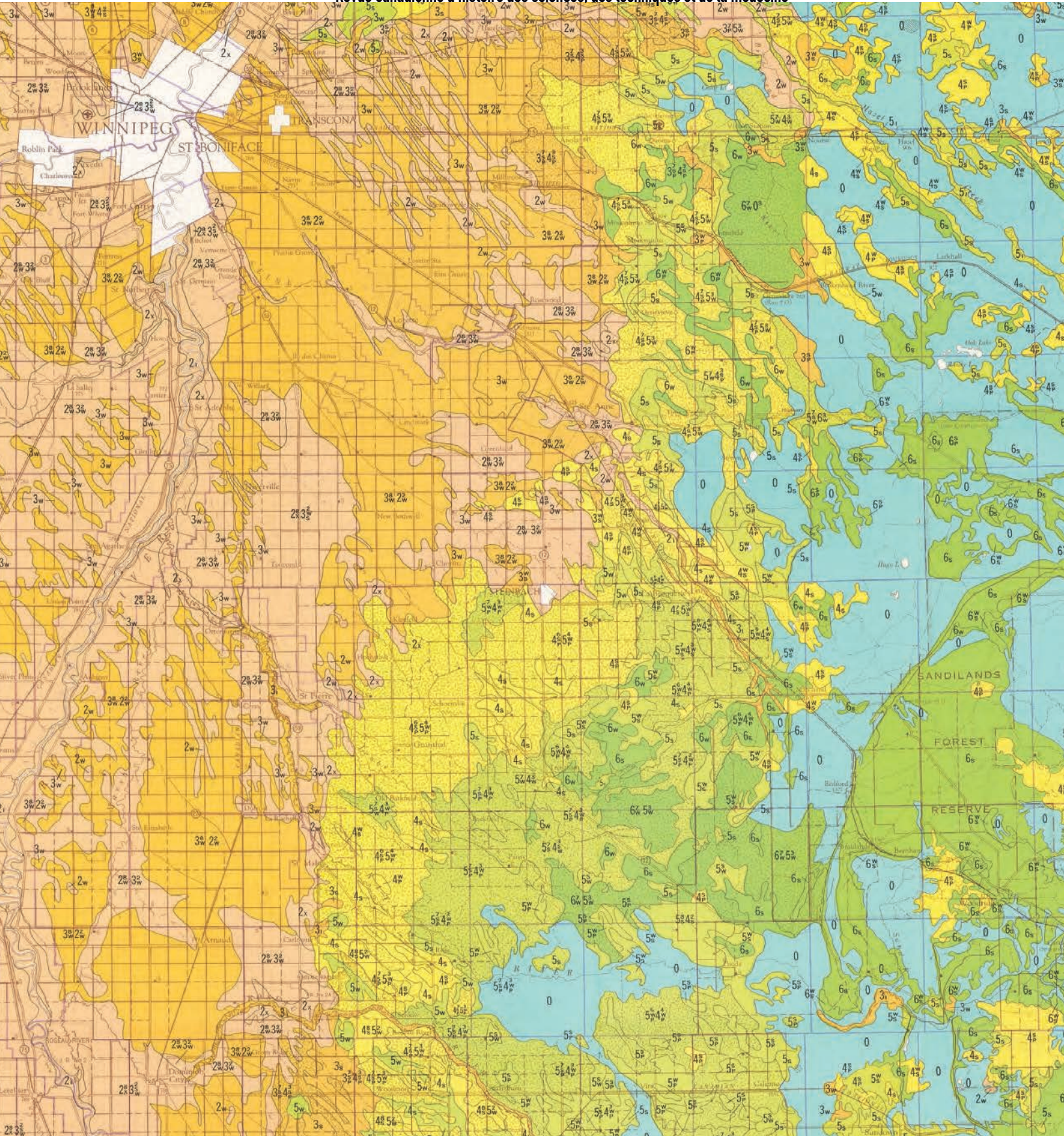


# Scientia **Canadensis**

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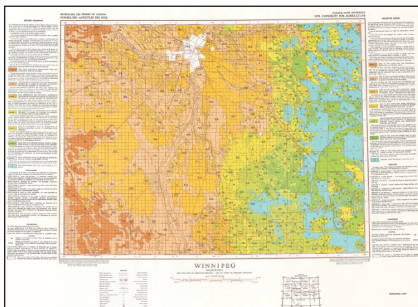
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 Editors' Note
 

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This issue is the result of a collaboration between Daniel Macfarlane, a Canadian historian working in the United States, and myself, *Scientia's* managing editor, William Knight. We are both interested in the intersection of environmental history and technology, a sub-field known as envirotech. Macfarlane has helped establish this approach in Canadian environmental history through his work on the St. Lawrence Seaway, the subject of his 2014 book *Negotiating a River*. And while not at all the writers in this number explicitly use an envirotech approach, they are all concerned with how technology and environment (an indeterminate term that has come, in some ways, to replace “nature”) work in and on each other. In *Hydro Democracy*, Macfarlane and co-author Andrew Watson explore how Timothy Mitchell's notion of carbon democracy can be transposed into hydrological terms, specifically how the emergence of a hydro-electricity infrastructure in Canada has reshaped political governance and how flows of power emerge from dams, turbines, and transmission lines. Blair Stein's *'One-Day Wide' Canada* takes an envirotech approach to the construction and deconstruction of an aerial imaginary through the publicity of Trans Canada Air Lines (TCA). Stein considers how TCA's public-relation efforts attempted to attract travellers to flying by using a discourse that compressed Canada's vast spaces and long history. This approach connected the flying experience to historical modes of travel at the same time that it erased any heroic aura by making long-distance travel routine. Travellers may or may not have noticed: they were busy enjoying the visual perspective of flight. Shannon Stunden Bower's *Tools for Rational Development* further explores how technology can skew the axes of time and space in her study of the Canada Land Inventory and the Canada Geographic Information System. These two ground-breaking efforts, initiated in the 1960s, integrated new computing technologies in an attempt to rationalize land use across Canada and make it more economically efficient, an old desire recast for new tools. As Stunden Bower shows, this administrative technology failed to account for how European settlement had already shaped the land and naturalized unequal access to resources. Finally, Jennifer Hubbard sheds new light on a historical debate in fisheries. In *The Global Repercussions of the 1947 Symposium* she shows how Canadian biologist A.G. Huntsman—a man with a passion for neologisms—gave new momentum to the persistent view that it was impossible to over-fish a fish population. Our thanks to the contributors, reviewers, and the editorial team who made this issue possible.

*Co-editors Daniel Macfarlane and William Knight*



**On the cover / en couverture:** Detail from “Canada Land Inventory (CLI): 1:250,000 and 1:125,000”, *Agriculture and Agri-Food Canada*, accessed 15 November 2017, <http://sis.agr.gc.ca/cansis/publications/maps/cli/250k/agr/index.html>

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## Guidelines for Authors

*Scientia Canadensis* is a peer-reviewed journal and invites submissions of original articles on the history of science, technology, and medicine. Please submit articles as Microsoft Word files to managing editor William Knight, [wknight@ingeniumcanada.org](mailto:wknight@ingeniumcanada.org), via email. Article manuscripts should not be currently under evaluation for publication by another journal.

Manuscripts articles may be written in English or French, and should not exceed 10,000 words. Please consult with the editor regarding word-limits for other types of content such as research notes, forums or roundtables. All manuscripts should contain the following elements:

- Title
- Author name(s)
- Author email address(es)
- Abstract (75-100 words)
- Keywords that broadly identify the article's subject
- Author bio appended to the end of the article

Please use Times Roman 12-point text and double-space the text using a page set to Word's "normal" margins. Graphics, tables, and figures are welcome: please note their recommended position in the body of the text (e.g. "Insert figure 1 here"), but please do not insert images into the manuscript. Save and attach all images as separate files. Images may be saved as JPG files. Line drawings or other vector-type images should be saved and submitted as EPS files. Please do not submit images in or as a Word file.

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- Les adresses électroniques des auteurs
- Un résumé de l'article n'excédant pas 100 mots
- Une liste de mots clés identifiant le sujet de l'article
- Une courte biographie des auteurs annexée à l'article

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## Research Note

**Hydro Democracy: Water Power and Political Power in Ontario**

Daniel Macfarlane and Andrew Watson

**Abstract:** *Drawing on Timothy Mitchell's Carbon Democracy, and using envirotechnical analysis, we probe how the materiality of energy—public hydropower—influenced democracy and governance in Ontario during the early twentieth century. Within Canada, hydro-electricity disproportionately shaped the politics of Ontario and Canada-US relations during the first half of the century. Within the province, it provided the energy-based affluence that underpinned claims for a liberal and democratic society. But residents experienced the consequences of hydropower unevenly. Urban and industrial residents enjoyed most of the benefits, while rural residents and Indigenous peoples living close to hydro developments endured the burdens of development.*

**Résumé :** *En s'appuyant sur « Carbon Democracy » de Timothy Mitchell et en utilisant un cadre d'analyse envirotechnique, nous examinons comment la matérialité de l'énergie — hydroélectricité publique — a influencé la démocratie et la gouvernance en Ontario au début du XXe siècle. Au Canada, l'hydroélectricité a influencé de façon démesurée la politique de l'Ontario et les relations canado-américaines au cours de la première moitié du siècle. Au sein de la province, elle a fourni la richesse basée sur l'énergie qui sous-tendait les revendications pour une société libérale et démocratique. Mais les résidents de l'Ontario ont subi les conséquences du développement hydroélectrique de manière inégale. Les résidents urbains et industriels ont profité de la plupart des avantages, tandis que les résidents ruraux et les peuples autochtones vivant à proximité des complexes hydroélectriques ont enduré le fardeau du développement.*

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**Keywords:** Hydro-electricity, Ontario, energy, Timothy Mitchell, hydro democracy

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DURING THE TWENTIETH CENTURY, the flow of hydro-electric power shaped the trajectory of Ontario's polity.<sup>1</sup> Our intention in this piece is, as energy and environmental historians of Ontario, to draw from Timothy Mitchell's "carbon democracy" concept in order to assess the Ontario hydro-electric context, and in particular the emergence of a public-power movement and the creation of the public-power utility, Ontario Hydro. Transformed into sources of electric-power generation, several of the Province of Ontario's largest rivers became sites of a new manifestation and scale of power: hydro democracy.<sup>2</sup>

Timothy Mitchell's *Carbon Democracy*, first published in 2011, made an immediate impact, and for good reason. Without providing all the answers, the book posed important questions. Mitchell contends that the materiality of energy systems has had a profound impact on politics and governance. More specifically, Mitchell claims that his revisionist, socio-technical history of carbon

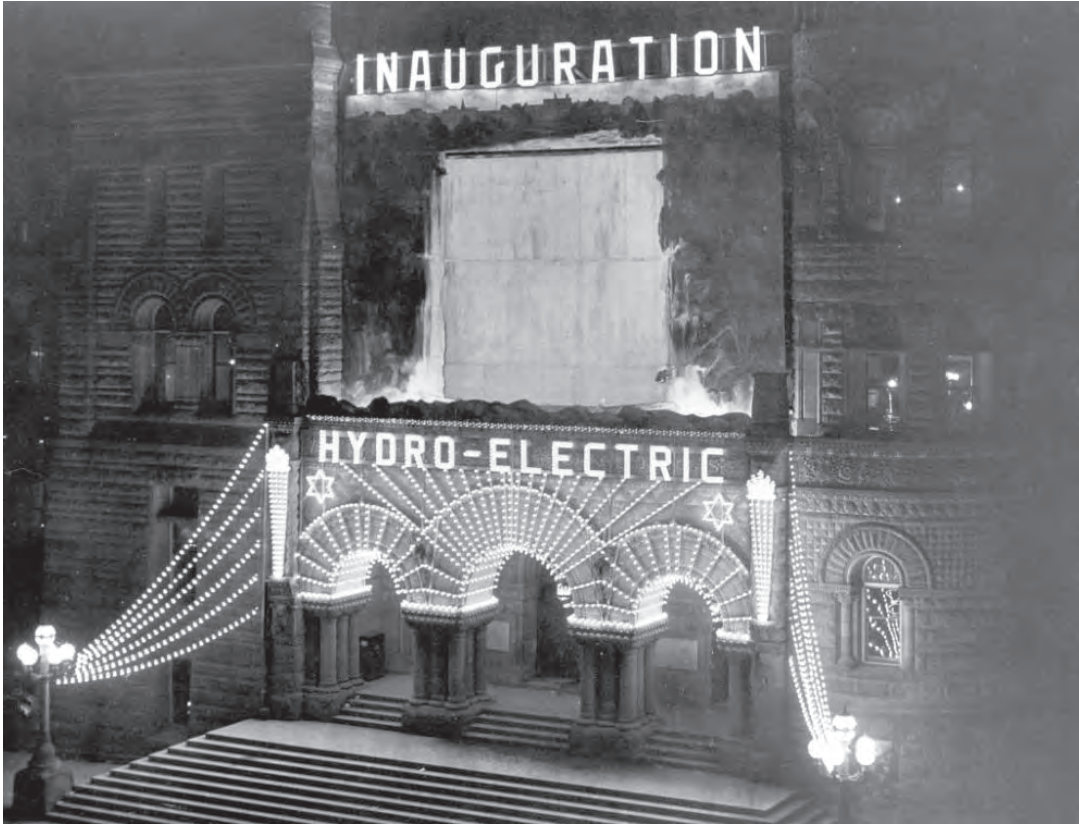


energy helps explain the history of modern democracy, where democracy “can refer to making effective claims for a more just and egalitarian world. Or ... a mode of governing populations that employs popular consent as a means of limiting claims for greater equality and justice by dividing up the common world.”<sup>3</sup>

According to Mitchell, the ways we access energy substantially shape our governing structures. During the late nineteenth and early twentieth centuries, coal was a catalyst for shifting forms of democracy. Sites of extraction and supply existed below the surface of the Earth, where unions exercised political agency to make democratic claims through their control of the mine environment. Along with oil, coal broke the ecological constraints of an organic-energy economy and allowed for the belief in unlimited economic growth. Unlike coal, however, the spatial and material aspects of oil lent themselves to less democratic and more elite control. The world’s largest oil supplies were situated great distances from consumers, and oil’s fluid properties required less labour at all stages of production, transportation, and refining. Relative to coal, oil did not require as many concessions to workers and collective social principles. Oil companies justified their control of the networks of power by convincing their home nations that carbon-energy production was an issue of “national security” and in the “public interest.”<sup>4</sup> Oil companies created scarcity by restricting production, thereby driving up prices, but only succeeded by securing overseas military protection and generous domestic subsidies. Turned into a critical energy resource during the first half of the twentieth century, the quest to secure oil demanded “imperial” actions by Western governments.<sup>5</sup> *Carbon Democracy* demonstrates that twentieth-century modes of popular governance, including the concept of “the economy” and the manufactured anxiety of the 1970s Energy Crisis, arose in response to, and were made possible by, the new political economy of carbon energy.

By foregrounding the centrality of energy to the emergence of the modern political and international system, Mitchell deftly demonstrates the ways that technology, energy, and materiality structured the historical evolution of contemporary social-democratic politics. However, Mitchell deploys “democracy” in ambiguous ways and, compared to his analysis of coal, deals rather lightly with the materialist links between oil production/consumption and democracy. It might be more accurate to summarize the book’s argument by stating that oil profoundly shaped the politics and economics of countries that happened to be democracies (i.e., western powers like the United States, Britain, France, and Germany), while inhibiting democratic development in Middle Eastern and South American oil-producing countries. Nonetheless, the notion that the materiality of energy had (and continues to have) a determinative effect on political structures makes Mitchell’s concept of carbon democracy persuasive.

Mitchell’s emphasis on the relationship between energy infrastructure and politics, however, tends to obscure the important ecological facets of fossil fuels. Energy infrastructures, including both hydropower and fossil fuels,



*Figure 1. Inauguration of Ontario Hydro at Toronto city hall, 1911. City of Toronto Archives.*

involved elaborate reorganizations of natural systems, which influenced the governance of the countries that developed and shared them. We argue that the term “envirotechnical” is a more accurate term than “socio-technical” to describe the relationship between the material realities of energy and political economies. Canada in the twenty-first century has been labeled a “petro state.”<sup>6</sup> However, since hydropower rivalled the mineral energy of fossil fuels, we argue that Canada, and central Canada in particular, was first a “hydro state.” Between the 1920s and the 1960s, hydro-electricity was arguably Canada’s, and Ontario’s, most important domestically-produced energy source, because of its disproportionate sway over democratic politics and the political imaginary.<sup>7</sup>

This essay is admittedly an impressionistic experiment, a think piece of sorts, to probe the potential impact of energy in Ontario history. We argue that hydropower enhanced democracy in the Province of Ontario in certain ways, both tangible and symbolic, while undermining or negating it in other ways. In Ontario, public hydropower provided the energy-based affluence that informed certain aspects of participation in liberal-democratic society. Hydro-electricity helped create the platform for social democratic governance, which enjoyed the consent of the population for interventionist policies that claimed to fairly, and liberally, apportion the state’s resources.<sup>8</sup> To invoke Mitchell’s definition of democracy, hydropower enhanced Ontarians’ claims to a more

just and egalitarian society. The populace often did not realize such promises and hopes of liberal and democratic benefits, or did so unequally, particularly as Ontario Hydro frequently tilted toward autocratic management. Nonetheless, a unique hydro nationalism developed in Ontario and Canada, which, when combined with the fact that most of Ontario's early hydropower came from the international border with the United States, initiated a new type of energy diplomacy that had profound implications for the Canadian-US relationship and, in turn, domestic democracy and political economy.<sup>9</sup> But the material realities of working with water and electricity, as we will show, also denied democratic opportunities. As the technological and spatial scale of hydro-electric projects increased, hydro democracy limited the rights and claims of those situated closest to hydro developments (particularly First Nations) ostensibly in the name of the wider public interest.

### Hydro-Electricity in Ontario

The magnitude of the impact of modern energy forms, including hydropower, reflect the scale of the complex envirotechnical systems that structure production, distribution, and consumption. The production of hydro-electricity is a material transformation: the energy of falling water, stored by dams and redirected through turbines, is converted into electrical power that is distributed through transmission lines. Energy scholars have separated energy regimes into “stocks” and “flows,” with the latter generally consisting of “organic” energy—e.g., wood, water, and human/animal muscle power—and the former (coal, petroleum, electricity) consisting of “mineral” energy forms.<sup>10</sup>

Unlike carbon sources of energy such as coal and petroleum, which are non-renewable stocks of fossil fuels, societies harness the renewable flows of hydropower contained in rivers and transforms them into electricity.<sup>11</sup> Owing to spatiotemporal realities, flowing water produces power that must be used on-demand and at a scale that justifies the construction and maintenance of the system designed to convert and deliver that power as electricity.<sup>12</sup> All other carbon-based fuels can be removed from their place of origin and then burned and utilized at a desired location.<sup>13</sup> But hydro-electricity is generated at the site of falling water, and the resulting electricity is transported if and where transmission lines make that possible (granted, hydropower generally is not exposed to the same supply problems as fossil fuels). During the first half of the twentieth century, water volumes and flow rates capped the amount of energy that could be produced by any particular hydro station, though the spread of massive electricity grids effectively removed these limits over large swaths of North America. Since hydropower involves both water and electricity, we contend that it is a hybrid form of energy regime: it is both flow and stock, both mineral and organic.<sup>14</sup>

Historically, Canada is a hydro pioneer and leader, with Ontario as the provincial pioneer.<sup>15</sup> In Canada, the provinces have the primary responsibility

for hydro-electric generation and regulation, with federal jurisdiction invoked under certain circumstances.<sup>16</sup> Dozens of hydro-electric generating stations appeared prior to the end of the nineteenth century. By 1886, there were 45 water-powered electric plants operating in the United States and Canada. The earliest major Ontario plants tended to be on or near border waters, such as at Niagara Falls, the cradle of large hydro-electric development and distribution. Importantly, these early plants were privately funded, although almost all were eventually taken over by the Hydro-Electric Power Commission of Ontario (HEPCO), or Ontario Hydro.

In the first decade of the twentieth century, the rise of Ontario Hydro, the source of the “people’s power” as the company’s slogan claimed, was a distinct development in North American energy history. Created in 1906, after much political debate and posturing, HEPCO became operational in 1910 (though only as a distributor of electricity at first), and was dismantled in 1999. This quasi-crown corporation relied on the rhetoric of “fairness” by sending cheap electricity—“power at cost” in the rhetoric of the time—to the underdeveloped middle class and small manufacturers, rather than rich industrialists in Toronto and across the border in the United States. As *Saturday Night* magazine put it in 1902, HEPCO championed “popular rights as opposed to monopolistic privilege.”<sup>17</sup> From the beginning, the discourse about and rationale for this public power utility centred around its ability to provide cheap and accessible electricity. In the words of official HEPCO historian Merrill Denison, this energy “had to be readily available wherever it was needed, freed from the limits imposed by self-interest and caution of the capitalist concerns which controlled most of Canada’s electricity power development.”<sup>18</sup> This cheapness facilitated a growth economy that at first promised Ontarians industrial growth and networked services, including lighting and streetcars, and then increasingly after 1945 offered the modern individual comforts and conveniences made possible, and sustained by, abundant energy.

