out, one difference between concrete and stone is that, with concrete, the bulk of the labour occurs on-site rather than in the quarries or stone fields, as with the Victoria and Lachine Bridges.[321] Thus, the Jacques Cartier Bridge engineers built in an economy of space by fabricating their building material on temporary, floating construction sites. The scientific approach to the piers and, by extension, to the landscape used a definite economy of space, material, and labour.

The bridge meets the harbour at the base of De Lorimier Avenue, on the wharf fronting the (then) Molson Brewery warehouse. During excavation for the foundations of Pier 25, the engineers established that "no suitable bearing stratum existed above the rock, some 70 feet below ground level."[322] They uncovered an old wharf filled in, which prevented the construction crews from driving piles. The archeological treasures, likely dated before 1874 when the harbour expanded, engulfed several small quays, including Molson, Poupart, and Longueuil, to build one long wharf, the length of St. Mary's Current. "Accordingly, two reinforced concrete caissons were sunk […] and carried down to rock about 80 feet below ground level at that point."[323] The reinforced concrete piers provided a solid foundation for the superstructure.

In October 1925, the DBC won the contract for manufacturing and installing the steel superstructure. The company appointed engineer and vice-president, L. R. Wilson, in charge of

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[320] Pratley, "How They Concreted 19 Piers," 28.
[321] Concrete is generally made up of crushed stone, sand, and cement. Forty, *Concrete and Culture*, 44.
[322] Wilson, *South Shore Bridge*, 37.
[323] Ibid.

operations. The engineer began by determining the logistics, including transportation, that is, the path of materials from the shops to the storage sheds. Where storage space was limited, Wilson came up with creative solutions. Wilson explained that "the only ground available for construction purposes was a strip about 100 feet wide by the main pier and the railway tracks."[324] The DBC took advantage of railway transportation, moving massive steel beams and trusses from Lachine's machine shop. The materials were laid in a temporary storage yard until they were "hoisted from the ground to the floor of the bridge above and distributed to the erectors over service tracks."[325] The construction engineers adapted to cramped working conditions at the wharf by using Pier 25 to create a vertical staging site.

The DBC manufactured the steel components as the plans were approved, and, when they reached their rolling capacity, the DBC subcontracted the work to the Canadian Steel Foundries, Limited, the Canada Foundries and Forgings, Limited, and the Canadian Vickers Co. Monserrat inspected the manufacture of the metal and, with little storage space available, "all material was subject to inspection at the point of manufacture."[326] The quality of work was following national standards, and Monserrat oversaw the specifications—quality and craft—at each mill.

The erection began at the south shore in September 1926. The workers installed seven of the nineteen spans, and the following spring, the crews completed all but three remaining spans. The crews used falsework or cantilevering to build the south channel spans, and they completed the works in 1928.

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[324] Wilson, *Montreal-South Shore Bridge*, 29.
[325] DBC, *Superstructure of Montreal Harbour Bridge*, 17.
[326] Wilson, *Montreal-South Shore Bridge*, 22.

For the north channel, the bridge contracts “stipulated that the navigation channel must at all times be kept clear of obstruction to shipping.”[327] In addition to the provisions, the depth of the river, approximately twelve metres (forty feet), precluded any falsework. While the river usually froze at that location, the ice shoves intermittently rammed the docks between January and late March to early April. Unlike the construction of the Victoria Bridge, the frozen river offered little support to the construction crews. Construction halted during the winter months to protect workers from climatic conditions.

In the meantime, the contractors erected the main span by cantilevering over the channel from either side and connecting the middle structure. In 1927, crews built a temporary tower to support a traveller and transfer material until the works progressed out far enough past the pier that the structure could support the traveller on its own. The traveller worked like a crane, lifting heavy material out over the channel and holding it in place until crews could permanently fix them. Much of the silicone steel trusswork was riveted, except at stress points where forged nickel pins connected the main truss members to posts. In 1928, when works finished on the south channel, an auxiliary traveller was used to advance works on the north side. On July 25th, 1929, the workers closed the gap between the two cantilevers.

Engineers and contractors experienced delays during the 1926 working season and asked for an extension to the original deadline, which the MHC granted. Construction advanced faster than anticipated in the second and third seasons, and the contractors were able to close the cantilever 1.5 years ahead of the new deadline.[328] City engineers and provincial planners were still in the process of expropriating land and designing highway connections[329] when the DBC began

[327] Wilson, *Montreal-South Shore Bridge*, 8.
[328] Further research is needed to clarify what timesaving advances the engineers made.
[329] For more on the efforts of transportation planners working on provincial highway connections to the bridge, see Fraser, “A New Six-Lane Boulevard.”

installing the north viaduct. “When completed,” the MHC explained, “the bridge roadway will leave the street grades at Burnett Street, just west of De Lorimier, but the final approach plaza or boulevard remains to be developed in conjunction with the City Engineering Department.”[330] While the bridge engineers and MHC celebrated the completed structure, provincial transport planners and city engineers rushed to integrate the bridge into the city street and regional highway networks.

[330] McDougald, Daoust, and Hersey, *Growth of a Great Port*, 68.

Chapter Three: Souvenirs from the Construction Site

The previous chapter brought together technical sources to present the bridges, and the construction project in a straightforward fashion. This chapter, "Souvenirs from the Construction Site," introduces the second set of primary sources produced during each bridge construction. For this discussion, the collections of photographs are referred to as albums. Some of the artifacts are albums, while others are souvenir booklets and commemorative books. Their content is the same images of the bridge-building. The albums appear to have a similar purpose, to observe the construction process.

The sources include a photographic collection and its use in three different souvenirs, which add a second (and third, and even fourth) perspective to the construction narrative. The photographer, thus, plays a role in establishing views of the landscape and (where possible) biographical and contextual information demonstrates how the commission fits into the professional career of the photographers. At times, the photographer is responsible for arranging the photographs, and other times he is not. Therefore, the chapter examines the roles of the compiler, lithographer, or book editor in establishing, at least in part, the narrative produced. This context helps see the visual artifacts as unique and valuable to the study.

Mid-nineteenth Century Bridge Photographs in Canada

Early on, engineers appropriated the photographic medium as a means of communication. Renowned British engineer, Isambard Kingdom Brunel, was, perhaps, the first western engineer to commission a photographer to document a railway construction project.[331] Press clippings

[331] For an overview of the history of construction photography, see Baillargeon, "Religious Fervor and Photographic Propaganda," 10-40.

confirm that, in 1847, Brunel received weekly updates in England on projects taking place in Italy, including daguerreotypes that showed advances up to the time of correspondence. The engineer was managing construction projects from afar and using photography to keep informed. By the early 1850s, British engineers used photography to overcome difficulties with long-distance communication and language barriers on international construction sites.[332]

If British engineers were using photographs to communicate between Italy and England, the Victoria Bridge photographs imaginably served the same purpose. During construction, Stephenson was in England while Hodges oversaw the day-to-day operations. There are no records to show that Stephenson employed photographers on this or any of his earlier projects, but in 2003, three photographs surfaced of Stephenson's Britannia Bridge under construction in 1850. The pictures confirm that at least one photographer—likely a nearby resident—recorded one of Stephenson's projects.[333] Determining the exact use of these photographs (or the era when the British began adapting visual communications in engineering)[334] is difficult. Contrary to French records, British railway records have no central holdings. Scattered across private archives and significantly affected by two world wars, the material is challenging to access.

The Victoria Bridge photographs are accessible. The William Notman Photographic Archives at the McCord Museum in Montreal holds approximately 100 photographs depicting the erection of the tubular structure and over 500 photographs of the British colony. The

[332] Baillargeon, 16.

[333] The photographs and their original purpose warrant further investigation. See "Bridge Photos Go at Auction," *BBC News*, April 9, 2003, http://news.bbc.co.uk/2/hi/uk_news/wales/north_west/2930135.stm.

[334] For example, in 1851, Norwegian civil engineer and photographer Carl A. Pihl worked alongside Stephenson on the first railway in Norway. A decade earlier, Pihl had studied engineering and photography in England and Sweden, and he applied his knowledge of photography to document change in the Norwegian landscape. Mari Hvattum, "The Man Who Loved Views: C. A. Pihl and the Making of the Modern Landscape," in Hvattum et al., *Routes, Roads and Landscapes*.

photographs were taken during the final two years of construction of the bridge and are available online.[335]

In 1856, during the second summer working season, Scottish businessman William Notman immigrated to Montreal. Notman came from a rising middle-class family and arrived in Montreal as T.C. Doane—a photographer who made a fortune with the success of his daguerreotype business—considered retirement.[336] "His training and experience as an amateur photographer and his studies in the art of painting were the foundation of immediate success."[337] Notman's first significant commission was documenting the construction of the Victoria Bridge.[338] Between March 1858 and January 1860, Notman photographed advances on the superstructure and notable sights around Montreal. His photographs formed the basis of various gifts and commemorative artifacts, three of which are described below.

A Gift for the Queen

When William Notman began photographing the construction project, he had been in the colony for approximately a year and a half. His grandson, Charles Notman, told the former curator of the McCord Museum (MM) and the Notman Photographic Archive, Stanley Triggs, in an interview that the photographer held two contracts. The first was with the Canadian government to capture bridges and general landscape scenes, like the countryside and Niagara Falls. Notman and the government gifted to Queen Victoria hundreds of images promoting natural features and the built environment in Upper and Lower Canada.[339]

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[335] "Dominion Bridge / AMCA International Finding Aid: MG28-III 100" (Ottawa: Library and Archives Canada, n.d.), accessed January 28, 2021, http://data2.archives.ca/pdf/pdf001/p000000325.pdf.

[336] Stanley Triggs, *William Notman: The Stamp of a Studio* (Toronto: Art Gallery of Ontario, 1985), 23.

[337] Ibid, 24.

[338] Paul Kennedy, *William Notman of Montreal - Part 1*, Podcast, vol. 300087110, Ideas, 2012, http://www.cbc.ca/player/play/2289759568.

[339] Stanley Triggs, "The Notman Photographic Archives," *History of Photography* 20, no. 2 (1996): 180–85.

Railway promoters in France began exploiting the communicative power of railway and landscape photography a half-decade earlier than Hodges and Notman. In 1855, Baron James de Rothschild—banker, industrialist, and president of the Chemin de fer du Nord (Northern Railway)—commissioned renowned French photographer Édouard Baldus to produce an album of religious, rural, and industrial landmarks along the railway.[340] Baldus adapted a rustic visual language that captured the agricultural structures and French countryside to tie together landscape, technology, and economic development in a series of images. Like the Claude glass that landscape painters used a century earlier, the frame of the photographs simplifies objects otherwise challenging to comprehend when viewed from a rapidly moving train. The picture frame thus mimics the structure of the train window, introducing what cultural historian Wolfgang Schivelbusch calls "panoramic perception" or a way of seeing objects while in motion. Schivelbusch asserts, "Panoramic perception, in contrast to traditional perception, no longer belonged to the same space as the perceived object: the traveller saw the objects, landscapes, etc., through the apparatus which moved him through the world.[341] The speed of railway travel altered human perception of time, space, and distance. The photograph reduced the landscape to an image to behold. Furthermore, the sequencing of photographs suggests movement along the train's path, giving viewers the visual tools to curate a landscape experience before they begin their journey, not unlike the literary devices of early British railway promoters.

The French collection was marketed as a personal keepsake of a trip through France during the Second Empire. Queen Victoria received the album at the end of her journey, which art historian Malcolm Daniel claims as the *aide-mémoire* of a diplomatic voyage aimed to

[340] Malcolm R. Daniel, Edouard Baldus, and Barry Bergdoll, *The Photographs of Édouard Baldus* (New York; Montreal: Metropolitan Museum of Art; CCA, 1994).

[341] Wolfgang Schivelbusch, *The Railway Journey: The Industrialization of Time and Space in the Nineteenth Century.* (Berkeley: University of California Press, 2014), 65.

strengthen economic development between the two nations.[342] The photographs also suggest industrial advancement without the implications of industrial noise and pollution—a common practice that architectural historian Eve Blau notes as the evocation of nostalgia for the simplicity of the pre-industrial landscape.[343]

Notman presented his gift to the Queen skillfully. He prepared a Bird's Eye Maple Box with silver fittings to hold two large portfolios. Each portfolio contained removable pages that Notman arranged with copies of his stereographs and photographs of all sizes. The box was lined with a midnight blue velvet and placed vertically; the portfolios tucked inside. The top held a stereo viewer (See Figure 3.0). Notman presented the box to the Prince of Wales during the opening ceremonies of the bridge. Like Baldus's gift to the Queen, it is a keepsake of the royal visit. The gift made the international news, "It was a good notion of the Canadian government to employ the celebrated photographer Notman of Montreal to prepare a series of photographs of all that is interesting in the Canadas and to present it to His Royal Highness, the Prince of Wales as a souvenir of his visit to the colony."[344] The case and folio are examples of colonial taste and artistry.

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[342] Malcolm R. Daniel, "The Photographic Railway Albums of Edouard-Denis Baldus" (PhD dissertation, New Jersey, Princeton University, 1991), 170–80.

[343] Photographic collections also eliminated undesirable urban features. Eve Blau, "Patterns of Fact: Photography and the Transformation of the Early Industrial City," in *Architecture and Its Image: Four Centuries of Architectural Representation: Works from the Collection of the Canadian Centre for Architecture*, ed. Eve Blau and Edward Kaufman (Montreal: CCA, 1989), 36–57.

[344] *The Illustrated London News*, 22 June 1861, 596-97.

Figure 3.0*: The Maple Box and Canada East, portfolio,* William Notman, 1859-1860. [MM: N-0000.193.320]

The folios contained between five- and six-hundred images of waterfalls, cities, public works, and events during the opening ceremonies. The total number of images included in the Queen's gift is unknown because the royal copy is missing.[345] Notman made two almost identical copies of the gift. He kept the second on display at his studio, and he won a prize at the 1862 International Exhibition or the Great London Exposition for his photographs.[346] The only extant copy is at the McCord Museum, and this study referenced the images online through the museum web page.[347]

Personal Album

The second contract was with GTR (or Hodges in other sources).[348] The second commission's purpose is unclear; the photographs were perhaps a form of communication between the shops in Birkenhead and Montreal or, like the first, to commemorate the construction process. Notman arranged copies of his photographs in at least one personalized photographs album and gifted them to Alexander Ross. The images are bound in an album with a dark green leather cover with, *Victoria Bridge Montreal,* embossed in gold foil (See Figure 3.1).

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[345] Robert G. Wilson, "The Maple Box: Stereoviews from William Notman, around 1860 | Thematic Tours | Musée McCord Museum," accessed January 28, 2021, http://collections.musee-mccord.qc.ca/scripts/explore.php?Lang=1&tablename=theme&tableid=11&elementid=56__true&contentlong.

[346] For more on Notman's marketing genius, see Kennedy, "William Notman of Montreal."

[347] "Photography | Collections | Musée McCord Museum," accessed January 28, 2021, http://collections.musee-mccord.qc.ca/scripts/explore.php?Lang=1&tableid=4&elementid=00016__true.

[348] The original contract no longer exists. See Triggs, "The Bridge," 65, 73.

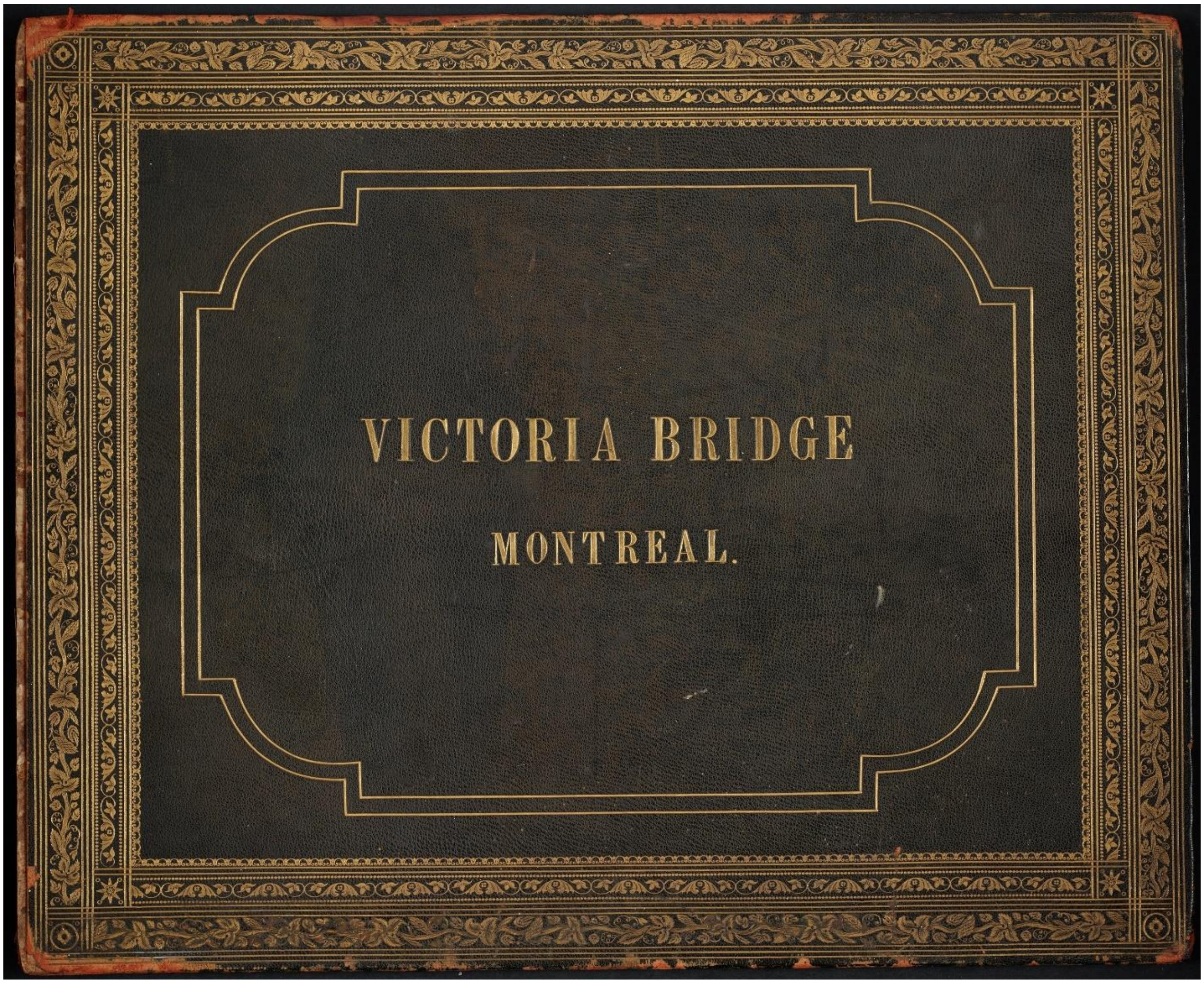

Figure 3.1*: Cover*, *Alex Ross Album*, 1860. [LAC: Alex Ross Album]

The album contains forty photographs of approximately twenty-five centimetres (eight by ten inches) and another seventy-nine stereographs, mainly laid out in six pairs per page. The opening picture shows Ross standing alone at the entrance to the north end of the bridge on the Island of Montreal (See Figure 3.2). The date of completion, 1859, is carved into a stone tablet marking the entrance (in Roman numerals) above the names of the appointed joint chiefs, Robert Stephenson and Alex M^{c} Ross. Ross appears to be holding a cane in his right hand, which is more likely a part of a posing stand used to keep the engineer still for the long exposure time.

e011297346-003

Figure 3.2: *North Entrance,* William Notman, 1860 [LAC: Alex Ross Album]

Twenty-four of the forty large photographs capture advances on the bridge from one of the abutments or the nearby shore (See Figure 3.3). The images act as a measure of time and progress, capturing the structure, the piers, and the river. Notman took ten photos from the top of a pier or the superstructure and provided a bird's eye view of the bridge. A survey of the photographs demonstrates that Notman positioned his camera at least five times below the structure, either from the ice or a boat, and provided a worm's eye view. A single image shows the inside of the GTR shops and the GTR locomotives.

e011297346-028

Figure 3.3: *Centre Tube,* William Notman, March 1859 [LAC: Alex Ross Album]

Notman represented the bridge in what Triggs calls "his [Notman's] own bold, new world imagery which best suited his expressive needs and the tempo of the time and place."[349] The photograph, *Centre Tube,* directs the eye to the workers bolting the bridge plates together. The wooden staging supports the iron structure. The river below blends into the background, and there is no apparent danger involved in traversing the frozen river to reach the centre tube. Three engineers peer back at the camera from the entrance to the tube. The photographs are cropped tight to their subject and rarely stray from the topic of the construction. Triggs writes, Notman's

[349] Triggs, "William Notman in Montreal," 24.

"forceful, straightforward style became the hallmark of the time and the model for all the photographers who worked for him."[350] Mid-nineteenth-century landscape photographs taken by William Notman and his sons shaped the vision of Canada's identity.[351]

The Victoria Bridge photographs differ from Notman's larger body of work. Possibly because these were early in his career, but it is also possible that Triggs and others notice how the photographs differ in style from other photographers because it was the engineer who was directing the gaze of the camera. In his study of engineering photographs in the French *École des Ponts et Chausées*, urban and architectural historian Sean Weiss finds that photography was taught to familiarize engineers with the process and manage photographers.[352] The French photographs "help increase managerial control over the building, and therefore take on a bureaucratic aesthetic," writes Weiss. The photographs, he continues, "depict the engineer as a technical expert, the bridge as a technological feat, and overall portray a technical language and industrial culture, an exacting science."[353] Notman's photographs represent the perspective of an engineer.

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[350] Triggs, "The Notman Photographic Archives," 24.

[351] J. M. Schwartz, "Photographic Reflections: Nature, Landscape, and Environment," *Environmental History* 12, no. 4 (2007): 966–93.

[352] Sean R. Weiss, "Engineering, Photography, and the Construction of Modern Paris, 1857-1911" (Ph.D., New York, City University of New York, 2013), 82-110.

[353] Weiss, 104.

e011297346-052

Figure 3.4: *Views in the City of Montreal,* William Notman, 1858-1860 [LAC: Alex Ross Album]

At the back of the album, Notman included thirteen sheets each containing six stereographs. The photographs are like those presented to the Queen. Notman's *Views of the city of Montreal* include, from the top left, a photo of the Post Office, St. Andrew's Church, McGill Street, Christ Church Cathedral, Hay Market Square, and the commemorative stone (See Figure 3.4). Like the bridge photographs, Notman isolated the architectural subject using a three-quarter view to maximize the visible surfaces. He also included human figures for scale. However, the figures are dressed mainly in formal attire and top hats, reflecting the status of the men and the business districts they inhabit. The image on the bottom right-hand corner of the page, "Laying Monumental Stone marking the Graves of 6000 [Irish] Immigrants Who died of Ship Fever at

Point St. Charles in 1847 and 1848," is an exception. The stereograph captures a crowd of about two dozen people, including what appear to be priests and women, commemorating those buried at the foot of the bridge. The public seems to be of mixed social standing and perhaps includes members of the Irish community.

The stereographs are not controlled by the engineer's gaze and offer a perspective on the city that Notman captures for the Queen. The urban photographs bypass any signs of poverty and ignore the French influences on the city; they reiterate the Scottish, English, and Irish bonds. For example, Notman included Christian churches—Presbyterian and Anglican—and not Catholic buildings. Notman chose to include streets and businesses that reflect Scottish and English wealth, like McGill Street, named after Scottish Canadian businessman, slaveowner, and philanthropist James McGill, and the (then) head office of the Grand Trunk Railway. The photographs represent the business community that a recent immigrant, like Notman, would relate to and represent a British establishment in the colony. Notman was not only producing a collection of photographs for the Queen but also potential clients in Montreal. His photographs were instant commodities.

The Construction Report

After completing the Victoria Bridge and before its opening ceremony, Hodges returned to England and published his account of the project. Over seven to eight weeks, Hodges helped prepare at least one set of presentation copies for the ceremonial opening with Edward, Prince of Wales.[354] Hodges dedicated the account to the prince before introducing "some of the difficulties and labours encountered by her Majesty's subjects in the accomplishment of this important

[354] "Book Review: The Construction of the Great Victoria Bridge," 348.

work."[355] For such an essential publication, Hodges turned to John Weale, the Architectural Library owner at 59 High Holborn, London.

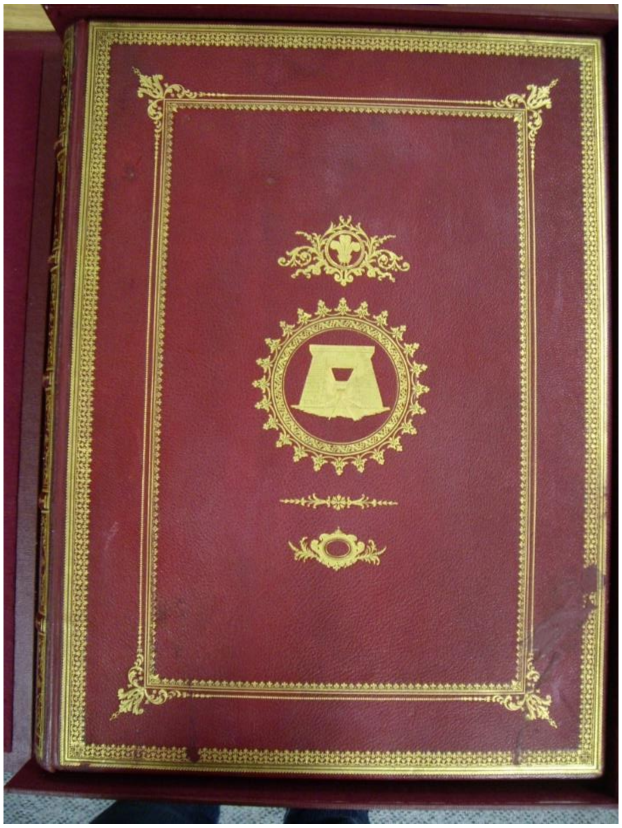


Figure 3.5: Photograph of the front cover of a presentation copy of *The Construction of the Great Victoria Bridge.* Heather Braiden, 2014.

Weale designed the Victoria Bridge publication for an aristocratic audience. He used quality materials, gold finishes, and full-colour imagery that cost, including binding, £4,000 for a limited edition of an unknown quantity of copies (See Figure 3.5). One reviewer claimed, "Here is a magnificent tome, of the most imposing folio size, produced with all possible luxury of hot-pressed paper, gilt edges, gilt-paper borders, enormous margins, costly illustrations, admirable printing, and other sensualities of the typographer's and illustrator's arts!" The publisher spared

[355] Hodges, *Construction of the Great Victoria Bridge,* iii.

little expense on the presentation and even produced a velvet-lined protective box for copies gifted to the opening ceremonies' special guests.[356]

Commentators had one major critique; they found the volume (60 × 45 inches; approximately A2 size) too big. They recommended that it be "condensed, or rather reduced, to an ordinary octavo" that would contribute "to the history of the great science of the day."[357] The inside cover weaves the native Canadian red and white oak and maple leaves with the Scottish thistle, the English rose, and the Irish clover, topped with the three-plumed royal emblem of the Prince of Wales. The design reinforces the close and entangled connections between the colony and imperial motherland.

The text is based on Hodges's account and accompanied by an array of visual representations. The text is organized chronologically, with each chapter marking the length of a working season. Early on in the book, woodcuts based on Notman's stereographs and lithographs based on artwork by other Montreal artists ornament the text. These images situate the project in Montreal. Meanwhile, later in the book, the images relate directly to the bridge construction. Notably, the intricacy of the imagery develops alongside the construction story.

The artwork included in the early pages of Hodges's book reflects his colonial view of the cultural landscape. Weale chose two lithographs after paintings by Montreal-based, Dutch-born painter Cornelius Kreighoff to represent Hodges's arrival to the colony (See Figure 3.6). Generally speaking, British art produced after the 1763 conquest of New France, argued

[356] The cost is measured in currency rates from 1860. Buckingham et al., *The Athenaeum*, 555. There is no indication of who paid the printing costs or how many copies were made. A search in WorldCat shows that thirteen editions were made and at least forty-seven copies exist in public institutions in the US (twenty), Canada (fourteen), UK (five), France (three), Germany (three), Spain (one), and Australia (one). These copies do not include private collections or museums, such as the MM. Overall, Weale printed an estimated one hundred copies for attendees of the opening ceremonies, including one signed by "the Author" and dedicated to T. E. Blackwell, vice-president and managing director of the GTR.

[357] Buckingham et al., *The Athenaeum*, 512.