As of 1920, hydro represented 97% of the electricity produced in Canada, and 20% in the United States. By the 1940s, hydro was still responsible for about 90% of the electricity generated in Canada.<sup>19</sup> At the mid-point of the twentieth century, a major turning point in the history of Canada’s energy transition to a mineral-energy economy, hydro produced 87 billion kwh, and the United States 50 billion kwh, of electricity. By that point, Ontario had developed over 40% of its hydro-electric potential—mostly through Ontario Hydro—compared to 22% for the rest of Canada, though Quebec was rapidly expanding.<sup>20</sup> Canada has traditionally been among the top, or at the top, of global per capita users of energy in general and electricity specifically. Today, Canada is the second largest producer of hydro-electricity in the world, behind only China.<sup>21</sup>

Nonetheless we should not forget that although hydro power was the source for most of the electricity consumed in Canada and Ontario before 1939, it was still a fairly minor percentage of energy consumed in households across the

nation. Outside of urban areas, Canadians remained reliant on solid fuels (i.e., coal and wood) for much longer than residents the US and UK.<sup>22</sup> Rather, industry and manufacturing accounted for the majority of electricity consumption. Indeed, hydropower exerted an influence on Ontario's political economy and statist evolution out of proportion to its actual statistical significance in the province's energy portfolio.

Like fossil fuel networks, as well as solid fuels like biomass, the environmental transformations required to build hydro-electric systems involved significant initial capital investments to construct and maintain technological infrastructures, such as dams, generating stations, and electricity-distribution grids.<sup>23</sup> Hydropower, like coal and oil energy networks, attracted investors and financiers with the promise of large rents, and they used their economic influence to shape the development of governing structures.<sup>24</sup> In Canada, this significant investment, and the attendant risks, often necessitated state involvement in hydro-electric development as installations grew larger in size. Indeed, the state became the only entity able or willing to assume the considerable risks of development. As public utilities, hydropower networks pushed the government into an interventionist role by framing their involvement in terms of strategic interests, the wider good, and the betterment of society.<sup>25</sup> Ontario Hydro demonstrated the vitality of publicly-operated utilities, and helped condition Ontarians to an interventionist state. Other subsequent hydro utilities in Canada, such as in Quebec and British Columbia, followed Ontario's lead after the Second World War.

Until distribution technology improved, industries chose to locate in close proximity to sources of hydropower, which had important spatial ramifications for Canada's industrial and urban development.<sup>26</sup> Part of the reason Niagara Falls was so attractive as a power-generating locale was its proximity to manufacturers in Toronto and the town and cities of southwestern Ontario (a region now known as the Golden Horseshoe). Together with US coal imports, Ontario's early development of major hydro sources in the Great Lakes-St. Lawrence basin powered manufacturing growth, and contributed to southwestern Ontario's consolidation as the economic and political centre of manufacturing, finance, and urban growth in Canada.<sup>27</sup> Elsewhere in the country, the availability of hydropower also helps explain why certain regions became centres of particular types of industrial production with all the attendant long-term impacts and path dependencies.<sup>28</sup>

To fin-de-siècle Ontarians, electricity symbolically ushered in the second industrial revolution. Electricity promised to revolutionize both home and work life and even to eliminate the separation between night and day. Hydropower was, by association, imbued with the same revolutionary properties and character. It allowed for new industrial processes that bespoke a new age, one fashioned from new electro-chemical and electro-metallurgical products such as aluminum. As electricity became available across the nation, it dangled the possibility of improvements in living standards—the reduction of labour for individual households in particular—and the resulting economic and material freedom many claimed to be the basis of democracy in North America.<sup>29</sup>



*Figure 2. Control room of the Queenston hydro-electric plant. Library and Archives Canada 1971-271 NPC.*

At the end of the nineteenth century, hydropower seemed almost limitless. Falling water was treated as inexhaustible, because the technology had not yet advanced to the point where hydro stations could fully exploit the head of water at places like Niagara Falls. Moreover, this “white coal” burned clean compared to coal, oil, or biomass. Once the public adopted the attitude that hydro energy was infinite, both energy producers and governments used the material abundance of energy to lend legitimacy to a suite of policies that claimed to offer greater opportunities to its citizens, while simultaneously obscuring the inequitable division of the benefits of that abundance. Hydropower’s material bounty enabled the state to act as the benefactor, distributing electricity for use in an almost endless number of applications—even though most hydropower users in the first half of the twentieth century were a small group of industries and manufacturers.<sup>30</sup> In the process, these abundant applications led people to frame hydro-electricity as indispensable energy for a constantly growing number of Canadians and thus a feature of modern democratic society.

The benefits of hydropower translated directly into hydro democracy. The Ontario state promoted the material abundance of hydropower to legitimize claims of the province as a prosperous and egalitarian society—with “egalitarian” referring chiefly to an equality of economic opportunities made possible by electricity for the province’s enfranchised citizens who stood to benefit (i.e., white, middle-class and elite males). The mass appeal of hydropower as a vehicle of democratic politics rested on the assumption that an ever-growing share of the citizenry would come to enjoy the individual material benefits and increased wealth provided by energy abundance. Hydropower gave rise to quasi-utopian visions of society that helped provide both the conditions for greater access to energy and also the implicit rationale for the ever-expanding consumption of a seemingly limitless energy resource. For the vast majority, however, the vision initially promised more than the reality could deliver. It took several decades before hydro-electricity consumption correlated strongly enough with per capita wealth to safely say that any gains in equality resulted from abundance underwritten by hydro energy.

In Ontario, the development of hydro-electricity was intimately connected to participatory democracy that juxtaposed domestic hydropower with foreign fossil fuels, particularly coal. Because of Ontario Hydro’s public nature, hydro-electric development became a subject of party platforms, electoral debate, and democratic contestation. To illustrate, in addition to the formation of the power commission itself, the development of hydro-electricity stations, purchases of hydropower from Quebec, and Mitch Hepburn’s “Back to Niagara” campaign were all the key issues in provincial elections during the first three decades of the twentieth century. Moreover, as will be touched on below, Ontario’s hydro-electricity development also became a hot topic in intra- and inter-governmental relations, as was the case in other provinces.<sup>31</sup>

In Ontario, and even Canada as a whole, hydro-electricity has been, and continues to be, intimately intertwined with political identity.<sup>32</sup> As one engineering journal put it in 1953, Canada was “hydro-conscious,” while Canadian historian H.V. Nelles insists on a “hydro myth” in Ontario.<sup>33</sup> The link between identity and riverine environments has a long lineage in Canada, including the meta-historical and nationalist Staples and Laurentian theses.<sup>34</sup> Generating stations represented modern Canada’s ability to exploit its natural resources and control imposing environments. Many waterways amenable to hydro development became repositories of hydraulic and technological nationalist associations, gathered under the concept of “hydro nationalism.”<sup>35</sup>

Since many of the earliest large hydro-electric development sites were along Ontario border waters with the United States, negotiations over power stations involved both federal governments and the provincial governments adjoining the rivers and lakes. As a consequence, a distinct form of energy diplomacy emerged as another facet of hydro democracy in Canada during the twentieth century. For example, Canada and the US signed the Boundary Waters Treaty in 1909 and created the International Joint Commission to facilitate the



*Figure 3. Opening Ceremonies for St. Lawrence Power Project. Ontario Power Generation.*

cooperative development of border waters for power and navigation.<sup>36</sup> Decades of jurisdictional wrangling over the development of navigable waters shaped federal politics. Until the 1940s, when constitutional settlements clarified the issues, power developments often instigated federal-provincial tensions, such as the negotiations over dam sites on the Ottawa River.<sup>37</sup> The joint development of major hydro-electric installations—such as those located on the Niagara and St. Lawrence Rivers—required extensive international negotiations and diplomatic treaties and agreements. Sometimes these negotiations flared into major diplomatic disputes, though hydro-electricity ultimately did more to create long-term cooperation and integration than it did conflict.<sup>38</sup>

Hydro-electric development was so attractive in Canada not only because the country was endowed with ample viable sites, but because “white coal” offered an energy source that would not necessarily be controlled by a foreign power.<sup>39</sup> Hydro-electricity reduced Canadian reliance on American sources of energy, coal in particular, and allowed governments to weave energy security into projects focused on economic growth and democratic politics. Ontario (and Canada) exported much of its hydro-electricity to the United States since domestic production of hydro-electricity often exceeded domestic demand in the early years. Historically, a great deal of Canadian hydro-electricity has been exported to the United States, from the first American-owned Niagara developments during the early twentieth century, through the US-funded Quebec developments and the joint Canada-US St. Lawrence and Columbia River projects in the 1950s and 1960s, to the more recent Quebec projects in



James Bay.<sup>40</sup> Up to the 1960s, the majority of the power exported from Canada to the US was via Ontario, and St. Lawrence and Niagara hydropower played the leading role in shaping Ontario's and the federal government's approach to electricity exports and energy policy. These megaprojects, enhanced by the long-term firm power exports as part of the Columbia River treaty, entrenched Canadian-US energy relations and paved the way for the development of the trans-border electricity grids that proliferated beginning in the 1960s.<sup>41</sup>

### Hydro Undemocracy

Electricity exchange remains today a vital part of energy diplomacy, and the environmental impacts of the stations that produce the electricity are therefore a casualty—or the cost of doing business, depending on one's perspective—of Canadian-American relations. Few other developed nations export natural resources and energy to the same extent as Canada. Tying Canada energetically and economically to the United States contributed to Canada's slow but inexorable twentieth century shift from Britain to the United States as the primary ally and trading partner. Thus, even if a major motivation for the development of hydropower was domestically-produced energy, hydro developments arguably helped turn Canada—and Ontario, as the primary exporter of Canadian hydro-electricity for much of the twentieth century—into a partial energy and resource colony of the United States. This type of subservient relationship with the US is only one of a number of ways that hydropower in Ontario can be understood as corrosive to democracy. Neither Ontario's adoption of hydro-electricity, nor the formation and character of Ontario Hydro, was inevitable. As Mitchell, along with scholars such as Christopher Jones, Andreas Malm, and Ruth Sandwell, make clear, energy transitions are not foreordained. Rather, they depend on factors that may have little to do with technical efficiency or energy abundance.<sup>42</sup>

To transform land deemed unproductive into an electrical generator of the public interest, the state made assessments and decisions, based on the vested interests of particular groups, about what counted as a “cost” or a “benefit.” Put differently, the governmental rigged the cost-benefit analyses declaring power stations a good investment. It was also standard practice for power utilities, including Ontario Hydro, to give better deals to industrial consumers who contracted for firmly priced electricity in bulk, especially those who needed electricity outside the hours of peak demand. In this context, politics took its cue from patterns of economic growth, which privileged the wealth and social power of urbanites and industrialists who treated hydro-electricity as democratic. Thus, with Ontario Hydro publicly funded, taxpayers were effectively subsidizing the lower rates that corporate interests received for their bulk purchases, although many believed that the benefits trickled down.<sup>43</sup>

The abundance of hydropower was eventually constrained by the material limits of the volume and rate of flow of water passing a given fixed point (or series of points) in the landscape. As a system approached the



*Figure 4. Hydro-electric facilities Iroquois Falls on Abitibi River. Source: Library and Archives Canada/ Department of the Interior fonds/a043948.*

upper limit of hydropower potential, its capacity (or load) ran up against the promises of a political economy predicated on unlimited economic growth, even with the capacity of regional electric grids to interconnect and shift the load. As energy requirements grew beyond what could be provided by hydro generating stations, the state had to scale back, ignore, or alter its claims about energy abundance. One of the ways energy producers and governments grappled with these challenges was, according to Mitchell, through “produced scarcity.” During the early years of any new form of energy, a surplus exists for which suppliers must manufacture demand through the “rapid construction of lifestyles ... organised around the consumption of extraordinary quantities of energy.”<sup>44</sup> In Ontario, the business interests and monopolies that built the first private hydropower plants at Niagara followed this approach.<sup>45</sup> Ontario Hydro, which had assumed control of most of these private generating stations in the first decades of the twentieth century, did the same. In order to increase demand for electricity, the public utility sold inexpensive appliances on installment plans and even gave them away.

Of course, another way that a state could deal with unfulfilled expectations of limitless energy and growth was to develop additional energy sources—as Ontario did with nuclear power and coal-fired electrical-generation plants. However, these energy sources lent themselves to different political evaluations



*Figure 5: Sir Adam Beck Generating Stations at Niagara Falls. Photo by Daniel Macfarlane*

than did hydro-electricity. When controlled by a public utility, coal and nuclear power also became matters of political and democratic debate. But even as governments used abundant hydropower to claim to represent the interests of a widening segment of Ontario society, the physical infrastructure that embodied hydro's socio-political potential transformed a wide variety of distant communities and environments. In the places where envirotechnical systems converted falling water into hydro-electric energy, abundance could work against democracy. In many Canadian provinces, public utilities came to exercise a monopoly, or near-monopoly, on large-scale hydro-electric development. Unlike coal, but quite similar to oil, hydropower deployed and distributed expertise to take autonomy out of the hands of labour.<sup>46</sup> Planning and executing hydro developments required specially educated and elite hydraulic engineers, and once completed, such developments required only a handful of people to operate. Such a small coterie of operators, owners, investors, technocrats, and government officials formed "hydraulic bureaucracies" that functioned as special interest groups, even as they professed to be representing the public will and interest.<sup>47</sup>

Like fossil-fuel energy, hydro-electric networks formed grids with multiple delivery pathways.<sup>48</sup> Ontario Hydro was more willing than private utilities to supply small urban centres in southwest Ontario, and more remote industrial users in rural parts of Ontario.<sup>49</sup> But over time, the necessity to build transmission lines to connect with consumers produced a systemic urban-industrial imbalance of material benefits. Electric grids exhibited rigid rights-of-way and path dependencies akin to older rail-dependent coal pathways, rather than inter-modal routes followed by oil. Thus, at the same time as the government used mass-produced and mass-consumed energy to justify claims of greater equality within society, the realities of hydropower rationalized only a small share of abundant energy for rural communities. The mandate to extend service to regions with low-population density and little or no industry, as well as the flexibility offered by the interconnected North American electrical grid, really only emerged after the Second World War (when the proportion of people living in such communities was dropping sharply) and took many decades to develop.

The scale of hydro-electric development entailed social, health, and environmental consequences comparable to, though often different from, coal mining and oil drilling operations. But energy abundance became something that many citizens took for granted, while those in the know were more than satisfied with the tradeoff in which discrete locations became sacrifice zones for power development.<sup>50</sup> Generating electricity removes some of the river's energy from the ecosystem, where it would otherwise perform valuable natural functions (scouring and erosion, transport of sediment, supporting fish and aquatic life, etc.) or other functions for human society (navigation, logging, recreation, etc.). Furthermore, dams and reservoirs alter water temperature and present migration hazards for fish and other species. Thus, depending on settlement patterns along the shore and other uses, creating a reservoir changes the types of ecosystem services the river can provide. In some cases, the government and hydro developers consulted riparian landowners and users, but more often environmental changes took place through manufactured consent, or no consent at all. Thus building a hydro installation was to privilege the industrial and capital uses of a water body while foreclosing other uses and users.

Put differently, hydro democracy involved sacrificing hinterland watershed environments for metropolitan benefits. Acquired violently from Indigenous peoples, abundant natural resources facilitated Canada's rise as a nation of high-living standards.<sup>51</sup> Hydro installations typically occupy riverine locations featuring waterfalls or rapids, which historically served as important sites of fishing, trade, and cultural exchange for Indigenous peoples. As a result, hydro developments often inundated land of significant value to Canada's First Nations, who as a result of this "hydraulic imperialism" bore a disproportionate brunt of the costs for projects that represented progress, that ineluctable talisman of modern capitalist society.<sup>52</sup> For non-Indigenous Canadians, the need to move and/or relocate people and communities highlights the limits to government claims that large-scale energy systems received popular consent and produced democratic politics.

Spatial arrangements and locations of hydro sites created long-range path dependencies and technological momentum. As was the case with fossil fuels, the environmental consequences of hydro development usually unfolded at great distances from sites of consumption, and on a scale that most never considered. Combined with its abundance, envirotechnical infrastructures de-natured networked energy. And since the country's political structures took so much of its logic from the principles of unlimited economic growth made possible by energy abundance, as Mitchell asserts, democratic politics was also de-natured politics.<sup>53</sup> Apart from those who lived in close proximity to dams and directly confronted the environmental consequences of hydro-electric development, citizens judged the outcomes mainly by its benefits. And since public utilities and Crown corporations so often initiated, financed, and operated hydro facilities, their authority to claim that hydropower served the public good framed environmental change as democratic politics.

## Conclusion

In conclusion, we argue that the public development of large-scale hydropower exerted a discernable influence on the nature of the Ontario state, and had tremendous long-term repercussions, positive and negative. Returning to Mitchell's definition of democracy, it appears that hydro-electricity did, at least in the public imagination, allow for more effective claims for a just and egalitarian world than oil: at the same time, hydro democracy became a mode of governing populations that employed popular consent as a means of limiting claims for greater equality and justice by dividing up common resources.

Because hydropower in Ontario, and elsewhere in Canada, was mostly produced by state-sponsored agencies, it was able to longer resist certain facets of neoliberalism associated with oil, such as privatization and deregulation.<sup>54</sup> Canadian historians may wish to explore whether efforts to develop hydro-electric power helped lay the foundations for a Canadian interventionist state, which by the postwar period was largely committed to social-welfare programs across the country (e.g., national adoption of single payer health care, mortgage insurance, social support networks, etc.). Public power also meant that hydro-electricity often became a key electoral and political issue. Underpinning the development of electricity from falling water is the particular cultural resonance that Ontarians (and many other Canadians) attached to hydropower, which made the province (and the country) an exporter of energy, with an attendant range of implications.

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## Endnotes

- 1 The authors would like to thank R.W. Sandwell, Christopher F. Jones, Joshua MacFadyen, and William Knight for reading and commenting on early drafts, as well as Tina Loo for comments on some of the early ideas put forward here. We thank them for sharing some of their own work and statistical evidence.
- 2 When discussing coal in Britain, Mitchell has the advantage of addressing a relatively compact geographic area; Canada's spatial size and the resulting diversity of energy and political economy regimes, however, mitigated against our initial goal of addressing hydro-electricity across the entire nation. As a result, we decided to focus solely on the Province of Ontario—a territory that alone is still about four times larger than the whole of the UK.
- 3 Timothy Mitchell, *Carbon Democracy: Political Power in the Age of Oil* (New York: Verso, 2011), 9.
- 4 Mitchell, *Carbon Democracy*, 41 & 71.

- 5 For Mitchell, oil deposits in the Middle East explain the imperialist actions of colonial powers like Britain and France towards countries like Iraq. Indeed, the history of colonialism in that region would have been far different without oil. The outcomes of the First World War, particularly the promotion of the principle of self-determination, take on a whole new meaning when viewed through the lens of carbon imperialism. Mitchell, *Carbon Democracy*, 65; Daniel Yergin, *The Quest: Energy Security, and the Remaking of the Modern World* (New York: Penguin, 2011).
- 6 Since Canada's share of GDP from oil revenue has never exceeded 10 percent, some critics insist that only Alberta—which has exceeded the 20 percent threshold—qualifies as a petrostate. Meenal Shrivastava, “Liberal Democracy in Oil-Exporting Countries: A View from the Perspective of Staples Theory,” in Meenal Shrivastava and Lorna Stefanick, eds., *Alberta Oil and the Decline of Democracy in Canada* (Edmonton: AU Press, 2015): 31-67; Andrew Nikiforuk, *The Energy of Slaves: Oil and the New Servitude* (Vancouver: Greystone, 2012): chapter 10.
- 7 Richard W. Unger and John Thistle, *Energy Consumption in Canada in the 19th and 20th Centuries: A Statistical Outline* (Consiglio Nazionale delle Ricerche (CNR)), Istituto di Studi sulle Società del Mediterraneo (ISSM), 2013), appendix 1; Sam H. Schurr and Bruce C. Netchert, *Energy in the American Economy, 1850-1922* (Baltimore: John Hopkins Press, 1960), 22.
- 8 In this sense, our adoption of Mitchell's concept of carbon democracy contributes to a wider historiographical debate on the nature and influence of liberalism in Canada, a debate to which few environmental or energy historians have devoted much attention. Ian McKay, “The Liberal Order Framework: A Prospectus for a Reconnaissance of Canadian History,” *Canadian Historical Review* 81 (2000): 617-645; Stephane Castonguay and Darin Kinsey, “The Nature of the Liberal Order: State Formation, Conservation, and the Government of Non-Humans in Canada,” in Jean-Francois Constant and Michel Ducharme, eds. *Liberalism and Hegemony: Debating the Canadian Liberal Revolution* (Toronto: University of Toronto Press, 2009): 221-245; James Murton, *Creating a Modern Countryside: Liberalism and Land Resettlement in British Columbia* (Vancouver: UBC Press, 2007); Shannon Stunden Bower, *Wet Prairie: People, Land, and Water in Agricultural Manitoba* (Vancouver: UBC Press, 2011); Daniel Macfarlane, *Negotiating a River: Canada, the US, and the Creation of the St. Lawrence Seaway* (Vancouver: UBC Press, 2014).
- 9 Daniel Macfarlane and Lynne Heasley, *Border Flows: A Century of the Canadian-American Water Relationship* (Calgary: University of Calgary Press-NICHE Environmental History Series, 2016); Karl Froschauer, *White Gold: Hydroelectric Power in Canada* (Vancouver: UBC Press, 1999); Richard White, *The Organic Machine: The Remaking of the Columbia River* (New York: Hill and Wang, 1995).
- 10 On these issues, see also E.A. Wrigley, *Energy and the English Industrial Revolution*; E.A. Wrigley, *The Path to Sustained Growth. England's Transition from an Organic Economy to an Industrial Revolution* (Cambridge: Cambridge University Press, 2016). Stefanie Barca argues for the need to look at energy transitions as social processes that include the environmental costs: Stefanie Barca, “Energy Property and the Industrial Revolution Narrative,” *Ecological Economics* 70 (2011): 1309-1315. On water power as a vital energy transition predecessor to coal in the industrial revolution, see Ted Steinberg, *Nature Incorporated: Industrialization and the Waters of New England* (Cambridge: Cambridge University Press, 1991).
- 11 We should acknowledge that, like Mitchell, our use of “carbon energy” refers to mineral forms of energy. Although various forms of biomass, particularly wood, represented a sizeable portion of Canada's and Ontario's energy budget at the turn of the twentieth century, we consider only fossil fuels when referring to carbon energy.
- 12 Granted, reservoirs and reverse-pumped storage can partially alter the temporal availability of hydro-electricity.
- 13 As Bob Johnson points out, once people burned fossil fuels, the transmission of that power was spatially limited unless it was converted into electricity. Regardless of its original source, harnessing energy presents transmission challenges, which electricity is uniquely suited to overcome. From the standpoint of evaluating the systems that convert energy into useful human applications, up until the point energy is harnessed, one of the main differences between carbon power and hydropower is that it took much less effort to move the former to sites of power production. Bob Johnson, *Carbon Nation: Fossil Fuels in the Making of American Culture* (Lawrence, KS: University Press of Kansas, 2014), chapter 4.

- 14 Christopher Jones treats hydro-electricity as a stock and part of the mineral energy regime, whereas R.W. Sandwell emphasizes its renewable and flowing features, and places it within the organic energy regime. Christopher Jones, *Routes of Power: Energy and Modern America* (Cambridge, MA: Harvard University Press, 2014); Ruth Sandwell, ed., *Powering Up Canada: The History of Power, Fuel, and Energy from 1600* (Montreal: McGill-Queen's University Press, 2016); E.A. Wrigley, *Energy and the English Industrial Revolution* (Cambridge: Cambridge University Press, 2010); Vaclav Smil, *Energy in World History* (Boulder, CO: Westview Press, 2008).
- 15 See Matthew Evenden and Jonathan Peyton, "Hydroelectricity," in Sandwell, e.d., *Powering Up Canada*.
- 16 For an overview of hydropower in Canada see Evenden and Peyton, "Hydroelectricity."
- 17 Denison, 41. In addition see Nelles, *The Politics of Development*; Neil B. Freeman, *The Politics of Power*.
- 18 Denison, 28.
- 19 Daniel Macfarlane, "A Completely Man-Made and Artificial Cataract: The Transnational Manipulation of Niagara Falls," *Environmental History* 18 (4) (October 2013): 759-784; Daniel Macfarlane, "Current Concerns: Canadian-American Energy Relations and the St. Lawrence and Niagara Megaprojects," in Amelie Kiddle, ed., *Energy in the Americas: Critical Reflections on Energy and History* (Calgary: University of Calgary Press, forthcoming).
- 20 H.R. Rice, "More Canadian Kilowatts at Niagara," *Compressed Air Magazine* Volume 58, Number 8 (August 1953): 210-217. In the 1940s Quebec took its first step toward nationalizing its hydro utilities and then passed Ontario as the country's major hydro-electric producer, while provinces outside of central Canada began to develop their own hydropower resources.
- 21 <http://worldknowing.com/top-10-largest-hydroelectricity-producer-country-in-the-world/>
- 22 In 1941, oil represented 17%, coal 53%, and electricity 6% of total energy consumed, Unger and Thistle, *Energy Consumption in Canada in the 19th and 20th Centuries*. In terms of household rather than total national consumption, data from the Dominion Bureau of Stats figures shows that (unlike the US) Canadians were consuming very little electricity in their homes before World War II. On wood and biomass use for energy, see Josh MacFadyen chapter in *Powering Up Canada*. As Ruth Sandwell argues, Canada was an outlier compared to other industrialized countries because of the extent to which Canadians had 'free' and widespread access to the organic energy regime, generous homesteading system, cheap and often marginal agricultural lands at great distances from state surveillance, and the persistence of a dominant rural population more interested in 'getting by' than in 'getting rich'. Sandwell, *Canada's Rural Majority*; Sandwell, "Introduction," *Powering up Canada*; Ruth Sandwell, "Mapping Fuel Use in Canada: Exploring the Social History of Canadians' Great Fuel Transformation," in Jennifer Bonnell and Marcel Fortin, eds., *Historical GIS in Canada* (Calgary: NiCHE-University of Calgary Press Environmental History Series, 2014).
- 23 Thomas Parke Hughes, *Networks of Power: Electrification in Western Society, 1880-1930* (JHU Press, 1993); David E. Nye, *Electrifying America: Social Meanings of a New Technology, 1880-1940*, New edition (The MIT Press, 1992); David E. Nye, *American Technological Sublime* (The MIT Press, 1996); Harold L. Platt, *The Electric City: Energy and the Growth of the Chicago Area, 1880-1930* (University of Chicago Press, 1991); Paul Hirt, *The Wired Northwest: The History of Electric Power, 1870s-1970s* (University Press of Kansas, 2012); Gretchen Bakke, *The Grid: The Fraying Wires Between Americans and Our Energy Future* (Bloomsbury Publishing USA, 2016); Julie A. Cohn, *The Grid: Biography of an American Technology* (MIT Press, 2017).
- 24 Once the up-front capital costs were paid off, hydropower tended to be even cheaper per unit of production than coal and oil.
- 25 H.V. Nelles, *The Politics of Development: Forests, Mines and Hydro-Electric Power in Ontario, 1849-1941*, 2nd Edition (Montreal: McGill-Queen's University Press, 2005); Christopher Armstrong and H.V. Nelles, *Monopoly's Moment: The Organization and Regulation of Canadian Utilities, 1830-1930* (Philadelphia: Temple University Press, 1986); Andrew Dilley, "Politics, Power, and the First Age of Globalization: Ontario's Hydroelectric Policy, Canada, and the City of London, 1905-10," in

- Andrew Smith and Dimitry Anstakis, eds., *Smart Globalization: The Canadian Business and Economic History Experience* (Toronto: University of Toronto Press, 2014); Stéphane Savard, *Hydro-Québec et l'État québécois, 1944-2005* (Montreal: Septentrion, 2013); Desbiens, *Power from the North*; Evenden, *Allied Power*.
- 26 Keith Fleming, *Power at Cost: Ontario Hydro and Rural Electrification, 1911-1958* (Montreal: McGill-Queen's University Press, 1991).
- 27 Ian M. Drummond, *Progress Without Planning: The Economic History of Ontario from Confederation to the Second World War*. (Toronto: University of Toronto Press, 1987), chapter 8.
- 28 Mark Kuhlberg outlines the ways that hydroelectricity facilitated the pulp and paper industry in Northern Ontario. *In the Power of the Government: The Rise and Fall of Newsprint in Ontario, 1894-1932*. (Toronto: University of Toronto Press, 2015). On northern Ontario hydro developments see also Jean Manore, *Cross Currents: Hydroelectricity and the Engineering of Northern Ontario* (Waterloo, ON: Wilfrid Laurier University Press, 1999).
- 29 On this point see Matthew Huber, *Lifeblood: Oil, Freedom and the Forces of Capital* (Mineapolis: University of Minnesota Press, 2013); Ruth Sandwell, *Canada's Rural Majority*; Joy Parr, *Domestic Goods*; Dorotea Gucciardo, *Powered Generation: Canadians, Electricity, and Everyday Life* (PhD Dissertation, Western University, 2011); David Nye, *Electrifying America*; Ronald Tobey, *Technology as Freedom: The New Deal and the Electrical Modernization of the American Home* (University of California Press, 1997).
- 30 R.W. Sandwell, "Pedagogies of the Unimpressed: Re-Educating Ontario Women for the Modern Energy Regime, 1900-1940," *Ontario History*, 107,1 (Spring 2015): 36-59.
- 31 Neil B. Freeman, *The Politics of Power: Ontario Hydro and its Government, 1906-1995* (Toronto: University of Toronto Press, 1996); Jerry Bannister, "A River Runs Through It: Churchill Falls and the end of Newfoundland History," *Acadiensis*, Vol. XLI, No. 1, Winter/Spring-Hiver/Printemps (2012): 211-225; Philip Smith, *Brinco: The Story of Churchill Falls* (Toronto: McClelland and Stewart, 1975); James Feehan, "Smallwood, Churchill Falls, and the Power Corridor Through Quebec," *Acadiensis* XL, no. 2 (Summer/Autumn 2011): 112-27.
- 32 This is of course true of Quebec as well, for that province's heavy reliance on hydro-electricity allowed it to consume home-grown energy and become *maîtres chez nous* Caroline Desbiens, *Power from the North*; David Massell, *Quebec Hydropolitics: The Peribonka Concessions of the Second World War* (Montreal: McGill-Queen's University Press, 2011); Savard, *Hydro-Québec et l'État québécois, 1944-2005*.
- 33 H.R. Rice, "More Canadian Kilowatts at Niagara," *Compressed Air Magazine* Volume 58, Number 8 (August 1953): 210-217; Nelles, "Hydro as Myth," *The Politics of Development*.
- 34 Harold Innis, *The Fur Trade in Canada: An Introduction to Canadian Economic History* (New Haven: Yale University Press, 1930); Donald Creighton, *The Empire of the St. Lawrence: A Study of Commerce and Politics* (Toronto: Macmillan, 1956); Christopher Armstrong, Matthew Evenden, and H.V. Nelles, *The River Returns: An Environmental History of the Bow* (Montreal: McGill-Queen's University Press, 2009).
- 35 Macfarlane, *Negotiating a River*; Daniel Macfarlane, "Dam the Consequences: Hydropolitics, Nationalism, and the Niagara-St. Lawrence Projects," in Lynne Heasley and Daniel Macfarlane, eds., *Border Flows: A Century of the Canadian-American Water Relationship* (Calgary, AB: University of Calgary Press, 2016).
- 36 See Daniel Macfarlane, "Fluid Relations: Hydro Developments, the International Joint Commission, and Canada-US Border Waters," in Peter Stoett and Owen Temby, eds., *Towards Continental Environmental Policy? North American Transnational Environmental Networks and Governance* (Albany, NY: SUNY Press, 2017).
- 37 Christopher Armstrong, *The Politics of Federalism: Ontario's Relations with the Federal Government*.
- 38 Heasley and Macfarlane, *Border Flows*.
- 39 Andrew Watson, "Coal in Canada," in Sandwell, ed., *Powering Up Canada*.



- 40 The Canadian federal government initially adopted a laissez-faire approach to electricity exports, and by 1910 Canada exported about one-third of its electricity. Since the Second World War, non-firm (interruptible) power sales have dominated the Canada-US electricity trade. Janet Martin-Nielsen, "South over the Wires: Hydro-electricity Exports from Canada, 1900-1925." *Water History* 1 (2009): 109-29.
- 41 By 1975, at a time when new Canadian hydro-electric developments moved spatially away from the border (e.g., northern Quebec), Canada's hydro-infrastructure featured 65 cross-border interconnections, with a total transfer capability of over 6,000 megawatts.
- 42 Jones, *Routes of Power*; Malm, *Fossil Capital*, Ruth Sandwell, "Pedagogies of the Unimpressed" and Ruth Sandwell, "People, Place and Power: Rural Electrification in Canada, 1890-1950," in Paul Brassley, Jeremy Burchardt and Karen Sayer, eds. *Transforming the Countryside: the Electrification of Rural Britain* (London and New York: Routledge, 2017): 178-204.
- 43 Nelles, *The Politics of Development*.
- 44 Mitchell, *Carbon Democracy*, 41; Jones, *Routes of Power*.
- 45 See H.V. Nelles, *The Politics of Development*.
- 46 Mitchell, 192. On labour and the transition from hydraulic power to steam power in Britain, see Malm, *Fossil Capital*. In the case of Canada's move to hydro-electricity, however, controlling the labour force was only one reason among a number of motivating factors. See Gerald Bloomfield and Elizabeth Bloomfield, "Waterwheels and Steam Engines in Ontario: Industrial Power Reported in the 1871 Manuscript Census," *Scientia Canadensis*, Vol. 13, No. 1 (Spring-Summer 1989): 2-38.
- 47 Ontario Hydro's first chairman, Adam Beck, is a prime example. On "hydraulic bureaucracies" see F. Molle, P.P. Mollinga, and P. Wester, "Hydraulic Bureaucracies and the Hydraulic Mission," *Water Alternatives* 2 (2009): 328-349; on the application of "hydraulic bureaucracies" to the Ontario context see Macfarlane, *Negotiating a River*.
- 48 Mitchell, 38.
- 49 On Ontario Hydro and rural electrification see Fleming, *Power at Cost*.
- 50 The relationship between abundant energy and the failure to appreciate it is a central axiom of the Jevons paradox, in which increased demand results from greater availability. Bob Johnson, *Carbon Nation*.
- 51 A number of historians in Canada have explored the relationship between the consequences of hydropower development on rural and Indigenous communities and environments and the benefits enjoyed by urban residents and economies. Brittany Luby, "From Milk-Medicine to Public (Re)Education Programs: An Examination of Anishinabek Mother's Responses to Hydro-electric Flooding in the Treaty #3 District, 1900-1975," *Canadian Bulletin of Medical History*, 32, 2 (2015): 363-89; Daniel Macfarlane and Peter Kitay, "Hydraulic Imperialism: Hydro-electric Development and Treaty 9 in the Abitibi Region," *American Review of Canadian Studies*, 47, 3 (Fall 206): 380-397; Caroline Desbiens, *Power from the North: Territory, Identity, and the Culture of Hydro-electricity in Quebec* (Vancouver: UBC Press, 2014); Matthew Evenden, *Fish Versus Power: An Environmental History of the Fraser River* (Cambridge: Cambridge University Press, 2004); Matthew Evenden, *Allied Power: Mobilizing Hydro-electricity During Canada's Second World War* (Toronto: University of Toronto Press, 2015); Tina Loo and Meg Stanley, "An Environmental History of Progress: Damming the Peace and Columbia Rivers," *Canadian Historical Review* 92, no. 3 (September 2011): 399-427.
- 52 Macfarlane and Kitay, "Hydraulic Imperialism: Hydro-electric Development and Treaty 9 in the Abitibi Region," Luby, "From Milk-Medicine to Public (Re)Education Programs."
- 53 Mitchell, 251.

## 'One-Day-Wide' Canada: History, Geography, and Aerial Views at Trans Canada Air Lines, 1945-1955

Blair Stein

**Abstract:** *This article shows how Trans Canada Air Lines (now Air Canada) navigated celebrating Canada's geography while eliminating it using modern communications technologies in its midcentury public-facing material. TCA worked explicitly with modern and high-modern discourse of "space" and "time," manipulating the historical and geographic imaginary to position itself as a natural part of the Canadian envirotechnical landscape. In so doing, TCA also self-fashioned as the gatekeeper of geographic experiences in the form of aerial views. By embracing a new technological system—aviation—and a new type of environment—the geographic imaginary—this article pushes the boundaries of envirotech and argues that the Canadian tendency towards both geographic and technological nationalism is, at its center, an envirotechnical relationship.*

**Résumé :** *Cet article montre comment Trans Canada Air Lines (maintenant Air Canada) a opéré en célébrant la géographie du Canada tout en l'éliminant grâce aux technologies de communication modernes dans son matériel promotionnel du milieu du siècle. TCA exploitait explicitement avec le discours moderne de l'espace et du temps, manipulant l'imaginaire historique et géographique pour se positionner comme une partie naturelle du paysage environnemental canadien. Ce faisant, TCA s'est également façonnée comme le gardien des expériences géographiques sous la forme de vues aériennes. En associant un nouveau système technologique — l'aviation — et un nouveau type d'environnement — l'imaginaire géographique — cet article repousse les limites de l'analyse envirotechnique et soutient que la tendance canadienne au nationalisme géographique et technologique est, en son centre, une relation envirotechnique.*

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**Keywords:** Trans Canada Airlines, aviation, advertising, technology, environment, modernity

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IN EARLY MAY 1948, CBC human-interest reporter John Fisher received a puzzling telephone call from a representative of Trans Canada Air Lines. "How would you like a trip to Paris and London?" the TCA man asked. "It will only take you an hour." Fisher was shocked and "wondered whether he was dealing in some futuristic rocket chariot." He was not; the TCA man was referring to London and Paris, Ontario, and the inaugural flight of the airline's newest plane, the Canadair DC-4M2 "North Star." Once in the air, Fisher was immediately awed by the view of cars "crawling like ants" through Hamilton's "payrollish" streets, the "patchwork quilt of Ontario" farms—"solid, heavy, neat, prosperous, old, velveteen softness...blessed by geography"—and the "aqua blue of Lake Ontario," without which "Canada would not hold the world position she does today." The transcendence of the view and the speed, comfort, and power of

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Blair Stein, "One-Day Wide Canada: History, Geography, and Aerial Views at Trans Canada Air Lines, 1945-1955," *Scientia Canadensis* 40, 1 (2018): 19-43.

the North Star caused him to reflect on technology in Canadian history and identity:

I thought to myself—what an age—what would the Fathers of Confederation say. Here they are, the two symbols of this age of speed—the babies of the twentieth century—up in the clouds the Airways of TCA—below the Airwaves of CBC—both working like giant needles, knitting this country together...closing the gaps which worried the Fathers.<sup>1</sup>

Fisher's comments echo the twin concerns of settler Canadian national identity: environment—especially distances—and communications technologies. These two shaping forces are no surprise to settler Canadians, but how can Canadians celebrate the nation's size while at the same time celebrating modern technologies, such as railways, telephones, and airplanes, which obfuscate geographic distance as an obstacle to mobility? The process of assigning historical and cultural value to Canada's distances in order to use their erasure as a cornerstone of modern national identity is the subject of this paper.

I explore how TCA, as a state airline, navigated the challenges of Canada's envirotechnical identity in and around its 1947 decennial year. It simultaneously championed popular narratives of Canadian history and geography in its public-facing material while attempting to sell its space-shrinking services. In so doing, the airline engaged with modern and high-modern discourse, manipulating space and time to elide the tensions between environment and modern technology. High modernism, as James Scott has suggested, is associated with midcentury megaproject regimes: centralized state constructions of science and technology as a solution for society's ills and impositions of large technoscientific projects onto an oftentimes unaware or uncooperative populace.<sup>2</sup> Modern centralized governments relied on science and technology as stand-ins for state power and catch-alls for national belonging. Midcentury Canada saw its fair share of megaprojects imbued with these types of meanings, as Daniel Macfarlane, Tina Loo, and Joy Parr have shown.<sup>3</sup> In his work on the St. Lawrence Seaway, Macfarlane has identified what he calls "*negotiated* high modernism," which takes into account the smaller-scale political and social negotiations of high-modern megaprojects. He suggests that this is a distinctly Canadian type of high modernism, especially because of how the Seaway became a "lightning rod" for different Canadian nationalisms.<sup>4</sup> This study expands on this version of Canadian high modernism by emphasizing the delicate and deliberate work necessary to turn air travel into one of these "lightning rods." The high-modern "negotiations" at TCA did not result in a radical reshaping of the landscape as it did for the Seaway, but instead pointed towards a *discursive* reshaping of the Canadian envirotechnical imagination to make aviation in general, and air travel by TCA in particular, compatible with it.

In order to do this, state agents made use of modern technological rhetoric, emphasizing human triumphs over space and time, mobility, speed, and choice as modern technologies intruded into everyday life. TCA's advertising and promotional material placed airplanes as part of an established timeline

of transportation technologies, providing the machines themselves with a teleology connected to mythic Canadian distances. This had the added effect of turning TCA into the exclusive purveyor of what airline advertisers saw as an authentic Canadian geographic experience: viewing the nation from above. Just as Fisher was awed by the streets and farms of southern Ontario, passengers were sold a vision of Canadian geography that suggested that the only way to truly appreciate the scale and variability of the nation was to see it from an airplane window. As a Crown Corporation with a virtual monopoly on Canadian air travel, TCA was the dominant source of Canadian air travel discourse, and by extension articulated what might be seen as a state-supported rhetoric of nature, technology, and nation. By making discursive use of history and geography—time and space—TCA’s public-facing materials reflect anxieties about establishing Canadian-ness in a modern and high-modern world.