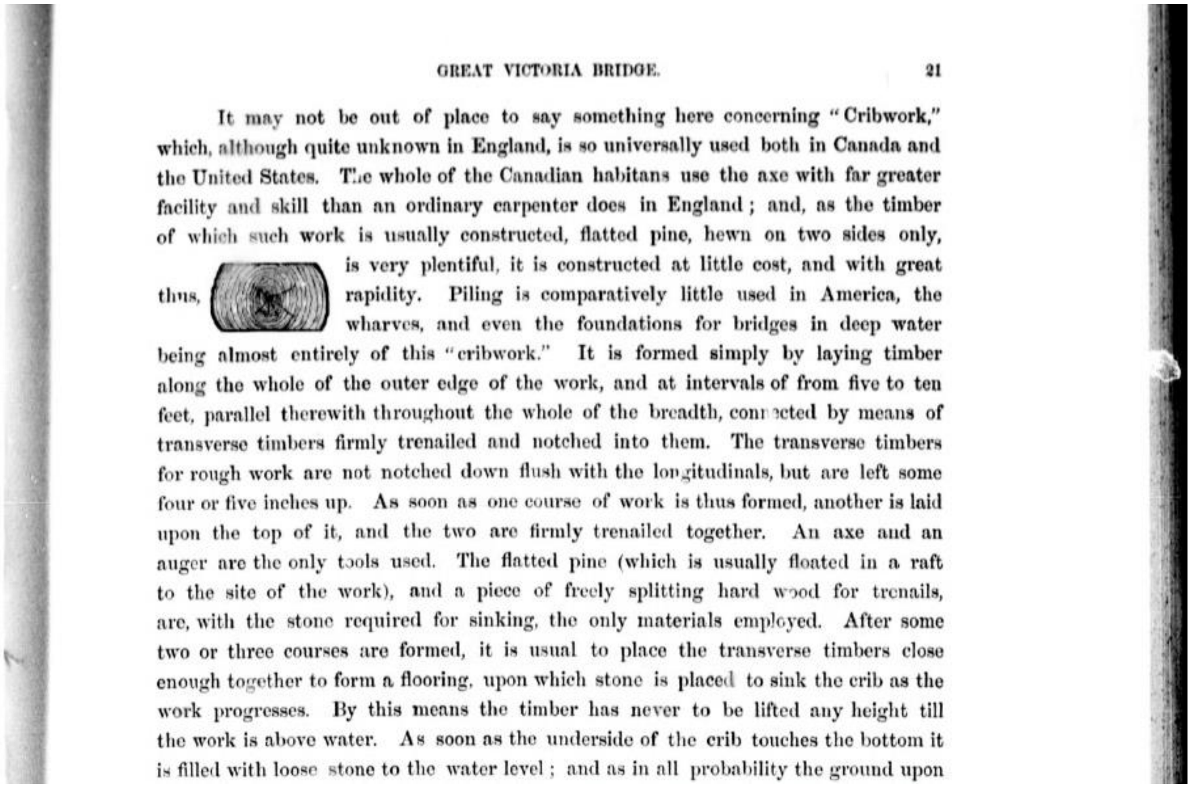
historian John Crowley, established lasting views of the colonies. He writes representations of "the sublime aspects of Canada's scenery confirmed the grandeur of the imperial project against New France, while the picturesque landscapes of towns, farms, and shorelines promised an easily governed population readily subject to British improvements."[358] Indeed, Krieghoff's art provides first impressions of a romantic colonial landscape, complete with a canoe bearing a British flag and the region's exotic inhabitants.

Figure 3.6: (Left) *Indian Chiefs (Réserve indienne de Caughnawaga, Québec)*, Kell Brothers, London, 1860. Lithograph after painting by Cornelius Krieghoff [Hodges, *Construction of the Great Victoria Bridge*, 9]. Courtesy of the Toronto Public Library. (Right) *Passengers and Mail Crossing River*, Kell Brothers, London, 1860. Lithograph after painting by Cornelius Krieghoff. [Hodges: *Construction of the Great Victoria Bridge*,78].

Construction practices along the St. Lawrence differed from Hodges's previous experiences. Hodges incorporates his learned experience into the text, and Weale included imagery that reflected the engineer's understanding of the local landscape. For example, Hodges observed from the river's edge how Canadian habitants were more skilled than the British at using local tools. He noted how a local man with nothing but an axe could hone a piece of timber in a matter of minutes, and the text is enhanced by a small woodcut, mid-sentence, showing a honed log cut flat on two sides for stacking (See Figure 3.7). Without interrupting the flow of the

[358] John E. Crowley, "'Taken on the Spot': The Visual Appropriation of New France for the Global British Landscape," *The Canadian Historical Review* 86, no. 1 (2005): 2, https://doi.org/10.1353/can.2005.0063.

text, the simple image "fill[s] in the details of our material surroundings."[359] The woodcut also indicates communication between the engineer and the publisher.


GREAT VICTORIA BRIDGE. 21

It may not be out of place to say something here concerning "Cribwork," which, although quite unknown in England, is so universally used both in Canada and the United States. The whole of the Canadian habitans use the axe with far greater facility and skill than an ordinary carpenter does in England; and, as the timber of which such work is usually constructed, flatted pine, hewn on two sides only, thus, is very plentiful, it is constructed at little cost, and with great rapidity. Piling is comparatively little used in America, the wharves, and even the foundations for bridges in deep water being almost entirely of this "cribwork." It is formed simply by laying timber along the whole of the outer edge of the work, and at intervals of from five to ten feet, parallel therewith throughout the whole of the breadth, connected by means of transverse timbers firmly trenailed and notched into them. The transverse timbers for rough work are not notched down flush with the longitudinals, but are left some four or five inches up. As soon as one course of work is thus formed, another is laid upon the top of it, and the two are firmly trenailed together. An axe and an auger are the only tools used. The flatted pine (which is usually floated in a raft to the site of the work), and a piece of freely splitting hard wood for trenails, are, with the stone required for sinking, the only materials employed. After some two or three courses are formed, it is usual to place the transverse timbers close enough together to form a flooring, upon which stone is placed to sink the crib as the work progresses. By this means the timber has never to be lifted any height till the work is above water. As soon as the underside of the crib touches the bottom it is filled with loose stone to the water level; and as in all probability the ground upon

Figure 3.7: *Simple woodcut inserted into the text.* [Hodges: *Construction of the Great Victoria Bridge*, 21]

Midway through the text recounting the second working season, the woodcuts are more detailed, copied from stereographs by Notman.[360] The images are no longer integrated into the text and instead are placed below a segment of text without captions or dates to identify them. In fact, the wood engravings appear chronologically in the text before Notman's contract for the photographs began. The woodcuts placed mid-way through the text show temporary structures used to support construction, such as the cofferdams that may have been built and photographed at any point during the construction process (See Figure 3.8).

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[359] Eugene S. Ferguson, "The Mind's Eye: Nonverbal Thought in Technology," *Science* 197, no. 4306 (1977): 827.

[360] Ralph Greenhill, *Engineer's Witness: A Photographic Panorama of Nineteenth Century Engineering Triumphs* (Toronto: Coach House Press, 1985), 17.

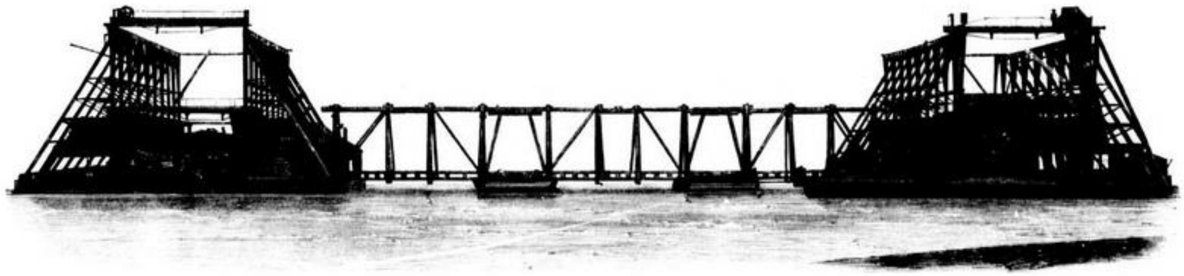

Figure 3.8: *Cofferdams for pier construction, Victoria Bridge* [Hodges, *Construction of the Great Victoria Bridge,* 36].

Lithographs after Notman's photographs appear more frequently at the end of the book and are modified in the mediatory process for reproduction. The photograph *Staging for the centre tube,* for example, captures the most challenging part of the construction over the frozen river. Meanwhile, an engraving, *Centre Tube in Progress—from the ice,* depicts a similar view on the bridge with visible alteration (See Figure 3.9). The photograph captures the staging for the centre tube before the iron plates arrived at the site and before the workers began riveting them in place. The placement of the derrick indicates the eventual height of the tube and establishes the likeness of the photograph and the lithograph.

Figure 3.9: (Left) *Staging for the centre tube,* William Notman, 1859 [LAC: Alex Ross Album]. (Right) *Centre Tube in Progress—From the Ice,* Kell Brothers, 1860 [MM: M1593.27].

The Kell Brothers of London produced the lithograph based on Notman's photographs. The figures placed in the foreground of the lithograph make the construction a spectacle for onlookers. Triggs writes, "The works as they progressed could be seen from many parts of the town and attracted numerous visitors by boat or on foot for closer inspection."[361] Whereas Notman produced what Triggs called "straightforward" representations of the bridge, the lithographs reflect a public curiosity unreplicable through photographic technology at the time.

Additionally, the lithograph exaggerates the scale of the workers found at the base of the bridge in the photograph and moves them to the middle ground to emphasize the scale of the works. "The sense of exaggerated scale in the engravings," explains architectural writer and photographer Paul Dobraszczyk, produce the "rhetorical character of visual depictions of urban industrial forms in this [Victorian] period: that is, images of industry designed to have a deliberately persuasive or impressive effect."[362] Indeed, the scenic background and vivid atmosphere excite the scene around the technological marvel.

In her overview of the uses of architectural photography, architect and philanthropist Phyllis Lambert finds that "*Villas on the Hudson*, 1860, was the first book in the United States to use photographs transformed into lithographs for the purpose of reproduction."[363] Lambert's observations make Hodges's book, 1860, an important example of print media on the continent. The bridge and its record are wonders for a curious public.

Merging Bridge and Landscape

Notman established his career with the Victoria Bridge contracts.[364] Notman also set a precedent for Canadian bridge photography in completing the commission as photographers documented all future railway projects. The Canadian government hired another promising

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[361] Stanley Triggs, *William Notman's Studio: The Canadian Picture* (Montreal: McCord Museum of Canadian History, 1992), 13.

[362] Paul Dobraszczk, "Sewers, Wood Engraving and the Sublime: Picturing London's Main Drainage System in the Illustrated London News, 1859-62," *Victorian Periodicals Review* 38, no. 4 (2005): 353.

[363] Phyllis Lambert, "Photographic Documentation and Buildings: Relationships Past and Present," *Archivaria* 5 (1978 1977): 64–65.

[364] Kennedy, "William Notman of Montreal."

amateur photographer, Alexander Henderson, to photograph its bridges along the Intercolonial Railway (ICR, built 1872–1876).[365] Henderson began taking photographs in the 1850s. In 1867, he "opened a studio in Montreal where he specialized in architectural, urban and landscape views, supplementing his activity with portraits."[366] Art historian Louise Guay notes how the IRC photographs differ from Henderson's previous work,[367] suggesting that Sir Sandford Fleming, the project's lead engineer, or the Canadian government was directing the camera's gaze. Shortly after the ICR contract, the Canadian government engaged Henderson to photograph lightweight, American-made bridges along the Quebec, Montreal, Ottawa, and Occidental Railway (QMO&O, built 1875–1881).[368] Following the lead of other bridge companies and the Canadian government, the Dominion Bridge Company hired landscape and bridge photographer Alexander Henderson to photograph their largest commission and the second bridge to span the St. Lawrence River at Montreal, the Saint-Laurent Bridge.

Henderson advances Canadian bridge photographs to a new level by using various devices to control or manipulate vision in space. Henderson modifies his prints in the production stages, adding atmosphere (clouds), adds foreground where there is none and adds shrubbery to screen unwanted views. Henderson uses framing and masking techniques to position his viewer and enhance the visual experience.

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[365] Ten of Henderson's Intercolonial Railway bridge photographs appeared in *Canadian Illustrated News*, the first national paper, post-Confederation. Alexander Henderson, "Bridges on the Intercolonial Railway," *Canadian Illustrated News*, August 18, 1877, Vol. XVI, No. 7 edition, 108–9, Images in the News: 1869–1883, LAC.

[366] Martha Langford, "Suspended Conversations: Private Photographic Albums in the Public Collection of the McCord Museum of Canadian History," (Ph.D., Canada, McGill University (Canada), 1997), 65.

[367] Louise Guay, "Alexander Henderson, Photographer," *History of Photography* 13, no. 1 (March 1989): 80, https://doi.org/10.1080/03087298.1989.10442170.

[368] Auerbach, "Album of Photographs."

Promotional Campaign

The DBC promotional campaign comprised a dozen or more collotypes—a late nineteenth-century mass-production printing technique—from Henderson's negatives (See Figure 3.10). Each image was printed in a standard format on a sheet of heavy white paper, with a border and descriptive information about the superstructure written at the bottom—a form Henderson used in previous campaigns. Unfortunately, access to Henderson's work is challenging because much of it was destroyed by the CPR and family members who saw little value in it.[369] His body of work is undetermined, and this promotional campaign may provide insight into more of his career.

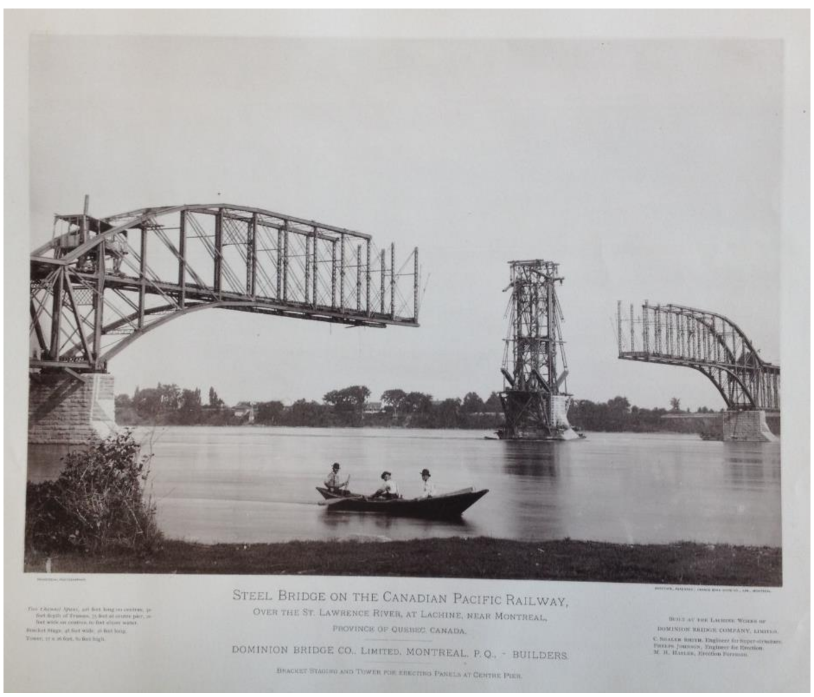

Figure 3.10: *Steel Bridge on the Canadian Pacific Railway: Centre Staging*, Alexander Henderson [LAC: 1976.72 SC 0027 PA-117233].

[369] Henderson was a significant landscape photographer, yet according to archivists Stanley Triggs and Louise Guay, his work is difficult to access because very few of his negatives exist and those that do are scattered in different collections. Triggs, former curator of the Notman Photographic Archives, McCord Museum, reports Henderson's family threw what was likely his amateur collection in the garbage on his passing. Guay, former archivist in Acquisitions and Research, Photo, Documentary Art and Photography, the National Archives of Canada reports much of Henderson's professional work with the CPR was erased in the 1940s. Stanley G. Triggs, "Alexander Henderson: Nineteenth-Century Landscape Photographer," *Archivaria* 1, 5 (January 1, 1977): 52, http://journals.sfu.ca/archivar/index.php/archivaria/article/view/10565; and Louise Guay, "Alexander Henderson, Photographer," *History of Photography* 13, 1 (1989), doi:10.1080/03087298.1989.10442170.

In his work for the DBC (1886-1887), Henderson paired his interest in the Canadian wilderness with railway industry contracts to promote railway projects. His photographs followed what photography historian David Harris called a set of guiding principles. "As producers of objects for sale in a commercial market," writes Harris, "the photographers recorded and marketed their photographs in a form that was striking without being either threatening or distressing to potential purchasers."[370] Henderson positioned his camera and oriented would-be clients in the natural surroundings. The angle brought the client close enough to observe the bridge without putting them in harm's way. The position made the viewer feel like they were coming close (but not too close) to a fast-moving and potentially flooding river while keeping the untidiness of the construction site out of view. The psychological effect emphasizes the "sensation associated with observing and participating in the events from a distance," rather than one of hardship or, in this case, hard labour.[371] Henderson was not just a commercial photographer; he understood the natural landscape's physical qualities and the engineering aspects of the bridges and railways.

Personalized Albums

In addition to the dozen or so promotional Henderson collotypes, the DBC *fonds* hold two photograph albums. Some of the pictures bear a striking resemblance to the promotional images, appearing to be test shots for the latter or else images that never made it to final production. Because the two albums are similar but not identical, they were probably made independently and assembled as gifts or select purchases.[372] The first was more skillfully presented than the

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[370] David Harris, "Alexander Henderson's 'Snow and Flood after Great Storms of 1869,'" *RACAR: Revue d'art Canadienne/Canadian Art Review* 16, no. 2 (1989): 159.

[371] Ibid.

[372] A. J. Birrell and National Photography Collection (Canada), *Private Realms of Light: Amateur Photography in Canada, 1839–1940*, ed. L. A. Koltun (Markham, ON: Fitzhenry and Whiteside, 1984), 7.

second. In his archival notes, former LAC curator Andrew Rogers labelled the first as an "album" and the second as a "scrapbook."[373] This terminology is used below in the description of the two artifacts.

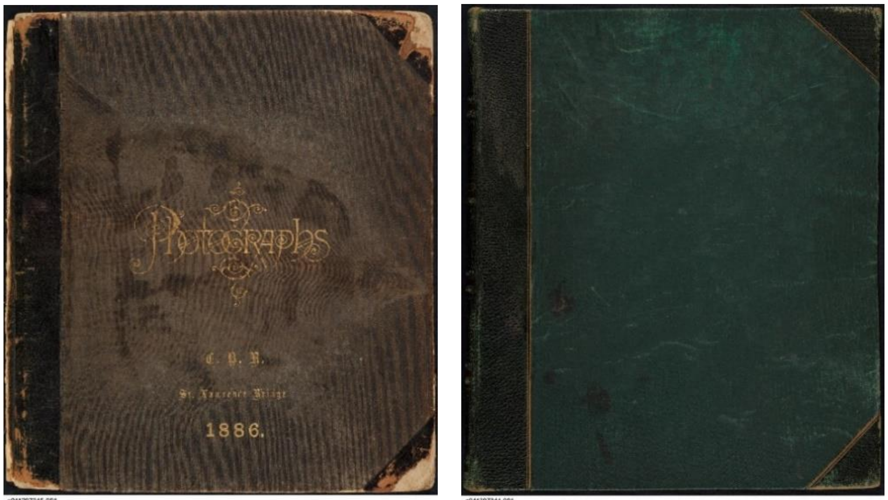

Figure 3.11: *Album front covers* (left: album; right: scrapbook) [LAC: C-256 Accession 1987-161, Box 2 #3 (right) and #4 (left)].

The Photographic Album of the Saint-Laurent Bridge

The album is wrapped and quarter-bound in brown binder's cloth and worn brown leather, with "Photographs / CPR / St. Lawrence Bridge / 1886" embossed on the cover (See Figure 3.11). In the top right-hand corner is a set of worn initials, perhaps the original owner's initials. The cursive, all-caps lettering occurs in the same gold embossing as the title, and the letters appear to read "I. A." or "J. A.," perhaps for Ira or Job Abbott, respectively. Like all four corners of the album, the initials are well worn, and the cover shows signs of damage from use.

The photographs are first organized by geographical location and then in a loose chronology to recreate scenes from the construction site. The captions identify the locations and scenes of the masonry works and, arranged from the north side (See Figure 3.12), the Swing Bridge over the Lachine Canal (See Figure 3.13), the Grand Trunk Railway overpass (See Figure 3.14), and the

[373] Andrew Rogers, email message to the author, April 14, 2014.

Blue Bonnets cut and fill (See Figure 3.15). Progress on the superstructure is viewed from several angles (See Figures 3.16 to 3.19). The photographs below are shown as arranged in the album and provide an overview of the project.

Figure 3.12: Opening pages of the album. Left: *View of Bridge, Aug. 2nd, 1886;* Right: *View of Bridge site,* (top) April 1886 and (bottom) no date. [LAC: C-256 Accession 1987-161, Box 2 #4, pages 1 and 2].

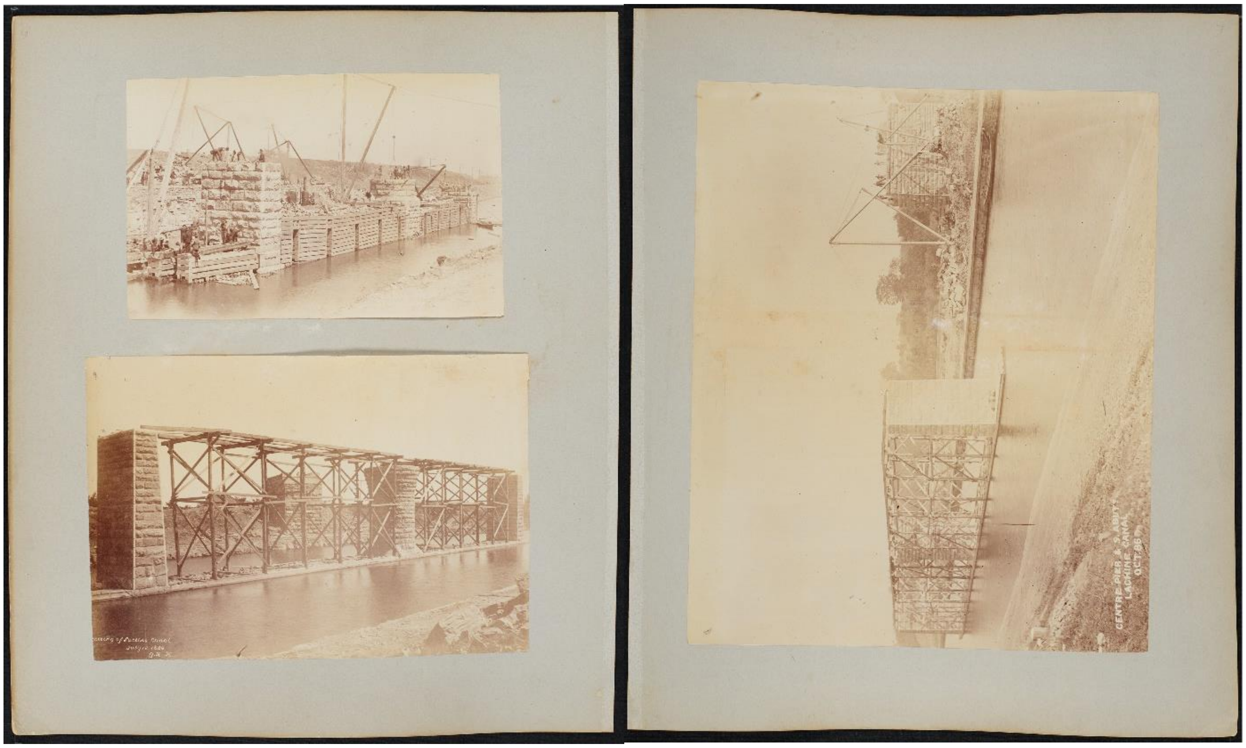

Figure 3.13: *Lachine Canal* (left) July 1886 and (right) October 1886. [LAC: C-256 Accession 1987-161, Box 2 #4, pages 3 and 4].

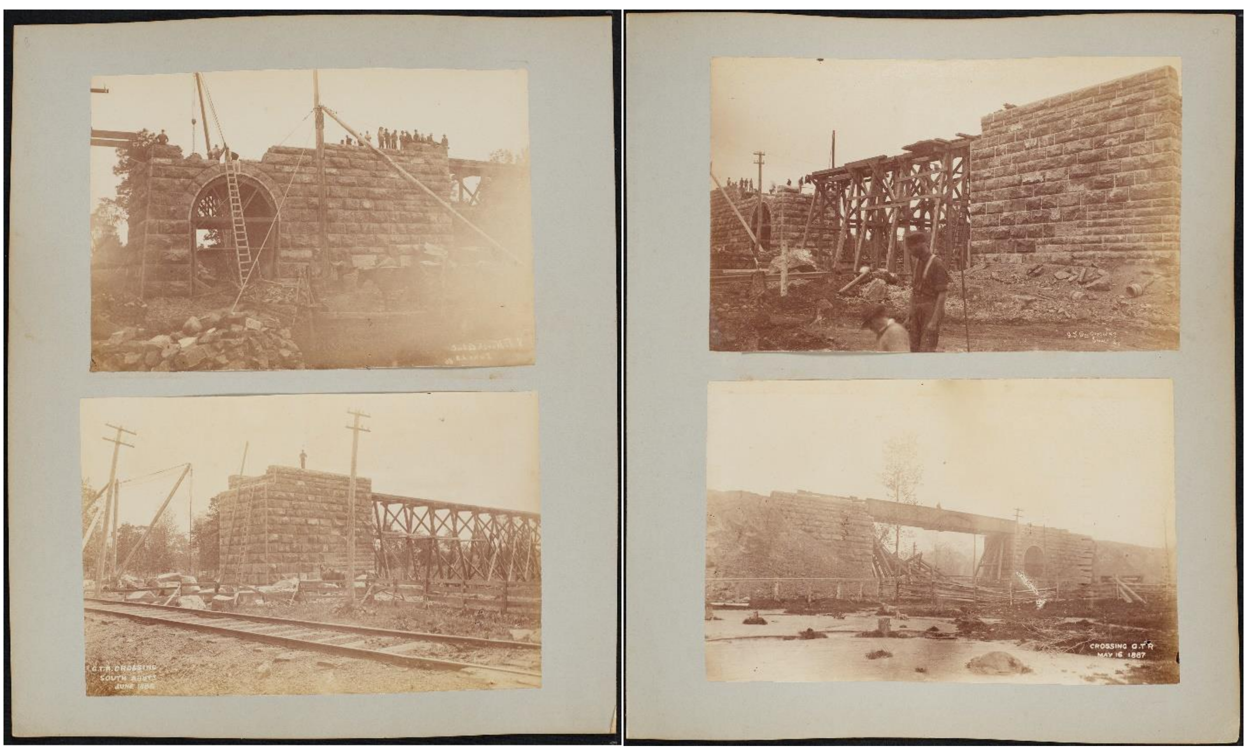

Figure 3.14: *Grand Trunk Railway North and South abutments, June 1886* and (bottom right) *May 16th, 1887.* [LAC: C-256 Accession 1987-161, Box 2 #4, pages 5 and 6].

Figure 3.15: *Blue Bonnets cut and fill. [LAC: C-256 Accession 1987-161, Box 2 #4, pages 7 and 8].*

Figure 3.16: Top left: *View of Bridge Sept 11-86*; Bottom left: *View of Bridge, Sept 22, 86*; Right: Untitled photograph. [LAC: C-256 Accession 1987-161, Box 2 #4, pages 19 and 20].

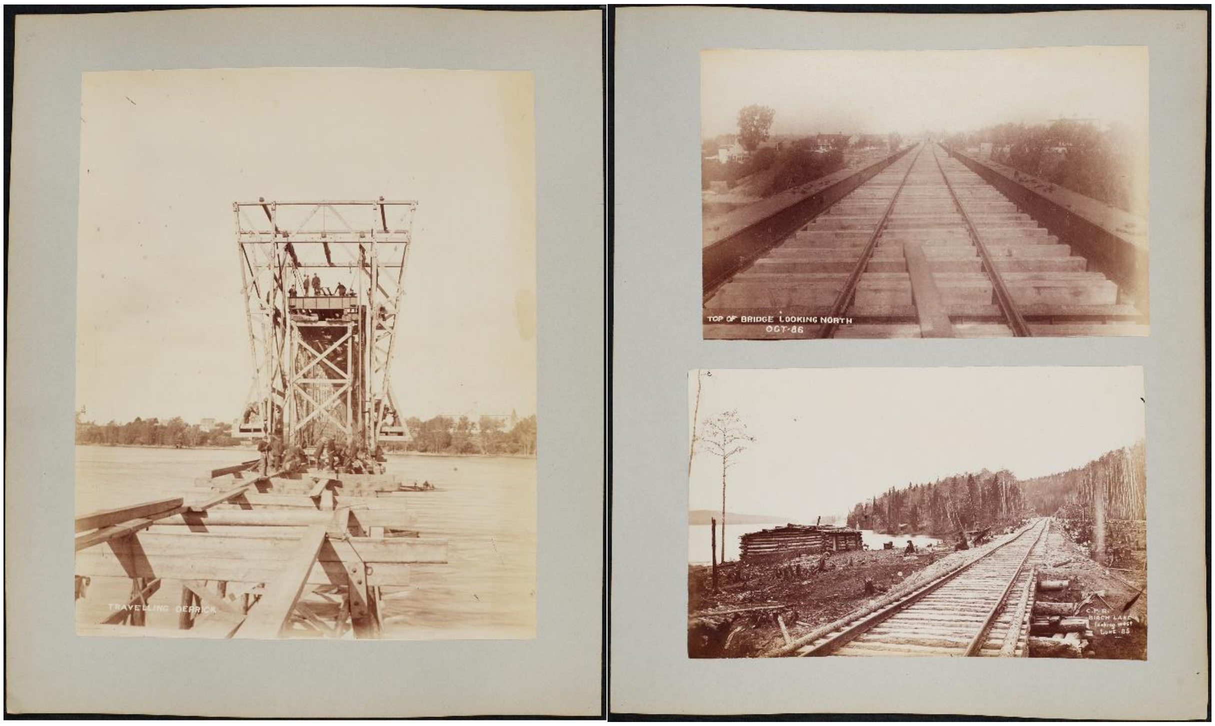

Figure 3.17: (Left) *Travelling Derrick,* (Upper right)*Top of Bridge looking north, Oct. 86,* (Lower right) *CPR Birch Lake, looking west, June, 85.* [LAC: C-256 Accession 1987-161, Box 2 #4, pages 21 and 22].

Figure 3.18: Left: *St. Lawrence Bridge under construction, Dec. 6, 1886*; Right: *St. Lawrence Bridge under construction, view form south side, Dec. 20, 1886.* [LAC: C-256 Accession 1987-161, Box 2 #4, pages 39 and 40].

Figure 3.19: The final page of the album, *St. Lawrence Bridge, during erection, May 5th, 1887.* [LAC: C-256 Accession 1987-161, Box 2 #4, pages 43].

Unlike Notman's "straightforward" photographs of the Victoria Bridge, Henderson represents the Saint-Laurent Bridge in a romantic style. His pictures convey technical aspects of the bridge and combine a sense of speed and atmospheric conditions, reminiscent of J. M. W. Turner's painting *Rain, Steam, and Speed – The Great Western Railway*.[374] The photograph, *St. Lawrence Bridge during erection, May 5th, 1887,* evokes a sense of movement and conjures the sound of a thundering train and its whistle.[375] Like Turner's painting, the photograph constructs an experience of landscape by capturing the soot from the steam engines blown by a lofting

[374] See for example, *Rain, Steam, and Speed – The Great Western Railway* by J. M. W. Turner, 1844 https://artuk.org/discover/artworks/rain-steam-and-speed-the-great-western-railway-115073

[375] Juhani Pallasmaa, "Space, Place, and Atmosphere: Peripheral Perception in Existential Experience Was Published in Architectural Atmospheres," in *Architectural Atmospheres*, ed. Christian Borch (Berlin, Boston: Birkhäuser, 2014), 18–41, https://www.degruyter.com/document/doi/10.1515/9783038211785.18/html.

wind, suggesting a smell or taste of coal will follow. Henderson's photographs engage multiple senses.

The Saint-Laurent Bridge Photographic Scrapbook

The scrapbook is wrapped and quarter-bound in green binder's cloth, with a black leather spine and no distinct markings on the cover (See Figure 3.11). Inside is written "J. R. Hooper 1886,"[376] scratched out and replaced with "G. H. Duggan 1888"[377] (See Figure 3.20). Both were engineers for the CPR at the time of bridge construction. According to former Library and Archives Canada curator Andrew Rogers, "the photos in the volume were either taken or acquired by either or both of these two individuals."[378] The scrapbook appears to be part of a personal collection and is well worn, with water damage and soot stains on the pages' upper edge. Although many of the scrapbook images are identical to those in the album, the scrapbook images are printed on inferior paper. Thus, many of the scrapbook images have faded over time.

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[376] Hooper was listed in *Lovell's Directory* as a civil engineer or assistant CPR engineer between 1885 and 1889. John Lovell, *Lovell's Montreal Directory for 1885–1886* (Montreal: Lovell and Sons, 1885), 410, http://bibnum2.banq.qc.ca/bna/lovell/; John Lovell, *Lovell's Montreal Directory for 1886–1887* (Montreal: Lovell and Sons, 1886), 396, http://bibnum2.banq.qc.ca/bna/lovell/; and John Lovell, *Lovell's Montreal Directory for 1887–1888* (Montreal: Lovell and Sons, 1887), 420, http://bibnum2.banq.qc.ca/bna/lovell/.

[377] Duggan was an accomplished engineer and faithful employee of the DBC: CPR Engineering Department, 1884–86; DBC Engineering Department, 1886–1901; chief engineer, 1891–1901. Claude Bélanger, "Quebec History: Prominent People of the Province of Quebec, 1923–24," *L'Encyclopédie de l'histoire du Québec/The Quebec History Encyclopedia*, accessed June 4, 2017, http://faculty.marianopolis.edu/c.belanger/quebechistory/encyclopedia/DugganGeorgeHerrick-QuebecHistory.htm.

[378] Andrew Rogers, email message to the author, April 14, 2014.

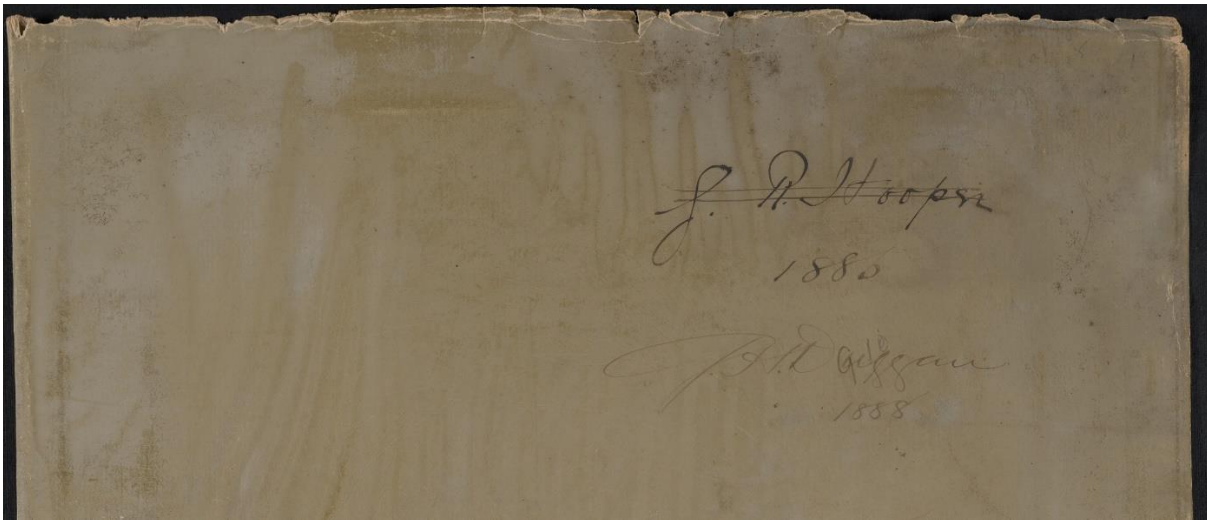

Figure 3.20: *Signatures on the inside cover of the Saint-Laurent Bridge Photographic Scrapbook.* [LAC: C-256 Accession 1987-161, Box 2 #3].

The images were carefully pasted into the scrapbook, and remnants of decorative black corners are visible in some cases. The photos have captions burnt onto the photographs and below each picture is a number. The images are loosely arranged chronologically and show little consideration in grouping by geographic location (See Figures 3.21 and 3.22). There are sixteen images unique to the scrapbook; they include various landmarks, like the Fleming windmill, St. Francis Xavier Mission Catholic Church in the Indigenous community of Kahnawake, and an active survey of a farmer’s field within view of the construction site (See Figures 3.23 and 3.24). Both the album and the scrapbook end without showing an image of the completed structure. However, the scrapbook displays the bridge in a state nearest to completion (See Figure 3.25).

Figure 3.21: The first page of the Saint-Laurent Bridge Photographic Scrapbook, no titles. [LAC: C-256 Accession 1987-161, Box 2 #3, Photographs one and two].

Figure 3.22: Left: *Cut and Fill operations,* Right: *Cofferdams*. [LAC: C-256 Accession 1987-161, Box 2 #3, Photographs fifteen to eighteen].

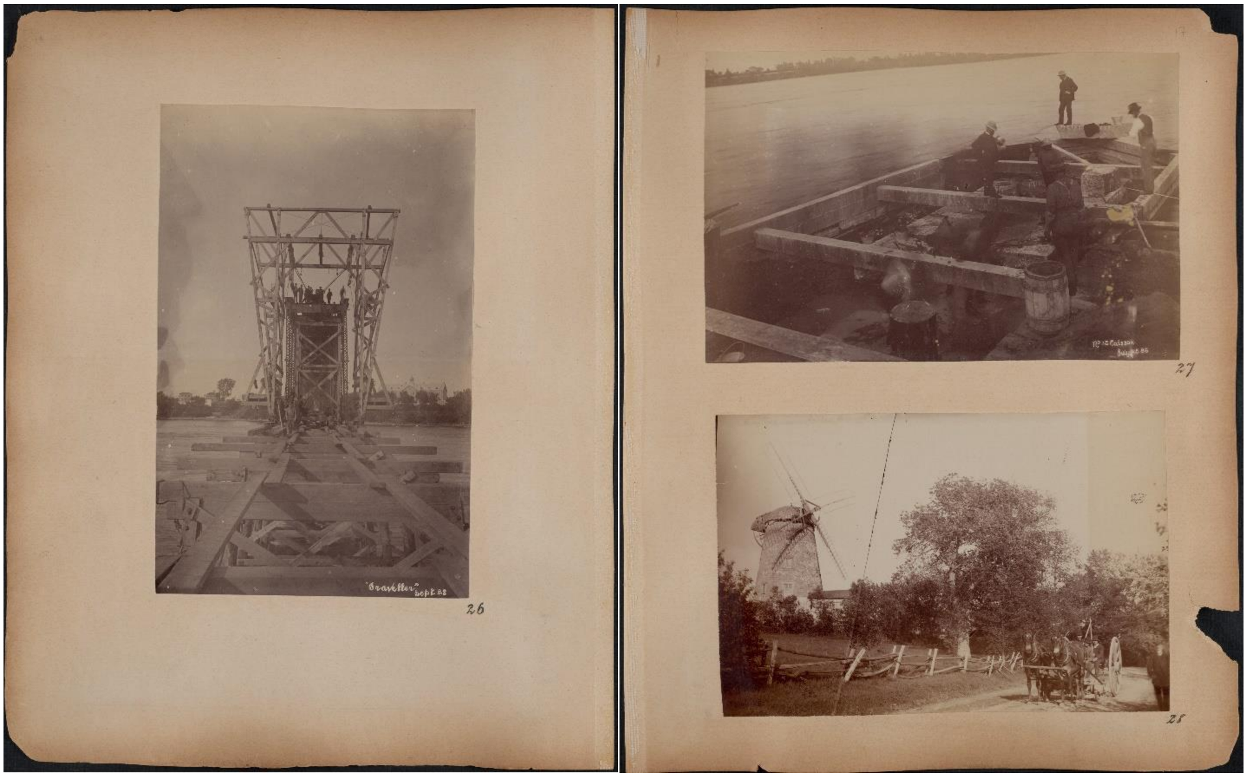

Figure 3.23: *Left: The "Traveller"*, Top right: *Pier construction,* Bottom right: *Fleming's Mill*. [LAC: C-256 Accession 1987-161, Box 2 #3, Photographs twenty-six to twenty-eight].

Figure 3.24: Sample images from inside the scrapbook: Left: *Slope Stake instrument;* Right: *Caughnawaga Church, 1886.* [LAC: C-256 Accession 1987-161, Box 2 #3; Photographs forty and forty-one].

Figure 3.25: *The final image in the scrapbook showing the superstructure.* [LAC: C-256 Accession 1987-161, Box 2 #3].

The second set of photographs show almost identical photographs to the album. Yet, they convey a story that engages with landmarks on the construction site's periphery in their arrangement. The Saint-Laurent Bridge photographs document change in a (then) remote part of the island, and they capture part of rural life on the island. Like the story of the bridge's construction in relation to the greater CPR, the photographs detail a little-known account of the history of Montreal.

The Jacques Cartier Bridge

The DBC began a tradition of photographing its bridge construction project with the Saint-Laurent Bridge and continued the custom well into the twentieth century. The Jacques Cartier Bridge photographs are organized in eight albums that capture advances on the superstructure, with particular attention paid to the cantilever. The images supplement a technical paper Wilson first presented to the Engineering Institute of Canada.[379] The photos also enrich a commemorative booklet that celebrates the construction of the cantilever. All three artifacts are described below.

The Jacques Cartier Bridge Photograph Albums

The albums are covered in black leather with no distinguishing marks on the front or back (See Figure 3.26). The manufacturer's name, “Charles F. Dawson Limited, Montreal,” is stamped in a small gold print font at the bottom of the inside cover.[380] Tacked onto the spine with six short nails are tags or identification plates. The embossed metal gives an industrial feel to the albums. The tags’ raised text marks each album with a serial number, one through eight, although album three is missing from the collection.[381] The labels are centred and oriented to be read when the albums are laid flat. The tags are cut to the album’s spine's width, showing they are designed specifically for these albums. The labels are longer than they are wide, and the short edges are rounded, cut into half-moons, softening the look and removing all sharp metal corners. There is no indication of whether the bookmaker produced the tags or made them with the tool and die equipment in the DBC shops. The number tags are powder coated or painted a steel-like colour and blend with the albums’ dark covers.

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[379] L. R. Wilson, “Fabrication and Erection of the Superstructure of the Montreal-South Shore Bridge,” *The Engineering Journal* XIII (January 1930): 3–57.

[380] Starting in 1889, Charles Dawson and his father, William, focused their efforts on stationery and blank-book manufacturing and import. George L. Parker, “Samuel Edward Dawson,” *Dictionary of Canadian Biography*, 1911–1920, accessed January 24, 2018, http://www.biographi.ca/en/bio/dawson_samuel_edward_14E.html.

[381] The archival box contains eight albums. The last, labeled #19 on the spine, differs from the main collection.

Figure 3.26: *Jacques Cartier Bridge construction photograph albums*. [LAC: Dominion Bridge Co. Accession 1974-234, Box 5430-5432]

The albums also have a dual numbering system adhered to their spine, indicating that the DBC managed the collection over time. Compared with the hundreds of photographs held in bankers' boxes, the care taken to arrange and label this collection suggests that the construction photographs are valuable. In contrast to the metal plates, the second set of identifiers are white self-adhesive labels with handwritten cursive text in black ink. These labels are positioned to the left of the dark metal tags and oriented to be read when laid flat, indicating someone considered the first before adding the second identification system. The second set identifies the albums as nine through sixteen, suggesting an additional eight albums exist or existed. Based on the dual numbering system, the missing photographs are of earlier works, like the piers.

Under the new system, the albums start with #12 and work up to #19 on the last.[382] A second white sticky label to the tag's right, written in the same cursive handwriting and black ink as the first album number, specifies the photographs inside. Their index number lists the photographs, and a summary of the total number of photos in each album is provided. The photographs are held between the covers by sturdy screw-pins.

[382] The album labelled #19 is covered in a lighter brown leather, has no number tag, and contains miscellaneous photographs of the bridge.

The arrangement of the photographs is in reverse chronological order. An engineer, photographer, or DBC administrator placed the newest photos (from 1930) were placed at the beginning of album number eight, leading back to the pictures (from 1926) at the back of album number one. In other words, a reader sees the deconstruction of the bridge when moving from the front of the album to the back.

Each album contains approximately fifty photographs that are affixed, single-sided, to the white cloth sheet. In many cases, the cloth is frayed at the edges, indicating years of use. The eight-by-ten-inch photographs are marked with a date and a unique code. The catalogue number begins with the letter "F" and is followed by four digits that progress in sequence alongside the dates.

Of the over three hundred photographs in the collection, only thirty-two indicate their source. The earliest photographs, taken between September 23 and December 10, 1926, are fixed with a photographer's stamp that reads, "Photography by British & Colonial Press Limited; 275 Craig Street West, Montreal; When ordering further copies of this print refer to Negative Nos: ____."[383] The company supplied news stories to readers in the Dominion and the stamp implies national and international interest in the project.[384]

The Technical Paper

Wilson wrote about the erection of the bridge, and an abridged version of his paper first appeared in the January 1930 issue of the *Engineering Journal*.[385] Wilson presented the full-

[383] "Jacques Cartier Bridge Photograph Albums" (Albums, 1930 1926), Box 20000777513, 5430 to 5432, Accession 1974-234, Fonds Dominion Bridge Company, LAC.

[384] "Huron Institute Papers and Records" (Huron Institute Papers, Collingwood, 1914), 36. Given that British & Colonial Press Limited had offices across the country and photographs of prominent architecture in every city, more work could be done on the role this agency played in shaping perceptions about the built environment.

[385] In a footnote, the article indicates it was first printed in the January 1930 issue and presented at the annual meeting in February. The copy consulted was printed in February 1930. Wilson, "Fabrication and Erection of the Superstructure of the Montreal-South Shore Bridge."

length paper at the Ottawa annual general and professional meeting of the Engineering Institute of Canada on February 14th, 1930. A reprinted copy of the article with the plates included is held at the Canadian Centre for Architecture (CCA) (See Figure 3.27). The document may have been bound for the engineer or an individual patron. The publication's soft cover is made of brown cloth, and its title, *The Montreal–South Shore Bridge: Fabrication and Erection of the Superstructure*, is foil-stamped in gold. The spine and back cover are blank.

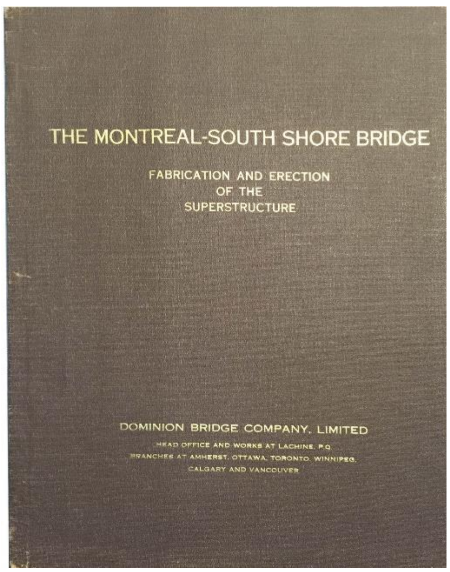

Figure 3.27: Book cover, *The Montreal-South Shore Bridge* [CCA]

The interior cover plate reverses the cover title, *Fabrication and Erection of the Superstructure of the Montreal–South Shore Bridge* and the publication body is printed in black and white on standard letter-sized, semi-gloss paper. The book has a portrait orientation, and the text is aligned in two evenly distributed columns (See Figure 3.28).

Figure No. 22.—North Approach—Typical Method of Erection—First Stage.

The trusses are supported at the main piers on shoes of special design, consisting in each case of a cast-steel base in three sections on which is mounted a structural member built up of four massive webs with inter-connecting diaphragms. (See figures Nos. 44 and 69.) The base rests on a bush-hammered surface on the pier concrete, layers of heavy canvas being laid on this surface and coated with red lead just prior to the placing of the castings in position. The base is connected to the pier by anchor bolts which were set in advance to template, and to the upper shoe section by rivets and turned bolts. All truss members converging on the shoes are pin-connected, important advantages being facility of erection and easement of secondary bending stress by rotation on the pins. The bottom chord and shoe connections consist of 20-inch diameter pins in split bushings of 30 inches external diameter. For the main post, the pins are 24 inches and the split bushings 36 inches diameter; for the diagonals, the pins are 16 inches diameter, no bushings being required. All bored holes are semi-circular; single plates were, however, extended on the bottom chords and on the inner webs of the shoes to fully engage the pin bushings, thus providing a positive connection during the early stages of erection. The base castings of the shoes weighed 17 tons each; the upper sections were divided longitudinally in halves for shipment, each unit weighing about 39 tons.

Each main post consists of six sections, the location of the splices being determined by weights and to suit the members connecting to the posts. The sections are built up of two webs 84 inches wide and 47½ inches apart, with a continuous middle diaphragm and a plane of lacing on either flange. (See figure No. 25.) The upper post sections which support the links are provided with wing plates on either side, bored to engage the pins which connect the upper diagonals to the links. (See figure No. 26.) The weight of each post section was approximately 40 tons.

In order to avoid heavy secondary bending stresses at the top of the main post during erection and in the completed structure, links are provided similar in principle to those used in the Quebec bridge. (See figures Nos. 27 and 28.) Each link is built up of four massive webs with inter-connecting diaphragms, and is carried on top of the main post on a pin with split bushings of the same size and type as at the base of the post. The converging truss members are pin-connected, the size of the pins being 21 inches for the top chords and 13 inches for the upper diagonals. The wing plates on the upper post sections provide interlocking connections with the links which ensure stability under all conditions, any unbalanced loading being readily compensated by the bending resistance of the posts. The construction also proved most convenient during erection. The links are surmounted by ornamental finials of simple plate construction with cast iron caps. The links were divided longitudinally in halves for shipment, each unit weighing about 25 tons.

The bottom chords of the anchor and cantilever arms are spliced at all main panel points, and at the mid-panel point where necessary on account of weight. The sections are built up of two webs 42½ inches apart and tapering in depth from 60 inches at the shoes to 39 inches at the anchor pier and 42 inches at *CLO* on the cantilever arm. (See figure No. 37.) In the heavier members the webs are connected by continuous coverplates on the top flanges and lacing on the bottom; elsewhere, by lacing on both flanges. (See figure No. 29.) The main gusset plates are spliced into the webs, the chord joints being located in each case at the edge of the gusset plates. All joints are of the butt-type but spliced in addition for practically the full value of the material. The various sections varied in weight up to a maximum of about 40 tons.

The top chords are spliced at all main panel points and were also divided longitudinally in halves for shipment where necessary on account of weight. The sections are built up of two webs 42½ inches apart and vary in depth from 62 inches at the main post to 40 inches at the ends of the arms. The depth is constant throughout each panel, but is made to reduce about 3 inches in each successive

Figure No. 23.—North Approach—Typical Method of Erection—Second Stage.

19

Figure 3.28: *Photographs of the unfinished viaduct,* in Wilson "The Montreal-South Shore Bridge," 19.

The fifty-four-page publication contains 102 images, including ninety-seven photographs from the album collection. The photos are scattered throughout at varying sizes. The pictures are cropped, and the catalogue number and date are removed. In their place, the images have captions assigned to them that describe the location and information about the construction process shown. The text references the photos; however, the images are separated from their citations by a dozen or more pages. The photos in Wilson's paper support the textual account.

The Commemorative Booklet

The commemorative booklet, *The Superstructure of the Montreal Harbour Bridge over the St. Lawrence River,* takes a visual approach to recount the story of the bridge. The book's cover, for example, emphasizes a visual approach by including an image of the nearly completed bridge (See Figure 3.29). The titles and pictures are screened directly on the paper cover. The main image consists of a travelling derrick located on the superstructure near the right side of the image that indicates that construction is ongoing and that motor vehicles have yet to cross the bridge. The harbour operations in the foreground and the ship in the centre background draw direct links between the MHC and the bridge.

Two smaller illustrations on the bottom half of the cover are symbolic of the enormous piers supporting the superstructure. The tiny graphics essentially "hold up" the bridge manufacturer's name. The image on the left depicts a large ship, perhaps the same boat seen in the larger image above, with plumes of billowing smoke. To the right is a sketch of a contemporaneous car and truck with what appears to be the bridge design in the background. The two small illustrations signify the primary modes of transportation passing under and over the bridge.

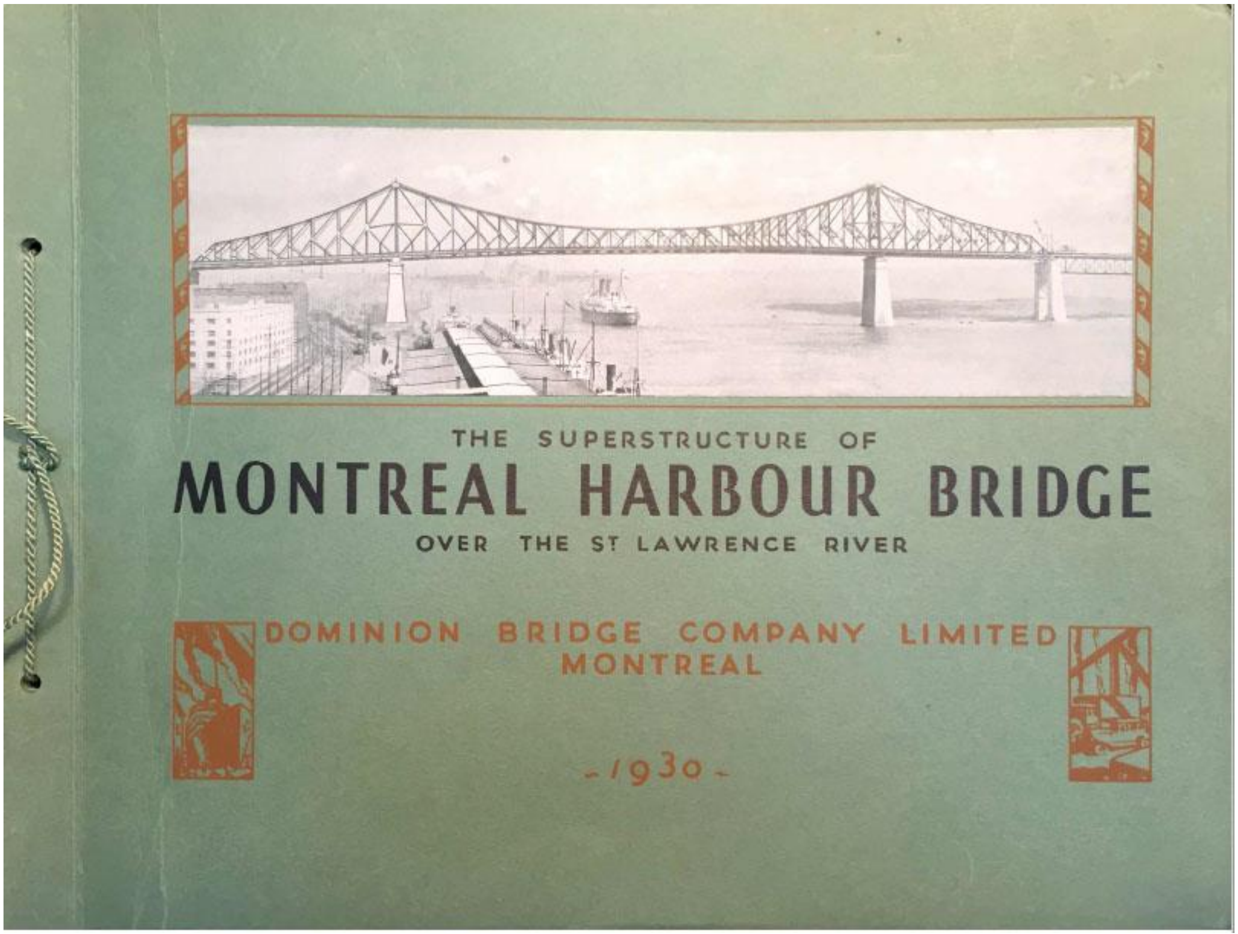

Figure 3.29: Cover of *The Superstructure of Montreal Harbour Bridge over the St. Lawrence River* [CCA].

The copy held at the CCA has its original covers and binding, a matching fern paper and a cotton string. The book's simple joining suggests that the Gazette Printing Company of Montreal made a limited number of copies. A second copy, held at the McGill University Rare Books and Special Collections Library, is rebound in a hardcover, reinforcing the original publication's delicate cover.

The contents are laid out in portrait format over fifty-one pages and printed in black and white on semi-gloss paper. Approximately two dozen pages are reproductions of photographs taken during construction and generally focus on the cantilever. The first photograph stands out because it captures Senator W. L. McDougald, the man credited with making the bridge a reality by the book's editor.

McDougald, and an unnamed editor, also described the MHC role and the importance of an advisory board of engineers in reviewing all plans and specifications and in disseminating technical details for the MHC. The short text introduces the design team and the pier and superstructure contractors, breaking down the project's complex administrative web. Before the booklet gives way to its visual narrative, a short synopsis of the construction process occurs. It borrows details from the paper, as mentioned above by Wilson. The abridged version focuses solely on the cantilever over the harbour, avoiding reference to manufacturing or other bridge elements, such as the piers and viaducts.

A simple line drawing captures Wilson's technical details and distills the information for the lay reader (See Figure 3.30). The diagram acknowledges some buildings, like the pump station and one of Molson's brewery building, as permanent fixtures by incorporation the structures in the ground plane. The construction required a significant amount of expropriation and demolition, and this diagram shows how the bridge steps over these two buildings without labelling them.