### **The modern Canadian envirotechnical nation**

Canada’s geography, especially its size, has long been central to the construction of Canadian national identity. This is evident in the interrelated Staples and Laurentian theses of Canadian history. Harold Innis and Donald Creighton, writing in the 1930s, both suggested that the movement of natural resources across large spaces was key to economic development; Innis famously argued that the energy of early Canada was channeled directly and indirectly into the extraction, transportation, and production of raw materials, while Creighton saw the St. Lawrence River as a geographic axis for political and commercial development.<sup>5</sup> Both of these theses have been challenged and even displaced in the twenty-first century as environmental historians have questioned the characterization of staples and complicated the value of the St. Lawrence river to Canadian-ness.<sup>6</sup> However, the foundational idea that the land itself has made Canada and Canadians special remains in cultural discourse.<sup>7</sup> Fisher even connected breadth of territory with magnanimity of spirit in his broadcasts, characterizing Canada as a “harmless giant,” performing well on the “test of bigness” set out by its founders.<sup>8</sup>

Of course, the Canadian culture of bigness, as this sea-to-sea-to-sea national vision might be called, could not be culturally resonant, let alone manageable by a centralized state, without a corresponding set of Canadian national myths about communications technologies. Maurice Charland has isolated the phenomenon of “technological nationalism,” relatively unique to English Canada, “which ascribes to technology the capacity to create a nation by enhancing communication.”<sup>9</sup> Rail in particular is frequently analyzed this way, especially since the Canadian railway system developed alongside Confederation; railway boosters argued that east-west networks of communications and transportation were the only way that Canada could become a functioning settler nation.<sup>10</sup> Recent works by Robert MacDougall, Liza Piper, and Caroline Desbiens have expanded the geographic and temporal scope of “technological nationalism,” showing how telephony, freighting, and power generation not only allowed

literal access to distant regions, but also helped develop a trans-national and sometimes regional connectedness in the Canadian imagination.<sup>11</sup>

These two nationalisms are compatible; as Canada's imposing distances defined economic development, technological networks allowed that development to have a longer reach and encourage the conditions necessary for nationhood and communities of belonging. This is especially evident in Harold Innis' inclusion of natural and human-made transportations as "communications" technologies. As communications scholar Robert Babe has shown, "even the production or extraction of natural resources (or 'staples') constituted 'communication' for Innis. The extraction or production of staples creates environments, or ecosystems, that *mediate* human relations and otherwise affect a people's thoughts and actions."<sup>12</sup> By this token, human interactions with communications technologies and the distances they seek to transcend give those distances meaning. As perhaps Canada's greatest railway storyteller, Gordon Lightfoot, sings, "the green dark forest was *too silent to be real*" before settlers arrived with their wheels and railways.<sup>13</sup>

However, the experiences of modernity and high modernity had the potential to destabilize this balance between environmental and technological self-fashioning. This is especially evident in what scholars of technological modernity have called "time-space compression," where "by accelerating the velocities of people, goods, and information, the world is made to feel smaller even as interactions are stretched over larger physical distances."<sup>14</sup> Put simply, modern communications technologies made a transcontinental Canada possible, but these new spatial regimes threatened Canada's identity as a nation existing just at the edge of geographic possibility. Writing in the 1970s, for example, Northrop Frye argued that Canada was especially prone to the "obliterated environment," as "jet planes, international hotels, and disappearing landmarks" exposed the incommensurability between unity on a national scale and more intimate place-based belonging; Canada's vulnerabilities lay in its "empty spaces, its largely unknown lakes and rivers and islands...[and] its dependence on immense railways to hold it physically together."<sup>15</sup> More recently Edward Jones-Imhotep has argued that the realities of the early Cold War and hostile Canadian environments made certain components of technological orders appear unreliable, highlighting once again the limits of geography as a marker of national ability and subsequently allowing instability and unreliability to become part of high-modern "technological nationalism."<sup>16</sup> Emerging technoscientific challenges, especially those in "new" environments such as the Arctic and upper atmosphere, made Canadian distances and Canadian communications more difficult to reconcile inside high-modern nationalist discourse and had to be therefore united by the rhetoric of technological failure.

Rail was able to escape the most obvious aspects of this irreconcilability because of its prominence before high modernity, but also because of the discursive focus on intimate technological body-work. The act of boring paths

through mountains and laying rails across the entirety of the Canadian nation has more cultural currency than actually travelling on the train. The technology itself, the landscapes onto which it was imposed, and the processes of building it therefore become wrapped up in what David Nye might call a “technological creation story,” where the land appeared to be specially laid out for settlers to apply their technology and industry.<sup>17</sup> Canada-as-nation could only exist through the labour and power required to construct the railways, which in turn could only exist because of the specificities of Canadian geography.

Air travel, on the other hand, did essentially the same time-space compression as rail, but was missing all the intimate body-work that made rail special in Canada and emerged inside a high-modern paradigm of nature, technology, and nation. Certainly, modern airports have affected how cities grow, and the development patterns of Canada’s northern regions were partially dictated by air routes, but this is *nothing* compared to traversing the nation rail-spike by rail-spike.<sup>18</sup> The rhetoric of struggle to overcome distance by industry and ingenuity that prevailed in railway boosterism was subsequently much harder to attach to air travel; compared to tunneling through the Rocky Mountains, the establishment of sea-to-sea radio communication necessary for transcontinental air travel seemed easy. Regular airline travel also threatened to stretch geographic reach *too far*, making Canada’s special distances irrelevant, or at least mundane. Rapidly expanding air-travel infrastructure through the immediate postwar years called for new Canadian envirotechnical paradigms that built on older narratives of “technological nationalism” but renegotiated them inside modern Canadian contexts. Canada had to be re-imagined as an “aviation nation” that made the virtual elimination of Canada’s mythical distances by high-modern systems as vital to national self-fashioning as the distances themselves.

Air travel’s influence on modern Canadian self-fashioning suggests that it can, and should, be examined as an envirotechnical system. Scholars have long associated technology with the human need to “modify, subdue, and control” their surroundings, but only relatively recently have environmental historians and historians of technology actively sought to open the black boxes of their field with the crowbars of the other.<sup>19</sup> “Envirotech” as a discipline makes use of the constructivist and materialist tendencies of environmental history and the history of technology in order to examine “nature, technology, and their relationship *within* and *as* history,” as Sara Pritchard has argued in her book about the Rhône.<sup>20</sup> Pritchard identifies a quadripartite set of concerns for envirotech scholars—nature, culture, technology, and politics—and suggests that envirotech must engage with all four without placing them in opposition or resorting to determinism.<sup>21</sup> Given these concerns, the majority of envirotech study has been devoted to large technological projects such as dams, nuclear power plants, and highways, which by their size require centralized state influence and have large-scale visible, measurable environmental impacts.<sup>22</sup>

This study pushes the boundaries of envirotech by focusing air travel’s

impact on the *imagined* environment. Air travel might not have the same sort of footprint that popular envirotechnical subjects such as dams might, but instead alters perceptions of geography and nationhood. Canada *looks* different from above and *feels* different when travelling at five-miles-a-minute, and airliners are the mediators for these perceptions. Canadian landscapes may have been minimally altered by commercial air travel, but midcentury “imagined” Canada owes a great deal to traveling across and viewing the nation from above. TCA’s promotional material worked inside an established envirotechnical narrative that framed Canada as a “communication nation,” using the Canadian state’s long history of transcending distance to its advantage in order to turn Canada into an “aviation nation.” It also prioritized the visibility of travel, framing its flights as authentic Canadian geographic experiences. Taken together, these two strategies show airline advertisers’ emerging awareness of the high-modern frictions between Canadian environmental and geographic identities and the wholehearted, if unintentional, embrace of high-modern discursive techniques to sidestep them.

### **The acceleration of time and the manipulation of history**

When TCA celebrated its tenth anniversary in April 1947, very little happened at the airline. Fisher made one of his characteristic “pride-builder” broadcasts on the subject, highlighting TCA’s new transatlantic routes, its new North Stars, and their overall impact on Canada:

You’ll never learn from TCA that the best record for flying in the world was made in a tough northern country of hard winters...Thursday is the Tenth Birthday. Greetings to the...men and women who have carried the Maple Leaf high and far. You have helped give Canada a feeling of nationhood.<sup>23</sup>

Passengers on April-10th flights received what TCA’s employee newsletter called a “generous cut” of birthday cake “in a neat little silver box,” while a transport company in Saskatchewan invited TCA managers to a luncheon in their honour. Other than that, “the birthday passed almost like any other day,” with little public fanfare.<sup>24</sup> It is unsurprising that TCA public-relations executives did not capitalize on this major event as advertising and promotions were not a high priority at TCA until Battle-of-Britain hero Gordon R. McGregor replaced Manitoba-lawyer Herbert Symington as TCA President in 1948.

In his previous position as the airline’s traffic manager, McGregor pressed Symington and his staff for a renewed public relations focus, since “unquestionably, a sustained and comprehensive program of advertising would improve” passenger traffic and the attitude of the “average man” towards TCA.<sup>25</sup> Symington’s executive and public relations staff were generally hesitant. Vice President W. F. English expressed concern about the airline’s relationship to government and worried that self-promotion might cheapen the airline, since TCA’s story should not be told “through paid advertising or news releases accompanied by pictures of pretty girls.”<sup>26</sup> Once McGregor took office, he focused on transforming the commercial side of TCA “from an

"We like flying—all year 'round!"

TRANS-CANADA AIR LINES

**FLY**  
**TCA** the smooth way  
"above the weather"

Aboard a TCA aircraft, you leave winter far below 'til your journey's end. The warm, club-like atmosphere of a TCA Skyliner invites you to relax in comfort all the way. You'll enjoy the courteous service, the complimentary meals. Your pilots know that wintertime is *good* flying time. Your TCA Skyliner, specially developed for year 'round operation, is every day setting new records for *on-time performance*.

★ **SMOOTHEST ROUTES . . .**  
TCA Flight Dispatchers analyze up-to-the-minute weather reports—advise TCA Captains on smoothest routes.

★ **IN CONSTANT TOUCH . . .**  
In the air, continuing radio reports are received so the aircraft may proceed smoothly over the weather.

★ **CONSTANT COMFORT . . .**  
With their pressurized cabins, TCA's great 40-passenger "North Stars" maintain constant "living room" comfort at all altitudes.

★ **VETERAN PILOTS . . .**  
TCA crews possess an unsurpassed skill and experience in all-year-round flying. 95 pilots have flown over a million miles each with TCA.

★ **POWER . . .**  
TCA Skyliners have the power and range that enable them to choose and fly routes where conditions are best.

★ **FAST, FREQUENT FLIGHTS . . .**  
Making over 100 scheduled flights a day, TCA Skyliners are flying over 20 million miles a year. Last year more than 685,000 passengers flew with TCA.

Your next trip, plan to go by TCA. For full information on fares and schedules, call your Travel Agent or any TCA Office.

**TRANS-CANADA** Air Lines  
International • Trans-Atlantic • Transcontinental

Figure 1: An early 1950 advertisement featuring "pretty girls" typical of McGregor's early tenure. Air Canada Collection, Canada Aviation and Space Museum (CASM).



order-taking department to a sales department actively stimulating business” through advertising (featuring lots of “pictures of pretty girls,”) promotions, and increased booking capacity (Figure 1).<sup>27</sup> By early 1949, TCA’s Advertising Department had expanded so much that it was separated from the airline’s Public Relations department.

As McGregor assumed his new role, two other TCA initiatives that marked its decennial year received promotional attention: the debut of both regular passenger service between Canada and the United Kingdom and the Canadair DC-4M “North Star,” TCA’s first new postwar airliner. The North Star’s recognizable image and evocative name featured heavily in promotional material, especially as it was used on TCA’s new routes. Built at the Canadair plant in Cartierville, Quebec, it combined the American Douglas DC-4 fuselage with four British Rolls-Royce “Merlin” engines and featured a number of wartime technologies such as cabin pressurization, long-range navigation, and electric de-icing.<sup>28</sup> Its Canadian manufacture, in particular, was celebrated as symbolic of national engineering prowess, industry, and “airmindedness.”<sup>29</sup> “This is no astral body in the usual sense,” a brochure about the North Star claimed. “It is a great airliner, the first of its kind. Built in Canada, the North Star represents the skills of a nation long-famed for aviation achievement in peace and war.”<sup>30</sup>

TCA’s transatlantic service merits a bit more attention, largely because promotions for this service incorporated many of the history-and-geography themes that carried through TCA’s public-facing material in this period. During the war, TCA had been mobilized as the Canadian Government Trans-Atlantic Air Service, shuttling personnel and supplies across the North Atlantic on repurposed Lancaster bombers. “Lancastrians,” as they were known, were noisy, uncomfortable, and lacked climate control and restroom facilities, and TCA had little hope of incorporating them successfully into postwar civilian service.<sup>31</sup> The North Star was the solution to that problem, and TCA began regular commercial flights to London and Prestwick on non-pressurized North Stars in 1947.<sup>32</sup> Promotions for the new service invoked a deep history of transatlantic travel, leaning especially heavily on symbols of exploration and discovery. In flying to and from Britain, the North Star represented the future of oceanic travel and the final step in a progress narrative that began with “the Vikings...in their little dragon ships,” as they were called in 1947 promotional copy, followed by “the coming of Cabot” and Jacques Cartier, the steamship *Royal William* “and her queer cargo,” and John Alcock and Arthur Brown’s 1919 transatlantic flight in a “tiny biplane” that looked “like a frail box-kite.” TCA’s “great new aircraft, the North Star,” was imagined as the heir to these exploratory traditions. Like its stellar namesake, it was tasked with guiding future generations of oceanic travellers, since “after a thousand years, the wide ocean has been reduced to a narrow pool.”<sup>33</sup>

Promotions such as these made the modern compression of space and time central to technological and historical progress. Not only did trans-Atlantic

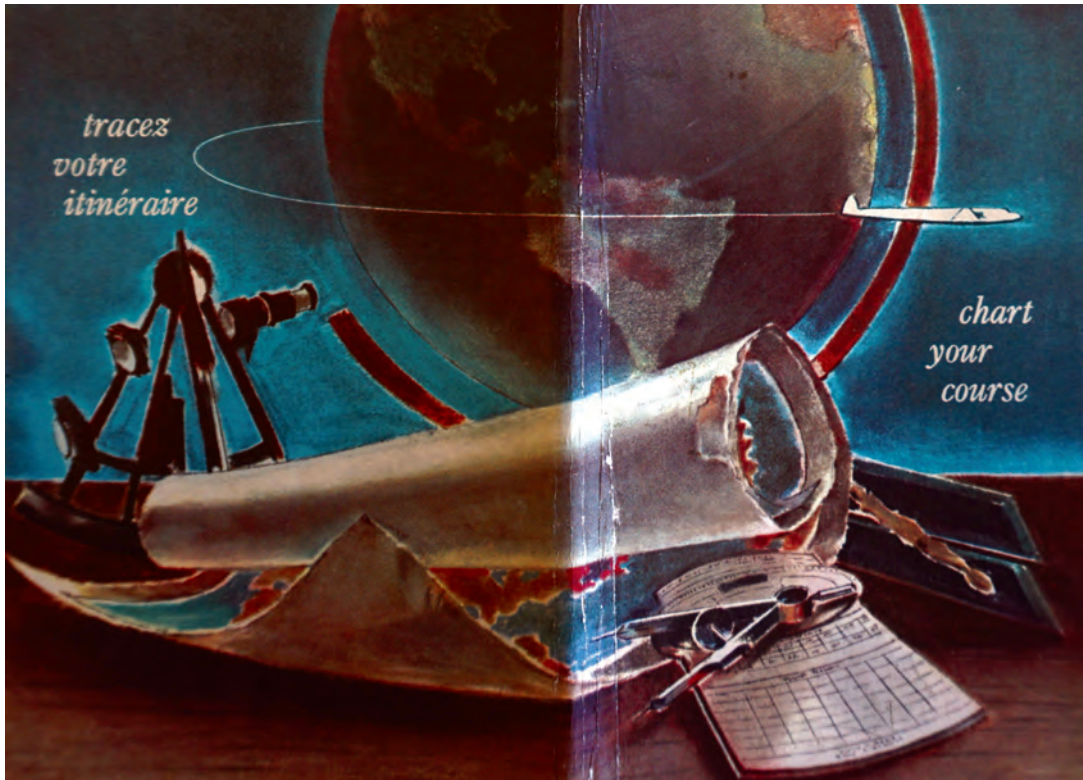


Figure 2: Detail from a 1956 brochure juxtaposing early modern navigational instruments with airplanes. Air Canada Collection, CASM.

travel times reduce with each technological system—from Cabot’s seven weeks to the *Royal William’s* 25 days to the *North Star’s* 14 hours—but the time between each transportation also accelerated. Approximately five hundred years passed between the Vikings and early modern explorers, three centuries between Cartier and the *Royal William*, and 86 years between the first steamship and air crossing. “In a millennium, eighty-six years is little more than the tick of the clock,” making the three decades between Alcock and Brown and the *North Star* even more impressive.<sup>34</sup> This double-acceleration made time appear especially elastic, placing the Vikings, great explorers, and aviation pioneers both very near to and very distant from TCA and its *North Stars*. It also provided airplanes with a history, which they lacked as a quintessentially modern technology. As Bernhard Rieger has shown for nineteenth- and early-twentieth-century Europe, many anxieties about modern technologies were rooted in their relative complexity and how they appeared to “burst into the present from nowhere.”<sup>35</sup> Airplanes had the dual problem of being so complex that their manufacturing processes were black-boxed to the average consumer and appearing to go against the forces of nature by flying.<sup>36</sup> Constructing transatlantic travel as a continuum of multiple time-space compressions offset some of these problems by tying airplanes to the great transports of history while suggesting that those great transports had the same time-space effect as an airliner.

These themes were made obvious by the juxtaposition of easily-recognizable symbols of exploration, such as compass roses, astrolabes, and sailing ships, and ultra-modern aircraft in both images and copy. A widely-circulated informational booklet from 1949 showed an image of colourfully dressed voyagers on an early-modern sailing ship pointing excitedly at an airplane in the distance, claiming “TCA flies the Atlantic on a schedule that would have filled the voyaging Norsemen with awe.”<sup>37</sup> An air-route map from the mid-1950s featured an illustration of an airliner flying past a sextant, since “the land beyond the horizon has always held a fascination for adventurers armed with a parchment map, a dream of discovery—and often very little else... Today...air travel is a certain, scientifically controlled excursion, but should the pioneer spirit of adventure still spark within you, TCA invites you to chart your course...beyond the horizon.”<sup>38</sup> Advertising manager Jack McGee highlighted the “Chart Your Course” slogan and “art treatment” as particularly likely to “arouse the interest of the reader.”<sup>39</sup> Perhaps the most popular example of this was TCA’s 1952 corporate Christmas card (Figure 2), which was “met with such favourable comment,” according to the Advertising Department, that it was re-printed as seat-back material the following year, with a total circulation in the hundreds of thousands.<sup>40</sup> Designed as a stylized early modern “seafaring mappe,” the card manipulated space and time by showing geographic features of the Atlantic and the paths of various voyages of exploration, from Eric the Red to the North Stars that “flieth” across the ocean. Time here appeared so compressed by advances in transportation that history happened all at once.

Even in TCA’s advertisements for Canadian destinations and “system” campaigns designed to inspire general brand-awareness and loyalty, TCA’s aircraft were discursively and pictorially placed along a transportation trajectory that traversed dogsleds, canoes, oxcarts, and railways. “Does it seem like a miracle?” an early brochure asked. “To speed across Canada on the wings of the wind[?] It will, if you give a fleeting thought to the past” when settlers crawled “across the prairies in ox-carts that squealed complaint with every turn of the wheel.”<sup>41</sup> This progression had been long entrenched in Canadian technological mythmaking, especially in terms of the ill-defined “northland.” Indigenous technologies, such as dogsleds, snowshoes, and canoes hold a great deal of significance to settler Canadian paradigms of mobility. As Bruce Erickson has shown in his work on canoeing, the settler use of canoes for leisure created a performative “natural” Canadian-ness which decontextualized settler colonialism, Canadian history, and the value of the canoe to indigenous Canadians by suggesting that canoeing presented an “allure of openness” that placed “the birth of the nation in the landscape itself.”<sup>42</sup>

Inside aviation discourse in particular, canoes, dogsleds, and other indigenous transports came to stand in for old “backward” ways of travel, as Johnathan Vance suggests in his work on early Canadian aviation culture.<sup>43</sup> Comparing airliners to other geographically appropriate transportation technologies made them seem even more modern, quick, and reliable. This was a common



Figure 3: TCA's corporate Christmas card, 1952. Air Canada Collection, CASM.

technique in midcentury aviation advertising in general, as airplanes were frequently pictured next to slow horse-drawn carts, broken-down jalopies, and even occasionally trains.<sup>44</sup> In TCA's public-facing material, this technological compression also drew on a century of envirotechnical nationalism and framed the nation's history as uniquely driven by mobility across space:

A little more than a century ago, Sir George Simpson, Governor of the Hudson's Bay Company...left Montreal on a record-breaking 3,000-mile journey to Vancouver. Twelve weeks later, after an arduous trip by canoe, ox-cart and on horseback, he arrived at the Pacific coast ... In Simpson's time that was no small achievement. Neither was the much later feat of organized ground transport in reducing the transcontinental crossing to four days. Yet now [TCA] bridges that great distance in just fourteen hours and sets standards of its own. The contrast is a measure of the swift transport progress of our times.<sup>45</sup>

Mobility from coast-to-coast was vital to the Canadian geographic nation, but Canadians infrequently flew from Halifax to Victoria.<sup>46</sup> Aerial transcontinentality therefore served TCA's symbolic purposes, using rail-based paradigms of transcontinental travel to build a history for aviation in general, and a state airline in particular, that spoke to and about the problem of existing at the border of geographic possibility. Canada seemed like natural fit for aviation, and airplanes a natural fit for Canadian environments, which implied that rail was simply a stepping-stone to the *real* coast-to-coast communications: aviation. As a 1939 TCA brochure claimed, "the railways made the Canada of the Nineteenth Century and led the way into the Twentieth. Without them, the

Dominion couldn't have been, but they were not enough. They still had their part to play, and always will have, but...Canada, too, must have wings."<sup>47</sup>

Most of Canada's interwar "wings" were attached to bush planes, the public and private enterprises that engaged in surveying, mapping, fire-fighting, and the transportation of people, goods, and mail to Canada's widely distributed Northern communities. Bush flying emerged as what historian Don Thompson has called "a peculiar Canadian phenomenon" in the interwar period.<sup>48</sup> Bush pilots – largely former military pilots – were cast as home-grown heroes who, along with bush planes (which were increasingly purpose-built through the 1930s) came to represent what an Edmonton newspaper called in the 1929 "the romance of transportation."<sup>49</sup> Bush flying served several discursive functions in TCA's public-facing material: it emphasized the airline's connection to national development, reinforcing the role of aviation and the nation's mythic geography in the Canadian imagination, while also providing the airline with an origin story loaded with adventure, heroism, and romance. The airline rearranged Canadian history to make what McGregor called the "lusty development of civil aviation" seem like the expected conclusion to national progress, especially as the "North" re-emerged in national mythmaking through the middle part of the twentieth century.<sup>50</sup> Promotional materials suggested that Canadians were active in aviation "when the Wright brothers were unfledged youngsters." Canadian pilots returning from the First World War took to "northland flying," as it was frequently called, and "began pioneering in forestry surveys and fire protection from the sky, in aerial photography and mapping." Eventually, as one 1946 institutional history claimed, "Canadians began to realize the value of wings in reaching the outposts of their vast northern wilderness." It made sense that the state should control, even at arm's length, the trajectory of aviation in Canada because "it was bush flying that put Canada into the front rank of world aviation...TCA grew out of the need for a swift, modern system of transportation between communities scattered across an area of more than 3,000 miles, out of a vision of a more closely integrated nation."<sup>51</sup> And there was a direct lineage from Canada's adventurous bush-flying heroes to regular reliable airline travel, since TCA was founded to operate on the Trans Canada Airway, the Canadian government's project through the 1930s to construct Canadian aviation infrastructure by consolidating private bush flying routes and establishing airfields and radio communications.<sup>52</sup> TCA's advertising personnel made frequent use of this pedigree, highlighting the "northland flying" experience of their personnel and suggesting that airline travel did the same national unity work that bush flying had done decades before.<sup>53</sup>

TCA's early public-facing materials feature several sorts of time-manipulations. TCA, for example, used a compressed historical perspective of Atlantic history, one that stretched back centuries, to naturalize its operations. Materials that juxtaposed caravels with sleek airliners made air travel less intimidating because it gave the machines and routes a teleology that invoked both adventure and routine. They also echoed the "speed-up," as David Harvey has called it, of

modernity by making transportation development appear to accelerate.<sup>54</sup> Similar techniques in TCA's system advertisements worked on a slightly smaller scale—Euro-Canadian settlement—to make airplanes and a state airline a natural, necessary part of national progress that could help modernize the nation.