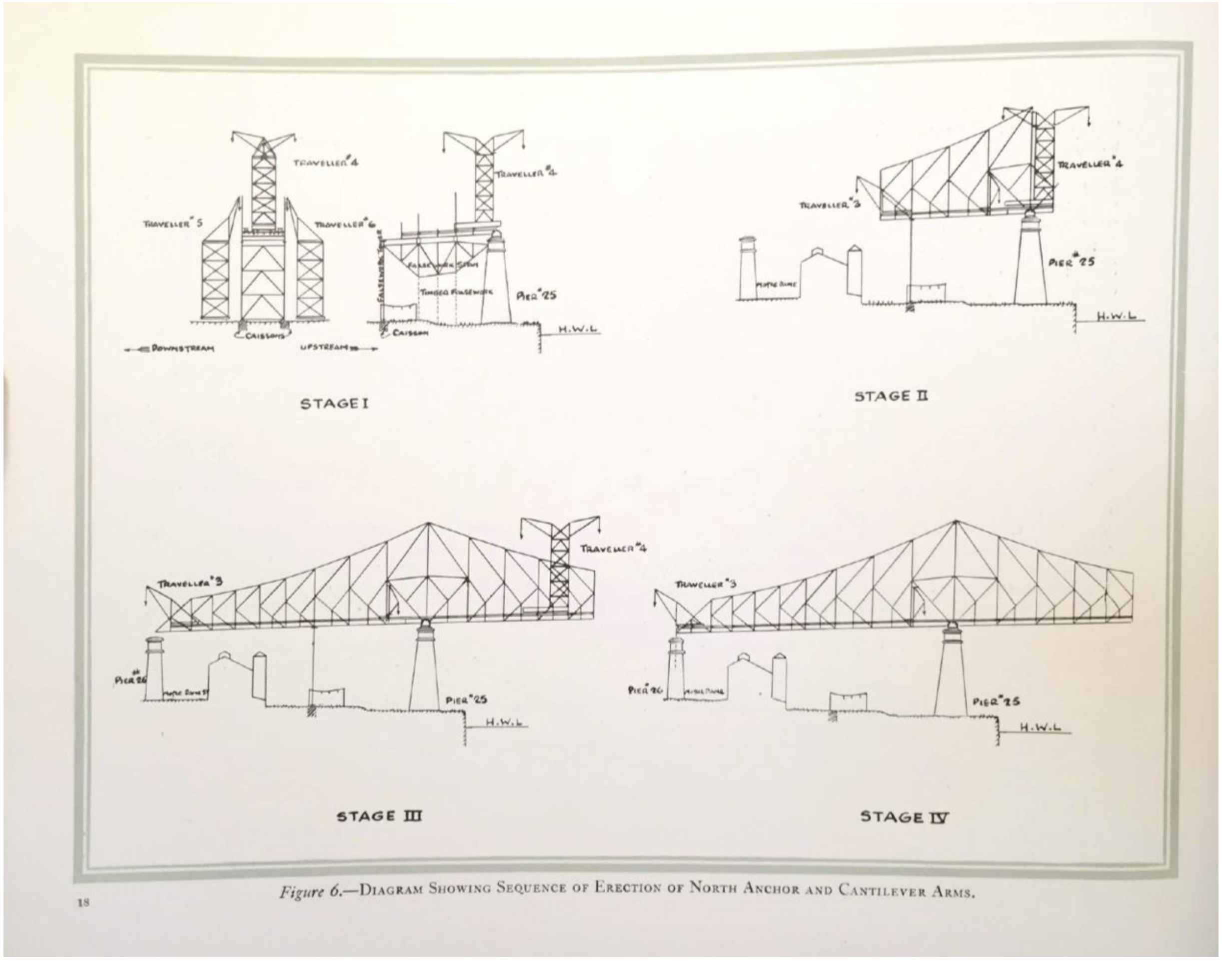

Figure 3.30: Diagram showing the sequence of erection for the north anchor and cantilever arms, Jacques Cartier Bridge [DBC, *Superstructure of Montreal Harbour Bridge,* 18 (Figure 6)].

The illustrated booklet progresses like a time-lapse photo-series about constructing the main cantilever, depicting a triumphant end without showing how the bridge connects to the ground. The photographs are mostly taken from the ground and mimic the diagram showing the sequence of construction. By contrast, a few images capture the city skyline and port activities from above (See Figure 3.31).

Figure 3.31: *Image showing advances on the bridge with the busy port in the background.* [DBC, Superstructure of Montreal Harbour Bridge, 22 (Figure 18)].

The MHC and its engineers likely gifted the booklet to special guests at the official opening. The booklet focuses on the superstructure by reducing it to a simple line drawing that teaches its audience how to read the bridge in relation to the harbour. Furthermore, the booklet's photographs represent the construction, much like tourists visiting a well-known site, presenting the best angle to capture the newest industrial landmark to modify the city's skyline.

In the 1950s, Pratley was employed to oversee the south approaches of all three bridges. The significant project was to accommodate the construction of the St. Lawrence Seaway.[386] Shortly

[386] For more on the Seaway, see Daniel Macfarlane, *Negotiating a River: Canada, the US, and the Creation of the St. Lawrence Seaway* (Vancouver: UBC Press, 2014).

after, Pratley oversaw the fifth bridge construction over the river, the Champlain Bridge (erected 1957-62 and decommissioned in 2019).

The first three bridges to cross the river had a significant influence on the movement of goods to and from the city's hinterland.[387] Moreover, the bridges shaped the experiences of passengers arriving in the city. Before bridge construction, passengers came by way of the river or crossed the river after travelling by carriage or train. In the winter, they crossed the ice bridge. The Victoria Tubular Bridge thrust passengers into a dark and smoke-filled tunnel, eliminating all the river's connection. The Saint-Laurent Bridge carried commuters over a relatively calm section of the river. At the same time, the Jacques Cartier Bridge brought automobile passengers from the city's edge to impressive heights above the river. Each new bridge and its photographic record created new ways of seeing the city.

[387] For more on the port's geographical timeline and rhythms of capital accumulation, see Jason Gilliland, "Muddy Shore to Modern Port: Redimensioning the Montréal Waterfront Time-Space," *Canadian Geographer* 48, 4 (December 1, 2004): 448–72.

Chapter Four: Landscape Narratives

The previous chapters introduced three Montreal bridges and visual records of their construction processes. This chapter, “Landscape Narratives,” explores the interpretive potential of reading the reports and the documents with and against one another. The first section, The Tourist Gaze, reflects on the colonial landscape and the potential conflicts of interest surrounding it by texting Hodges’s account with the visual narrative Notman produced in his album for Alexander Ross. The second section, The Scientific Gaze, considers the role of the ice in developing a landscape history of the St. Lawrence River by, again, assessing Hodges’s and Notman’s records of the ecological forces acting upon the bridge. The third section, The Landscape Gaze, explores movement through space and the significance of the order of photographs in an album by reading the Saint-Laurent Bridge album against the scrapbook. The final section, The Landscape Gaze Amplified, examines the problem with viewing from a single perspective by reviewing the DBC souvenir booklet with photographs from each of the other two collections.

The tourist gaze: A Bridge in the Colonies

When approached about his father’s achievements, nineteenth-century bridge architect and railway entrepreneur Robert Stephenson “expressed strong doubts” that engineering or engineers were of interest to readers. As proof, Stephenson cited a little-known publication on British engineers. It is about architect Thomas Telford’s lifework. Stephenson described Telford and the “building of bridges, the excavation of tunnels, the making of roads and railways are mere mechanical matters, possessing no literary interest."[388] In this instance, Stephenson played into the Victorian narrative that engineering was laborious work. Yet, by the middle of the century, the public celebrated the heroic efforts of bridge builders. Stephenson's Conwy and Britannia tubular railway bridges (1849 and 1850, respectively) in Wales—precursors for the Victoria Bridge that opened a decade later in Montreal—were celebrated among the outstanding achievements of Victorian engineers.

The subjects of a growing literary genre connected nature, technology, and economic expansion; the railways appeared in handbooks or travel guides for tourists. In 1846, British engineer and cartographer Charles Cheffins commissioned British artist and engraver John Cooke Bourne to produce a series of drawings of the Great Western Railway. As Bourne explained in the preface to his collection, *The History and Description of the Great Western Railway,* he "intended his direct, powerful drawings to display the stations, bridges, tunnels and viaducts to the passengers who were whirled past them so rapidly that, otherwise, they had no chance to appreciate their world."[389]The illustrations, inspired by "splendid heroic enterprises" were teaching the public how to look at achievements of engineers.

Mid-nineteenth-century, author Thomas Jackson played on an elite British audience's curiosity of the United Kingdom. He used text and images to entice train ridership in *A Tourist's Guide to the Britannia Bridge*. The book describes the proximity of Stephenson's railway bridge with nearby landscape features, such as the Menai Suspension Bridge (1826) by engineer and architect Thomas Telford, emphasizing the importance of the recent project and composing the

[388] Samuel Smiles, *Lives of the Engineers, with an Account of Their Principal Works Comprising Also a History of Inland Communication in Britain* (London: J. Murray, 1862), iii.
[389] Francis D. Klingender, *Art and the Industrial Revolution* (New York: Royal Publication, 1947), 158.

scene as a spectacle for consumption.[390] Jackson used the language of seventeenth- and eighteenth-century landscape painters to reiterate well-known landscape ideologies and invited would-be travellers to imagine the "picturesque beauty" and "truly sublime and gorgeous panorama" of a landscape.[391] Railway guidebooks, often accompanied by aquatint imagery, unite readers with dramatic scenes before they begin their journey to see the latter.

Like Jackson's, tourism books and those produced by John Weale's publishing house, the Architectural Library, sparked the public imagination. For example, in honour of London's 1851 Great Exhibition, Weale published a guidebook called *London Exhibited*, portraying the city (in 205 illustrations and scientifically "accurate maps") as the largest and wealthiest in the world.[392] Reviews printed at the back of the book praise the publisher for his ability to convey the great architectural, engineering, and artistic works in the city; one reviewer writes, "For London, at an epoch like the present, the publication before us is a most complete statistical, artistical, and amusive poof of reference."[393] The book promoted the incorporation of geology, natural history, the arts, manufacturing, architecture (both historical and contemporary), and economics and trade to attract "learned and scientific minds" and those inclined to business and tourism.

In 1860, Weale printed Hodges's book on the Victoria Bridge. In her article, "Photographic Documentation and Building: Relationships Past and Present," Phyllis Lambert points out that

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[390] John Urry, "The Tourist Gaze 'Revisited,'" *American Behavioral Scientist* 36, no. 2 (November 1992): 173.

[391] The account reads as follows: "Standing on this fossiliferous throne, you find yourself surrounded with a scenery of great diversity and picturesque beauty, forming at once a truly sublime and gorgeous panorama." Thomas Jackson, *The Tourist's Guide to Britannia Bridge: Containing a Descriptive Account of the Towers, Tubes and Stages, Mode of Floating the Tubes, the Hydraulic Press, and of All Objects of Interest Connected with This Wonder of the World, Also a Particular Account of the Conway Tubular Bridge, the Grand Menai Suspension Bridge, and Other Interesting Information: Illustrated with Numerous Engravings* (London: Smith and Sons, 1851), 14.

[392] John Weale, *London Exhibited in 1852; Elucidating Its Natural and Physical Characteristics; Antiquity and Architecture; Arts, Manufactures, Trade, and Organization; Social, Literary, and Scientific Institutions; and Numerous Galleries of Fine Art.* (London: J. Weale, 1852).

[393] Weale, *London Exhibited*, 913.

the first books in the United States to use “photographs transformed into lithographs for the purpose of reproduction”[394] appeared the same year as Weale’s publication. Lambert’s observation asserts that Weale’s publication was extraordinary for its time and for those in the colonies who received a copy. The book stands out for many reasons, and great care was taken to explore its many contributors and versions.[395]

The text and imagery described the scientific and technological measures used to build the bridge while giving a brief overview of life in the colonies. Like the content of *London Exhibited*, the text and imagery in Hodges’s book were presented for “learned and scientific minds.” Several lithographs in the book are from Notman’s photographs and James Hodges wrote the text; both men arrived in the colony within two to four years of their participation in the construction and representation of the bridge. While not typical tourists, the two men arguably fix a “tourist gaze”[396] on the landscape.

For American sociologist John Urry, a tourist gazes upon something that is set apart from the everyday, or mundane activities. “Tourists have heightened senses,” writes Urry, and their “visual awareness can be tied to preconceived or pre-learned notions of landscape [or convey] small signifiers (signs) telling us [the viewer] to look and find interest in the mundane.”[397] While many of Notman’s photographs are transposed into lithographs, observing at the original prints

[394] Lambert, “Photographic Documentation and Buildings,” 64–65.

[395] In total, I consulted seven copies of the souvenir book: including four copies held at the Canada Science and Technology Museum (CSTM), and one each at the ROAAR, CCA, and MM. It was important for me to see if the images appeared in the same order (they do) and I was curious to see the condition of the different copies (they vary in condition, size, and presentation). The book is typically listed as a double volume, meaning that a set of fold-out engineering plates were bound into the back of the edition. In one CSTM copy only, the plates were a separate volume. The CSTM also holds a signed copy in its original velvet-lined presentation box and two copies of a condensed or ordinary octavo version (at roughly half the standard size) that incorporates the full text and lithographs but not the pull-out technical drawings at the end. The size and condition of the different copies of the book has little bearing on this research.

[396] John Urry, *The Tourist Gaze: Leisure and Travel in Contemporary Societies*, Theory, Culture & Society (London: Sage Publications, 1990).

[397] Urry, “The Tourist Gaze ‘Revisited’,” 172.

in conjunction with Hodges's text demonstrates how the camera lens reflects a tourist's gaze. The former McCord Museum Curator Stanley Triggs identifies the photographic record as "one of the greatest records of engineering works" that mould art and science together "like the stone and steel of the bridge."[398] The photographs also fuse the ways in which Hodges and Notman viewed and wanted the colonies to be viewed by others.

For the most part, Notman's photographs of the Victoria Bridge are cropped tightly to their subject, framing the bridge or machinery, and eliminating all extraneous detail, including the expansive landscape. For Baillargeon, the camera is a tool of the engineer, operated by the photographer. The storyline is internal to the engineer and influenced by the photographer. Photographs, "as expressions of engineering triumphs and architectural price, construction and other industrial photographs," he writes, "were well adapted to promote and monumentalize both individual and collective achievements."[399] Most of these photographs position the viewer from the shore or a raised position, like the top of a pier, looking out on the river. The pictures assess advances on the superstructure. The position imitates the role of the engineer overseeing advancements on the project. Thirty-five out of the forty full-sized photographs—affixed one-per-page in the *Alex Ross Album*—follow this pattern. The deviations within the thirty-five are understandable; they expose the bottom of a caisson and machinery associated with the project, a dredge bucket, locomotives, and snow removal machines.

[398] Stanley Triggs, *William Notman: The Stamp of a Studio* (Toronto: Art Gallery of Ontario, 1985), 24.
[399] Baillargeon, "Religious Fervor and Photographic Propaganda," 18.

Figure 4.0: *No. 1 Grand Trunk Works from Entrance to Tube and No. 2 View from North Abutment,* William Notman, April 19, 1859 [LAC: Alex Ross Album].

The five photographs that position the viewer with their back to the bridge stand out; they draw a distinct connection between the construction project and the built environment. The panorama lays claim on the city, from the perspective of the bridge builders; the mostly British railway entrepreneurs and British engineers. “Each alteration to the city's landscape resolves but also provokes,” writes urban historian Eric Sandweiss.[400] The photographic sequence captures the line of the bridge in relation to the industry, the built environment, and the river. “It freezes some social relation within a structure of wood or stone,” Sandweiss continues, “yet the very presence of that material image, like a tree fallen in a fast-moving stream, rechannels the currents of human intercourse, making a quiet backwater of one spot and a raging torrent of another.”[401] The camera's position, approximately at the entrance to the tube, captures the cause and effect of the bridge in relation to the city.

[400] Sandweiss, “Claiming the Urban Landscape,” 16.
[401] Ibid.

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Figure 4.1: *No. 3 View from Entrance to Tube,* William Notman, April 19, 1858 [LAC: Alex Ross Album].

The first two photographs, *No. 1 Grand Trunk Works from Entrance to Tube* and *No. 2 View from North Abutment,* capture development directly associated with the construction project (See Figure 4.0). The first pictures the Grand Trunk Railway warehouses and shops used to store and assemble the bridge components. The second provides an overview of the housing constructed for the workers brought over from Britain to work on the bridge. Hodges describes the first working season as "a period of disaster, difficulty, and trouble."[402] His inexperience with the climate and country, coupled with environmental and mechanical delays—storms carrying materials downstream, forest fires obscuring sightlines, and inadequate pumps—slowed

[402] Hodges, *Construction of the Great Victoria Bridge in Canada*, 25.

progress. A construction boom across North America and competition for labourers in the Montreal shipping and agriculture sectors and, combined with sickness and striking workers, meant labour was scarce. Hodges complained that "those brought from England barely worked four days a week, even though their contracts said otherwise."[403] Therefore, the GTR laid claim on the space around the entrance to the bridge in building the housing and industrial complex.

Early in his book on the Victoria Bridge, James Hodges cast his impressions on the colonial landscape. "The scenery at the point at which the bridge is thus constructed, if not grand, is far from uninteresting," and Hodges continues, "the City of Montreal [lays] on a sloping site [and] the towers of its cathedral and numerous church spires adding continually to the picturesque appearance of its white, well-built houses, which are frequently well placed amid shrubberies and gardens."[404] His descriptions are evident in the third photograph of the panorama, *No. 3 View from Entrance to Tube* (See Figure 4.1). Hodges concludes, "the whole character of the scenery is agreeable and English." Thus, every aspect of his report and the imagery that supports it, must be considered as part of Hodges's experience in the colony. The album photographs, coming from Notman and gifted to Ross, are an extension of the colonial view.

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[403] Ibid.
[404] Ibid., 5.

Figure 4.2: *No. 4 View from the Entrance to Tube* and *Boat House Piers & St. Helen's Island from Top of North Abutment,* William Notman, April 19, 1859 [LAC: Alex Ross Album].

Images *No. 4 View from the Entrance to Tube* and *Boat House Piers & St. Helen's Island from Top of North Abutment* complete the panorama. This series of photographs represent Hodges's preliminary observations of the city. Yet, visual evidence of the state of the city is missing from his account. The photos provide a view of the city that, until the bridge, could only be seen by people travelling on the river by boat.

Until the completion of the Victoria Bridge, British tourists travelling to Montreal arrived by boat with preconceived notions about the colonies. In describing cultural representation and appropriation in colonial settings, literature scholar, Mary Louise Pratt describes the "seeing-man," whose "imperial eyes … look out and possess," presents "an utterly benign and abstract appropriation."[405] In other words, the British tourist impresses their view on what lay before them.

Hodges cites books and music as his source to understand the colonies. "After so much form and ceremony as had been expended on the preliminaries, he [Hodges himself] certainly expected to have met chiefs ornamented after the manner of those in [James Fenimore] Cooper's

[405] Mary Louise Pratt, *Imperial Eyes: Travel Writing and Transculturation*, 2nd. (London; New York: Routledge, 2008), 9.

novels."[406] Hodges anticipated painted faces, feathered headdresses, and the sharing of a peace pipe and was disappointed to find the Chiefs in Kahnawake dressed otherwise. Even though Hodges's does not see what he expects, Weale inserts an image of the Chiefs that reflects both Hodge's prejudice and fosters Cooper's idealized image.

While Hodges did not see what he anticipated, he heard songs on the river that he expected. Early in this tenure, Hodges describes the movement of the ice. He writes, the "ice comes rushing down from all around, from the Ottawa River, over the rapids of St. Anne's (as heard in the song)."[407] He is referring to Thomas Moore's "A Canadian Boat Song" with the lyrics:

> Faintly as tolls the evening chime,
> Our voices keep tune and our oars keep time.
> Soon as the woods on shore look dim,
> We'll sing at St. Anne's our parting hymn.
> Row, brothers, row, the stream runs fast,
> The Rapids are near and the daylight's past!

The song represents yet another cultural appropriation. Historian Daniel Laxer finds, "Moore's song promoted the image of a picturesque and pliant French peasantry, complimenting their ancestral folk songs yet demonstrating how they might be civilized through harmonization and recomposition."[408] The songs set the French "voyageurs" in a romantic wilderness whereby they were willful participating in the British conquest, and translated into English, the songs assimilate the French experience with that of a British tourist. Hodges draws attention to the

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[406] The most popular of Cooper's books, *The Last of the Mohicans* (made into a feature film in 1992), chronicles one Mohican's courageous journey through war while protecting two English girls from an evil Huron. Cooper detailed the characters' clothing and customs throughout the novel. James Fenimore Cooper, *The Last of the Mohicans* (New York: Pocket Books, 2008).

[407] Hodges, *Construction of the Great Victoria Bridge,* 7.

[408] Daniel Laxer, "'Row, Brothers, Row': Canadian Boat Songs, Imperial Glee, and National Identity, 1805–67," *Journal of Canadian Studies/Revue d'études Canadiennes* 50, no. 1 (December 10, 2016): 76–77.

song, and, notably, the French experience is overshadowed by his tourist gaze. Notably, the art in Hodges's account typifies Indigenous populations (See Figure 3.6), and there is no mention of the French inhabitants.

Other individuals and events are missing in the construction reports of the Victoria Bridge. Remarkably, Hodges praises the GTR for building housing, a church, and a schoolhouse to support the social development in the colony and yet says nothing of child labourers. Triggs notes how boys, as young as eight, played supporting roles in the vital work of riveting and that males over the age of fourteen were given the jobs of "men."[409] This omission speaks to the status of protective labour regulation in the colonies at the time.[410]

Figure 4.3: *Bottom of No. 11 Cofferdam,* William Notman, n.d. [LAC: Alex Ross Album].

Notman's photographs capture what appear to be boys. A stereograph in the second half of the Alex Ross Album, *Bottom of No.11 Cofferdam,* shows the bottom of a cofferdam before the stones arrive (See Figure 4.3). The image captures the temporary rails laid to move debris and

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[409] Triggs, "The Bridge," 49.

[410] Jane Humphries, *Childhood and Child Labour in the British Industrial Revolution* (Cambridge: Cambridge University Press, 2010).

three or four workers who pose to the right of the tracks. To the left appear to be three or four young boys holding a woman on their shoulders. The woman is wearing a white dress and shoes. There is no mention of the children or the woman in Hodges's report. By rendering women invisible, Hodges' report actively constructs difference by implying that the construction site is not a place for women. Landscape historians, writes Dianne Harris, "need to ask how difference is constructed, who is left in, who is left out, and look carefully at what's visible, but also at what is erased or consciously rendered invisible and for what purposes."[411] Invisibility is a form of barrier that may have delayed the entry of women into engineering schools in Montreal or reflect how they were treated by others when they overcame differences.[412]

Hodges was known to invite railway officials, representatives of the press, and parties of ladies to celebrations. On May 24, 1854 (Queen Victoria's birthday), Hodges invited a special group to celebrate the beginning of the working season. A *Montreal Gazette* reporter writes, "Having mounted this in safety, they descended to the inside where, dry-shod, they partook of a luncheon provided for them. It was a somewhat novel sort of dining room; but the fact, certainly, did not damp the mirth of the occasion, and the gruff old St. Lawrence never has his bed kicked about by a happier set of people."[413] The photographs capture events and people unmentioned in the construction reports.

Other events left out of Hodges's report and captured in photographs contained at the back of the Alex Ross Album: August 1859, approximately 300 people attend the laying of the first stone of the last pier; December 17, 1859, nearly 1,000 people gathered at long tables for a

[411] Harris, "Self and Landscape," 190.

[412] For an extreme example, see Peter Eglin and Stephen Hester, *The Montreal Massacre: A Story of Membership Categorization Analysis* (Waterloo: Wilfrid Laurier University Press, 2006).

[413] John Kalbfleisch, "From the Archives: An Unusual Dining Room," *Montreal Gazette*, July 23, 2017, accessed January 28, 2021, http://montrealgazette.com/sponsored/mtl-375th/from-the-archives-an-unusual-dining-room.

banquet inside the stone abutment at Point St. Charles. They gathered to celebrate the end of construction. Hodges overlooks these moments. "To honour the inhabitants of Montreal it should be recorded that [...] the workmen decided to erect a monument for the 6000 some victims of ship fever (cholera). […] A large granite boulder, weighing some thirty tons, was selected, which was placed upon a pedestal some six feet high, and which it may be hoped will to future generations preserve the remains of the dead from desecration."[414] A close reading of the albums is a reminder that the bridges are about more than technology and individual identity; they are about the shared experiences and social change.

Engineering reports, such as Hodges, are an excellent source for a broader explanation of the landscape. His exceptionally detailed descriptions reveal aspects of the natural and cultural landscape fragmented elsewhere, including the importance of social structures. Comparing the book with the album also helps establish what is missing from Hodges's report on life in the colonies. The analysis of the document shows that the construction site is a social environment, where Victorian politeness and diplomacy ruled. Hodges used qualitative descriptive passages and quantitative accounts as evidence and left any political will out of his narrative. Examining the content and placing it in context with other texts answers some questions about its message and leaves other questions unanswered.

The scientific gaze: Ice in Montreal

The ice is hard to observe in the bridge construction photographs. After reading Logan's extensive descriptions (Chapter 1) of ten metres (thirty feet) shoves that could topple an unprotected five-storey stone building "like a house of cards,"[415] a viewer might expect a more

[414] Hodges, *Construction of the Great Victoria Bridge*, 76.
[415] Logan, "On the Packing of Ice in the River Saint Lawrence," 766.

memorable presentation of the ice[416] in either the construction report or the photographic record. Without the inherent scale of the urban environment and forest offered in many of the famous winter scenes or the staged scale provided by an individual or a horse, the significance of the ice in the bridge photographs is overlooked.

The sky and the ice, for example, blend in the Montreal bridge photographs. For W. J. T. Michell, the "landscape exerts the passive force of setting, scene, and sight. It is generally the "overlooked," not the "looked at," and it can be quite difficult to specify what exactly it means to say that one is "looking at the landscape."[417] The ice, as ascertained by now, plays a big role in defining the unique condition of the St. Lawrence River at Montreal and a consideration of the construction report and the photographic album together establish the ways in which the photographs and the bridge are tools for scientific measure.

The Alex Ross Album opening photograph sets the stage for the wintery conditions; the foreground is covered in a light dusting of snow (Figure 3.2). The following three photos are dated March 1858 and show the progression on the tube from the south shore (See Figure 4.4) and from the north shore (See Figure 4.5) under a thick cover of snow and ice. The photographs capture the abutment, staging, and piers set closest to the shore. Noticeably, the state of the river is different in the three photos. The foreground shows a dark reflection of the bridge above; the water is open, and the ice has yet to form fully. Meanwhile, in the second photograph, several figures stand at the base of the first and fourth piers, indicating the river is solid ice.

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[416] The McCord Museum Notman Photographic Archives have numerous examples of winter photographs taken by both William Notman and Alexander Henderson. See for example photographs, I-6744.1 | *Ice shove on the St. Lawrence River at Montreal, QC*, 1863 by William Notman and MP-0000.1452.48 | *Winter ice on the St. Lawrence River, Montreal, QC*, 1873-74 and MP-0000.1452.49 | *Ice shove at City Hall* (Bonsecours Market), Montreal, QC, 1873-74, by Alexander Henderson.

[417] Mitchell, *Landscape and Power*, vii.

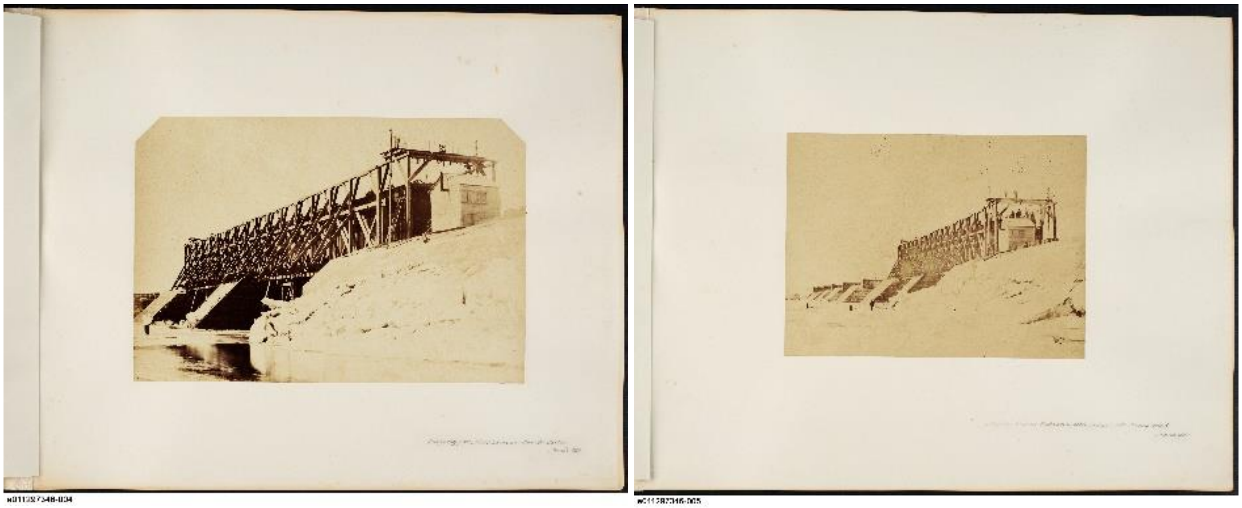

Figure 4.4: *Staging for First Tube on South Side and Staging for First Tube on South Side with Piers Erected*, William Notman, March 1858 [LAC: Alex Ross Album].