### **The collapse of Canadian distances and the aerial view**

These time-manipulations were accompanied by a set of space-manipulations that used airplanes to discursively shrink the nation without completely interrupting the mythology of Canadian distances necessary to make that “shrinking” resonant. “Canada has often been referred to as a land of magnificent distances,” a 1947 air route map claimed. “That was before the coming of Trans-Canada Air Lines. [Now] east and west coasts are less than 24 hours apart.”<sup>55</sup> If Canada was only a land of “magnificent distances” *before* air travel, how could those distances remain foundational to Canadian national identity as TCA? Constructions of Canada as a nation with distances only human ingenuity could overcome were artifacts of nineteenth- and early-twentieth-century rail and other communications paradigms, but with an added level of high-modern technoscientific rhetoric that suggested that rail was inadequate to the needs of the twentieth century. Airlines in general, and TCA in particular, appeared to be natural and necessary, since, as one wartime public-relations packet claimed “it had become evident that something more was needed; that a nation so vast in its distances and so various in its economic divisions could not afford to do without the fullest time and distance-destroying advantages of aviation. So Trans-Canada Air Lines was designed to meet a great Canadian need.” TCA's public-facing institutional histories frequently claimed that commercial aviation in the guise of a state airline was vital to Canadian success on a national and international scale, especially in wartime. That same public-relations packet pointed out that “it was a fortunate circumstance for Canada that the very moment her geographic immensity most threatened her efficiency the distance-destroying power of transport aviation should have come newly to hand.”<sup>56</sup> Canadian geography was a double-edged sword, threatening national security and unity while at the same time supporting discursive constructions of nation.

TCA partially avoided those sharp edges by making distance necessary to the *establishment* of Canadian aviation, which kept geography as part of foundational myths while still removing it in the present. TCA's public-facing material suggested that Canada, which McGregor called “by census...a small country, and by Atlas a very big one,” was environmentally primed for a successful space-shrinking civil aviation industry.<sup>57</sup> Geography's role as a barrier for Canadians to overcome with ingenuity is what gave it its value; a mid-1950s pamphlet pointed out how it was “understandable in a country of great distances” that “Canadians are among the world's most airminded travellers” and were “among the first to put the airplane to practical use.”<sup>58</sup> Air travel's time-space compression could

be a detriment to Canadian environmental identity because it made character-building geographic features, such as what McGregor called the “great natural barriers” of the Rockies and “Precambrian Shield,” disappear, but also a benefit because it extended travelers’ geographic reach towards those features, increasing accessibility to a diversity of Canadian vacation experiences.<sup>59</sup> Shrinking the nation by air allowed access to “all Canada’s famed vacation lands...the Rockies—the Prairies—the holiday resorts of Ontario, Quebec, and the Maritimes,” as one 1947 advertisement suggested, because “T.C.A. takes you there in hours instead of days.”<sup>60</sup> The Canadian culture of bigness was supported and dismantled in the same breath; the Rockies were no longer an obstacle to mobility, but more Canadians could visit them, helping them to appreciate what it meant to nationhood to overcome those same obstacles.

The other way TCA negotiated with its removal of distance from Canadian-ness was discursively substituting time for space. Canada’s “magnificent distances” were subtly transformed into magnificently long travel times; time-space compression and time-space conflation went hand-in-hand. This allowed Canada’s size to remain the same, but highlighted TCA’s role in making that size less overwhelming to the popular imagination as well as addressing more tangible concerns such as freighting and air mail. Thanks to TCA, the Canadian businessman “can now fashion his activities and ambitions...secure in the knowledge that Canada is only twenty hours wide and that time of travel has ceased to be a major obstacle.”<sup>61</sup> In so doing, TCA explicitly used the rhetoric of space and time, arguing frequently that, as one of the airline’s first newspaper advertisements claimed, “a people of vision and enterprise could not be held back by the barriers of time and space. Trans-Canada Air Lines came into being, and now the Dominion is no wider than a single day!”<sup>62</sup> This was a visual metaphor as well; the 1948 TCA promotional film “A New Map for Canada” opens with a boy drawing a map of Canada as a homework assignment, “but it proves a task too large and too overwhelming.” He asks a family friend, a TCA Captain, for help and is taken on an imaginary coast-to-coast air journey along TCA’s routes to learn “that the Dominion is not the wide expanse of past generations but the ‘one-day-wide’ Canada of today.”<sup>63</sup> A 1949 trans-Atlantic newspaper advertising campaign literally juxtaposed time and space, replacing the hands of clocks and watches with a North Star flying over maps of Europe.<sup>64</sup> Promotional material frequently also used violent language when discussing TCA’s role in transforming space into time; North Stars, for example, “will scatter our old concepts of distance...by slashing” travel times, and “so effective has been the attack of TCA upon Canadian distances that already they have lost much of their old significance.”<sup>65</sup> It was with great force, apparently, that TCA and its machines eliminated distances in Canada, but it still maintained the value of those distances by making time and space interchangeable and turning distance into a foundational myth.

This tendency to replace distance with time—“Canada is now one day wide”—was a symptom of modern time-space compression as well as the modern

obsession with speed. Speed was TCA's most obvious benefit over rail, but speed could be scary. Even as late as 1961, the advertising department labelled "FARE and FEAR" as "the main barriers against flying."<sup>66</sup> Evoking speed in promotional material meant dealing with passengers' greatest anxieties about the air travel experience, as Rick Popp has recently shown for the United States. Just as railway accidents in the nineteenth century exposed the hubris of speed, "puncturing the veil of the ordinary that such technologies needed to pass as natural fixtures of the modernizing landscape," so too did airlines struggle with routinization.<sup>67</sup> Popp suggests that midcentury air travel was one of the only instances where advertisers' goals were "to allay fears, rather than amplify them," and they developed a core set of themes and techniques to accomplish this goal, such as reducing advertising after a crash received a great deal of media attention.<sup>68</sup> TCA faced similar obstacles, perhaps amplified by its public ownership; McGregor complained in 1950 of the "blinding light of publicity which is turned upon all [TCA's] activities...with the astonishing result that even a blown tire at an airport 10,000 miles away is faithfully reported by press."<sup>69</sup>

Marketing the experience of flying in general, and aerial views in particular, helped TCA reduce public anxieties about both the speed and altitude of air travel. Aerial views, especially views of cities, and the production of vertical spaces in general are hallmarks of the modern experience, as Nathalie Roseau, Thomas Campanella, and art historians and geographers Denis Cosgrove and William Fox have suggested.<sup>70</sup> In his landmark book on high modernism, James Scott has argued that "it would be hard to exaggerate the importance of the airplane for modernist thought and planning;" verticality and the "God's-eye view" transformed city planning and megaprojects such as the Great Lakes-St. Lawrence Seaway.<sup>71</sup> Although Scott and other scholars of modernism have argued that the "God's-eye-view" eliminated local and regional texture, Jason Weems has recently claimed that aerial views actually *created* a regional identity for "the prairie landscape, with its vast and undifferentiated topography and its rigidly imposed cadastral grid" of the American Midwest by making "it possible to see the region as a unified whole and to understand the relationships that shaped regional life."<sup>72</sup> The view from above, it seems, has been a conduit for the creation, maintenance, and disruption of modern communities of belonging and difference on a variety of scales.

Passenger aviation has received relatively little attention from scholars interested in these themes, despite it being one of the few channels through which everyday consumers could experience these unique views. Other sorts of "democratic" modern technological views have been analyzed as symptomatic of modernity and high modernity: Krista Thompson and Bernhard Rieger have both examined cameras and photography as conduits for modern communities of belonging, and David Louter and Ben Bradley have used car windshields as focal points for their studies of North American parks.<sup>73</sup> Commercial air travel touches on many of these gazes, as passengers frequently looked through windshields and cameras, sometimes at the same time. TCA estimated in the





*Figure 4: The centerfold of a popular late-1940s TCA brochure featuring aerial photography. Air Canada Collection, CASM.*

early 1950s that up to 75% of passengers brought cameras on board and provided travel agents with information on how “to get the best results from in-flight photography...through Skyliner windows,” including how to hold the camera to avoid vibration—“well braced against the body”—and glare.<sup>74</sup> Furthermore, *any* gaze from an airplane was a modern technological gaze; TCA’s airliners acted as mediators between Canadians and their surroundings, providing them with a concrete experience of time-space compression.

Aerial photography as a technological gaze has a special currency in Canada, as it developed as part of the bush-flying industry. Viewing Canada from above was necessary to make Canada legible, and making Canada legible was necessary to making Canadian governance possible, resulting in what Marianne Cronin has identified as a geographic *and* cultural co-construction of bush planes.<sup>75</sup> This made aerial views of Canada easy to fit into TCA’s public-facing material as a comfort and a corrective to air-travel-related ills, rather than a cause of them (Figure 4). “There’s no boredom in air travel,” a 1947 brochure claimed. “The miles pass too quickly for that. Forest and farm land, wide prairies, rolling foothills and the majesty of the Canadian Rockies...the landscape is always changing.”<sup>76</sup> Canada’s geographic variability worked to break up the perceived monotony of air travel while representing Canadian technoscientific ingenuity, invoking the conditions that made air travel part

of the Canadian environmental imagination. Passengers were told that “from your skyliner window the world below is a fascinating display of our resources and the way we use them,” and the airplane itself was “an illustration of science at work on these same resources to overcome time and space. We hope you feel by now that ‘flight-seeing’ adds measurably to the pleasure of your trip.”<sup>77</sup> More importantly, TCA’s supply of altitude made looking at Canada from above an authentic Canadian geographic experience that only it could provide. Aerial photography and illustration featured heavily in TCA’s public-facing material, appearing everywhere from airmail envelopes to the “not in any way promotional...[and] purely functional” passenger comment cards.<sup>78</sup> Postcards showing aerial views of TCA’s destinations, and often meta-views of the aircraft flying above a destination, were provided in seat-back portfolios through the late 1940s and early 1950s. Exhibition displays also emphasized passengers’ access to aerial perspectives: visitors to the TCA booth at the 1949 Canadian National Exhibition were greeted by “eight large window frames through each of which will be shown as series of 30 coloured slides” of aerial views of TCA’s destinations, which the advertising department considered “one of the most extensive showings of photographs of this type ever brought together.”<sup>79</sup> This was not an uncommon strategy at other airlines, as aerial photography was still relatively novel. At TCA, aerial views echoed the “romance” of bush-flying-era aerial surveying and photography, making air travel an organic extension of the Canadian transportation pantheon, one that gave passengers a visual experience they could not get with train travel.

This seemed to work. Passengers came to expect a view and complained when they did not get what was promised, as one passenger did in 1948: “our only disappointment was the weather. We couldn’t see New Brunswick from the air.”<sup>80</sup> The “dirty state of windows” upset “camera fiends” on a different 1948 flight.<sup>81</sup> A Lethbridge “land lover” on a flight to Winnipeg was left uneasy because “it was necessary for the plane to fly above the clouds and the earth was not visible” and a couple’s trip from Saskatoon “was largely reduced from a holiday trip to mere transportation” when “a line of men pushed in and took all the window seats.”<sup>82</sup> Passengers asked for more windows, larger windows, tinted windows, for the glass to be removed from the windows to “see that much more,” and that the “wings be painted a drab black” to reduce glare.<sup>83</sup> One even asked, tongue-in-cheek, for “deck chairs on the wings. Of course, tied down.”<sup>84</sup> Historians of advertising have pointed out the problems of identifying if advertisements “worked,” but the volume of passenger requests for more or better views suggests that TCA’s public relations priorities resonated with at least some of its passengers.<sup>85</sup>

Some of them may have resonated too much, as passengers sometimes wondered why their views didn’t look like what they expected from high-modern aerial photographs or maps. One 1953 passenger was surprised that “that the Stewardess could not tell me anything about the geographic nature of the country over which we flew,” and suggested educating the cabin crew in geography and

cartography.<sup>86</sup> Usually, though, passengers wanted detailed topographic maps, which TCA eventually released in the mid-1950s; announcements of landmarks by the pilot; or that “the names of larger places over which the plane passes [be] given by flashing on a screen or similar device.”<sup>87</sup> They also occasionally asked for access to the same altitude, airspeed, and positional information the pilots had, generally in the form of “flight instruments” displayed in the cabin, which would help passengers identify their views while at the same time giving them a glimpse into the inner workings of the aircraft.<sup>88</sup> Passengers seemed to want the same kind of legibility that the state got from aerial surveys, but their suggestions for flight aids also implied that demystifying their views might also help demystify the aircraft itself.

In general, passengers were receptive to TCA’s aerial visual priorities, and they found viewing Canada from above as transcendent as the airline wanted it to appear. The fact that they wished for a “plane made of transparent material” as well as “a map handy with plenty of topographic information” shows that they wanted their air travel experience to be as visually rich as possible.<sup>89</sup> And, as a handful of passengers suggested, it was that they were *flying over Canada in particular* that made air travel worthwhile. An American passenger flying to Canada for the first time thought that “God planted the most beautiful landscape directly beneath TCA’s routes.”<sup>90</sup> A 1950 passenger praised the “perfect visibility” on their flight from Calgary to Vancouver that allowed them to enjoy the “clear skies above and snow and glacier covered mountains below.”<sup>91</sup> Still another, from the summer of 1948, “wondered if your publicity department has played up” how beautiful flying was compared to ground transportation—“not even a Winston Churchill could properly describe the allure of it all.”<sup>92</sup> Clearly the publicity department had. Promoting the views afforded by air travel was not unique to Canada, but Canada’s overwhelming size, and the already-established role of bush flying in reducing that size, made the manipulation of geography by airplane especially evocative. It also involved an appeal to technological history, discursively opening the airplane’s intimidating black boxes and making it seem as organically connected to the Canadian landscape as rail appeared to be. Rail may have been responsible for coast-to-coast connections and the confederation of the Canadian state, but flying made those connections visible and legible to everyday Canadians. One 1950 passenger brought these themes together by claiming that only a “poet-scientist” could properly describe the power of flying over Canada in a TCA aircraft:

Riding a TCA North Star is the closest you can get to Heaven—It’s an experience that no human being should miss. Besides, it gives one a new and unusual sense of the oneness of Canada. As you watch the provinces slip beneath your eyes in all their colorful beauty—the breath-taking magnificence of the Rockies, rich-chequered Prairies, small lonely farms, brilliant welcoming cities—you discover with a freshness and impact never achieved by history books or geographies that this is one country, our own.<sup>93</sup>



*Figure 5: A brochure advertising the debut of TCA's Vickers Viscount, 1954. Air Canada Collection, CASM.*

The rhetoric of air travel visibility persisted beyond the decennial years and the launch of the North Star. In 1955, TCA debuted North America's first turbine-powered airliner: the turbo-prop British-built Vickers "Viscount" powered by Rolls Royce "Dart" engines. The powerplant was sufficient cause for celebration, but TCA had slightly different priorities. The logo for the rollout was a stylized aircraft window, and documents for travel agents suggested they tell clients about how "the large elliptical windows—26" high, 19" wide give an opportunity for visual enjoyment of flight unequalled by any other transport aircraft. Yes, even the passenger on the aisle can enjoy an uninterrupted view."<sup>94</sup> These windows were allegedly the industry's largest, complete with special anti-fog coatings to allow "unrivalled flight-seeing."<sup>95</sup> Despite flying even faster than the North Star, and having a higher operational ceiling, the Viscount's design appeared to support and sustain TCA's discourse of aerial views and the modern legibility of Canada by air.

### Conclusion

In the public-facing material released in and around its decennial year, TCA worked with the rhetoric of postwar high modernity, centralizing human technoscientific triumphs over the natural world while delicately maintaining

the value of the natural world to Canadian national identity. As a government airline, its growing focus on public relations through the late 1940s and early 1950s meant that TCA represented what appeared to be a state narrative of technology, environment, and nation. However, this state narrative needed to be deliberately constructed to create compatibilities between modern time-space compression and older paradigms of the Canadian envirotechnical imaginary. The airline's decennial provided a unique opportunity to highlight the history of transportation, including the first transatlantic Norse voyages, indigenous Canadian transports, and pioneer aviators, and to retroactively make air travel appear to be the natural conclusion to this transport teleology. This teleology, in turn, was framed as responsible for the modern Canadian relationship between communications networks and mythic distances. TCA discursively built a new "one-day-wide" Canada whose modern width was only made possible by civilian aviation, itself a product of the much wider Canada of the past.

In what remains really the only cultural history of Canadian aviation, Jonathan Vance argues that Canada was "a nation tailor-made to be exploited by air."<sup>96</sup> This wasn't just because of Canada's sheer size and geographic variability, but also because it was a nation clamoring for new, modern technological creation stories of its own. Aviation, especially commercial aviation, was easy to fold into a recognizable sea-to-sea technological nationalism established around Confederation as well as environmental constructions of Canada as uniquely confronted by geographic and climatic obstacles to mobility and unity. But the successful dissemination of an aviation creation story had the potential to threaten this envirotechnical imaginary by displacing those obstacles. This study of TCA's public-facing material from the 1940s and early 1950s reveals the uses of, contradictions in, and anxieties about *making* Canada "one-day wide," and how TCA navigated that construction as it promoted civil aviation and the experience of flying.

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### Endnotes

- 1 Script, "John Fisher Reports: Up and Down," 2 May 1948, Air Canada fonds, RG 70, vol. 254, Library and Archives Canada, Ottawa. Hereafter LAC.
- 2 I refer to "modern" as a cultural category and "high-modern" as a political and temporal category, as James Scott might in *Seeing Like a State* (New Haven: Yale University Press, 1998).
- 3 Daniel Macfarlane, *Negotiating a River: Canada, the US, and the Creation of the St. Lawrence Seaway* (Vancouver: UBC Press, 2014); Tina Loo, "People in the Way: Environment, Modernity, and Society on the Arrow Lakes," *BC Studies* 142:3 (2004): 161-196; Joy Parr, *Sensing Changes: Technologies, Environments, and the Everyday, 1953-2003* (Vancouver: UBC Press, 2010).

- 4 Macfarlane, 17-18; 228-229.
- 5 Harold Innis, *The Fur Trade in Canada* (New Haven: Yale University Press, 1930); Donald Creighton, *The Commercial Empire of the St. Lawrence, 1760-1850* (Toronto: Ryerson Press, 1937).
- 6 On the Laurentian thesis, see Daniel Macfarlane, especially 13-15. On “staples” see Eric W. Sager, “Wind Power: Sails, Mills, Pumps, and Turbines” in *Powering Up Canada: A History of Power, Fuel, and Energy from 1600*, ed. R. W. Sandwell (Montreal and Kingston: McGill-Queen’s University Press, 2016), 162-185.
- 7 See, for example, Ryan Edwardson, *Canuck Rock: A History of Canadian Popular Music* (Toronto: University of Toronto Press, 2009). For an excellent summary of historiographic, cultural, and pedagogical approaches to Canada’s culture of “big,” see Alan MacEachern, “A Little Essay on Big: Towards a History of Canada’s Size,” in “Big Country, Big Issues: Canada’s Environment, Culture, and History,” eds. Nadine Klopfer and Christof Mauch, *Rachel Carson Center Perspectives* 2011, no. 4, 6–15.
- 8 John Fisher, *John Fisher Reports* (Hamilton: Niagara Editorial Bureau, 1949), 3-5.
- 9 Maurice Charland, “Technological Nationalism,” *Canadian Journal of Political and Social Theory* 10 (1986): 197. See also Marco Adria, *Technology and Nationalism* (Montreal and Kingston: McGill-Queen’s University Press, 2009), especially 33-71.
- 10 A. A. Den Otter, *The Philosophy of Railways* (Toronto: University of Toronto Press, 1997), R. Douglas Francis, *The Technological Imperative in Canada: An Intellectual History* (Vancouver: UBC Press, 2009).
- 11 Macfarlane, *Negotiating a River*; Robert MacDougall, “The All-Red Dream: Technological Nationalism and the Trans-Canada Telephone System,” in *Canadas of the Mind: The Making and Unmaking of Canadian Nationalisms in the Twentieth Century* eds. Norman Hillmer and Adam Chapnick (Montreal and Kingston: McGill-Queen’s University Press, 2007), 46-62; Liza Piper, *The Industrial Transformation of Subarctic Canada* (Vancouver: UBC Press, 2010); Caroline Desbiens, *Power From the North: Territory, Identity, and the Culture of Hydroelectricity in Quebec* (Vancouver: UBC Press, 2013).
- 12 Emphasis added. Robert Babe, *Canadian Communication Thought: Ten Foundational Writers* (Toronto: University of Toronto Press, 2000), 59.
- 13 This, of course, ignores millennia of indigenous occupation and their very “real” envirotechnical ways of knowing.
- 14 Barney Warf, *Time-Space Compression: Historical Geographies* (London: Routledge, 2008), 6. This particular term is largely attributed to David Harvey, whose book *The Condition of Postmodernity* (Oxford: Blackwell, 1989), suggests that time-space compression is not just a result of technological change, but also new forms of capitalism and economic cycles.
- 15 Northrop Frye, “Preface to *The Bush Garden*,” in *Northrop Frye on Canada Volume 12*, eds. Jean O’Grady and David Staines (Toronto: University of Toronto Press, 2003), 414. See also Edward Jones-Imhotep, *The Unreliable Nation: Hostile Nature and Technological Failure in the Cold War* (Cambridge: MIT Press, 2017), 4.
- 16 Jones-Imhotep, 6-10.
- 17 For a list of features necessary for a “technological creation story,” see David Nye, *America as Second Creation: Technology and New Beginnings* (Cambridge: MIT Press, 2004), 12-15
- 18 See Christopher Shaberg, *The Textual Life of Airports: Reading the Culture of Flight* (New York: Continuum, 2012) and Drew Whitelegg, “Keeping their eyes on the skies: Jet aviation, Delta Air Lines and the growth of Atlanta,” *Journal of Transportation History* 21 (March 2000): 73–91. Jenifer Van Vleck has also shown how air route maps manipulated political borders to reflect American nationalism and globalism in *Empire of the Air: Aviation and the American Ascendancy* (Cambridge: Harvard University Press, 2013), especially 113-115.
- 19 Jeffrey Stine and Joel Tarr, “Technology and the Environment: The Historians’ Challenge,” *Environmental History Review* 18:1 (Spring 1994): 1. For more recent historiographic analysis of the technology-environment nexus, see Hugh Gorman and Betsey Mendelsohn, “Where does Nature

- End and Culture Begin?" in *The Illusory Boundary: Environment and Technology in History*, edited by Martin Reuss and Stephen H. Cutcliffe (Charlottesville: University of Virginia Press, 2010), 265-290.
- 20 Sara Pritchard, *Confluence: The Nature of Technology and the Remaking of the Rhône* (Cambridge: Harvard University Press, 2011), 2-3.
- 21 Pritchard, 17. See also Pritchard, "Joining Environmental History with Science and Technology Studies," in *New Natures: Joining Environmental History with Science and Technology Studies*, edited by Dolly Jørgensen, Finn Arne Jørgenson, and Sara Pritchard (Pittsburgh: University of Pittsburgh Press, 2013), 1-17.
- 22 For example, David Biggs, *Quagmire: Nation-Building and Nature in the Mekong Delta* (Seattle: University of Washington Press, 2012); Christopher Jones, *Routes of Power: Energy and Modern America* (Cambridge, MA: Harvard University Press, 2014); Chandra Mukerji, *Impossible Engineering: Technology and Territoriality on the Canal du Midi* (Princeton: Princeton University Press, 2009); Thomas Zeller, *Driving Germany: The Landscape of the German Autobahn, 1930-1970* (New York: Berghahn, 2007).
- 23 "John Fisher Reports," 6 April 1947, C. D. Howe Fonds, MG 27 B20, vol. 94, LAC.
- 24 The cake was cut by the "smallest and the largest passengers leaving Montreal:" a seven-year-old girl and a famous wrestler. "Tenth Birthday Celebrations," *Between Ourselves*, May 1947, 4.
- 25 Letter from Gordon R. McGregor to W. F. English, "Decline in Volume of Passenger Traffic," 7 December 1946, Air Canada Fonds, RG 70, vol. 5, LAC.
- 26 Report by W. F. English, "Financial Outlook and Company Organization," 12 November 1946, Office of the President papers, Air Canada fonds, RG 70, vol. 5, LAC.
- 27 Gordon McGregor, *Adolescence of an Airline* (Montreal: Air Canada, 1970), 36.
- 28 For more on the North Star's de-icing systems, see Renald Fortier, *Propellers* (Ottawa: National Aviation Museum, 1996), 22-24.
- 29 To be "airminded," a term popular in the interwar years, was to follow aeronautical developments and embrace the potential of aviation to better human life, a sort of part-technological part-spiritual aviation boosterism. See in particular Joseph Corn, *The Winged Gospel: America's Romance with Aviation* (Oxford: Oxford University Press, 1983), 51-70.
- 30 Card "Some North Star Facts," c. 1947, Air Canada Collection 005.003, Canada Aviation and Space Museum, Ottawa. Hereafter CASM.
- 31 Ferry command and TCA pilot George Lothian recalled in his memoirs "a din that could only be compared to a boiler factory," a heating system that either fried or froze the crew, and makeshift urinals. George Lothian, *Flight Deck: Memoirs of an Airline Pilot* (Toronto: McGraw-Hill Ryerson, 1979), 110.
- 32 The first North Stars in service at TCA in April 1947 were not pressurized, as the project had to be rushed; by mid-1948, they had been replaced by pressurized versions. Larry Milberry, *The Canadair North Star* (Toronto: CanAv Books, 1982), 42-46.
- 33 Brochure, "North Star over the Atlantic," 1947, Air Canada Collection 005.003, CASM.
- 34 Ibid.
- 35 Bernhard Rieger, *Technology and the Culture of Modernity in Britain and Germany, 1890-1945* (Cambridge: Cambridge University Press, 2005), 34.
- 36 Like the speed of railways and steamships through the nineteenth century, flight seemed to go against the natural order. On rail see Wolfgang Schivelbusch, *The Railway Journey* (Berkeley: University of California Press, 1986) and John Tomlinson, *The Culture of Speed: The Coming of Immediacy* (London: Sage, 2007), especially 14-17. See also note 67.

- 37 Booklet, “Horizons Unlimited,” 1949, Air Canada Collection 005.003, CASM.
- 38 Brochure ADV. 41603-11-56-250M, “Chart Your Course,” 1956, Air Canada Collection 005.003, CASM.
- 39 Memorandum by J. A. McGee, “‘Chart Your Course’—Route Map Booklet,” 18 January 1957. Air Canada Collection 005.005 Box 07, CASM.
- 40 Memorandum by J. A. McGee, “Advertising—Souvenir Flight Portfolio,” 26 June 1953, Air Canada Collection, CASM.
- 41 Brochure, “Flying Across Canada,” c. 1939, Air Canada Collection 005.003, CASM.
- 42 Bruce Erickson, *Canoe Nation: Nature, Race, and the Making of a Canadian Icon* (Vancouver: UBC Press, 2013), 37. Daniel Francis has argued that the twentieth-century surge in canoeing and kayaking was connected to nostalgia and “discontent with the fruits of progress.” Settlers saw these “native” activities as harkening to an earlier, purer form of interacting with Canadian wilderness. Daniel Francis, *National Dreams: Myth, Memory, and Canadian History* (Vancouver: Arsenal Pulp Press, 1997), 147-148. Sport historian Gillian Poulter has also written on snowshoes and toboggans in nineteenth-century settler culture in *Becoming Native in a Foreign Land: Sport, Visual Culture, and Identity in Montreal, 1840-85* (Vancouver, UBC Press, 2009).
- 43 Jonathan Vance, *High Flight: Aviation and the Canadian Imagination* (Toronto: Penguin Canada, 2002), 154.
- 44 For some air travel histories that deal with advertising, see Daniel Rust, *Flying Across America: The Airline Passenger Experience* (Norman: University of Oklahoma Press, 2009); A. Bowdoin Van Riper, *Imagining Flight: Aviation and Popular Culture* (College Station: Texas A&M University Press, 2004), especially 83-108; and Guillaume de Syon, “Lufthansa Welcomes You: Air Travel and Tourism in the Adenauer Era” in *Selling Modernity: Advertising in Twentieth-Century Germany* eds. Pamela Swett et. al (Durham: Duke University Press, 2007), 182-201.
- 45 Booklet, “Horizons Unlimited,” 1949, Air Canada Collection 005.003, CASM.
- 46 Rob MacDougall has similarly argued that for early long-distance telephony in Canada, transcontinentality was more symbolic than practical, since Canadians were generally not terribly interested in calling the opposite coast. MacDougall, 53-55.
- 47 Brochure, “Flying Across Canada,” c. 1939, Air Canada Collection 005.003, CASM.
- 48 Don W. Thomson, *Skyview Canada: A story of Aerial Photography in Canada* (Ottawa: Energy, Mines, and Resources Canada, 1975), 29.
- 49 “Air Service From Waterways Links Simpson to Steel,” *Edmonton Journal*, 8 January 1929.
- 50 Address by Gordon R. McGregor to the Royal Canadian Flying Clubs Association, 25 January 1949, Gordon R. McGregor fonds, MG 30 E283, vol. 13, LAC. “North” emerged in the 19th century as a way for Canadian settlers to differentiate themselves climatically from the British and Americans as Carl Berger argues in “The True North, Strong and Free,” in *Nationalism in Canada*, edited by Peter Russell (Toronto, McGraw-Hill, 1966), 3-26. See also Berger, *The Sense of Power: Studies in the Ideas of Canadian Imperialism* (Toronto: University of Toronto Press, 1970) and Sherrill Grace, *Canada and the Idea of North* (Montreal: McGill-Queen’s University Press, 2001).
- 51 Robert H. Ayre, “TCA Wins Place Among World Air Lines,” *Canadian Geographical Journal*, July 1946, Air Canada Collection 005.003, CASM.
- 52 On attempts to make bush flying “mundane,” see Vance, *High Flight*, 108-132.
- 53 Advertisement, “The Men ‘Up Front,’” 1949, Air Canada Collection, CASM.
- 54 Harvey, 265-266. For more on the connections between the modern acceleration of time and increasing transportation speeds, see Chandra Bhimull, “Empire in the Air: Speed, Perception, and Airline Travel in the Atlantic World” (PhD Diss., University of Michigan, 2007), 41-51.



- 55 Brochure, "Air Lines Map of Trans-Canada Air Lines and Connections in Canada & United States," 1947, Air Canada Collection 005.003, CASM.
- 56 Draft, "Trans-Canada Air Lines: Questions and Answers," 29 November 1945, Air Canada fonds, RG70 vol. 5, LAC.
- 57 Address by Gordon McGregor to the Royal Canadian Flying Club, 25 January 1949, Gordon R. McGregor fonds, MG 30 E283, vol. 94, LAC.
- 58 Brochure, "Winged Facts about TCA," c. 1955, Air Canada Collection 005.003, CASM.
- 59 Address by Gordon R. McGregor, 1 June 1948, Gordon R. McGregor fonds, MG30 E283, vol. 13, LAC.
- 60 Advertisement, "T.C.A. Makes ALL CANADA Your Vacation Land," 1946, Air Canada fonds RG 70, vol. 11, LAC.
- 61 Draft, "Trans-Canada Air Lines: Questions and Answers," 29 November 1945, Air Canada fonds RG 70, vol. 5, LAC.
- 62 Advertisement, "TCA Speeds the Nation's Business," c. 1942, Air Canada Collection 005.003, CASM.
- 63 "A New Map for Canada" script, c. 1948, Air Canada Collection 005.005 Box 1, CASM.
- 64 Advertisements M-49-23-A and M-49-24-A, 1949, Air Canada Collection 005.001.003, CASM.
- 65 "North Stars Across the Continent," *Between Ourselves*, December 1947, 16-17. "Doing a Job for Canada," *Between Ourselves*, March 1947, 12.
- 66 Memorandum by J. A. McGee, "North American Services – Canada," 12 April 1961, Air Canada Collection, CASM.
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## Tools for Rational Development: The Canada Land Inventory and the Canada Geographic Information System in Mid-twentieth century Canada

Shannon Stunden Bower

**Abstract:** *From the 1960s through the 1980s, Canadian scientists, resource managers, and computer experts collaborated on two linked undertakings: the Canada Land Inventory (CLI) and the Canada Geographic Information System. CLI was an extensive project that assessed the state of key resources across much of the country, while CGIS was a pioneering effort at computerizing CLI data to support decision-making about resource use. Fundamental components of the Agricultural Rehabilitation and Development Act, CLI and CGIS reflect Canadian innovation in new information-management tools designed to facilitate state goals. This paper examines the production and affordances of CLI and CGIS, and considers the renewed optimism and collaborative relationships that emerged from them. It also examines historical concerns over the limitations of these technologies and explores how CLI and CGIS were oriented to change over space, not time. Ultimately, these technological innovations served to naturalize patterns of inequality and normalize urban-industrial modernity.*

**Résumé :** *Des années 1960 aux années 1980, des scientifiques canadiens, des gestionnaires de ressources et des experts en informatique ont collaboré à deux entreprises liées: l'Inventaire des terres du Canada (ITC) et le Système d'information géographique du Canada. L'ICA était un vaste projet qui évaluait l'état des ressources clés dans une grande partie du pays, tandis que le SCIG était un pionnier dans l'informatisation des données de l'ICA pour appuyer la prise de décisions concernant l'utilisation des ressources. Éléments fondamentaux de la Loi sur la réhabilitation et le développement de l'agriculture, CLI et CGIS reflètent l'innovation canadienne dans les nouveaux outils de gestion de l'information pour faciliter les objectifs de l'État. Cet article examine la production et les potentialités de CLI et CGIS, et considère l'optimisme renouvelé et les relations de collaboration qui ont émergé de ces deux organisations. Il examine également les préoccupations historiques sur les limites de ces technologies et explore comment CLI et CGIS étaient orientés vers le changement dans l'espace, et non dans le temps. En fin de compte, ces innovations technologiques ont servi à naturaliser les schémas d'inégalité et à normaliser la modernité urbaine-industrielle.*

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**Keywords:** Canada Land Inventory, GIS, ARDA, rational management, modernity

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IN 1954, GEOGRAPHER F. KENNETH HARE PUBLISHED in *The Canadian Geographer* a call for what he termed a “re-exploration” of Canada. Made necessary by the inadequacy of available information about Canada’s substantial landmass, the re-exploration envisioned by Hare would ideally take the form of a “national inventory of land and resources.” As he saw it, the inventory should encompass multiple facets, accommodating varied environmental features in one coherent effort. Hare also emphasized the importance of geographical expertise in leading this effort.<sup>1</sup>

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A decade later, Canadian scientists and resources managers, together with representatives of Canada's emerging computer industry, were at work at the problem Hare diagnosed. From the 1960s through to the early 1980s, the federal and provincial governments collaborated in two linked undertakings understood as fundamental to the future prosperity of the Canadian nation and its peoples. The Canada Land Inventory (CLI) was an extensive project to assess the state of key natural resources across much of the country. The Canada Geographic Information System (CGIS) was an innovative effort to develop new means of using CLI data to make better decisions about resource use. Together, these inter-related efforts seemed poised to accomplish much of what Hare had proposed undertaking. This was made possible by the use of computers. My analysis explores how resources management and regional inequality, longstanding themes in Canadian history, intersected with mid-twentieth century efforts by the Canadian state to explore the utility and potential of emerging computing technologies.

Both CLI and CGIS were fundamental components of the *Agricultural Rehabilitation and Development Act*, federal-government legislation that, when passed in 1961, was designed to help stabilize agriculture and resource industries as Canada made what policy-makers saw as “a relatively abrupt transition from a primarily agricultural economy to a primarily urban-industrial economy.”<sup>2</sup> ARDA operated as umbrella legislation designed to facilitate programs jointly-funded with the provinces addressing a diverse array of agriculture or resource-related challenges, chief among them unproductive farms and inefficient or inappropriate land use. The legislation was conceived amid interest on the part of governments, both federal and provincial, in reducing inequalities between regions and across economic sectors.<sup>3</sup> ARDA's broad scope was underlined when a 1966 amendment renamed it the *Agricultural and Rural Development Act*, making explicit its relevance to non-farming rural areas.<sup>4</sup> In both original and revised forms, ARDA reflected the federal government's conviction that problems of rural development and regional inequality could be addressed by managing natural resources more effectively, in a manner frequently described as rational.

CLI and CGIS were among the few aspects of the ARDA program that remained directly under federal auspices.<sup>5</sup> Most ARDA initiatives derived from efforts by provinces and agencies to seek federal money in support of suitable programs. This helps explain the multivalent nature of the development imperative as it operated in mid-twentieth century Canada, at least until Ottawa's 1969 creation of the Department of Regional Economic Expansion, which promised to bring greater coherence to development efforts.<sup>6</sup> Also, ARDA operated alongside and in relation to government-led, 1960s-era community development programs aimed specifically at Indigenous peoples living in territory claimed by the Canadian state.<sup>7</sup> Historians of Canada have engaged with development in various ways, with some presenting it as a factor within ongoing historical processes and some taking one of its various forms as a focus of analysis.<sup>8</sup> More

research is necessary before we will adequately understand how development, as an ideology and a practice, emerged and operated in Canada. This research should probe the links between manifestations of development within Canada and their international analogs, contextualizing domestic processes in relation to imperatives of global significance in the period after the Second World War.<sup>9</sup> As reflected in the federal government's approach to ARDA, development involved deliberate, government-led efforts to change human behavior, and especially behavior related to natural-resources use, thought by proponents to lead to improved outcomes in line with urban-industrial modernity.<sup>10</sup> Importantly, this conception of modernity, development's implied endpoint, was narrow. The development imperative animating mid-twentieth century federal-government policy was fueled by the presumption that the lifestyles believed to characterize prosperous urbanized and industrialized areas were good for everyone and desired by most, and that those who did not seek them needed assistance in adjusting their aspirations.

While it was F. Kenneth Hare's 1954 call that most clearly anticipated CLI and CGIS, both these and the ARDA legislation that enabled them had other important antecedents. In scope and ambition, one of ARDA's key forerunners was the Commission of Conservation, a federal-government body operating between 1909 and 1921 that aimed to increase support and capacity for what was seen as efficient administration and use of natural resources.<sup>11</sup> In the CLI's orientation to inventory, important antecedents are found in earlier efforts to classify soils and, more broadly, lands according to their most suitable uses.<sup>12</sup> In setting the stage for CLI and CGIS, the Resources for Tomorrow Conference of 1961 was particularly significant because it demonstrated broad support for federal-government leadership in enhancing the availability, quality, and accessibility of environmental information.<sup>13</sup> At least since the 1959 publication of Samuel Hays' *Conservation and the Gospel of Efficiency*, an influential analysis of the American progressive conservation movement, historians and allied scholars on both sides of the Canadian-American border have analyzed the various ways governments have sought to improve their management of natural resources.<sup>14</sup> My analysis builds on this existing work by exploring the relation between natural-resources management and mid-twentieth century advances in computer technology, an intersection that has not received much scholarly attention.<sup>15</sup>

Examining the Canadian government's efforts to develop CLI and CGIS offers an opportunity to consider resources management as a dynamic process with consequences for both natural resources and the state. James C. Scott's *Seeing Like a State* has influenced many historians of Canada, with numerous scholars drawing on Scott's notion of high modernism in explaining the ideology behind massive state-led projects of human and environmental change.<sup>16</sup> Scholars invoking high modernism often attend in some way to a process Scott termed the production of legibility, the construction of forms of knowledge facilitating state administrative functions. As Scott explains, much of his thinking around

techniques of legibility drew on earlier work by Benedict Anderson. Anderson's *Imagined Communities* focused on the rise of nationalism and the nation-state as historical phenomena, with the management of territory and population a key means through which nations consolidated their authority.<sup>17</sup> Because of differences in analytic purpose, these two important scholars focused on different aspects of the techniques of legibility they both considered. Scott was more concerned with what the state could do with these techniques, while Anderson was more interested in how these techniques helped consolidate the state. In my analysis of CLI and CGIS, I address both angles, considering how these technologies, in prospect and in realization, had consequences for natural-resources management and for the state doing the managing.