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Figure 4.5: *First-Tube Erected on North Side, with Piers from the Ice,* William Notman, March 1858 [LAC: Alex Ross Album].

This photograph firmly situates the viewer, for the first time, on the ice with the help of the caption. The caption on Figure 4.5 reiterates the river's state; it reads *First-Tube Erected on North Side, with Piers from the Ice, March 1858.* The photograph is taken from the Island of Montreal and shows that one of the tubular structures released of its staging for the first time in the album. With a relatively short foreground in the receding photographs, the distinction between the permanent solid ground and the ice is challenging to construe.

By contrast, one photograph in the Saint-Laurent Bridge album captures the ice piled on the shore. Again, without the caption, the ice is challenging to decipher. The photograph, *Ice Shove, St. Lawrence Bridge, April 25, 1887* (See Figure 4.6), was taken when the seasonal temperatures warmed the ice. The heavy rains weakened the thick winter cover. If it had not started already, the ice would soon start packing and piling downstream and cause the spring floods. Seven of the last nine photographs in the album were taken while there was still snow on the ground and ice on the river, however, the captions are needed to draw attention to the climatic conditions. The ice appears unspectacular and non-threatening to the viewer.

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Figure 4.6: *Ice Shove, St. Lawrence Bridge,* April 25, 1887 [LAC: C-256 Accession 1987-161, Box 2 #4, page 38]

Capturing ice in photographs continued to be a challenge into the twentieth century. A single picture of the Jacques Cartier Bridge under construction captures the height of the ice in relation to the high and low water line of the piers. Still, it again is challenging to decipher (See Figure 4.7). The image, *Ice Conditions* on March 28, 1929, shows an uneven ground plane looking ice, yet it offers little information to scale the ice or the bridge. On close inspection, it appears that the ice reaches the top of the ice break.

Figure 4.7: *Ice Conditions on March 28th, 1929* [*Bridge* [DBC, Superstructure of Montreal Harbour Bridge, 39 (Figure 25)].

The ice appears less frequently and with less intensity in the Jacques Cartier Bridge album and reports. A simple explanation is that engineers learned from the past and had the technology and construction techniques to avoid building with the ice. More importantly, construction on the Jacques Cartier Bridge closed during the winter months. The lack of winter scenes is unsurprising because the construction halted in the winter for health and safety concerns.[418] The album photograph, *Ice Conditions on March 28th, 1929,* is the only photograph of the ice in the commemorative album. That is not to say that early engineers held little concern for the workers in winter conditions. There is evidence that Hodges was concerned about the health of his

[418] Wilson, *Montreal-South Shore Bridge,* 58.

workers,[419] but they needed the ice to reach the bridge in the winter. The remainder of this section reports on the representation of the ice during the construction of the Victoria Bridge.

After completing the Victoria Bridge and before its opening ceremony, Hodges returned to England and published his account of the project. The detail and references to events and dates suggest that Hodges, or one of his staff, kept a journal that he later used to compose the chapters. Other bridge builders, such as Scottish civil engineer John Rennie, kept accounts of their early-nineteenth-century construction projects; engineer and historian Ted Ruddock, for example, acknowledged that “much of our knowledge of the construction of Waterloo Bridge comes from the manuscript account of the site work written month by month by Rennie’s eldest son, George.”[420] Over seven to eight weeks, at least one set of presentation copies was prepared for the ceremonial opening with Edward, Prince of Wales.[421] The story of the bridge construction is a social and cultural record of the colonial city.

In the introductory pages of his report, *The Construction of the Great Victoria Bridge in Canada*, the British engineer set the scene of one of the young colony's most exciting industrial projects of the nineteenth-century by helping his readers imagine towers of the Notre-Dame Basilica and “white, well-built houses, […] placed amid shrubberies and gardens” that characterized the city. He pointed out the “range of blue hill forms” in the distance that shaped a composition he found “agreeable and English.”[422] After a few short descriptive paragraphs about his initial impressions of the city, the author turns his (and his reader’s) awareness to the river.

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[419] Hodges, *Construction of the Great Victoria*, 77.

[420] Ted Ruddock, *Arch Bridges and Their Builders, 1735–1835* (Cambridge: Cambridge University Press, 1979), 185–86.

[421] “Book Review: The Construction of the Great Victoria Bridge,” 348.

[422] Hodges, *Construction of the Great Victoria Bridge*, 5.

For the engineer to succeed on the other side of the Atlantic, he had to look beyond the "agreeable" scenery and learn the seasonal habits of the river, adjusting to local customs, materials, and construction practices. Until he became familiar with his surroundings, Hodges relied on other people's interpretations of the landscape. He drew on the (then) Provincial Geologist, Sir William Logan's concepts of "taking" and "shoving" of the ice; these concepts were essential in helping engineers understand the relationship of the natural environment to the built landscape and in designing the bridge foundations. While Hodges did not credit Logan directly, his use of Logan's concepts suggests that the geologist's report informed Hodges's early experience and ability to learn.

Hodges diverted from Logan's scientific language—the taking, packing, and piling of the ice—when he described the spring melt. The phenomenon repeated itself, in reverse, in the spring, usually starting in March, when the warm sun and heavy rains "rotted" the ice and awakened the icefields. The heat and moisture weakened the ice to a state locally known as "honeycombed." Hodges noted how a blunt force applied to a one-metre- (three-foot-) thick block of ice would shatter it "as if [it were] composed of millions of crystallized reeds placed vertically." Cracking and breaking out of hibernation, the newly released ice would once again "shove," and "pack" downstream until the natural dam at the base was clear. [423]

Hodges used literary devices, such as similes and metaphors, to make the ice phenomenon relatable and, possibly, to help investors understand the delays. Hodges described how the anchor ice grew in rapid currents and attached itself to rocks "in the shape of a spongy substance, not unlike the spawn of frogs." Likewise, when writing that the ice accumulates "at the foot of rapids in such quantities as to form a bar across the lake (like bars of sand at mouths of rivers)

[423] Hodges, *Construction of the Great Victoria Bridge,* 8.

some miles in extent,"[424] he was providing a comparison to tidal rivers in Britain. Thus, Hodges compared the regional landscape to what was familiar to him and his British readers. In his first year at the British colony, Hodges was still learning—and by extension teaching—from a British context. By extension, he is also explaining the complicated nature of the river to his investors as one reason for the delays and overruns.

His report is so clear that someone today could go back and built the bridge. Each of the six middle chapters in Hodges's book conveys a full year of construction and progresses in a strict chronology: 1854–1859. These chapters typically open with a description of below-freezing temperatures, unpredictable weather, disruptions to work, and ice conditions. Hodges indicated when the ice formed, dammed, broke, and the precise commencement date for each season. Altogether, these chapters progress by recording advancements, milestones, and innovative discoveries. They conclude with a quantitative summary of materials—stone, clay, wood, and iron—employed in the year's advances.

Victorians, aware that they were living through a period of industrial and social change, "approached the growth of their cities first and foremost regarding *numbers*."[425] Hodges was no exception, accounting for the materials used for each pier, abutment, and span; the distance materials travelled from quarry or foundry to site; the 3,040 workers and 144 horses employed. These numbers, found throughout the book, were summarized again in the appendices. Repeated use of numbers helped measure the progress, and Hodges's generous description fills where

[424] Hodges, *Construction of the Great Victoria Bridge*, 6.

[425] Out of curiosity or "social control," Victorians collected data about urban change, such as industrial growth, social organizations, and populations, in trade directories, chambers of commerce, national census reports, and blue books. Asa Briggs, "The Human Aggregate," in *The Victorian City: Images and Realities*, ed. H. J. Dyos and Michael Wolff (London: Routledge and Kegan Paul, 1973), 84; emphasis original.

imagery is missing. He is recording the ice; however, his scientific measures are ill-defined until the end of his account.

After the first gruelling summer working season, Hodges and his crew were anxious to see how the first set of piers and cribwork had fared against the river and ice. They waited and watched the following spring from a "transit tower"—a raised position from which engineers supervised the line of the bridge—through a "transit instrument" (an optical tool for surveying, like a transit level or a telescope).[426] Hodges heard, before he saw, the first signs of movement in the ice and poetically described the outcome.

The ice began to "pack" in November 1854 and reached the construction site by January 4, 1855. Around noon on November 4, Hodges reported a "universal stillness" interrupted by an intermittent creaking sound, perhaps like a dock shifting under the wave of a passing boat. Then suddenly, the rushing waters roared. Hodges expressed how the ice behaved by describing the sounds it made as it started to move: "the cracking, grinding, and shoving, burst on our ears."[427] Astounded, he continued, "The sight of twenty square miles (over 124,000,000 tons) of packed ice (which but a few minutes before seemed as a lake of solid rock) all in motion, presented a scene grand beyond description."[428] Hodges described a sensory experience by relating how the ice creaked and groaned in warning and how the sounds informed them that it was time to vacate the area immediately.

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426 Hodges, *Construction of the Great Victoria Bridge*, 30.

427 An additional account in the *New York Times* helps us imagine the power and sound of the whole phenomenon. The article stated that "immense packs are sometimes broken up with sudden crashes, and the pieces, grinding each other almost to a powder, are carried away to increase the size of other floating ice-islands." We are left to imagine what crashing, grinding, and floating ice sounds like. "From Canada: The Two Crossings of the St. Lawrence at Quebec and Montreal—The Controversy as to the Original Designs of the Victoria Bridge," *New York Times*, January 5, 1860.

428 Hodges, *Construction of the Great Victoria Bridge*, 29–30.

As the ice gave early warning, Hodges headed directly for the construction works and watched through a transit instrument as rushing waters and ice neared the whole season's work, set out in the shallows. At first, the framework and dams appeared to be carried downstream unharmed. But as the river, liberated from its icy cover and increased its flow, it became evident that rushing waters would sweep the timber supports away. Hodges wrote that "after performing some three or four evolutions like huge giants in a waltz, they were swallowed up, and reduced to a shapeless mass of crushed fragments."[429] The framework, which like the ice, stood lifeless minutes earlier, was animated as a graceful defeat through the metaphor of dance. The sound of the ice was enough to quiet the men waiting in the transit tower. When Hodges knew the worst of the shoving was over, he expressed relief that the "solitary pier," poetically described as "battling the chaos," had escaped the ice throws and was undisturbed.[430]

Throughout the report, images of the ice do little to capture the intensity of the experience. The engineering plates showed signs of high- and low water levels. The text described the upstream facing slope to bear the brunt of the ice, without ever demonstrating the impact. Even Notman's photographs fail to convey the immensity. However, an exceptional diagram located at the back of the appendices offers visual insight into the ice phenomena.

Hodges quantified yearly advances on the bridge and used the bridge to measure the ice. Thus, Hodges finally drew upon his years of experience on the construction site to create a distinctive diagram. The diagram, *Sketch of Shoving of Ice,* represents the "taking and shoving" of ice and applies Hodges's love of numbers in his interpretation of the bridge (See Figure 4.8).

[429] Ibid., 30.
[430] Ibid.

The diagram shows the formation of ice around the piers throughout three construction seasons. Hodges informally references the diagram in the book, describing how it "shows the position of the shovings, of the grounded ice, and of the air holes after the river had become safe for crossing."[431] Having spent several winters observing the ice, Hodges adapted the scientific language first proposed by Logan, without any indication of how he gathered the information it displays. One year later, French engineer Charles Joseph Minard began producing several *cartes figuratifs* representing quantitative and spatial information in diagrams.[432] For a Victorian construction engineer so fond of numbers, Hodges presented this diagram as a rare compilation of his seasonal observations.

[431] Hodges refers to "Page 47," which appears to be of the second volume. Hodges, *Construction of the Great Victoria Bridge*, 57.

[432] Sandra Rendgen, *The Minard System: The Complete Statistical Graphics of Charles-Joseph Minard* (New York: Princeton Architectural Press, 2018); and Arthur H. Robinson, "The Thematic Maps of Charles Joseph Minard," *Imago Mundi* 21 (January 1967): 95–108.

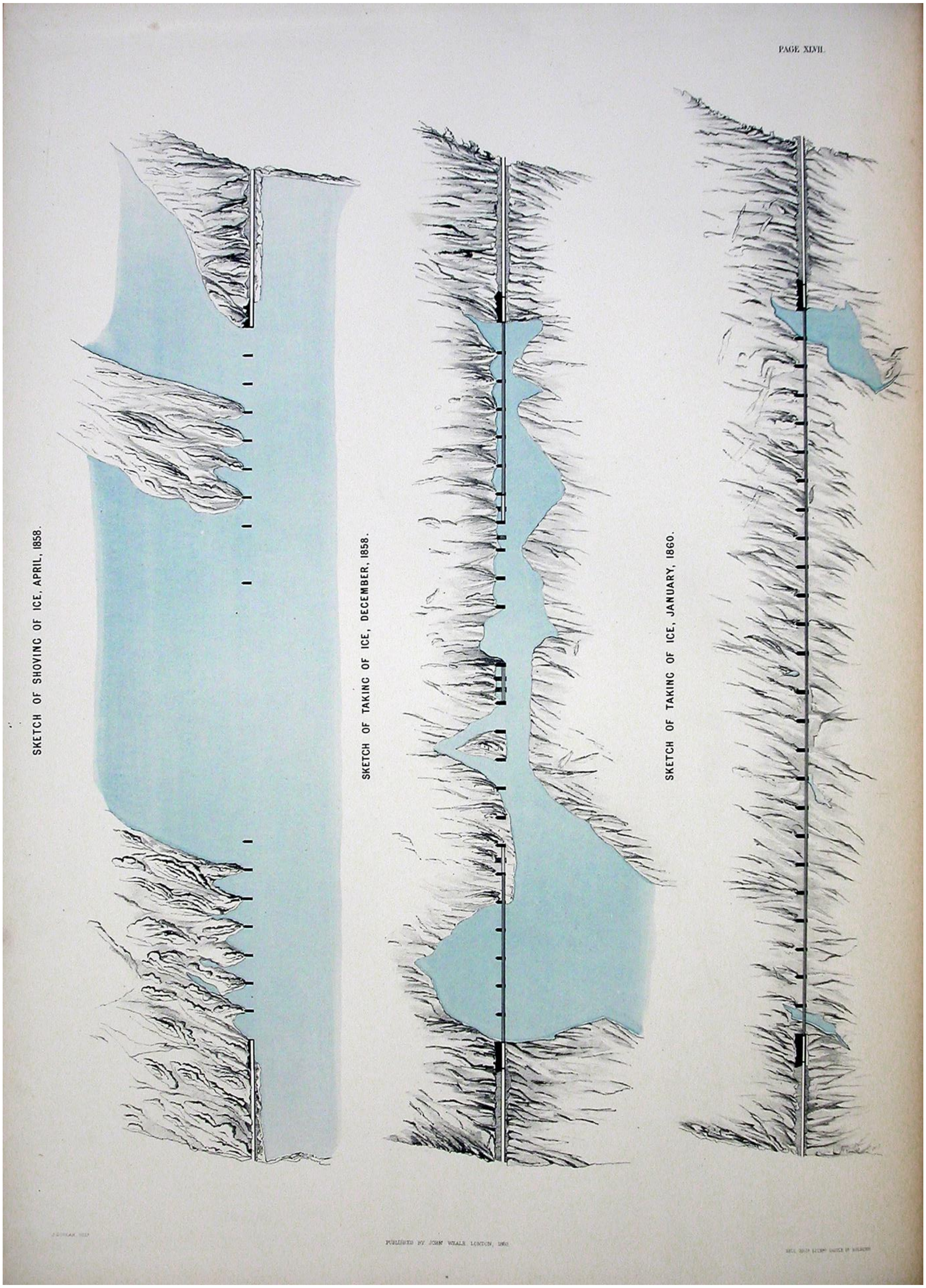

Figure 4.8: *Sketch of Shoving of Ice,* J. Duncan, 1860 [Hodges, *Construction of the Great Victoria Bridge*, 57].

The diagram is not a map and its orientation does not conform to cartographic conventions. The left side of the page represents the south shore, and the right side represents the island. In this scenario, the river flows from the top of the page to the bottom and the piers are positioned to receive the ice. The orientation rejects the typical representation of "north" at the top of the page and ignores the sense of north typically attributed to Montreal. The dark points represent a pier, and the horizontal line that extends over more and more of the piers, from the topmost image down to the third, represents the tube. Thus, the same layout repeats three times on the pages. Each iteration conveys information about the progress of both the construction and the ice.

The river is a pale blue colour that contrasts with the uncoloured ice, and in all three drawings, the long white lines extending from the shore represent the solid abutments encased in ice. The ice is more readily formed, packed, and shoved in the shallows, so it makes sense to see it adhering to the solid ground. Critics feared the long abutments would interfere with the flow of ice. Still, Keefer argued that the fast-flowing and deep channel would sweep free ice away and, indeed, the top diagram shows a clear central channel as the spring shoves move past the bridge.

The top third of the page represents how the ice shoved in April 1858. The two abutments and fifteen of the twenty-four piers were then built and taken by the ice. The other lower diagrams show the taking of the ice in the winters of December 1858 and January 1860. By this time, Hodges was impatiently awaiting winter. Work on the superstructure could continue because of the added convenience of solid ice. With his workers' safety and the superstructure in mind, he was cautiously monitoring rising temperatures, gazing for "rotten" ice. In other words, the diagram translated his local experience and accumulated knowledge of the landscape dynamics into visual terms.

In his study of the archive at the *École des Ponts et Chausées,* Antoine Picon finds that early-eighteenth-century French engineers saw the bridge as a stand-alone spatial structure. Still, by mid-century, through the influence of Jean-Rodolphe Perronet, engineers began to see the bridge as one with its environment. Picon found the students' drawings began integrating "different phases of construction, together with the formal apparatus required to resolve any difficulties which might arise."[433] He writes, "As far as Perronet was concerned, the model of the bridge was no longer limited to a spatial structure, but integrated conception and execution, objectivizing and summarising their various phases."[434] The students' ways of seeing the natural and built environment are strongly tied to learned rendering principles. The bridge was an active form, one that required materials, technology, and human labour to execute, and student drawings expressed the quantitative and dynamic nature of the bridge and showed the process of building alongside the structure.

The quantities Hodges carefully reported elsewhere came together in the diagram. The diagram represents the 2,713,095 cubic metres of masonry in the piers and the 9,044 tons of iron in the superstructure, held together by 1,540,000 rivets. Until then, information about the fluctuations of the river was limited to elevations, such as the pier diagram (See Figure 2.4), and it specified only summer and winter water levels. Thus, the engineering plates give no indication or measure of the height or impact of the ice and, although the text does vividly describe some of the encounters with the ice, this economic sketch, easily overlooked in the text, communicates the relationship between the ice and the bridge, the passage of time, and the behaviour of the ice. The dynamics of the construction site graphically reflect the dynamics of the river.

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[433] Picon, *French Architects and Engineers in the Age of Enlightenment*, 166.
[434] Picon, 167.

Hodges provides no clues as to how he gathered his scientific data. Landscape historian John Wylie finds the scientific gaze is linked to "practical sciences" of cartography and navigation, sharing a closeness to the science through the principles of proportion and perspective. Wylie writes, “landscape representations present themselves with a stamp of accuracy, reliability and trustworthiness; [they] take their place alongside more microscopic scientific illustrations [and] other visual forms such as navigational charts and sketches, as part of an overall system of faithful and repeatable observation.”[435] Where Hodges neglects to reveal his scientific process, Notman’s photographs provide some clues.

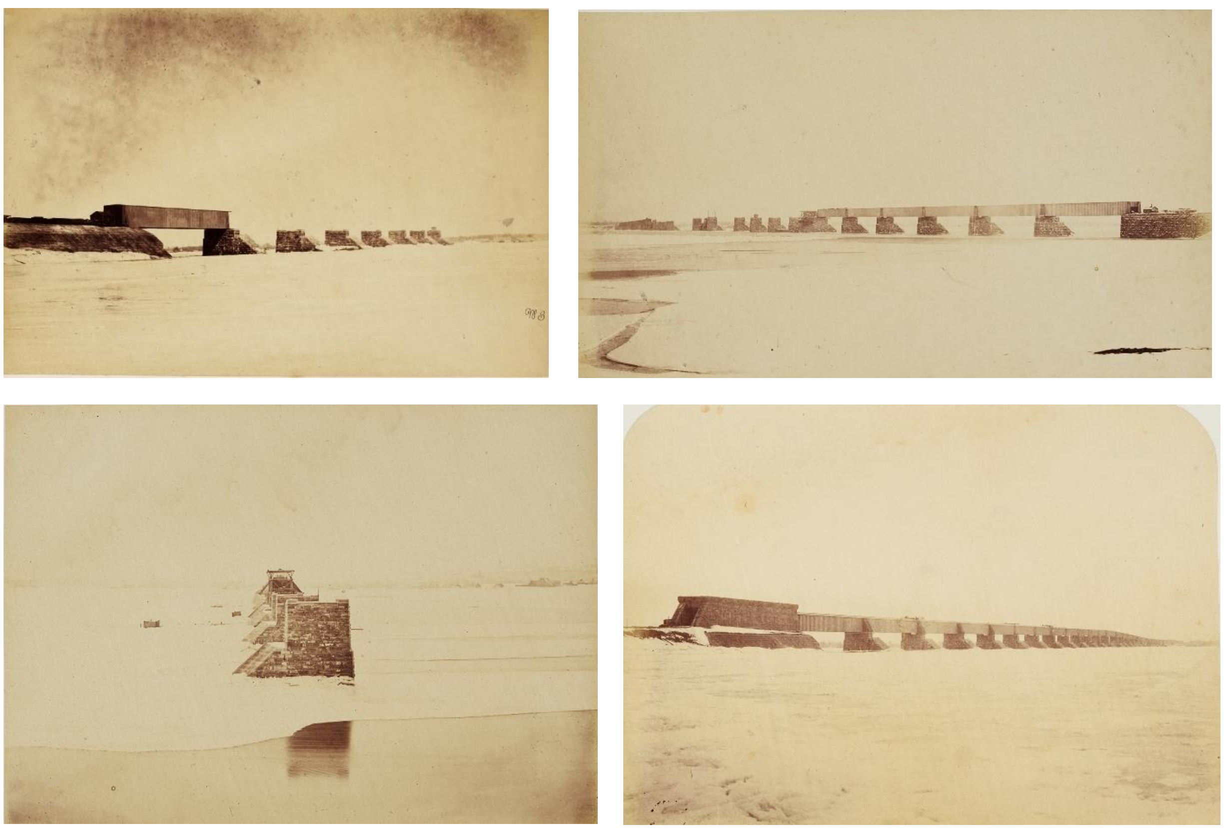

Figure 4.9: *Upper Left: First-Tube Erected on North Side, with Piers from the Ice, March 1858. Upper Right, Bridge in Progress from Point St. Charles, Dec. 18th, 1858. Lower Left: Pier No. 12 Looking In, March 1859. Lower Right, General View of the Bridge Completed, January 1860* [LAC: Alex Ross Album].

[435] John Wylie, *Landscape*, Key Ideas in Geography (Oxon: Routledge, 2007), 128.

The photographs are an instrument for reading the ice. The photographs were taken at regular intervals and capture the "taking" and the "shoving" without directly acknowledging Logan's or Hodges's use of the terminology. Notman was likely drawn to capturing the clean lines of the bridge. However, the construction of the Victoria Bridge stopped only when it was no longer safe to approach the river due to the ice conditions. In fact, during the last full working season, construction took place twenty-four hours a day, and "those gangs working at night being lighted by large fires in braziers."[436] Learning about the ice was essential for building the bridge, and the photographs represent the different stages of ice formation.

The map shows change over time from the perspective of someone present. "In the classical theory of rhetoric," writes W. J. T. Mitchell, memory is specifically related to place since "the classical memory technique is a way of reconstructing temporal orders by mapping them onto spatial configurations, most notably architectural structures, with various "loci" and "topoi" or memory places inhabited by striking images and sometimes even words; it is also a way of mapping an oral performance, an orientation from memory, onto a visual structure."[437] The engineer's maps represent specific knowledge learned *in situ*, including the everyday activities and the moments of danger, challenge, or hardship.

The ice and the story of building the bridge are layered in the photograph. The bridge in its construction is a measure of ecological time. The temporal language of the ice is not only translated into terms that British readers can understand and visualize but the process is also spatialized. As Hodges plots the ice phenomena, he also plots the ecological processes of the site and uses the bridge as a measure of the ice. The image reflects the determination of the

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[436] "Book Review: The Construction of the Great Victoria Bridge in Canada," 345.

[437] W. J. T. Mitchell, *Picture Theory: Essays on Verbal and Visual Representation* (Chicago: The University of Chicago Press, 1994), 192, https://press.uchicago.edu/ucp/books/book/chicago/P/bo3683962.html.

contractor, the material choice of the geologist, material pathways, and so on; it builds a narrative around the scientific and ecological components. It represents the measure of narrative time (the last three seasons of construction) and pairs it with ecological time. The implication of the ice and reading it in the time sequence replicates ways that ecologists and landscape architects read the landscape; in other words, the bridge is part of an ecological process.

The Landscape Gaze

The reports that describe the steps taken to complete the bridges make the processes of assembling the three Montreal bridges available to readers, and the serial nature of the photographic collections demonstrate how engineers managed the flow of materials. Still, some elements of the construction stories are overlooked. A close reading of the photographs and their arrangement in the *CPR St. Lawrence Bridge* album provides a landscape perspective on the project and the ways in which photographers contribute to establishing narratives and sub-narratives that have, until now, gained little scholarly attention.

The *CPR St. Lawrence Bridge* album is divided into two parts; each provides a sequence of movement and vision through the construction site. The album begins and ends at a raised position near the base of the bridge (on the island side, marked by a ★ in Figure 4.10) and moves along a linear path from one end of the construction site to the other. The spreads in the first half of the album each represent one aspect of the earthworks and secondary overpasses. The areas include (1) the base of the bridge, (2) the Lachine Canal and the Swing Bridge, (3) the Grand Trunk Railway Overpass, (4) Blue Bonnets cut and fill operations, (6-8) the caissons, piers, and superstructure, and (9) the Indigenous community of Kahnawake.

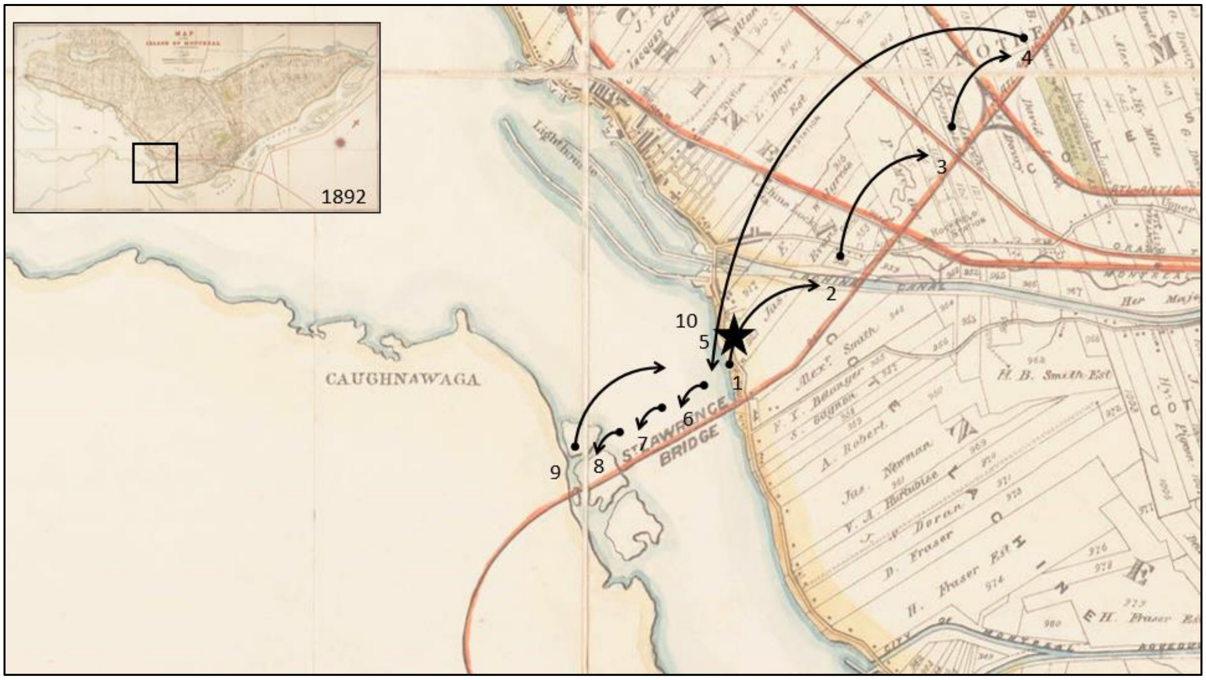

Figure 4.10: Diagram showing the locations of photographs in the first half of the album [J. Rielle, *Map of the Island of Montreal* 1892 (VM: CA M001 VM066-5-P015)].