Legibility was at the core of a recent piece by Canadian historian Tina Loo arguing for the value of seeing synoptically, of sacrificing detail and complexity to highlight a particular scale of analysis. As Loo sees it, this way of seeing is often dismissed as “imperial, encompassing, reductive vision” without due consideration of its advantages and perhaps its inevitability, at least when confronting large quantities of information.<sup>18</sup> Scholars who both write and read abstracts of academic articles (otherwise known as synopses) possess some familiarity with the advantages and disadvantages of the synoptic. Rather than either condemning or defending the synoptic, in this paper I consider the production and affordances of a particular synoptic perspective, one conceptualized as a key part of mid-twentieth century efforts to achieve rationality in resource management. Insofar as I attend not just to technological aspects but also to broader cultural contexts, my work is in line with what historian William Rankin has recently termed geo-epistemology: the study of the production and use of knowledge about the earth or parts of it.<sup>19</sup>

In the past few decades, scholars from various disciplines, including history, have made use of GIS as a means to display and analyze spatial information. While historians have used GIS to generate new insights on the past, as of yet few have turned their analytic gaze on the history of GIS itself or of its antecedents. It has been primarily within the discipline of geography that the development, evolution, and effects of GIS have been considered.<sup>20</sup> My analysis offers a historical perspective on the emergence of a GIS antecedent from within Canadian resource-management efforts. It resonates with the critical perspective on GIS evident in the work of scholars such as Matthew W. Wilson.<sup>21</sup> My analysis also contributes to a small body of recent scholarship probing the relations between geographical knowledge and the Canadian state.<sup>22</sup>

My paper develops as follows. I begin by exploring how the conceptual and technological innovations of CLI and CGIS inspired a new optimism among resource managers. I situate this optimism in relation to emergent trends within the social sciences, and especially within the discipline of geography. Then I consider how CLI fostered collaborative innovation that helped build relationships among people from a range of professional perspectives, particularly federal and provincial administrators and technical experts,

and scholars from the academic world. I also note historical concerns over the limitations of the synoptic perspective offered by the CLI. Finally, I explore efforts to develop CGIS as a robust technology that could store and manipulate information from the CLI and other sources to support rational resource management. I also explain how the challenges of developing CGIS served to temper initial optimism and complicate collaborative working relationships. Drawing on the historian's emphasis on change over time, I identify a key limitation of both CLI and CGIS in their privileging space over time. Ultimately, my most important argument relates to this limitation: CLI and CGIS, innovative tools intended to arm decision-makers with essential geographic information, registered neither the historical factors that created intractable resource-management problems nor the prospect that people living in Canada might maintain diverse ambitions for their futures. As a result, these new technologies worked to naturalize patterns of inequality and normalize urban-industrial modernity.

### **Innovation and optimism**

CLI and CGIS emerged out of the belief of federal-government administrators involved in ARDA that rational resource use depended on the availability of what they considered relevant and usable data. The problem was, at the time ARDA was passed, such information was not readily accessible to decision-makers. This was a particular type of information problem, one defined not by a dearth of information, but by an overwhelming abundance of ill-coordinated data-points. In any particular situation, how could decision-makers ever hope to have at hand the most appropriate bits? And even if they did, how could they efficiently integrate data pertaining to distinct geographic areas, expressed through different units of measurement, or contained on separate maps? In light of this information management problem, Canada remained to mid-1960s policy-makers an “unknown country”—one that was “unknown not only in the distant Arctic Archipelago, but even in the places where millions of Canadians make their homes and their livings.” Without reliable means for policy-makers to access relevant and usable information, decisions about resources use continued to be made, but, as ARDA administrators worried, there were few means of determining if these decisions reflected “the best things to do with our resources.”<sup>23</sup> Rational decision-making about natural-resources management simply was not possible.

The CLI was a key aspect of efforts to address this information problem. As a federally-led effort involving substantial participation from the provinces, the CLI was to standardize basic information about natural resources both across the nation and across resource sectors. The CLI was primarily an exercise in information consolidation, not information collection. Though fieldwork was required to verify accuracy and deal with data-thin areas, the major tasks were identifying existing data sources and extracting relevant information. This information was then used to create resource-specific maps—for instance, maps

of soils, wildlife, or forestry—indicating variation in resource quality across space. The result was a series of jigsaw-puzzle-like maps delineating more and less valuable areas of the particular natural resource under consideration.

This new inventory was promising, but ARDA officials worried that producing more information—even in a usefully standardized format—might actually serve to compound the existing information management problem. Computer technology seemed like one potential solution. Computers might expedite the work of manipulating information that was simply too time-consuming and labour-intensive to tackle manually. As noted in a mid-1960s report, there was at that date no suitable computer system yet in existence that could manage land-use information, but ARDA officials were optimistic the necessary technology could be developed.<sup>24</sup> And so an essential second aspect of this new effort at data processing was the CGIS, designed by computer experts purpose-hired by the federal civil service. At inception, CGIS represented an effort to harness computer technology to the CLI in a way that would permit easy retrieval of information and rapid integration of multiple maps and data sets, including those from non-CLI sources such as the Canadian census.<sup>25</sup>

By the early 1960s, Canada was, as John Vardalas has shown, among those nations scrambling to develop domestic civilian capacity for computer design and manufacturing.<sup>26</sup> Emphasizing the innovative character of Canada's mid-twentieth century computer industry, Vardalas positions his rendering as a counterpoint to those of economic nationalists, who have bolstered their critique of Canada's branch plant economy by underplaying domestic innovation. CGIS is an over-looked example that extends Vardalas' argument; moreover, it shows how the Canadian government sought to make legible Canada's landmass and natural resources through the development of new and innovative computerized data-management tools.<sup>27</sup>

If the prospect of cutting-edge technology was important in federal-government administrators' ambitions for CLI and CGIS, so were particular conceptions of the past and the present. Administrators framed the need for improved use of information in relation to a settlement period that was considered to have passed.<sup>28</sup> As those who worked on CLI and CGIS saw it, many of the problems confronting Canadians and policy-makers alike could be linked to how, during the settlement period, colonizers did not have or use accurate environmental information in making decisions about where and how to establish themselves. In the absence of a more historically-robust understanding of why colonization played out as it did, administrators asserted it was luck as much as anything else that was a key determinant of immediate and longer-term success in settlement. As federal administrators saw it, the situation was compounded over decades by government's "laissez faire" or "hands off" approach to resource management.<sup>29</sup> Those involved in the development of CGIS and CLI saw themselves as working to ensure that logic, not luck, underlay resource management across Canada and to position governments to take a more "hands-on" approach.<sup>30</sup> Such an effort was built



on the interventionist orientation of the Canadian federal government, fundamental to the development imperative that cohered in the aftermath of the Second World War.<sup>31</sup>

Government efforts to achieve rational resource management were in tune with concurrent developments in the academic realm. Canadian historians have noted shifts in scholarly inquiry from the late-nineteenth through the mid-twentieth centuries, with increased emphasis on “scientific principles and rigorous research.”<sup>32</sup> Scholars Roger E. Backhouse and Philippe Fontaine have argued that the period after the Second World War saw a significant reconfiguration of social-sciences inquiry, one characterized by increased emphasis on models and quantification by scholars keen to establish their “scientific credentials.”<sup>33</sup> For Canadian natural-resources managers concerned with the challenges of administering Canada’s vast landmass, among the most relevant of such reconfigurations took place in the academic discipline of geography. As R. C. Hodges, chief of the federal-government division responsible for ARDA, wrote in *The Cartographer*, the resource-management challenges of the Canadian state were defined by “spatial characteristics” as much as by “physical, economic, and social aspects.”<sup>34</sup> It was not just effective use of data but effective use of spatial data—the special province of geographers—that seemed poised to bring rational resource management into the realm of the achievable.

In 1962, F. Kenneth Hare organized a session on quantitative methods at the annual meeting of the Canadian Association of Geographers. One of the speakers was University of Toronto geographer Ian Burton, who would later rework his paper for publication in *The Canadian Geographer*. In this published paper Burton dubbed the reconfiguration within his discipline the quantitative revolution.<sup>35</sup> For some scholars swept up in the quantitative revolution or parallel transformations, emphasis on quantification and models was significant because it positioned academics to engage more effectively in the world of policy-making. According to Brian J. L. Berry, who was immersed in this disciplinary transformation, the quantitative revolution focused on “the application of the scientific method to geographic research and of geographic research to important issues of public policy.”<sup>36</sup> At the same moment when some geographers were looking to deploy new disciplinary approaches in service to the public, Canadian civil servants were grappling with a resources-management challenge they perceived as spatial in character. The alignment of interests between academic geography and state resource managers was inflected by how, as Trevor Barnes has shown, academic geography was still establishing itself in Canada in the years following the Second World War.<sup>37</sup> Indeed, the Canadian state’s interest in natural-resource development represented an opportunity for academic geographers to demonstrate the value of their skills, as Hare recognized in the episode that opened this article.<sup>38</sup>

In the immediate aftermath of the passing of the Agricultural Rehabilitation and Development Act in June 1961, work on the CLI began. A series of meetings

involving federal and provincial civil servants as well as representatives from universities and industry resulted in the establishment of some basic parameters.<sup>39</sup> In November 1962, a seminar on the proposed inventory took place in Ottawa. Participants representing various perspectives and from all regions of the country confirmed the need for a project of this sort. The participants also worked to finalize the range of environmental and cultural features the inventory would include: soil capability for agriculture, land capability for forestry, wildlife, recreation, present land use, socio-economic characteristics, and climatological considerations. The CLI was to address the areas of Canada perceived by organizers to be the most economically productive portion of the nation: “the southern, settled portions of Canada”, consisting of 260 million hectares, about 25% of the country.<sup>40</sup> In October 1963, the federal government formally confirmed it would move ahead with the CLI. Shortly after that, the Canadian Council of Resource Ministers, a recently-created body that brought together federal and provincial representatives, approved the plan.<sup>41</sup>

The CLI was understood as fundamental to ARDA’s goals. In the absence of such an initiative, it was feared a lack of basic information would mean that “programs of land adjustment and regional economic development” would be “fallible and costly.”<sup>42</sup> But moving ahead with the CLI presented its own difficulties. Publishing spatial information related to 260 million hectares of Canadian land at a useful scale would require many thousands of sheet maps. Parsing this information to support rational decision-making around resource use would more than redouble the task. For example, it was estimated that the data management and analysis necessary to determine how Canada’s dairy and beef industries could best be managed would take about 550 people working for three years and would cost about \$8,000,000.<sup>43</sup> And even if the time and money were available to support this work, Canada did not have appropriately skilled analysts in sufficient numbers. More challenging still were situations in which managers wanted to determine how best to use any particular parcel of land – whether for raising cattle, or growing trees, or developing parks, for instance. ARDA’s ambitious goals appeared achievable only because of the prospect of computer-supported analysis, “whereby quantities of data from both maps and statistical tables can be stored in a form which is amenable to analysis by electronic computers.”<sup>44</sup> Using CGIS, it was estimated that the required 1,650 person-year analysis of the Canadian dairy and beef industry could be accomplished in mere days.<sup>45</sup>

Together, CLI and CGIS represented federal government efforts at conceptual and technological innovation that, when linked, substantiated the transformative ambition envisioned by civil servants at the core of the ARDA program. As it was put in a 1966 document aimed at potential users, the goal of these two linked innovations was to “develop an information system an administrator could do everything with.”<sup>46</sup> Fundamental to these innovations was the role of “the high-speed electronic computer” in supporting decision-makers.<sup>47</sup> Just as railway technology was fundamental to the anticipated success

of Ottawa's National Policy of the late nineteenth century—a project that sought to establish the west as a resource hinterland and consumer market in service to the east's manufacturing industry—so was the computer essential for the realization of ARDA's goals around natural-resource management: “what the steam engine did for muscles, the electronic computer is beginning to do for brains.”<sup>48</sup> In both instances, from the perspective of those at work on CGIS, technology was fundamental to overcoming the challenges posed by Canada's vast geography.

CLI and CGIS emerged as innovative tools promising to rationalize the use of natural resources. The potential success of ARDA was seen to hinge on the development of synoptic-scale datasets summarizing key information from across the nation, as well as new methods of manipulating these datasets to make them useful in answering any number of resource-management questions. Civil servants involved in work on the CLI and CGIS perceived these linked undertakings as “essential for the most effective implementation of the ARDA program.”<sup>49</sup> Those working on CLI and CGIS were building on past government efforts at resource management and aligning their activities with trends in the social sciences in general and the discipline of geography in particular. Over a period of years, state-driven efforts at innovation resulted not only in the production of new maps and new technologies, but also in the renewal of optimism about the potential for rational management of Canada's natural resources.

### **The work of inventory**

Resource management in mid-twentieth century Canada was riven by at least two major fractures: the jurisdictional divisions between Ottawa and the provinces characteristic of Canadian federalism and the siloed administration typical of that era in natural-resources management, which saw different bureaucracies administering different resources. The work of the CLI involved a reconfiguration of these divisions sufficient to allow the inventory to proceed. The effort of producing a national inventory—a synopsis of Canadian resources—brought together civil servants who previously had little formal professional connection to each other. But modifying bureaucratic structures and relationships did not alter the magnitude of the task at hand. The work of producing a useful synopsis of Canadian natural resources foundered on the diverse environmental conditions of the vast mass of land under consideration. Further, some provincial civil servants were concerned about the CLI's failure to provide information on topics and at scales they perceived as necessary. Ultimately, even as the CLI emerged from a collaborative process, these provincial officials recognized the geo-epistemology embodied in the CLI reflected the perspectives and purposes of the Canadian federal government.

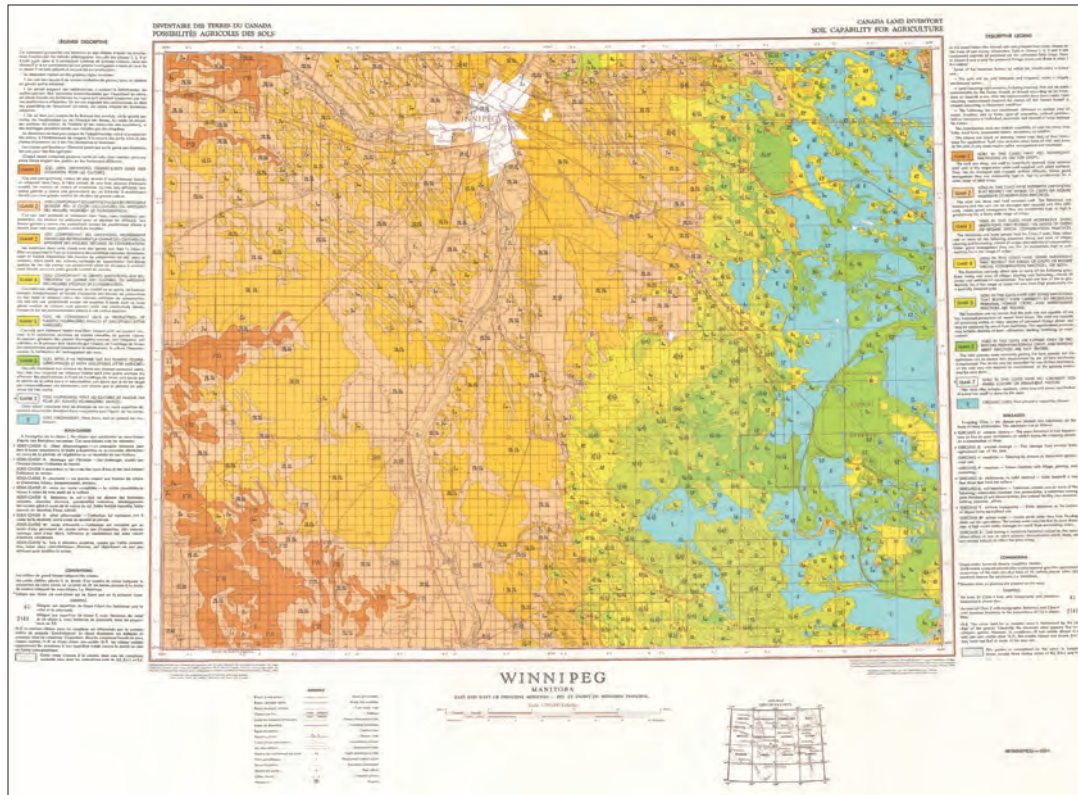
Considering ARDA's emphasis on agriculture and previous national soil survey work, it is unsurprising early progress on the CLI was most rapid with respect to soils. By spring 1963, even before the federal government's confirmation

of its intention to move ahead with the CLI, a system was developed for the classification of soil according to agricultural potential.<sup>50</sup> The classification system, developed in partnership with the federal-provincial Canada Soil Survey Committee, divided mineral soils into seven classes, with Class One being the most valuable for agricultural purposes and Class Seven being subject to the most severe limitations.<sup>51</sup> In general terms, classes one through three reflected soils of significant value for agricultural purposes (Figure 1). Thirteen sub-classes were developed to reflect the particular nature of the limitations to which some soils were subject, including for example salinity (indicated with an S), topography (T), and low fertility (F).<sup>52</sup> Using this system, a mid-quality soil subject to erosion might be indicated as 3E. By 1964, pilot efforts to create CLI maps were underway using this classification system.<sup>53</sup>

The soil classification system reflected elements that would be incorporated into other components of the CLI project. With respect to wildlife, recreation, and forestry, land would be divided into discrete units according to suitability for each particular purpose. These units would be irregularly shaped, reflecting the variability of the landscape. The result was the creation of a new set of maps, one that expressed not the geo-political borders characterizing the Canadian state, nor the private-property lines reflecting the imperatives of liberal capitalism, but rather a view of the landscape derived from the intersection between ecological characteristics on one hand and a specific method of resource use on the other. These new maps were highly useful for a variety of users; for the Canadian Wildlife Service, for example, the newly-available data “constituted a coherent body of information on wildlife habitat that far exceeded anything hitherto available in Canada.”<sup>54</sup>

The CLI addressed human as well as natural resources. It did so by incorporating census data such as income and educational attainment by geographical area. Analyzing this data at the national scale implied there should be some sort of relative equivalence in life experiences across the 25% of Canada’s landmass under consideration. From this perspective, it became noteworthy, for instance, that educational attainment in Manitoba was the lowest among the prairie provinces, on par with that of the maritime provinces.<sup>55</sup> In building a body of knowledge about its citizenry that was oriented to nationwide comparison, the federal government was conceptualizing as problems instances of deviation from apparent norms. Such problems could then be targeted through programs developed under the auspices of ARDA or complementary legislation.

Committees made up of representatives from federal and provincial governments, the academic sphere, and industry governed the CLI work. That the committees straddled federal and provincial governments was particularly significant within Canada’s federal system, in which jurisdiction over natural resources was a complicated and contentious matter.<sup>56</sup> Within the resources included in the CLI, migratory birds were a federal responsibility, for example, while agriculture was shared, and the provinces held jurisdiction over the rest.



**Figure 1:** This CLI map displays soil capability for agriculture for an area of southern Manitoba that includes the city of Winnipeg. In a manner typical of CLI soil maps, irregular parcels of land are labeled with numbers indicating agricultural potential and letters specifying particular limitations. Credit: “Canada Land Inventory (CLI): 1:250,000 and 1:125,000”, Agriculture and Agri-Food Canada, accessed 15 November 2017, <http://sis.agr.gc.ca/cansis/publications/maps/cli/250k/agr/index.html>

In this uneven jurisdictional terrain, the CLI represented a means through which the federal government could encourage improved resource management without treading on provincial toes. The arrangement was that the federal government paid for the inventory and the provincial governments conducted it for areas within their borders using categories developed nationally.<sup>57</sup> The assembled information would then be provided to the federal government, which was responsible for compiling and publishing it. During the five most intensive years of work on the CLI—from 1963 to 1968—over \$15 million was spent (amounting to slightly more than 5% of the ARDA budget for the years in question), with over \$11 million handed directly to the provinces.<sup>58</sup> Federal money and logistical support helped ensure the inventory moved ahead despite challenges derived from what one analyst called the “rather inelegant structuring of the Canadian federal system.”<sup>59</sup>

The CLI depended on the bridging of divides not only between Ottawa and the provinces, but also between bureaucracies oriented to the management of distinct natural resources. In the mid-twentieth century, the federal government included 18 different institutions with responsibilities for an environmental

feature considered to be a natural resource, with each institution operating independently of the others.<sup>60</sup> This division of responsibility meant natural resources were managed largely in isolation from each other, without any formal means for inter-agency coordination or collaboration. With provincial institutions brought into the picture, the challenges were magnified. Expanding on the basic parameters established during early meetings on the CLI required the formation of committees involving experts drawn from each of the key sectors to be surveyed, including, for example, soils, forestry, and wildlife.<sup>61</sup> As of 1965, representatives from 100 government agencies were involved in these committees, along with members from universities and private industry.<sup>62</sup> The bridging of divisions of various sorts became a fundamental aspect of the CLI effort. In fact, the integrative aspects of CLI work were so compelling they led to the development of a further inventory effort oriented to the “biological and physical” features of the environment “without reference to any particular land use.” What became known as the biophysical land classification system was in part an effort to shed the trappings of resource-specific efforts at environmental management, with recognition of the need for such a system emerging partly out of collaborative work on the CLI.<sup>63</sup>

The bridges that spanned jurisdictional and sectoral divides were made possible by the federal government’s financial support, but the bridges themselves were built out of professional relationships. Historian Perrin Selcer has recently explored the relationships developed during the mid-twentieth century international effort to produce a global soil map, arguing that these came to represent in themselves a resource of significance.<sup>64</sup> The situation was similar in Canada. The perceived value of the professional relationships that developed during CLI was reflected in how it prompted a federal effort to determine the viability of using “the federal-provincial relationships established under the Canada Land Inventory as a basis for co-operative programs in areas in which there is an environmental concern and to encourage good land use practices.”<sup>65</sup> This effort followed up on the resolution passed by the Canadian Council on Resource Ministers some two years earlier, commending the co-operative approach taken with the CLI.<sup>66</sup>

But while professional relationships bridged jurisdictional and sectoral divides, the sheer scale of Canada’s geographic variation strained the CLI’s national framework, even despite the exclusion of the distinct landscapes of the north. With respect to forested lands, none of the prairie provinces had any areas that qualified as Class 1 or 2, and Quebec and the maritime provinces lacked any Class 1. In this context, Class 3 forested lands assumed a regional importance on the prairies they would not have had elsewhere in the country, reflecting how technically-correct national classifications could fail to capture local significance.<sup>67</sup> Manitoba ended up re-scaling the forestry classification for that province’s pilot land-use planning project.<sup>68</sup> With respect to soils, it was clear early on that even soils within a single class varied substantially in terms of productivity. Barley yields on CLI Class 2 land from Alberta provide an example

of this. In the central region of the province, such land would produce only 72% of what it would produce in the south; in the northern region, it would produce only 62% of this.<sup>69</sup> As the CLI soil survey developed, it became clear the survey would offer less an assessment oriented to the scale of the nation-state and more an analysis of “the comparative capability of lands in local areas for agriculture of the types adapted to the districts concerned.”<sup>70</sup> By 1976, it was recognized that the CLI’s classifications, though “standardized nationally”, amounted to “a comparable series of regional ratings.”<sup>71</sup> All of this reflected an enduring tension between the large geographic area being addressed and the classification system being deployed. Even in an effort aimed at a national inventory, the geographic diversity entailed in Canada’s vast expanse made it hard to avoid a regional framework.