The compiler reiterated the importance of the opening vantage point, returning the viewer to the same location no less than six times, which includes the opening and closing shots (See Figure 4.11). The camera's position is likely set up to mimic the position of the engineer's transit; one of two fixed places used to calculate the location of the piers and survey the alignment of the bridge.[438] When mounted on a raised stand, both ocular instruments—transit and camera—provide a view of distant objects. The camera was placed away from the base of the bridge and above the river level, which situates the viewer in a position of authority over the project or dominance of the landscape. Thus, the movement through the site mimics the perspective of an engineer or inspector.

[438] Massy, "Foundations of the St. Lawrence Bridge," 37.

Figure 4.11: Left: *View of Bridge, August 2, 1886,* and, Right: *St. Lawrence Bridge during Erection, May 5, 1887* [LAC: C-256 Accession 1987-161, Box 2 #4, pages 1 and 44].

The photographer or the compiler adds a narrative element to the album in the structure and presentation of the photographs. According to the opening photograph, the viewer is brought into the story, over eight months after preparations for construction began. Meanwhile, the billowing plume of dark smoke in the distance of the closing image is imaginably the locomotive's release of steam. The image evokes a sense of atmosphere used in early-nineteenth-century British Romantic painters John Constable and J. M. W. Turner.[439] This implication of use also suggests a completed project even though the bridge was at least two months away from opening to traffic.

The compiler controls the viewer's understanding of the project through a clever arrangement of the photographs. Each of the first ten double-page spreads engages the viewer with one aspect of the project at a time. The layouts also move the viewer along a linear path from a site nearest the base of the bridge away from the river and back again. The content and structure orient the viewer from one end of the construction site to the other. As a result, by the

[439] See for example, *Rain, Steam, and Speed – The Great Western Railway* by J. M. W. Turner, 1844 https://artuk.org/discover/artworks/rain-steam-and-speed-the-great-western-railway-115073

time the album reaches the mid-point (and the structure changes), the viewer is returned to now-familiar spaces. According to Charlesworth, the "process of imagining a place through a photograph will be different according to whether or not the viewer has visited the place depicted in the image."[440] The album's structure creates a sense of orientation and allows the story to unfold spatially rather than chronologically.

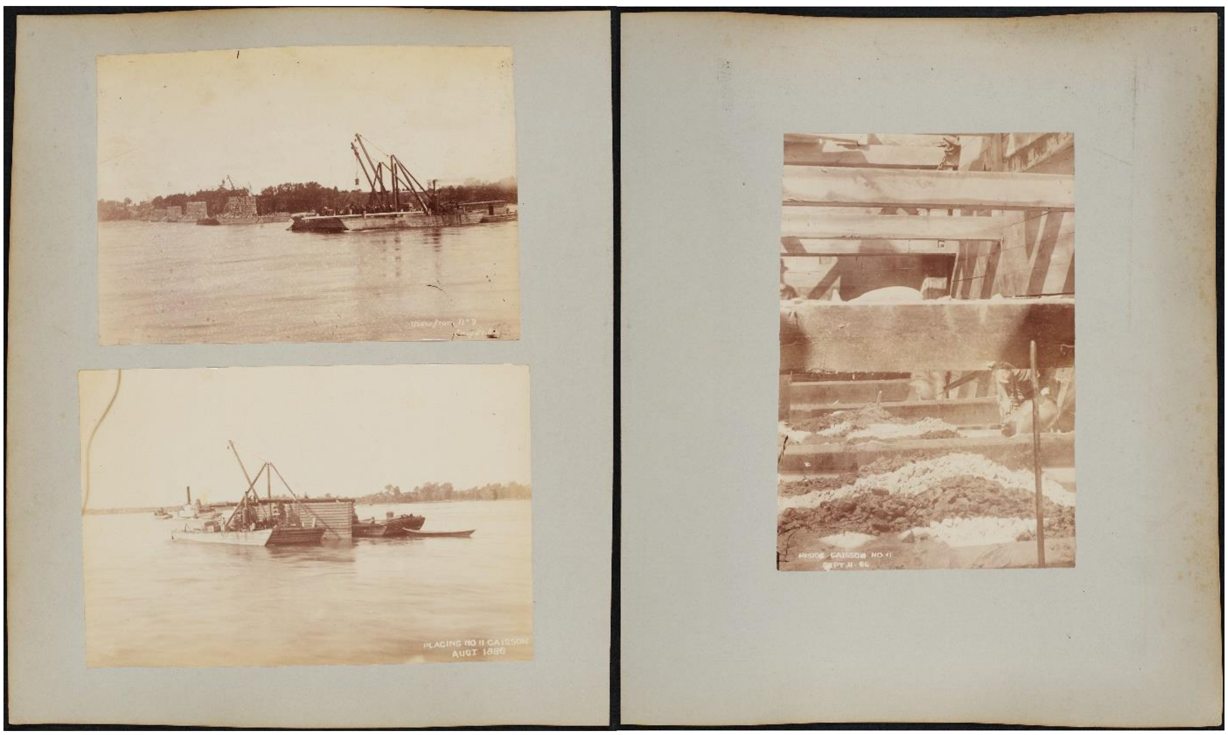

Figure 4.12: Top left: *View from No. 9*, July 21, 1886. Bottom left: *Placing No. 11 Caisson*, August, 1886. Right: *Inside Caisson No.11*, September 11, 1886 [LAC: C-256 Accession 1987-161, Box 2 #4, pages 13 and 14].

In the first half of the album, the double-page spreads structure how the viewer experiences time. The spreads are composed of three to four images that capture the advances on the single aspect of the project from as many different angles as there are photographs (See Figure 4.12). The spreads are composed of a photograph taken days, weeks, and even months apart from one another and reiterate the narrative style of the album. The narrative, writes film and literary critic Seymour Chatman, has a "double time structuring" that can move forward or back, independent

[440] Charlesworth, "India," 240.

of time order.[441] The viewer sees time advance on each double-page spread and is returned to an earlier point in time with each turn of the page. The date that the masonry contractors break ground on one project or the time they wait for the ice to move in the canal is inconsequential in the narrative space for the album because the overall project is constantly moving forward.

The pattern of the spreads creates a tempo. Each pays equal attention to the site, demonstrating that the earthworks (and, by extension, the masonry contractors) were essential to the bridge's story. The different angles on the same site might have referenced a milestone achieved, a challenge overcome, or a visit by an important figure. The angles frame the views so that the construction appears effortless.

The layout in the second half of the album shifts as the double-page spreads return the viewer to now-familiar locations (marked by a ★ in Figure 4.10) and the arrangement no longer follows a linear path. The photographs are larger, most covering a full page in the album, and the change in size marks a shift in tempo. The larger photo acts as a focal point for the subject of the spread, and the two smaller photographs act as supporting documents, which adds detail, a small side story, or comic relief. For example, the central spread introduces the arrival of the superstructure and is arranged such that the photograph represents the view of the engineer as he peers through his surveying equipment (See Figure 4.13).

[441] Seymour Chatman, "What Novels Can Do That Films Can't (and Vice Versa)," in *On Narrative*, ed. W. J. T. Mitchell (Chicago: The University of Chicago Press, 1981), 118, http://hdl.handle.net/2027/mdp.39015020724368.

Figure 4.13: Top left: *View of Bridge Sept 11-86*; Bottom left: *View of Bridge, Sept 22, 86*; Right: Untitled photograph [LAC: C-256 Accession 1987-161, Box 2 #4, pages 19 and 20].

The photograph on the right-hand page of Figure 4.13 depicts a man, dressed in a modest suit and worn derby hat, standing and peering into a transit instrument affixed to a permanent base, with a propped-open box of tools and an axe on the ground. His equipment suggests that he was present on official surveying business. His position in the layout of photographs across the two-page spread suggests that he is surveying through the transit at the superstructure photographed on the left-hand page. In this arrangement, the man—a surveyor, contractor, or engineer—carefully observes the bridge.[442] His active participation defines the scope of this half of the album by directing the viewer's gaze to the advancing superstructure and foreshadowing the photographs that bring the viewer to the south shore.

The placement of this photograph also suggests that the photographer was taking cues from the engineer. This image of the transit instrument echoes the camera's placement. Engineers

[442] The same three photographs are found in the scrapbook. However, in the scrapbook, the photographs are arranged with the surveyor placed on the left-hand side of the page, gazing off the page and thus stripped of his contextual relationship to the work. C-256 Accession 1987-161, Box 2 #3, LAC.

argued Weiss directed the camera's gaze during the construction of mid-nineteenth-century bridges in Paris.[443] The photograph was an extension of what the engineer observed. Thus, the layout of Figure 4.13 suggests the importance of the location of this view, repeated so many times throughout the album. For a moment, the photographer and the engineer trade places in this playful layout, and the viewer is invited to actively participate in the process of construction, regardless of training or experience.

The album produces what landscape historian John Wylie identifies as the "landscape gaze." "The landscape gaze," writes Wylie, is "projected out through the eyes of European explorers and scientists from the seventeenth to the twentieth centuries, it is quite often a detached gaze, and a controlling gaze."[444] The engineer's implied position in Figure 4.13 is an example of this gaze, with the engineers' suggested placement standing above the bridge and commanding authority over its construction. The landscape gaze, writes Wylie, is "the commanding prospect, offering objective, authoritative, and wide-ranging vision, and establishing the viewer in a place of epistemological and juridical supremacy, is a classic trope within the art and literature of imperial travel and exploration."[445] Throughout the album, the viewer is afforded a position of authority by revisiting the construction site through an engineer's lens.

Although the album appears to take on the engineer's perspective, it is also inherently representative of the photographer and the compiler. The album presents at least two views on the same landscape and, the perspective of viewers adds yet another perspective. In each one of these ways of beholding the project, several readings are possible. "There are different protocols for reading the landscape as a visual and a spatial narrative," write Potteiger and Purinton, "the

443 Weiss, "Engineering, Photography, and the Construction of Modern Paris, 1857-1911," 41.
444 Wylie, *Landscape*, 127–28.
445 Wylie, 128.

viewers enter at different points and are free to pause, take in a whole image or inspect its parts."[446] One viewer may move quickly from page to page while another moves with the tempo of the album. The review below explores some of the possible interpretations and meandering storylines made available through a close reading of the album, the scrapbook, and construction reports.

The Lachine Canal Swing Bridge

In 1661, René-Robert Cavelier, Sieur de La Salle, established the segment of land known as Côte Saint-Sulpice in the area later captured in photographs in the album. French settlers cleared the forests and cultivated the low-lying, fertile lands. The new land uses led to the establishment of a trading post and small French colonial village along an ancient Iroquois footpath used to bypass the Lachine Rapids. Once known as the King's Highway (Le Chemin du Roi) and later the Lower Lachine Road (now LaSalle Boulevard), the road is parallel to the river and a critical east-west circulation path.

Talks of digging a canal along the path and using the Saint-Pierre River and Lake Saint-Pierre amounted to little during the French regime. Financial issues, wars, and other events delayed progress until British investors, worried about claims to Canadian natural resources, pushed to complete the canal before the American Erie Canal reached the Great Lakes. Thus, British colonists excavated the river to create the Lachine Canal during the first quarter of the nineteenth century.[447] In 1821, the canal opened a bypass to the Lachine Rapids for boats and

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[446] Potteiger and Purinton, *Landscape Narratives*, 136.

[447] Sulpicians François de Salignac Fénelon and Dollier de Casson began talks of excavation in the seventeenth century, but plans were put on hold due to financial difficulties. For a history of Montreal's Lachine Canal, see Gerald J. J. Tulchinsky, *The River Barons: Montreal Businessmen and the Growth of Industry and Transportation, 1837–53* (Toronto: University of Toronto Press, 1977); Bélisle et al., *An Industrial Landscape Observed*; and Desloges and Gelly, *The Lachine Canal*.

attracted industries and a primarily Scottish and Irish Catholic immigrant population to the area.[448] The Hudson's Bay Company (1804), Dawes Brewery (1811), and Fleming's Mill (1827) were among the first industries to be established in the area—architectural landmarks that are still visible today.[449] These industries profited from improved circulation and proximity to fertile agricultural lands and a water source. By the mid-nineteenth century, the GTR laid tracks parallel to the canal, reinforcing east-west circulation patterns and creating obstacles for future north-south routes.

As first built by Loyalists, the canal measured 15.5 metres (fifty-one feet) long, fifteen metres (forty-nine feet) wide, and 1.5 metres (five feet) deep; seven locks rectified an elevation change of thirteen metres (forty-three feet), and wide, flat Durham boats were used to navigate the canal. The first of two subsequent modifications (1842–1847) widened the canal to thirty-six metres (118 feet) and deepened it to 2.75 metres (nine feet), which made the route accessible to steamships. That construction also reduced the number of locks to five, which shortened lockage time, accelerating navigation, and increasing flow. The third significant modification, 1874–1883, increased the depth to 4.25 metres (fourteen feet). Thus, despite these improvements, the short, narrow, and shallow canal limited transportation opportunities, but the railway overcame this limitation.

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[448] Montreal saw many immigrants from the British Isles arrive during the nineteenth century. See Marsan, *Montreal in Evolution*, 174–78.

[449] For imagery, see Alexander Henderson, *Farmhouse and Fleming Windmill, Lasalle, near Montreal, QC, about 1870*, ca 1870, MP-0000.10.119, MM; William Notman & Sons, *Old Windmill, Lower Lachine Road, Lasalle, QC, about 1890*, ca 1890, VIEW-2499, MM. For a history of the architecture, see Guy Pinard, *Montréal: Son Histoire, Son Architecture* (Montreal: Les Éditions La Presse, 1987).

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Figure 4.14: *Centre Pier & South Abutment, Lachine Canal, October 1886*, s.n. [LAC: C-256 Accession 1987-161, Box 2 #4, page 3].

The treatment of the canal wall at the Swing Bridge is notable (See Figure 4.14). As early as the 1830s, the size of timber rafts entering the canal was restricted to reduce damage to the canal walls.[450] During the 1840s enlargement, engineers laid out the most extended section of the channel, between Lachine and Côte-St.-Paul, with an embankment. Excavators used the stones from the canal bottom to build up the so-called Rockfield Walls for this section of the canal.[451]

[450] Rafts had to be 8.5 × 97.5 metres, divided into two section of 8.5 × 48.75 metres each. Desloges and Gelly, *The Lachine Canal*, 71.

[451] Ibid., 48.

The small stones used to reinforce the wall proved susceptible to freeze-thaw cycles and crumbled—a challenge that would not find resolution until the use of reinforced concrete in the 1930s.

The construction reports do not indicate or specify if the walls required reinforcement. Regardless, high levels of foot and horse traffic—necessary to guide non-motorized boats along this high-maintenance section of the canal— needed at least some reinforcement or structural support along the walls to protect the new bridge. The stone wall pictured at the far side of the canal (See Figure 4.14) appears to be capped with an evenly cut stone, suggesting that the builders reinforced the canal walls in the making of the bridge.

The reports are also missing the colloquial place names. For example, the Rockfield Wall is a local place name that appears on the 1892 map of the area (See Figure 4.10) and is confirmed in other secondary sources.[452] The reports and photographs make no mention of the "place." By contrast, the Blue Bonnets appear in the pictures as a placename and is absent from the literature of the area.[453] These two examples point to the familiarity of the photographer (or engineer) with the local customs. They are made by someone familiar enough with the area to call it by a colloquial place name.

Blue Bonnets Cut-and-Fill Operations

The St. Lawrence Bridge album images help spatially locate the "Blue Bonnets" on a map of Montreal. The third double-page spread of the album depicts the site farthest from the river. The photographs show cut-and-fill operations, and their captions christen the area as "Blue Bonnets." The informal place name came from a local tavern that a Scottish, Montreal-based

452 Ibid.
453 Al Palmer, "Blue Bonnets 1830 Had Horsy Set Too," *The Montreal Gazette*, April 9, 1964, sec. Our Town.

soldier opened in 1842. Captured in a popular ballad, "Blue Bonnets Over the Border," the name refers to the blue woollen beret that eighteenth-century Scottish Lowland farmers wore and were adopted as an emblem of Jacobitism.[454] The bonnet also became part of the British Army uniform and came to Canada when the Fraser Highlanders participated in battles at Louisburg and the Plains of Abraham.[455] The traditional Highlander head covering then carried over in name to nineteenth-century Montreal, as local soldiers patrolling the St. Lawrence River reportedly called their thick winter hats "blue bonnets."[456]

The Blue Bonnet Tavern and Inn drew horse and stagecoach traffic from the King's Highway and was likely a meeting place for the owners of the thirty to forty homes located near the thoroughfare. The stage-coaching era disappeared with the arrival of the railway, rendering the tavern obsolete after ca 1890.[457] Until then, the pub and horses played a symbolic role in establishing a sense of place. Once known as Côteau-Saint-Pierre, the area was separated from Nôtre-Dame-de-Grâce in 1883, and a cluster of homes appropriated the name Blue Bonnet Hill.[458] The place name, "Blue Bonnets," appeared to have been interchangeable with Saint-Pierre and was used by those familiar with the local establishments. One of the oldest farms in the area, established by Jean Décarie in 1666, was converted in 1872 to a racetrack, fittingly

[454] The song remains popular in Canadian military marches. Tim Stewart, "'The Pipes Play On': Canadian Pipers at War, 1914–1918: An Inspired Tradition," *Canadian Military History* 9, no. 4 (Autumn 2000): 60.

[455] Bruce Bolton of the 78th Fraser Highlanders, email message to the author, May 23, 2017. The main timeframe for this group was 1757–63, and soldiers present during the construction of the CPR were forebears to the Black Watch, Royal Highland Regiment of Canada.

[456] Hugh McQueen, Concordia Professor Emeritus in Engineering, personal conversation with the author, April 2, 2014.

[457] John Fraser, "The Blue Bonnets," in *Canadian Pen and Ink Sketches* (Montreal: Gazette Printing, 1890), 195–99.

[458] In 1894, the place name changed again—to the Village Municipality of Saint-Pierre-aux-Liens—and it was incorporated in 1904 as Ville Saint-Pierre before merging with Lachine in 2000. "Municipalité du Village de Saint-Pierre-Aux-Liens," Archives de Montréal, accessed December 3, 2018, https://archivesdemontreal.ica-atom.org/municipalite-du-village-de-saint-pierre-aux-liens.

named the Blue Bonnets Racecourse.[459] Therefore, as with "Rockfields" for the swing bridge, the "Blue Bonnets" designation for the cut-and-fill operations (rectifying grades between the GTR Overpass and Côte St.-Luc) demonstrates the valuable local history of this area.

Figure 4.15: *Blue Bonnets Cutting, Sept 17-86* [LAC: C-256 Accession 1987-161, Box 2 #4, page 8].

Taken from high and low angles, photographs of the Blue Bonnets' cut-and-fill operations convey the extent to which the rails fragmented the landscape (See Figure 4.15). As high as ten metres (thirty feet) and as long as 1.6 kilometres (one mile), the embankments were graded into

[459] The original racetrack was located near the intersection of the CPR and A&NWR lines on or beside the Décarie farm. In 1907, the Jockey Club of Montreal opened a new Blue Bonnets Raceway on Decarie Boulevard. The establishment changed ownership and was renamed the Hippodrome in 1995 and was permanently closed in 2009. Al Palmer, "Blue Bonnets 1830 Had Horsy Set Too," *The Gazette*, April 9, 1964; "In and around the Town...," *The Montreal Gazette*, August 30, 1969; Hélène Lamarche, "About Saint-Pierre, a Part of Lachine's Past and Present," *La Lucarne: Les Amis et Propriétaires de Maisons Anciennes Du Québec* (Summer 2011), accessed February 1, 2015, http://ville.montreal.qc.ca/portal/page?_pageid=8197,90911629&_dad=portal&_schema=PORTAL; and Rielle, *Map of the Island of Montreal*.

farmland north of the bridge and beyond the Lachine Canal to level out the approach.[460] The small, simple, wood- or stone-construction, single-storey farmhouses or outbuildings lining the earthworks help establish the cutting depth. The village experienced little industrial growth until the turn of the century, and, at the time of this photograph, several homes were built by the owners with "their own hands and in their spare time."[461] Farmers and members of the working class inhabited the rural area.

Running parallel to the CPR tracks in the photograph are telegraph or telephone poles, a secondary communication line introduced alongside the construction project. Fleming biographer Mario Creet wrote, "Side by side with steel rails went telegraph poles. Steam and electricity, Fleming maintained, were the 'twin agencies of civilization.'"[462] Bob Fleming noted the installation of a telephone in his office, without mention if it drew off existing lines or if this construction brought lines to Lachine for the first time.[463]

The long shots along the earthworks help establish the extent of development in the area at the time and the capabilities of large steam-powered earth-moving machines. The photographer was perhaps positioned on the back of a locomotive, at a safe distance from the heavy machinery, using the visible locomotive as a measure of scale but again reducing the human element. In the making of this approach, the enormous ramps, framed with timber and backfilled with earth, and the five-metre- (sixteen-foot-) wide trenches dramatically alter the spatial relationships. Earthworks severed farmland and fences built up along the corridor prohibited

[460] Locomotives pulling heavy cargo were restricted to inclines of 1.5:3 and therefore needed major earthworks to achieve heights over existing built forms.

[461] Robert D. Lewis, *Manufacturing Montreal: The Making of an Industrial Landscape, 1850 to 1930* (Baltimore: The Johns Hopkins University Press, 2000), 247.

[462] Creet, "Fleming."

[463] For a socio-political look at the implementation and impact of telephones on the island, see Claire Poitras, *La cité au bout du fil: le téléphone à Montréal de 1879 à 1930* (Montréal: Presses de l'Université de Montréal, 2000).

people and domestic animals from encroaching. While the construction reports detail how the change must happen, they neglect the expropriation and demolition processes made evident in the photographs.

Navigating the Waters

This photograph, *Clearing the Bottom of No. 6 Piers* (See Figure 4.16), appears to be related to the previous earthworks, but it is not. Its precise placement signifies a change, as does the activity captured in the photograph. For the first time, the album displays an active construction site at the water's edge. The boats in the background, and the caption, place the photographer at a construction site approximately 300 metres (968 feet) away from the shore (See Figure 2.9).

Figure 4.16: *Clearing the Bottom of No. 6 Pier, June 1886* [LAC: C-256 Accession 1987-161, Box 2 #4, page 10].

The album photographs explore a "wet" construction site—something very few people would have experienced—at the caissons used to build bridge piers. The caissons were prefabricated on land with timber members, 30.5 × 30.5 centimetres (twelve by twelve inches), spiked together, braced, and caulked before being towed upstream and sunk in place with heavy anchors. Placing the caissons was a challenge because they needed to line up at right angles with the centreline of the bridge and at an acute angle to the river's flow. The interior of a caisson permitted for 1.5 metres (five feet) of movement around the piers but only allowed for about a 15.25-centimetre (six-inch) placement tolerance.[464] The uneven and muddy riverbed made it challenging to form a seal; dredge buckets removed excess mud, and divers fastened chains around oversized boulders so that tug boats could move them out of the way.

Figure 4.16 consequently depicts a dozen or so men primarily focused on the mud-covered dredge bucket with its jaws open. They need to clear the bottom of all loose stones and mud before placing and sealing the cofferdam. To seal the bottom, divers spiked sheet piles of 7.6 centimetres (three-inch) planks all around the bow and fastened a canvas curtain on the inside. Two gangs worked day and night to mix and lower concrete in an iron box—2.3 metres (2.5 yards) at a time—to the bottom of the caisson until approximately seventy-three metres (eighty yards) filled the space. Workers waited two to three days for the concrete to set and then began pumping water out of the caissons.[465]

The camera was set up at the edge of a caisson, under the A-framed derrick holding the chain and pulleys activating the dredge. The photograph brings the viewer candidly to the centre of the action, where most of the men posed strategically away from the camera. Two workers

[464] Massy, "Foundations of the St. Lawrence Bridge," 38.
[465] Ibid., 39.

deviated from the group and faced the camera, the first of many faces to appear in the album. Although some elements are out of focus, the photograph's inclusion in the album creates an imperfect impression. In some ways, the blurred image is more "real" than a staged composition, which conveys the firsthand experience of everyday work on the construction site. The photograph is evidence of a personal experience and enlivens a fading memory of the speed at which the project advanced.

This part of the construction site was only accessible by boat, so the photographer relied on a river pilot and possibly a tugboat called the *Nellie Reid*, pictured in the background. The 179-metre (70.5-foot) screw-propelled steam vessel was likely built for this project[466] and likely named after the only daughter of Robert Gillespie Reid.[467] Like so many in the album, this photograph interlaces a place-based history with the lives of those present.

Figure 4.16 was taken out on the water, where time was a challenge. Except for the navigation channel, where depths reach thirty metres (ninety feet), the river at the location of the crossing is shallow. It fluctuates by approximately two metres (six feet) between high-winter and low-summer water levels.[468] The contractors raced against the low-summer water levels, as Fleming noted: "Tugs [were] striking boulders very often" and the "water [was] getting very low for them to work at [Piers] No. 4 + 5."[469] Summer water levels, along with spring and winter ice, shortened the working season, which required advanced planning to deliver wood for caissons and cement and stone for piers. It also needed carefully sourced equipment: chains to lift the

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[466] The boat was registered (registry number 90544) at the Port of Montreal from 1886 to 1912, after which the registry was transferred to the Port of Toronto. Information about the boat's depth and hull material are unavailable. "Nellie Reid," LAC: Ship Registrations 1787–1966, October 16, 2015, accessed April 28, 2019. http://www.bac-lac.gc.ca/eng/discover/ship-registration-index-1787-1966/Pages/item.aspx?IdNumber=52326&DotsIdNumber=.

[467] Reid had three sons and one daughter. Peter D. Locke, "Czar of Newfoundland: A Profile of Sir Robert Gillespie Reid," *Canadian Rail* 419 (November-December 1990): 184.

[468] Massy, "Foundations of the St. Lawrence Bridge," 40.

[469] Fleming, "Collins' Commercial Diary," June 4, 1886.

materials, a dredge bucket to level the riverbed and a tug to tow and power the operations, all before the water dropped below the tug's ability to operate.

During the summer when masonry work began, the Montreal Harbour Commission (MHC) undertook a significant deepening of the harbour between Montreal and Quebec. To expedite the process, Reid and Bob Fleming ran many wet construction sites at once. The parallel projects required multiple sets of equipment: boats, dredge buckets, and chains. The project employed seven elevator dredges, two to three spoon dredges, two stone lifters, seven screw tugs, five barges, fifteen hopper-bottom scows, and four flat scows.[470] Thus, the harbour project occupied a large portion of the MHC-owned equipment.

Bob Fleming reported challenges in securing the equipment needed to build several piers at once. At first, he was unsuccessful in finding a boat and hired a tug in the interim.[471] However, on May 16, 1886, Fleming travelled to Buffalo to secure a tugboat and returned a few days later with the *Nellie Reid*. Fleming likely searched for a medium-sized iron- or steel-hulled boat, suitable for towing cargo and usable in the canal locks. Although Canada was then among the world's top four builders of wooden sailing ships, metal shipbuilding in Canada did not begin until after World War I (WWI).

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[470] Ministry of Public Works, *Annual Report of the Minister of Public Works*, 345–47.

[471] The May 7 entry in the diary reads, "Tried to get tug from Syracuse, but they had not any," and the May 10 entry reads, "Ready to place caisson but could not get tug. Hired tug Scicluna." The hired tug may have referenced the Emmanuel Scicluna, which was registered in Montreal in 1884. Fleming, "Collins' Commercial Diary," May 7, and May 10, 1886.

Figure 4.17: *Inside Caisson No. 11, Sept 11-86* [LAC: C-256 Accession 1987-161, Box 2 #4, page 14].

Upon his return from Buffalo with a tug boat, construction on the piers resumed. The only image taken below the waterline is *Inside Caisson No. 11* (See Figure 4.17). Horizontally stacked timbers formed the vertical walls, which were reinforced by large timber beams against the immense pressure of the moving water outside the caisson. The photograph demonstrates the exposed riverbed covered with stone that was broken to pass a 6.4-centimetre (2.5-inch) ring, waiting to be mixed with Portland cement and sand—at a ratio of 3:1:1—and manually levelled.

Until the last quarter of the nineteenth century, cement was reliably inconsistent—of poor and uneven quality—and generally unsuitable for bridge piers. It could not withstand the effects of frost, was expensive (Fleming quoted $2 per barrel in February and $0.12 per pound in May, purchasing one thousand pounds at one time), and had so few precedents that engineers were reluctant to use it.[472] Toward the end of the nineteenth century, as material standards improved in general, higher-quality cement became available, which included long-lasting hydraulic cement that was set in water.[473] The Lachine Bridge was the first bridge across the St. Lawrence to use any form of cement.[474] Therefore, the project was a marker of how the materiality of bridge construction was about to be transformed entirely in Canada.[475] It also, in a sense, foreshadowed the emerging cement industry in Canada, originating in Montreal.[476]

The photograph presents the raw materials in the caisson: the stone from local quarries and timbers brought in by railway. Although out of focus in reproduction, the intense sunlight in Figure 4.17 articulates every grain, knot, and splinter in the wood and rich texture in the gravel. The heavy caissons hold back the force of the water, and the crossbeams appear to be sweating from their exertion. Thus, the architectural elements seem to exert the energy of unseen workers. The photograph foreshadows the significance of concrete in construction.

The Lachine Canal, Blue Bonnets cut and fill, and the bottom of Caisson No. 11 are all places the photographer visited during the construction of the Saint-Laurent Bridge. They were all locations deemed necessary enough to photograph and memorable enough to place in a souvenir album. These places are part of an expansive landscape that gives insight into the

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472 McNally, "Roads, Streets, and Highways," 53.

473 Cement is "a powdery substance made with calcined lime and clay. It is mixed with water to form mortar or mixed with sand, gravel, and water to make concrete." "Cement," Minerals Education Coalition, accessed January 28, 2021, https://mineralseducationcoalition.org/minerals-database/cement/.

474 For an overview of Canada's cement manufacture in Quebec and its implications for engineering and construction in Canada, see ibid., 54.

475 Subsequent bridges, such as the Jacques Cartier (1930), Mercier (1934), and Champlain (1962), increasingly used cement in their sub- and superstructures.

476 Early attempts to establish a cement industry failed, but by 1909, Montreal manufacturers were supplying materials for most of the country: the Canada Cement Co., Ltd., controlled 100% of Quebec cement manufacturing that year and 40–50% of all Canadian production. Marc Vallières et al., *Des mines et des hommes: histoire de l'industrie mínerale Québécoise: des orgines au début des années 1980* (Quebec City: Publications du Québec, 1989), 111. For more on the cement industry in Montreal, see Arthur Charles Tagge, *The Cement Industry in Canada* (Montreal: Canada Cement, 1924).

material flows and the coordination required to assemble the pieces that eventually equal the whole. The result demonstrates the inherent details revealed by looking closely at images and across textual records.

Henderson structures the story in a narrative sequence that weaves through the different zones and moves back and forth through various construction stages while following a transect along the railway line to break down the complexity and build it back up again into an understanding of the whole. The different storylines intersect with the overall narrative of showing that the contractor must continually circle back. Each time the album brings the viewer along the construction path, new layers of information or traces of the past that overlap with previous generations of builders and stories outside of the bridge become apparent. Although the stories can be somewhat distracting from the history of the construction, they add layers to the landscape history that can only be observed through an intertextual reading of the sources in this research.

The Landscape Gaze Amplified

This fourth section examines the content, structure, and presentation of the albums to show the ways in which the albums' compiler(s) engage viewers. The number of possible readings is beyond the scope of this study, and the examples provided below incorporate visual devices like selective presentation, positioning the viewer, framing, and others. The examples below show how the albums direct the viewer(s)'s gaze and stage or even choreograph how the construction projects might be understood.

Corruption, greed, and power struggles nearly derailed the Canadian Pacific Railway project. Yet, when Donald Smith ceremoniously drove the last spike into the CPR on November

17, 1885, at Craigellachie, British Columbia, general apprehension dissipated.[477] The railway emblematically bound the now-sovereign provinces (See Figure 3.19). Canadian Confederation hinged on the network of steel rails destined to bind the country, which promised to conquer spatial divides and unite a vast and varying territory.[478] The Canadian government and British investors saw the railway to gain political power, capitalize on natural resources, and overcome rough country and climate.

Figure 4.18: *The Last Spike*, Photograph, 1885 (from CPR archives, Globe and Mail)

Construction preparations began on the St. Lawrence Bridge at Montreal, as mentioned previously, a month after the historical moment captured in the photograph, *The Last Spike.* Behind Donald Smith, to the left, stands Sir Sandford Fleming with a white beard and a tall top hat. Fleming, as mentioned previously, passed through Montreal on several occasions during the bridge construction to visit with his son and masonry contractor Bob Fleming. There are no

[477] Berton and Friedman, *The Last Spike,* 415.

[478] A. A. den Otter, "Nationalism and the Pacific Scandal," *The Canadian Historical Review* 69, no. 3 (1988): 315–39; den Otter, *The Philosophy of Railways*.

photos of Fleming Sr. at the Montreal bridge site, in fact, there are no photographs of the complete bridge or any celebrations that may have taken place. After all, the bridge doubles freight capacity over the St. Lawrence River, overcomes the monopoly held by the Grand Trunk Railway, and physically connects the western branch of the line in British Columbia with the Inter Colonial Railway and its terminus in Halifax, Nova Scotia.

Figure 4.19: Senator W. L. McDougald is symbolically turning the "last crank," Jacques Cartier Bridge [DBC, *Superstructure of Montreal Harbour Bridge*, 6 (Figure 2)].

The Jacques Cartier Bridge album's opening photograph echoes the institutional "power" stance established by an earlier generation of builders. The picture depicts Senator and Montreal Harbour Commissioner Wilfrid Laurier McDougald symbolically turns the crank that closes the two sides of the cantilever (See Figure 4.19). The scene draws a comparison to the well-known *Last Spike* photograph of Donald Smith emblematically driving the final pin into the CPR in 1885. It is impossible to know if the photographer or McDougald anticipated the similarity; the photograph does, however, present the Commissioner in parallel to the railway builders of a previous generation and, by extension, the highway bridge at the same level of importance as a national railway.

Subsequent photographs in the album produce a repetitive (and now iconic) view of the bridge's main span. The photographs centre on the construction of the main cantilever, and to capture the network of lattices and trusses on the superstructure, the photographer had to step back from the base of the bridge (See Figure 4.20). The widening frame exposed earlier Montreal Harbour Commission (MHC) investments, such as storage sheds and railway lines.[479] The space is what landscape historian John Stilgoe called the metropolitan corridor. The landform marked a "coming of age" for railway cities and introduced new spatial forms and building materials: "more than urban areas, the corridor spoke of the power of the new, expert builder, the engineer, the architect, and the landscape architect."[480] Occasionally, the camera exposed extraordinary architectural forms; however, the bridge is the main subject.

The MHC invested significantly in the corridor to remain competitive in a growing global market. The grain silos, for example, not only supported the economy but also forever changed the form of the city. Geographer Jason Gilliland writes, the silos were "exempt from the city's ten-storey height restriction (enacted in 1901)" and rose two storeys above the traditional city skyline.[481] Its architecture was exceptional and inspired an entire generation of modern architects.[482] The silos are missing from the photographs.

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[479] For more on port architecture, see Carl W. Condit, *The Port of New York: A History of the Rail Terminal System from the Beginnings to Pennsylvania Station* (Chicago: University of Chicago Press, 1980).

[480] John R. Stilgoe, *Metropolitan Corridor: Railroads and the American Scene* (New Haven, CT: Yale University Press, 1985), 8, 13.

[481] Jason Gilliland, "Muddy Shore to Modern Port: Redimensioning the Montréal Waterfront Time-Space," *Canadian Geographer* 48, no. 4 (December 2004): 467.

[482] Walter Gropius, Mies van der Rohe, and Le Corbusier borrowed from the industrial language, such as "the rectangular grids of American factories and the closed cylinders of grain elevators," while rejecting "the diagonal lattices and tapering trusses of bridges and cranes" in their designs. Le Corbusier, *Toward an Architecture*, translated by Frederick Etchells (London: Architectural Press, 1946); Reyner Banham, *A Concrete Atlantis: U.S. Industrial Building and European Modern Architecture, 1900-1925* (Cambridge, Mass.: MIT Press, 1989), 216.

Stage I: Main Post

Stage II: Progress on North Main Span

Stage III: Concurrent Erection of North Anchor and Cantilever Arm

Stage IV: Progress on Main Span

Figure 4.20: Collage of photographs representing the four stages of construction, Jacques Cartier Bridge [DBC, *Superstructure of Montreal Harbour Bridge*, 26 (Figure 12) for Stage I; 27 (Figure 13) for Stage II; 28 (Figure 14) for Stage III; 41 (Figure 27) for Stage IV].

Art historian Steven Jacobs argued that a link exists between the empty city portrayed in photographs and the psychological isolation felt in growing industrial cities. Jacobs claims that, while depictions of vacant urban spaces, such as a “harbour on a Sunday, park or undeveloped areas,” imply silence, and that “by giving form to vacancy, the artist suggests the frantic tempo of the city."[483] The photographs depict industrial life without portraying the experience or emotional isolation of people in the city.

The photographs capture the more vernacular forms associated with the port that has an equally powerful message about the importance of the Commission (and, by extension, the Commissioners). Montreal was the first fully electrified port in the world,[484] and the evenly spaced electrical poles in the photographs are dwarfed by the bridge and mountains of raw material. The electrical lines, railway lines, and raw materials all indicate forms of investment in this landscape. "As the opposition with vernacular implies," writes sociologist Sharon Zukin, "powerful institutions have a preeminent capacity to impose their view on the landscape—weakening, reshaping, and displacing the view from the vernacular."[485] The album portrays the bridge as a commodity that symbolizes the power this location had within the national economy and, by extension, the power the MHC had over the harbour. The landscape is consequently entwined with economic, political, and social values, which for Zukin, "represent, transmit, and transform institutionally embedded power relations."[486] The landscape is interwoven with the views of the MHC.

The landscape is political and ideological when cropped in this way. The photographs capture a popular view and omit undesirable elements or even a larger, referential context. For W. J. T. Mitchell, the landscape and its representations are an "instrument or agent of cultural

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[483] Steven Jacobs, "Amor Vacui: Photography and the Image of the Empty City," *History of Photography* 30, no. 2 (June 2006): 109, https://doi.org/10.1080/03087298.2006.10442853.

[484] Ibid., 46.

[485] Sharon Zukin, *Landscapes of Power from Detroit to Disney World* (Berkeley: University of California Press, 1991), 16.

[486] Zukin argues that the patterning of social spaces is set in a particular time and place, is influenced by economic, political, and cultural models, and is reflective of change in both economic and cultural systems. Ibid., 21.

power," exposing the development of national, social, and personal identities.[487] McDougald's photograph and the repeated view of the bridge that absorbs the layers of MHC investments is, for Mitchell, a fetishized landscape and an "emblem of the social relations it conceals that reflects personal and political ideals.[488] The representations are helpful to understand a dominant view and question what (and why) elements of a deeply layered historical landscape were omitted.

Figure 4.21: *First and last pages of the Alex Ross album.* Left: *Northern Entrance,* William Notman, January 1860. Right: *Untitled,* William Notman, s.d. [LAC: Alex Ross Album].

Notably, some photographs exclude the engineer. The names of individuals are missing from William Notman's gift to Alexander Ross, and still, the position of individual characters invites inquire (See Figure 4.21). The front page is a photograph of a man, likely the GTR superintendent and recipient of the album, Alexander Ross. The back page contains a stereograph of the inner section of the same entrance. Three men stand to the right of the image and the stone above reads, "Built by James Hodges for Samuel Morton Peto, Thomas Brassey, and Edward Ladd Betts Contactors." The image size of the two photographs and their placement

[487] Mitchell, *Landscape and Power,* 1.
[488] Ibid.

in the album suggests the photographer shared a different esteem of the superintendent than the construction engineer.

Notman clearly involved himself in the bridge project beyond taking photographs. Shortly after Hodges's book came out, a second book about the bridge appeared: *A Glance at the Victoria Bridge, and the Men Who Built It* (See Figure 4.22). The book was written by Charles Legge, the superintending engineer, to complete the south end of the Victoria Bridge. In his introductory pages, Legge writes that the book was written on request of "an artist who has given to the world a series of views of the wonderful structure."[489] There is no further mention of that artist, but his identity merits speculation. A copy of Legge's original publication, found at the CCA, has a full-page advertisement for Notman's studio on the back, making Notman a sponsor of the book.[490]

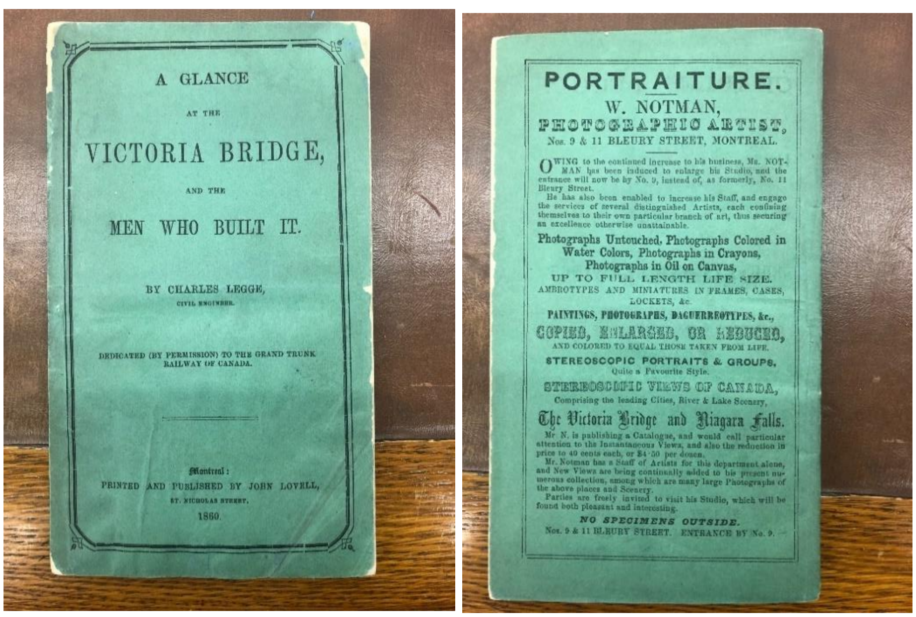

Figure 4.22: Front and back cover, *A Glance at the Victoria Bridge and the Men Who Built It,* by Charles Legge, 1860, Photo credit, Chris Lyons

[489] Charles Legge, *A Glance at the Victoria Bridge, and the Men Who Built It* (Montreal: J. Lovell, 1860), 3.

[490] The MRBSC copy of Legge's book was rebound with a hard cover that provides no indication of what the original cover looked like. The second copy, found at the CCA, is in delicate condition and protected in a plastic sleeve. Although it is no longer attached, the original green cover, with Notman's advertisement, is kept in the sleeve.

The purpose of the book was to give credit to the many men involved in the construction project. Legge wrote about the roles played by various men, including Hodges's important role in overseeing construction. In very long-winded passages—some sentences running the length of a page or more—Legge described Hodges's generous nature and attention to detail, finding that Hodges possessed a "simple, manly and straight-forward style which characterized his daily walk and conversation."[491] Legge also praised Hodges for his care and concern for the workers, considering the latter a man of high moral standards. While Legge acknowledges Hodges's contributions to the construction of the bridge, he also reminds readers that Canadian engineers, like Thomas Keefer, also contributed.

[491] Legge, *A Glance at the Victoria Bridge,* 85.

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Figure 4.23: *Dredging Machine,* William Notman, September 1858 [LAC: Alex Ross Album].

The photographs show how engineers distinguish themselves from workers; they wear different clothes and position themselves apart from workers (See Figure 4.23). For Hodges, the Canadian landscape was a place that fostered creativity and ingenuity. He observed how an emigrant mechanic, without familiar tools, was forced to manufacture “simple labour-saving machinery” and became a better person—self-sufficient, proficient, and resourceful on the construction site.[492] Hodges reflected on the story behind the ingenious “steam-traveller” and of Mr. Chaffey, an Englishman “who had been in Canada a sufficient length of time to free his

[492] Hodges, *Construction of the Great Victoria Bridge,* 33.

genius from the shackles riveted to him in early life."[493] When faced with severe labour shortages and a need to move the heavy stone quickly, Chaffey came up with a steam-powered derrick to do the heavy lifting.[494] Hodges cited this as an example of ordinary men leaving England and proving "themselves full of enterprise and resource"[495] in the Canadian landscape.

Hodges asked, "Why is it that a plodding man […] shut out (as he is usually considered to be by those who pay him a transitory visit in the colonies) from all means of getting information or knowledge, should, in a short time, become self-reliant, competent, and able?"[496] He did not answer the question directly, but he found that industrialization in Britain impacted workers. He observed how the oppressive trade unions locked workers into a single job. Although he acknowledged that a person doing one job repeatedly became good at that job, efficient as a machine, he warned that repetitious work dulled the mind.[497] In North America, however, Hodges found that men had to take on many jobs and, without familiar tools, their creativity and capacity for independent thinking increased.[498]

Yet, the albums demonstrate that engineers differentiated themselves from related professions and vocations, such as surveyors and contractors. As mentioned, engineers were trying to define and protect their domain. They formed a professional association, the CSCE, to determine their scope of work, elevate their profession, protect the public from substandard

[493] Ibid.

[494] Hodges noted how costly labour was in America, and Arthur Helps explained that machinery was used "on account of the scarcity and consequent dearness of labour." Arthur Helps, *Life and Labours of Mr. Brassey, 1805–1870* (Boston: Roberts Brothers, 1874), 189, http://hdl.handle.net/2027/uc1.%24b50173.

[495] Hodges, *Construction of the Great Victoria Bridge*, 33.

[496] Ibid. Hodges consequently did not question the local decision to use cofferdams (watertight enclosures pumped dry for construction below the water level), over British caissons, for pier building. The fast-flowing St. Lawrence differed from the tidal waters to which he was accustomed.

[497] Helps, *Life and Labours of Mr. Brassey*, 193.

[498] Ibid.

work, and differentiate themselves from their American and British counterparts.[499] The CSCE held its inaugural meeting in Montreal in February 1887, as work neared completion on the superstructure for the Lachine Bridge.

e011297345-035

Figure 4.24: *St. Lawrence Bridge, View from South Side,* s.n. October 1886 [LAC: C-256 Accession 1987-161, Box 2 #4].

The CPR photographs helped the engineers' cause by depicting complex construction sites as clean, organized, and well managed. "Landscape, in this way of thinking," writes James Elkin, "is an exemplary encounter with subjectivity […] understood as a kind of unity—"framed" or

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[499] Ball, *Mind, Heart, and Vision*, 23.

other wise “composed,” and always “seen”—which reflects, or articulates, the sense of self.”[500] The photographs stress that the engineer is organized and in charge. When special guests visit the construction site, they and the engineers take a prominent place in the pictures. Their identity takes on a spatial arrangement. For theorists, architectural historians, and landscape historians, self is always a self located in space.[501] For example, in the photograph *St. Lawrence Bridge, View from South Side,* the workers sit to the side. At the same time, an official takes a prominent seat, gazing at the bridge with his back to the camera (See Figure 4.24).

Figure 4.25: *Setting Shoe on South Main Pier*

[500] Rachael Ziady DeLue and James Elkins, eds., *Landscape Theory*, vol. 6, The Art Seminar (New York: Routledge, 2008), 103.

[501] Lefebvre, *The Production of Space*; Harris, “Self and Landscape,” 191.

The prominent position of the engineer is a recurring theme in the Montreal bridge photographs. In the picture, *Setting Shoe on South Main Pier*, the camera is positioned in line with the top of the works. In contrast, the engineer is placed in the bottom right-hand corner (See Figure 4.25). He is recognizable by the paperwork he carries in his left hand. With his hands on his hips, the engineer's relaxed stance indicates that the works are progressing as planned. The raised camera position provides an overview of the results and places the viewer such that they appear to be observing over the engineer's shoulder. The composition is reassuring that everything is under control and that the men guiding the shoe, along with the riveters, are safe despite their lack of safety gear and position high above the river.

Most of the photographs also make the labourers' dangerous work feel like an everyday job. The unnamed workers' identities are impossible to decipher, and even their manner of dress provides little information about who they were or what their roles were on the construction site. Their contributions are, for architectural and urban historian Dolores Hayden intangible. She writes, "The experience of physical labor is also part of body memory. In a dusty vineyard, a crowded sweatshop, or an oil field, people acquire the characteristic postures of certain occupations - picking grapes, sewing dresses, pumping gas."[502] Riveting was a highly trained skill and the workers' bodies hold clues to landscape history beyond Montreal. A significant number of steel workers trained on the Montreal bridges would build riveted bridges and steel-framed skyscrapers across North America.

[502] Hayden, *The Power of Place*, 48.

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Figure 4.26: *"Travelling Derrick," Sept. 23 [LAC: C-256 Accession 1987-161, Box 2 #4, page 21].*

The role of steel workers and specifically those from Kahnawake are not shown in the bridge stories. In the photograph, *"Travelling Derrick,* about two dozen men sit atop the bridge structure and at the base of the travelling derrick (See Figure 4.26). Assuming they were a mix of engineers and steelworkers, they were likely waiting for materials to advance construction. The derrick—a crane-like machine—lifted steel from boats to the scaffold or lifted scaffolding to the workers above. Mohawk members of the crew consisted of young apprentices, or “punks,” who were learning the trade from their relatives, men in charge of pacing the team, and a bilingual Elder.[503] Thus, both the engineers and the steelworkers took an intergenerational approach to teaching and learning their occupation.

During the construction of the Saint-Lawrence Bridge, the residents of Kahnawake, the *Kahnawakehro´:non*, proved themselves worthy of more challenging work, including the high-paying riveting jobs. The men had, in fact, decades of experience building railway bridges. During the construction of the Victoria Bridge, Mohawks worked alongside French and English labourers. To overcome language barriers at the Victoria Bridge, the GTR hired entire crews that were managed by a bi- or tri-lingual foreman who could communicate among the Mohawk workers and the engineers.[504] Historian Edward Devin wrote, “Their [Mohawk] brawn and muscle were eagerly sought by the builders of the Victoria Bridge, where hundreds of them were developing those qualities of skill and reckless daring.”[505] The men learned valuable bridge-building skills and continued in the trade, working for the GTR and CPR on lines between Montreal, Ottawa, and Quebec City.[506] When construction began on the Lachine Bridge, Joe

[503] David Blanchard, “High Steel! The Kanhawake Mohawk and the High Steel Construction Trade,” *Journal of Ethnic Studies* 11, no. 2 (Summer 1983): 45.
[504] Ibid., 44.
[505] E. J. Devine, *Historic Caughnawaga* (Montreal: Messenger, 1922), 402, http://hdl.handle.net/2027/wu.89060960838.
[506] Blanchard, “High Steel,” 44.

Regis and Napoleon Rice, two *Kahnawakehro´:non* bridge workers secured employment and, by the following year, nearly fifty other Mohawk men joined work gangs.[507]

The erection process required three groups of workers.[508] The raising gang operated the cranes and derricks to lift the heavy steel members and roughly place them according to the predetermined numbering system on a plan. The fitting crew adjusted the steel components so that the pieces were plumb and level with all the rivet and bolt holes aligned and ready for permanent attachment. They temporarily secured the steel in place with bolts, carrying approximately sixteen kilograms (thirty-five pounds) of bolts and tools in a canvas pouch attached around their waist by a canvas or leather belt.[509] The job required strength and balance. The third group, the riveting gang, had the all-important job of permanently fastening the steel members with red-hot rivets. This team had to synchronize their pace. For every raising and fitting gang, there were two to three riveting gangs.

Riveting was one of the most dangerous jobs on the construction site. It also paid the most for labourers. It took four men to form a riveting gang: a heater, a sticker-in, a bucker-up, and a riveter.[510] The heater set up a temporary forge on a wooden scaffold close to the fitted steel members. He was responsible for feeding the fire with coal, heating the rivets, picking them up with tongs, and tossing them to the sticker-in. The heater's workshop, complete with hot coals, was moved only when the works advanced to the extent that he could no longer safely toss the red-hot rivets to the sticker-in. The rest of the gang positioned themselves on a makeshift

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[507] Ibid.

[508] Job titles and responsibilities come from an article first published in *The New Yorker*, 1859. Joseph Mitchell, *Apologies to the Iroquois: With a Study of Mohawks in High Steel*, ed. Edmund Wilson (New York: Vintage, 1959), 15–17.

[509] Blanchard, "High Steel," 47.

[510] Riveting evolved from the time of the Victoria Bridge; where contemporary descriptions are lacking, I draw my description from the following: "Book Review: The Construction of the Great Victoria Bridge," 345; and Triggs et al., *Le Pont Victoria*, 49.

scaffold, cantilevered out from (or hung by ropes below) the riveting area. Standing high up on a temporary, swinging platform with nothing but the river below is thus not work for the faint of heart.

The sticker-in was responsible for catching the red-hot rivets in a metal can, which he passed to the bucker-up, who had removed the temporary ties and bolts in anticipation of the rivet. Once the bucker-up had the still-hot rivet in place, the riveter took over. Using a steam-powered pneumatic hammer, he hammered away until the rivet stem formed a mushroom top. The process permanently secured the steel in place and, imaginably, shook one's body to the core. This team had to coordinate their movements to avoid dropping any rivets into the river and to keep the pace of work moving forward.

The DBC likely trained twelve men from Kahnawake as riveters, enough to form three whole gangs.[511] According to a DBC spokesperson, "these Indians were very odd because they did not have any fear of heights. If not watched, they would climb up into the spans and walk around up there as cool and collected as the toughest of our riveters."[512] Initially hired by the DBC and CPR as general labourers, the Mohawk riveters earned a reputation for being fearless and adventurous.

In the minds of non-Indigenous commentators, working at dangerous heights was assumed to be a rite of passage into adulthood for young Mohawks.[513] These myths, however, are as unlikely as the notion of a railway defining a Canadian national identity. Author Bruce Katzer

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[511] No records exist for the individuals who trained for the job, but company tradition was to train three gangs at a time. Mitchell, *Apologies to the Iroquois*, 15.

[512] Joseph Mitchell, *Up in the Old Hotel and Other Stories* (New York: Pantheon, 1993), 274–78.

[513] Mitchell's 1959 article in *The New Yorker* perpetuated stereotypes about Indigenous workers from *Kahnawá:ke*. Mitchell, *Apologies to the Iroquois*, 3.

argued for a more likely scenario: the Lachine Bridge jobs were convenient.[514] Katzer also pointed out that structural steelwork required focus and attention rather than adventure. Steelwork was challenging for older, less agile men. Yet, many were members of the steelworkers' union for decades, showing dedication to the trade. As Katzer stated, the men took these unstable jobs, plagued by labour disruptions and the risk of bad weather, to meet the community's immediate economic needs.

The labourers proved themselves as capable steelworkers, and following the Lachine Bridge, the DBC hired more Mohawk apprentices. By 1907, upward of 110 Mohawk men registered as steelworkers, and seventy or more found employment on the Quebec Bridge. From the early nineteenth century onward, the men followed the structural steel work to New York, Philadelphia, Detroit, and Chicago; they travelled from city to city, building some of North America's most notable bridges and skyscrapers. Today, the men still work in small teams to avoid a repeat tragedy.

In its contemporary sense, the albums' photographs similar to the one shown above but titled *"Traveller"* or "*Travelling Derrick"* assume more than one meaning. Immediately, their captions are understood to draw attention to the mechanism used in the erection process. The travelling derrick, assessed retrospectively, suggests employment opportunities and the distances that steelworkers who trained on the St. Lawrence Bridge travelled to find work over the course of the next century.[515]

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[514] Bruce Katzer, "The Caughnawaga Mohawks: The Other Side of Ironwork," *Journal of Ethnic Studies* 15, no. 4 (1988): 39–55.

[515] A similar photograph in the second album, the "scrapbook," is labelled with the caption "Traveller" was used to ascertain the buildings in the background. "Photograph Album" (Photographic scrapbook, Montreal, ca 1887), 43, Box 2 #3, C-0256 to C-0257, R5607-4-3-E, Accession 1987-161, Fonds Dominion Bridge, LAC.

The caption, as demonstrated above, gives clues to the technology and the identity of the people who build the bridge. Without it, or without the album, this photograph could be of any bridge over any river along the CPR line. The album gives a timeline and clues to the historical record. To the right of the bridge, the Church of Sainte-Agnes of Lachine seems to have stood. In 1977, the Canadian Register recognized the remaining foundations of the church as a historic archeological site.[516] According to the register, the religious complex succumbed to demolition in 1869, nearly twenty years before the photographer took this image. Therefore, this and other photographs in the album could help historians and archeologists refine the history of individual buildings and offer clues to land-use changes related to the bridge.

With work advancing rapidly on the superstructure, the album returns, once again, to the South Shore—to *Jocks Quarry* (See Figure 4.27), one of the stone suppliers. Quarrying operations began in the Mohawk territory in the 1820s, supplying high-quality, durable stone for large scale infrastructure projects such as the original construction of the locks of the Carillon Canal and the piers of the Victoria Bridge.[517] Several quarries in the area opened and closed based on demand, and they frequently changed ownership or management. At the time of construction on the Lachine Bridge, Atonwa Karatoton, aka Thomas Jocks, Chief of the Old Bear Clan (1842–1893), seems to have owned and operated the quarry,[518] although other sources indicate that a younger band member, John Waniente Jocks (1865–1917), owned the quarry at the time.[519] Bob Fleming mentioned transactions with "Tho' Jocks" on two occasions: the first,

[516] "Site Archéologique de l'Église-Des-Saints-Anges-de-Lachine," HistoricPlaces.ca, accessed April 29, 2019, https://www.historicplaces.ca/en/results-resultats.aspx?m=2&Keyword=11248.

[517] Parks, *Report on the Building and Ornamental Stones of Canada*, 48–49.

[518] Gerald F. Reid, "Culture and History: Kahnawake's Council of Chiefs: 1840–1889," Kahnawake Branch of the Mohawk Nation Six Nation Iroquois Confederacy, accessed April 29, 2019, http://www.kahnawakelonghouse.com/index.php?mid=2&p=2.

[519] Daniel Rueck, "Enclosing the Mohawk Commons: A History of Use-Rights, Land-Ownership, and Boundary-Making in Kahnawá:Ke" (PhD dissertation, Montreal, McGill University, 2013), 330.

on February 18, 1886, to confirm the delivery of plans for a transit house and the second, on April 3, 1886, to record a payment of $1,000.[520]

The photographer captured Jock's Quarry in October 1886, when Reid and Bob Fleming completed the masonry works a month ahead of schedule. Assuming that Henderson correctly labelled this photograph (which is not a given), [521] it remains unclear why the engineers and photographer would have visited the quarry when the masonry works were completed.

Figure 4.27: *Jocks Quarry, Caughnawaga, Oct-86* [LAC: C-256 Accession 1987-161, Box 2 #4, page 23].

The CPR was the second railway to cross through the Indigenous territory in less than forty years. "Each decision as to where a fence will stand, where a sidewalk begins, and a street ends,

[520] Fleming, "Collins' Commercial Diary," February 18, and April 3, 1886.

[521] According to Guay, Henderson seemingly went back through his collection, as a professional, and (mis)dated the negatives that corresponded with a numbering system unrelated to the date or location, adding to the confusion over his body of work. Guay, "Alexander Henderson," 82.

where a public hall shall give way to a private apartment," writes urban historian Eric Sandweiss, "is a decision to delineate the limits of one person's property against that of another."[522] For the Indigenous community, the bridge represents more than a division of property; it is a territorial incursion into the lives and lands of the Mohawk community.

In the 1850s, the Lake St. Louis and Province Line (LSL&PL) Railway opened between Plattsburgh and Kahnawake, with a ferry service to the Island of Montreal. Its tracks cut through communally held agricultural land and woodlots and threatened the autonomy of the residents.[523] The railway company expropriated five hectares (thirteen acres) of riverfront property from the Indigenous community to build a ferry terminal and essentially reorganized how goods and services moved through the community.[524] The money for that right of way went to the government-controlled Department of Indian Affairs (DIA),[525] and the community never saw a penny.[526] Shortly after, the railway connection was rerouted to Portland, Maine, with the Victoria Bridge as a crossing downstream of this site.

Once the Victoria Bridge contractors began construction in 1854, the colonial government abolished the seigniorial system in Quebec and the boundaries around the Mohawk community consequently softened. The Seigneury of Sault St. Louis was granted to the community in 1680 and was managed by Jesuit missionaries. "By the nineteenth century," wrote historian Daniel

522 Sandweiss, "Claiming the Urban Landscape," 16.

523 Anthropologist Audra Simpson argued that new, colonial-based settler laws put the Mohawk community's over two hundred years of self-governing autonomy at risk. Audra Simpson, *Mohawk Interruptus: Political Life across the Borders of Settler States* (Durham: Duke University Press, 2014).

524 Daniel Rück, "« Où tout le monde est propriétaire et où personne ne l'est »: droits d'usage et gestion foncière à Kahnawake, 1815–1880," *Revue d'Histoire de L'Amerique Française* 70, no. 1–2 (2016): 39, https://doi.org/10.7202/1038288ar.

525 The government refused to pay for the land (valued at approximately $99,000) or for the land expropriated for the ferry terminal. Chiefs remained upset throughout the 1850s about not getting paid for their land. Consequently, twenty families left the community for a short time. Devine, *Historic Caughnawaga*, 393.

526 Blanchard reported that confusion exists over where the money went. The Catholic Church wanted the money to repair the church, the chiefs wanted to distribute funds to the community, and the DIA wanted the money for their own projects. The government won. See Blanchard, "High Steel," 59.

Rück, “two-thirds of this land had been conceded to non-Mohawk farmers and the seigneurial boundary had been modified several times, generally not in favour of the Mohawks.”[527] Neighbouring farmers encroached on the territory and, throughout the 1870s, the community requested a survey to define (and protect) the boundary.

The DIA considered the boundary survey, but on the condition that an internal subdivision survey be conducted simultaneously, the community refused, and the DIA kept pushing. Rück reported the DIA’s claim: “Kahnawakehro´:non were, like all Indians, incapable of governing themselves, which served as justification for further intervention.”[528] The 1876 Indian Act gave the DIA and its agents the authority to identify and determine rights and benefits within Indigenous communities.[529] The laws were enacted to assimilate and abolish native culture by controlling First Nations’ identity, political structures, governance, cultural practices, and education.[530] The DIA felt that the subdivision survey would benefit the community by decreasing land-use conflicts, increasing land productivity, and moving the community toward enfranchisement. In 1880, the DIA agreed to conduct the boundary survey.

In August of that year, architect, engineer, and provincial land surveyor William McLea Walbank won the boundary survey contract. He conducted his field research and submitted his findings by the end of the year, summarizing that, without historical maps, the boundaries were difficult to determine. He also noted that the non-Native farmers challenged the boundaries,

[527] For more on the boundary survey, see Rueck, “Enclosing the Mohawk Commons,” 246–48.

[528] Rueck, “Commons, Enclosure, and Resistance in Kahnawá:Ke,” 360.

[529] For more on the 1876 Indian Act, see Mary-Ellen Kelm and Keith D. Smith, Talking Back to the Indian Act: Critical Reading in Settler Colonial Histories (Toronto: University of Toronto Press), accessed January 26, 2021, https://books-scholarsportal-info.proxy3.library.mcgill.ca/en/read?id=/ebooks/ebooks3/utpress/2018-11-16/1/9781487587383#page=13.

[530] William B. Henderson, “Indian Act,” in *The Canadian Encyclopedia*, accessed March 31, 2019, https://www.thecanadianencyclopedia.ca/en/article/indian-act.

trying to keep control of lands they claimed as their own. Walbank concluded that an internal survey was the next logical step to controlling and assimilating the population.[531]

The following year, Peterson, newly appointed as the CPR's engineer-in-chief of the A&NWR, surveyed two viable locations for the St. Lawrence crossing of the line. Peterson rejected both locations and suggested a shorter crossing between Lachine and Kahnawake; it was the least costly.[532] The government anticipated the construction and, when Walbank worked on the subdivision survey in 1884, he wanted to consider the future railway in his plan.

In June 1886, Walbank had returned to the community after about a year's absence. The surveyor had spent the time collecting evidence and trying to subdivide the reserve justly. The community felt the work was unnecessary, unfair and costly. Walbank spent approximately $15,000 to conduct the survey—a cost borne by the community[533]—only to undervalue the properties by assigning value based on resale within the Indigenous community only, rather than fair market value.[534] Mohawks protested by removing survey markers and demanding reasonable compensation. The government hoped to have the survey complete in the spring of 1887. The image of Jocks Quarry taken in October 1886 may be a sign of discontent over the mounting costs of the survey and the territorial incursion.

Based on the caption in Figure 4.27, Jocks is presumably standing front and centre in this photograph; he assumed control of the quarry when the government abolished land ownership.[535]

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531 For more on the survey, see Rueck, "Enclosing the Mohawk Commons."

532 Werry, "Rails across the River," 480.

533 The money came from government-held funds and from the LSL&PL Railway's expropriation. Rueck, "Enclosing the Mohawk Commons," 281.

534 Walbank's land survey also included a population survey. The Indian Act defined who was eligible to own land on the reserve, based on a newly defined patriarchal system, which replaced the community's longstanding matriarchy. For more on the impact of colonization on Kahnawake, see Simpson, *Mohawk Interruptus*.

535 Blanchard wrote, "When common ownership of land was outlawed by the Canadian government, the quarry came under the control of Thomas Karhatoten Jocks, a traditional Six Nations Chief. There are still tools in use in Kahnawake with his initials imprinted on them." Blanchard, "High Steel," 59.

The photograph shows how sophisticated the operations were, with stacks of stone sorted by size and with numerous outbuildings and technological devices, such as temporary derricks and railway lines in place to move materials. The quarry was as orderly and clean as the other construction sites depicted in the album.

Jocks wore a western hat and a dark shirt; his body position, with hands held behind his back, set him apart from the other three men in the foreground, who wore bowler hats, white shirts and silk vests. Jocks and the man standing nearest to him face each other in the photograph (the former putting his back to the quarry workers primarily sheltered in the trenches below), but the man to the left turned his head toward the camera. Jocks knew the value of the quarry stone, and it is possible he was protecting the commodities pictured behind him in the photograph.[536]

When it came time to negotiate land for the Lachine Bridge, the Mohawks wanted the transaction to benefit the community directly. They insisted on employment in exchange for the right to occupy their land. Historian Joseph Mitchell writes, "In obtaining the right to use reservation land for the bridge abutment, the Canadian Pacific and the D.B.C. promised that Caughnawagas would be employed on the job whenever possible."[537] The CPR and DBC complied, offering low-wage, general-labour work to "as many Indian workers as possible."[538] While many men found employment with the bridge company and succeeded as steelworkers, others contributed to the construction process by extracting, sorting, and moving stones for the foundations.[539] Recent scholarship shows how removing status and land from Indigenous

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[536] In 1875, stone in Kahnawake was valued at $32/ton or about $77,000 total. In times of economic hardship, the commodity was worth protecting. For more on quarries and the economic importance of Montreal's limestone, see Parks, *Report on the Building and Ornamental Stones of Canada*; and Monson Goudge, *Limestones of Canada, Their Occurrence and Characteristics* (Ottawa: J. O. Patenaude, 1934).

[537] Mitchell, *Apologies to the Iroquois*, 14.

[538] Katzer, "The Caughnawaga Mohawks," 41.

[539] The DIA recorded that, from 1885 to 1890, these quarries employed thirty to fifty men. Devine, *Historic Caughnawaga*, 334.

populations was an attempt to disempower and assimilate the communities. In contrast, anthropologist Audra Simpson argues that, in reality, bridge building strengthened community bonds as the Mohawk community assembled again on temporary sites across North America.[540]

For years after construction, the railway increasingly troubled residents. No concessions, such as the pedestrian tunnel at the GTR crossing, were made for people, animals, and carts on the South Shore. When the railway returned to the site to fill in the trestles, the southern abutments in Kahnawake hindered circulation.[541] Rueck explains how poorly maintained railway ditches flooded nearby farmers' fields and fires started by train engine sparks damaged fences—resulting in the death of livestock in subsequent train collisions—and destroyed crops.[542] Additionally, Rueck commented, when the CPR banned pedestrian crossings of the bridge, employment in DBC and other factories along the Lachine Canal became cut off from the potential workers who were stranded at the first signs of winter.

In addition to neglecting details about the impacts of the land struggles or effects of the bridges at a local level, the reports and documents omit views on the finished bridges or details about the experience of travelling over the river. Hodges described in detail his experience of shooting the rapids and other tense moments. Hodges made no mention of crossing over the river or through the tube.

Shortly after the bridge's opening, the popular media published an account of travelling through the tubular structure. An article in the *New York Times* described how passengers were "dashed into the gloom of the Great Tube. You have just time to look around at the faces of your

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[540] Simpson, *Mohawk Interruptus*, 2.

[541] "Correspondences between Caughnawaga Agency and Atlantic and North West Railway Company Regarding Circulation around Bridge Abutment Trestles" (Letters and plan, Montreal, 1890), File 110,237, Volume 2532, RG 10, Indian Affairs, LAC.

[542] Daniel Rueck, "When Bridges Become Barriers," in Castonguay and Dagenais, *Metropolitan Natures*, 235.

fellow-passengers, which the lamps inside the car (then first perceived) reveal to you. You cannot speak, or do not attempt it, for, if you did, you could not be heard."[543] The locomotives overwhelmed passengers with the sounds of industrialization—sounds that overpowered the cracking and grinding that Hodges used as an early warning sign of impending danger—and alienated them from their immediate landscape.[544] Passage through the bridge blinded the traveller to the natural processes and the inherent beauty of the ice, as Hodges astutely described because travelling through the tube was not the same as shooting the rapids or crossing the ice bridge. Traversing above the river, rather than on or through it, distanced people from the experience of the flow of nature and the seasonal nuances of the water.

As passengers began to cross the river in August 1860, Hodges returned to Britain, but it was not the end of his experience with the Canadian landscape. Two years after the construction project, Hodges's wife died (suddenly), and he subsequently returned to Canada to establish peat-farming operations.[545] Moreover, in 1864, Hodges began manufacturing inexpensive fuel with his commercial peat-extracting process. Over the next eight years, his fuel was used for local consumption and to power GTR locomotives.[546] The peat operation also suggests a continued concern for the wellbeing of Canadians; however, as an agent of the GTR,[547] Hodges's full intentions are unknown. Regardless, much like the construction project, the peat-extracting

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543 The firsthand experience of travelling through the bridge was quite unlike observing the bridge from the shores. See "From Canada."

544 Schivelbusch, *Railway Journey*, 23.

545 Hodges purchased from 8,000 to 10,000 hectares (20,000 to 25,000 acres) of bog land near Victoriaville, Quebec, and with his own invention—"some very ingenious machinery"—tried his hand at manufacturing inexpensive fuel from crude peat. Maw and Dredge, "The Late Mr. James Hodges."

546 These activities were perhaps the first use of wet extraction techniques in Canada. Barry G. Warner and Pierre Buteau, "The Early Peat Industry in Canada, 1864–1945," *Geoscience Canada* 27, no. 2 (June 2000): 57.

547 Jacques Matthieu, "James Hodges," *Dictionary of Canadian Biography, Volume X (1871–1880)*, accessed April 18, 2016, http://www.biographi.ca/en/bio/hodges_james_10E.html.

operations were limited by the winters.[548] Short working seasons again proved to be a problem. When Brassey called him to duty once more, Hodges accepted another contract to oversee the construction of floating docks in Callao, Peru.[549]

Hodges's continued interest in the colony is one of the ways in which the construction narratives intersect with other landscape history and interlace stories of the built environment. This chapter has demonstrated the ways in which an intertextual approach to the sources can expose multiple perspectives on the landscape that can be used to create overlapping landscape narratives. The sources bring new connections to the construction projects and reveal aspects of the natural environment and ecological processes. The chapter also establishes that mid-nineteenth to early-twentieth-century engineers in Canada found themselves as capable managers with the intent of enhancing their professional and social status. Moving forward, landscape histories should consider multiple and interlacing perspectives on the land.

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[548] His peat extraction invention proved more profitable in the US and Germany. Maw and Dredge, "The Late Mr. James Hodges," 79.

[549] Ibid.

Conclusion

This research stems from my experience building a bridge in South America and the natural, social, and symbolic relationships I encountered throughout the process. While building, I learned about the ecological and cultural communities in a remote Amazonian village, interacted with people who had expertise and knowledge from all over the world, and exerted a lot of hard, physical labour. The bridge provided a new spatial configuration for community social structures by giving families a safe pedestrian passage over a seasonally disruptive river and year-round access to healthcare and education. The community's values motivated the project, which carried over to the construction site. One generation of builders passed its understanding and connection to the land to the next *in situ*. Accordingly, the bridge and the building process capture a deep understanding of place. The goal of my dissertation was to investigate this cultural landscape of bridge building and the natural, cultural, and social relations that operate inside this framework.

While not all these ambitions were fulfilled in this dissertation, I provided insight into the history of Montreal during the construction of three major bridges by employing a landscape lens. I paid close attention to the human processes of shaping the land and its repercussions on cultural aspects of surrounding neighborhoods. I scrutinized written and visual reports to capture multiple facets of the act of building.

The engineers who designed the bridges attempted to shape the legacies of their work by the ways they documented and recorded the construction. The research showed that the engineer's souvenir albums of the Victoria, Saint-Laurent, and Jacques Cartier bridges are meaningful cultural artifacts that reflect evolving cultural and professional agendas in relation to building. I studied the development of British engineering reporting to demonstrate the distinctiveness of the reporting on the first bridge built over the St. Lawrence River, the Victoria Bridge. I concluded that this was the first time Robert Stephenson used photography to record advances on one of his projects; a practice already in place in France and one that was widely adopted by British and North American engineers thereafter.

Probing the historical context of the engineers' reports is a way to understand their significance as ideologically motivated cultural documents. By the middle of the nineteenth century, British engineers were at the forefront of a continuing process of industrialization. Consequently, the ways in which they recorded their work changed. As Tom Peters, Nathan Rosenberg and Walter Vincenti argue, Stephenson's Conwy and Britannia bridges are remarkable examples of the British processes of industrialization and the conceptualization of building as a process.[550] Notably, the British engineers overseeing these projects wrote about the processes (rather than the products) and left details about the site and historical context to others, such as travel writers. Meanwhile, the British engineers adapted drawing styles similar to the French engineers at the *École Nationale des Ponts et Chaussées* a century earlier.[551] The British reports differed, however, in that they spread through networks across Continental Europe and the British Empire, finding their way into the libraries of investors and members of the British Royal family. The circulation of mid-nineteenth-century British engineering reports reflected the importance of social status and ensured a place for engineers alongside their industrialist clientele.

During the construction of the Victoria Bridge in Montreal, engineers promoted themselves through similar channels as before, with the addition of illustrated newspapers. Mid-

[550] Peters, *Building the Nineteenth Century;* Rosenberg and Vincenti, *The Britannia Bridge.*
[551] Picon, *French Architects and Engineers in the Age of Enlightenment*.

nineteenth-century bridge engineers working in Montreal were among the first in North America to embrace photography. British illustrated newspapers produced woodcut engravings drawn from the photographs, allowing their growing middle-class readership to follow the construction of the bridge. Watching a Canadian bridge appear from across the Atlantic Ocean may have created a bond between the British public and colonists, but it was above all a brilliant display of British colonial power taming the Canadian "wilderness."

The photographs capture the simultaneous acts of shaping and depicting the city and thus illustrated the ways in which engineers laid claim on Montreal. In all three bridge case studies, the photographs showcase an organized construction site. Engineers wore suits in these photos, setting them apart from labourers, surveyors, or divers. The photography promoted the entirety of their achievement, and themselves, to the public, however, toward the end of the nineteenth century the number of bridges built across the country increased significantly and thereby reduced the awe-effect. Still, by hiring Alexander Henderson, a talented photographer, Sandford Fleming promoted his philosophy of railway building and the use of durable materials on the Intercolonial Railway while forgetting the political effort it took him to achieve his goal.[552] Henderson's photographs appeared in the *Canadian Illustrated News*, connecting a growing readership to the landscape and the engineers' motivations.

The sheer number of bridges along the Canadian Pacific Railway meant that only the most impressive bridges made headlines in newspapers. Even the Saint-Laurent Bridge found itself in the back pages of the *Railway News*, which had no illustrations. By the mid-twentieth century, engineering reports became more specialized, and comprehensive bridge accounts waned as engineers targeted their papers for technical audiences. Nevertheless, the photographs

[552] Sandford Fleming, *Report on the Intercolonial Railway Exploratory Survey: Made under Instructions from the Canadian Government in the Year 1864* (Quebec: Hunter, Rose & Co., 1865).

and souvenirs from the construction sites of three Montreal bridges serve as rich primary sources, revealing information that hovers between technical writing and artistic representations. They provide a privilege, close-up, and sometimes backstage view of the construction process. Also, by tracing the provenance of the albums' content, I explored how engineering knowledge is passed from one generation to the next.

My research process involved categorizing archival material as either reports or documents and my research questions centred on these classifications. I asked how the interpretive power of each type of artifact differed, how the two classes of materials worked together to offer information on the construction projects, and what unique aspects of the landscape can be revealed through a comparative approach to reading the visual and material culture of Montreal bridge builders. By engaging with the everyday aspects of the construction site, made available through the visual documents, I revealed some of the narratives and concerns of the people involved. At times, the engineer and the photographer appeared to work together to record the bridge. In other cases, comparing the types of sources revealed priorities or commissions through the photographer's selective presentation, framing and screening, and perspective manipulations. The stories I extracted emphasized various aspects of the building process, such as the visual culture of engineering or the multiple cultural background of the construction crews.

Throughout the dissertation, I acknowledged multiple perspectives on the landscape by repeatedly comparing and testing the textual and visual evidence against each other. I established, where possible, the role of the promoter, engineer, photographer, book editor, and artist in shaping views of the landscape. My close reading of the different artifacts exposed an interconnected web of engineers and the ways in which each generation of builders adapted to their physical and social environments. Additionally, by tracing material pathways and the arrival of particular materials, like concrete and steel, I researched urban textures made visible in the photographs. As a result, I argued for a layered understanding of place that engaged with both the real-time act of building and its representation in multiple media, not previously considered in the socio-economic or technological histories of the bridges.

Exploring the histories of science, technology, construction, and the visual culture of engineering, I observed a disconnect between those stories reported in textual sources and the versions legible in visual materials. Scholars writing technological histories of the bridges provided the political, economic, and social context as justification for the projects. In addition, a technical focus privileges scientific advances that enabled the bridge designs. In this way, my use of hybrid sources was able to initiate a critical evaluation of the engineer's narratives. The mix of sources allowed me to read between the technological process and gaps in the photos. An example is the role of labourers, which at times become clearly visible in the photographs. Likewise, some elements repeat in parallel artifacts, such as a single vantage point that persisted over several months or years.

My research explored the ways in which engineers in Canada conceived, operated on, and represented the landscape. For example, engineering records describe the Victoria Bridge (1854-1860) as a wonder of the industrial world that was a powerful new union between two port cities: Montreal and Portland in Maine. However, as Stéphane Castonguay argued there is little scholarship dedicated to the study of rural regions in Quebec.[553] Photographs and other visual records show that the engineers studied the river and its winter ice cover, providing detailed observations about the formation and movement of the ice across the Montreal region.

[553] Castonguay, "Society, Territory and Ecology in Québec: A Historiographic Review."

Comparably, the accounts of the Saint-Laurent Bridge (1886-1887) and the Jacques Cartier Bridge (1924-1930) reflected the institutions that built those structures and the social and economic development of the country and the city. For example, the Dominion Bridge Company planned and oversaw the construction of the Saint-Laurent Bridge, part of a much larger infrastructure system. By virtue of the bridge's relationship to the Canadian Pacific Railway, it reinforces the homogenizing narrative of Canadian nationhood and its concomitant conception of a Canadian wilderness as a blank slate for British expansion and its power over economic and natural resources. In this case, two personal souvenir albums revealed important information on the local scale, uneven development on the island's south-facing shore, and the role of the photographer in curating landscape narratives.

The story of the final case study, the Jacques Cartier Bridge, is also told by engineers who worked for the Dominion Bridge Company, with supplementary discourse provided by Senator and Montreal Harbour Commissioner Wilfrid Laurier McDougald. The technological and social narratives written about the city during the interwar period centre on post-World War I development, the automobile revolution, and a rise in American tourism. My analysis of the reports and documents found that the city's textures—the cobblestone roads built for horses and the streetcar tracks and electrical wires—deserve scholarly attention, as the Jacques Cartier Bridge, like the Victoria and Saint-Laurent bridges, has a very significant regional context.

In the chapter "Bridging the River," I demonstrated the ways in which the regional context was missing from not only the histories of the bridges but also in British settlement maps. I filled this gap by building an understanding of the river and its unique conditions between the Island of Montreal and the south shore through a close reading of geological and engineering reports. I established how and why bridging the river was a challenge and then explored the significance of each bridge by examining their material and technological components. Newspaper clippings, construction reports and diaries, quantity logs, and secondary sources reveal expert views on the construction projects. The technological perspective is frequently a source material for broader economic, social, and political histories. The chapter's scholarly contributions are to establish a deeper understanding of the river and the ice phenomena, the relationship of regional resources and the construction process, and a notable change in the reporting styles of engineers over time.

The third chapter, "Souvenirs from the Construction Site," engages photo albums that provide a deliberately crafted story of the bridges. I revisited each case through the lens of the photographer's camera and the thoughtful selection of photos by the compiler. Where contracts are no longer extant, I established motivations for the type and choice of photographs and speculated on their social connections and symbolic meanings. These photo albums appeared to guide the viewer through the physical space of the construction site rather than the chronological process established in the reports. As spatial stories, they suggested movement and a lived experience. As a viewer, I found I was better grounded in the space and able to make connections between place names used in the reports, that are absent from contemporary maps, by studying the albums and the sequence of photographs within the sources.

These sources informed my process of discovery. Their careful curation by photographers and book editors revealed several site elements are missing in the reports. For example, a photograph of the *Nellie Reid* tugboat in the Saint-Laurent Bridge project became the subject of a multi-layered investigation into the use of heavy equipment and the procurement of the boat. My close reading of the photograph and searches in shipping registries and personal diaries traced the route of the boat from Buffalo, via Toronto, to Montreal. This analysis addressed gaps in the historiography and formed the basis layered landscape narratives.

Chapter Four, “Landscape Narratives,” explored the everyday experiences of the people and long-forgotten places by layering multiple perspectives and examining spatial relationships – “landscape narrative” designating such interplay and relationship between story and place. My analysis of the Victoria Bridge artifacts revealed who and what is included or excluded in the construction stories. I found that the materials portrayed Indigenous and French communities with discriminatory stereotypes. While women and children were present on the construction site, their stories are absent from written records.

The main scholarly contribution of this thesis, then, is the comparative method used to deepen our understanding of the layered landscape. My comparative analysis of maps, plans, photographs, and textual evidence revealed how engineers were thinking about the relationship of the river’s ecological forces and the space in the river occupied by the bridge. My research provided insight into the visual communication practices of engineers in the British colonies and their representation of landscape. The report represented natural elements as dynamic and sublime forces acting upon the Victoria Bridge during construction. At times it appeared that the photographers, engineers, and drafting technicians worked together to produce a consistent visual record, one that displayed the interrelationship of the natural and built environment. This view countered the socio-economic and technological histories that represent the bridge as a triumph over nature when, in fact, first-hand observation and tacit knowledge played an important role. This research created an opening to look even more deeply at British views of the ice and integrated French and Indigenous knowledge of the subject into landscape narratives.

The photographs suggested uneven development on the two sides of the river and, based on an ongoing injustice that has lasted for multiple generations, the unacknowledged ramifications of colonial cultural processes on Indigenous land use. Further research must reconnect the images with the Mohawk community and seek to emphasize traditional Indigenous knowledge in oral histories held by Elders.

The names of each bridge changed with time to reflect social and cultural meaning. The Victoria Tubular Bridge became known as the Victoria Jubilee Bridge in honour of Queen Victoria's anniversary. Again, it was renamed when significant alterations took place alongside the construction of the St. Lawrence Seaway; today, it is simply known as the Victoria Bridge. During the Jacques Cartier Bridge construction, the structure was interchangeably known as the South Shore Bridge or the Harbour Bridge; its contemporary name was chosen in response to citizens who actively sought commemoration of local French history. Furthermore, the bridge built by the DBC for the CPR was known as either the St. Lawrence Bridge or the Lachine Bridge. The changeability of bridge names—yet another example of cultural layers added to the landscape—is thus an opportunity to affect positive change in acknowledging the Mohawk steelworkers, either by renaming the bridge in their honour or by continuing to reconcile the inequalities the bridge (and railway) construction brought and continues to bring into the present.

While today's bridge engineers may be more aware of the cultural complexities of the landscape, the history of bridge design is a new and growing topic. This study of the visual and material culture demonstrates how engineering is mediated by multiple stakeholders. The Montreal bridge construction photographs present a view of the crossings as discrete objects, while both the bridges and the photographs are part of a much larger infrastructure network. This network of people, places and pictures kept the engineers and the larger public informed while also bringing them closer together through the construction of bridges.

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