While ARDA staff found in CLI and CGIS reason for optimism in resource management, this optimism proved at times hard to maintain. In November 1964, L. E. Pratt, Chief of the Canada Land Inventory, opened meetings of provincial representatives by noting the federal government was “very gratified by the provincial response” to early CLI work.<sup>72</sup> Indeed, the written record of the discussions that took place at the 1964 meetings confirm that provincial views were generally positive at this early stage. By May 1970, when R. J. McCormack, a successor of Pratt’s in the role of CLI Chief, authored a report on progress, more nuance was apparent. In a section titled “comments on inadequacies of CLI,” commentators voiced their complaints. Some were of the sort that could be relatively easily addressed: greater effort to generate public awareness and adoption of more effective map colour schemes, for instance. But a commentator from British Columbia offered a more penetrating observation. As they saw it, a “major inadequacy is the scale and detail of the inventory for many uses,” with the implication that more detail would make for a more useful tool. In responding to this critique, McCormack echoed further comments from the critic suggesting such inadequacy could perhaps be excused as an acceptable sacrifice given the national scope of the inventory. McCormack concluded by acknowledging that, acceptable or not, such inadequacies “should not be overlooked in the use of the data and should be pointed out.”<sup>73</sup>

It was precisely the issue of understanding and working within the limitations of the data that concerned E. A. Poyser, Manitoba’s ARDA co-ordinator who had additional responsibilities related to Indigenous peoples in that province. Confronted with the 1966 suggestion that civil servants and Indigenous leaders work together to ensure effective application of the CLI to reserve lands, Poyser pushed back. He felt quite clearly that the CLI would offer very little to support Indigenous peoples or government officials in “making any decisions about the development of Indian lands.” As Poyser saw it, the sort of information necessary for improved policy-making (which, as Poyser saw it, included data pertaining to “markets, financial requirements, management requirements, labour availability” as well as information about “the preferences and likings of the Indian people”) would not be captured in the synopses generated through

the CLI. Considering what he perceived as the limitations of CLI data in terms of both type and scale, Poyser worried that enthusiasm for the CLI might result in “well intentioned, but useless delay” in “the matter of improvement of wellbeing of Indian-Metis.”<sup>74</sup> Unlike McCormack, Poyser did not see missing information as an acceptable sacrifice, but one with real potential for harm. Poyser’s misgivings bear out what Hugh Shewell has characterized as conflicts within governments erupting around mid-1960s efforts to bring development programs to bear on Indigenous peoples.<sup>75</sup>

From a contemporary perspective, it seems clear how, under the guise of an objective inventory, the CLI served to privilege the perspectives of the colonial state. The summary report for the recreation inventory noted the abundance of historic sites of potential tourist interest in eastern Canada and the comparative paucity of such sites in the west.<sup>76</sup> In the absence of any recognition of the cultural landscapes produced by Indigenous peoples, the nation’s western expanse seemed to lack historical depth. While the soils inventory came to be recognized as a set of rankings that had to make local sense, the assumption persisted that historical value could be assessed on a national basis and by agents of the colonial state. The CLI also failed to accommodate resource uses that operated in terms of subsistence needs, rather than market exchanges or recreational opportunities. Consistent with earlier state practices, the inventories pertaining to wildlife and waterfowl addressed these as significant for the leisure opportunities they presented, not the subsistence needs they fulfilled.<sup>77</sup> Ultimately, as most evident in its inventories of recreational, wildlife, and waterfowl resources, the CLI operated not only in descriptive but also in prescriptive terms, privileging colonial landscapes and market-based ways of interacting with natural resources.

By the 1970s, the CLI was being used extensively by both public and private agencies in a variety of manners. W. A. Benson, co-ordinating chair of the CLI in BC, noted that “asking how Canada Land Inventory information will be used is parallel to asking the originator of the wheel, the screw and the inclined plane what effects their invention would have.”<sup>78</sup> From a historical perspective, the significance of the CLI derived not just from its finished form, but also from the process of its development. Through the work of developing the inventory, professional networks proliferated nationally, spanning divides related to jurisdiction and sector that often served to complicate natural-resources management in Canada. By 1981, roughly five years after its completion, CLI data was being used by 79% of provincial land management entities.<sup>79</sup> But even as these usage rates suggest a successful undertaking, there were concerns that CLI’s synoptic national vision foundered on the diversity of the Canadian landmass. Some provincial representatives worried about the information that went uncaptured at the CLI’s scale of operation. And others felt that time and resources devoted to the CLI might detract from more meaningful efforts to help communities, with such concerns suggesting how the federal state’s national goals ultimately trumped local needs in the CLI’s design.



## The prospect of the digital

CLI's ambitious vision gained traction when it became the incubator for a critical piece of technological infrastructure: the Canada Geographic Information System (CGIS). For those working within ARDA, CGIS made rationality in resource management seem not just desirable, but also achievable. CGIS was the result of a chance meeting in 1962 between Roger Tomlinson and L. E. Pratt, who had recently become the head of CLI.<sup>80</sup> Tomlinson (1933-2014), the key architect of CGIS, had trained as a geographer in Britain and Canada before taking up a position with Spartan Air Services in Ottawa. Spartan was a Canadian commercial-aviation firm established in 1946 that conducted air-survey work on contract for the federal and provincial governments.<sup>81</sup> As Tomlinson tells it, frustration within Spartan at inconsistencies among provinces in the classification of forest resources prompted the firm to investigate the possibility of mapping individual tree species and then using an overlay technique to generate species groupings as needed. Using traditional technologies, the costs were prohibitively high.<sup>82</sup> But Tomlinson and his team wondered if a digital approach might change the economics by solving a key problem with paper maps: the difficulties of combining and recombining large quantities of detailed information.

In his role as CLI head, Pratt recognized the difficulties of managing the large quantity of spatial information that CLI was to generate and was keen to learn about Spartan Air Services' efforts to address this challenge. Soon after they connected, Pratt invited Tomlinson to make a presentation to CLI developers that argued for the use of digital techniques in managing CLI data.<sup>83</sup> In his presentation, Tomlinson made the case for investigating "the extent to which computer mapping is applicable to the problems of the Agricultural Rehabilitation and Development Administration."<sup>84</sup> The presentation was well received: Tomlinson was hired on by the federal government and work on CGIS began in earnest.

Those involved in the early years of CGIS conceptualized the technology as consisting of three key components. The first was the system of input and editing, which enabled the incorporation of data. The second involved data manipulation, which involved data management and processing so as to ensure any set of data could be brought into relationship with another. The third system pertained to data output and display. It was to ensure necessary data could be retrieved rapidly and in a useful form. Each system presented its own challenges. Efforts to meet these challenges involved collaboration between the public and private sectors. Spartan Air Services, Tomlinson's former employer, continued working on related contracts through 1967.<sup>85</sup> Tomlinson also built a fruitful relationship with International Business Machines (IBM). The CGIS system was originally designed to work on an IBM S/360 model 50, with 512K bytes of storage.<sup>86</sup> The 360 series was IBM's first offering of computers that ran standard software across varied model sizes, and represented a powerful effort to dominate the computer market.<sup>87</sup> IBM's track-record of innovation



**Figure 2:** This scanner was developed by International Business Machines (IBM) for the Canada Land Inventory. It converted graphic information to digital format, an essential step in relation to the Canada Geographic Information System. The scanner is now part of the Ingenium (Canada's Museums of Science and Innovation) collection. IBM Scanner, 1963, Artifact No. 1986.0821

was also evident in relation to the CGIS project. An early assessment of the technological feasibility of CGIS warned there was not “any existing instrument suitable for directly reading map data into computer storage.”<sup>88</sup> In the mid-1960s, IBM designed a digital map scanner for the CGIS project, based in part on work they had already been doing on similar issues.<sup>89</sup> The scanner, the first ever to be made and used, was operational from 1967 to the early 1980s, and is now preserved in the Canada Science and Technology Museum’s computing collection (Figure 2).<sup>90</sup>

CGIS harnessed these new digital technologies to transform static maps into dynamic ones that allowed users to ask new questions of data and more easily derive meaningful answers. The most renowned capacity of CGIS was the layering of information. This digital operation was equivalent to the analog process of “placing several maps transcribed on transparent material one on top of the other on a light table.”<sup>91</sup> Layering separate maps would allow users to readily generate useful information. For example, combining data from maps documenting agricultural capability and current land use would make it possible to easily locate “the high capability agricultural land that is not in agricultural use.”<sup>92</sup> The product of layering has been termed a layer cake, a

phrasing that, though facetious, expresses how the end product was intended to represent something greater than the sum of each component overlay.<sup>93</sup>

Other key capabilities of CGIS included connecting small maps to encompass a larger area (termed linkage by developers because of how it involved linking maps together) and combining distinct areas within maps to permit new types of analysis using simplified data (termed dissolve because of how it involved dissolving borders to facilitate aggregate analysis).<sup>94</sup> Together, these two functions allowed for the creation of a region-wide, province-wide, or nation-wide database that could be analyzed in a variety of ways. The utility of this database was heightened through the use of an analytical function described by developers as a cookie cutter, an analogy that conveyed the system's capacity to introduce new units of analysis.<sup>95</sup> The cookie cutter could be shaped in a variety of ways: in reflection of, for instance, the borders of a national park, the radius around a city, or the extent of acid rain deposition. Neither layering, nor linking, nor dissolving were new functions; they had long been possible through laborious hand methods. But the sheer time and expense of such analyses limited the extent to which they were undertaken.

If CGIS emerged in part out of federal-government collaboration with the private sector, connections to academic geography were also significant. In the mid 1960s, the Canadian federal government tapped geographer Brian J. L. Berry, then a professor at the University of Chicago and a key figure in geography's quantitative revolution, to assess the proposed Canada Geographic Information System. As he put it in his laudatory assessment (underlining in original):

It is not so much a question of whether the proposed system is better than the alternatives considered, or is the best available. It is the only system which will enable the Canada Land Inventory to achieve its objectives satisfactorily!<sup>96</sup>

Berry's assessment must have been read by Canadian officials as a rousing academic endorsement. To the extent that CGIS aligned with the concerns of professional geographers, the effort gained legitimacy and prestige from its parallels in the academic world. This buttressed the optimism of state resource managers. Berry was similarly emphatic when commenting on the project's academic significance, arguing that CGIS "can only have a healthy impact on the development and nature of Geography as a science, not only in Canada, but also throughout the world."<sup>97</sup>

Between 1963 and 1968, 30% of federal spending on CLI was dedicated to CGIS, amounting to approximately \$1,180,000.<sup>98</sup> By 1968, the initial phase of developing CGIS was completed.<sup>99</sup> That year also saw the first use of the term 'GIS' in published material.<sup>100</sup> Heralding these milestones was an effort to build awareness and understanding about CGIS. These efforts included seminars that introduced the system to potential users and a 1968 National Film Board offering titled "Data for Decision".<sup>101</sup> This film demonstrated visually the challenges in information management that led to CGIS's development. The narrator earnestly described how CGIS functioned, contextualizing it in relation

to the federal government's efforts to address rural development challenges. One extended sequence featured a resource manager parsing a tricky land-management conundrum through collaboration with a CGIS expert who was able to rapidly produce the necessary data. In the end, the problem is better understood, and the manager is positioned to develop an innovative solution (Figure 3).

In retrospect, such outreach efforts were premature. CGIS was not yet able to service the demand that proponents were working so hard to generate. From 1968 through the early 1970s, CGIS experienced what some have termed serious teething problems.<sup>102</sup> A key difficulty stemmed from the simple reality that a system that was functional did not amount to one that was ready to use: even as developers celebrated their achievement, the time-consuming process of entering CLI data was far from complete. By the early 1970s, provincial officials associated with the CLI were expressing dismay at how long it was taking to come up with a usable tool.<sup>103</sup> Even once the system was partially operational, users were not always pleased with what they found. While the original plan had been to include data at the 1:50,000 scale, CLI managers adopted the less detailed 1:250,000 scale because of time and cost concerns,<sup>104</sup> despite demands from provincial civil servants for detailed maps that could support local environmental management.<sup>105</sup> While perhaps sensible from the perspective of the federal government, with its interest in broad long-term resource strategy and its responsibility for project finances, the adoption of the less detailed approach demonstrated how collaboration in resource management remained bounded by time and money.

Problems also ensued from the awkward intersection between CLI and CGIS, two innovations that had been conceptualized in relation to each other but developed through distinct processes. CGIS had the unintended effect of exposing flaws in the CLI data. As Canadian-government administrators recognized, work on the CLI was "a combination of art and science."<sup>106</sup> The CGIS function of linkage, which joined small maps, exposed inconsistencies in CLI data by showing how a single geographical area divided between two mapping efforts could be assessed differently. Such inconsistencies were attributed to the CLI's reliance on student labour and diverse sources of data.<sup>107</sup> Even disregarding worries about the quality of CLI data, the intersection between CLI and CGIS was still a cause of concern. The precisely located lines that characterized CGIS outputs were inconsistent with the gradual transitions that marked changes in the natural resources assessed through CLI. As William Warren argued in his study of the matter, CGIS represented a too-precise locating of the rough-cut data generated by CLI.<sup>108</sup>

These various concerns, though perhaps only to be expected considering the groundbreaking nature of both CLI and CGIS, made it more difficult for civil servants to maintain the optimistic belief that these innovations would make rational resource management readily achievable. Indeed, some viewed CGIS as "the greatest disappointment" of the entire suite of activities associated with



**Figure 3:** These images are stills from the 1968 film about the Canada Geographic Information System [CGIS] titled “Data for Decision.” The top and bottom images illustrate the challenges with storing and analyzing available data pertaining to natural and human resources. The middle image on the left shows a stylized human eye at the top and a series of transparent maps below, dramatizes the layering function of CGIS. The middle image on the right shows a manager consulting CGIS-generated data in developing an innovative solution to a resource-management problem. The film can be viewed online via the National Film Board website: [https://www.nfb.ca/film/data\\_for\\_decision/](https://www.nfb.ca/film/data_for_decision/) Credit: Data for Decision ©1968 National Film Board of Canada. All rights reserved.

ARDA, a remarkable perspective given that CGIS is now widely considered a notable technological innovation.<sup>109</sup> In retrospect, disappointment was perhaps inevitable given how proponents vested CGIS with the overreaching ambition embedded within ARDA: that rational management would solve perceived problems of rural development and regional inequality. The potential for disappointment was heightened by how, in their efforts to gain support for their innovative undertakings, advocates of CGIS constructed a direct link between their work and better decisions. They framed intractable problems of resource management as easily resolvable through use of CGIS's efficient and effective techniques of data management. That framing is evident in 'Data for Decision-Makers,' a 1967 document that claimed CGIS would "give to those who make decisions affecting our nation's resources, an information system with which they could achieve almost anything."<sup>110</sup> As the ambition embedded in the ARDA programme was linked to CLI and CGIS, so these innovations were sometimes taken as promised solutions to the problems ARDA was to address. Those directly involved in developing CGIS, however, were clearer about their work; they recognized they sought to produce better information to support—not replace—the decision-making process, that "[w]here computation finishes, interpretation and evaluation begins."<sup>111</sup> But for those who had been sold on CGIS as the solution to complex resource-management problems, the limitations of CGIS were less clear. In this context, even when it functioned as designed, CGIS could seem like a failure because of the persistence of the resource-management problems that spurred its development.

Ultimately, CLI and CGIS were unlikely to position decision-makers to effectively address the problems of rural inequality and resource degradation targeted by ARDA because neither accounted for the historical processes through which inequality and degradation operated. As political scientist Janine Brodie has made clear, inequality is produced through processes that accumulate over time.<sup>112</sup> Drawing on scholars like Harold Innis and Vernon Fowke who explain regional inequality as a product of political and economic decision-making, Brodie emphasized the necessity of considering history as well as geography in making sense of the uneven nature of outcomes across Canada. Regional inequality was a spatial problem, as ARDA chief R. C. Hodges wrote in 1965. But it was also a temporal problem, one with historical dimensions that required consideration. While historians, historical geographers, and scholars in allied fields have in recent years used GIS as a tool to analyze change over both time and space, in inception both CLI and CGIS privileged space over time.<sup>113</sup> The failure to reckon with the consequences for Indigenous peoples of historical and ongoing processes of settler colonialism was a particularly egregious omission, but as Janine Brodie's work makes clear, patterns of disadvantage evident across places like the Maritimes and the Prairies have their own histories that bear consideration. The very innovations fueling the optimism of ARDA proponents were designed to illuminate spatial variation, but not to shed light on the historical circumstances contributing to differential outcomes.

What contemporary historians might see as a shortcoming of CLI and CGIS reflected parallels between the perspective of those involved in developing CLI and CGIS and those of scholars in the field of quantitative geography. Geographer Trevor J. Barnes has argued that geographers associated with the quantitative revolution deployed a “God’s-eye view”, not perceiving, as have many later geographers, that “who you are and have been affects what you know and tell others.”<sup>114</sup> When deployed by Canada’s federal government in the 1960s and 1970s, the “God’s-eye view” failed not only to encompass the historical processes that created patterns of inequality, but also to accommodate the perspectives of those with different ambitions for the future. Modernity as conceptualized within ARDA was narrowly defined in a manner that reflected urban-industrial needs and lifestyles. Recognizing this, it is possible to more fully comprehend the concerns of Manitoba ARDA co-ordinator E. A. Poyser, who worried about how CLI might affect efforts to support Indigenous peoples. As Poyser explained to CLI proponents in 1966, it was difficult to imagine how CLI could effectively engage with “the preferences and likings of the Indian people” without considering their community histories or their ambitions for the future, dimensions that the CLI neither reflected nor measured.

As umbrella legislation intended to facilitate jointly funded and provincially-led rural development programs, ARDA’s influence was felt across Canada. From fisheries modernization in Newfoundland and ski development in Quebec to water management in Saskatchewan, ARDA funds flowed in diverse avenues through the 1960s across a broad swath of the Canadian nation.<sup>115</sup> Further research is necessary to understand the historical significance of these efforts, individually or in sum. Considering that CLI and CGIS were fundamental to the ARDA program, understanding how these two innovations privileged space over time positions us to better appreciate aspects of the mid-twentieth century development imperative reflected in ARDA. This was rural development oriented to eliminating—not to understanding or accommodating—modernity’s unevenness.

Challenges and limitations aside, by 1971 so-called teething problems had resolved sufficiently to permit the declaration that CGIS was the world’s first fully operational GIS. It is at this point that the system entered full-scale operation, serving clients within and beyond government.<sup>116</sup> That same year saw a major reconfiguration of the federal bureaucracy that managed CLI and CGIS. In May 1971, responsibility for CLI moved from the Department of Regional Economic Expansion to the Department of Fisheries and Forestry, in advance of the anticipated creation of a Department of the Environment. Amid shifting bureaucratic structures, the federal government sought to alter funding for any successor initiatives. New programs would be distinguished by at least one key factor: they would be cost-shared between the federal government and the provinces.<sup>117</sup> Through the late 1970s, CGIS projects depended increasingly on the user-pay principle, reflecting growing fiscal restraint by the federal government.<sup>118</sup> By this point, the optimism that had surrounded the CGIS effort had largely dissipated. In the early 1980s, privatization and cost-

cutting ultimately led to the shuttering of the CGIS project within the federal government.

By this point, Roger Tomlinson had left the federal government, in part to pursue his ambition of developing “a globally consistent logical schema for the organization of earth data from many areas in a form viable for nearly all users.”<sup>119</sup> In 1980, the Province of Saskatchewan hired him to investigate the value of computer systems such as CGIS in relation to the province’s particular resource-management needs. In the end, Tomlinson determined that none of the existing systems were yet sufficiently advanced to be of real benefit to the province.<sup>120</sup> Just a few years earlier, advocates had declared that CGIS was “the largest and most technically sophisticated system for handling land data in existence today.”<sup>121</sup> But by the early 1980s, CGIS occupied an ambiguous position: even as it was recognized internationally as a notable innovation, it was inadequately supported by the government that funded it and deemed insufficiently advanced by the man most directly responsible for its creation.

### Conclusion

In *Imagined Communities*, Benedict Anderson considers how nation-states established their sovereignty, whether in territorial or cultural terms. Among the tactics Anderson examines is map-making, which he understands as part of the state’s “totalizing classificatory grid.” For Anderson, this grid functioned not just as a tool to facilitate administration but also as a technique of political legitimization, something that “could be applied with endless flexibility to anything under the state’s real or contemplated control.”<sup>122</sup> CLI and CGIS embellished and extended Canada’s “classificatory grid”: together, they generated a series of jigsaw-puzzle-like overlays describing particular environmental features and uses, with these overlays made manipulable through new computer technology. And just as traditional maps spoke to legitimacy, so did CLI and CGIS. If a grid map functioned as a tool of political power, CLI and CGIS legitimized this power in environmental and technological terms, terms that were increasingly resonant in the mid-twentieth century.

CLI and CGIS projected a vision of natural-resources management in Canada. In prospect and realization, they also affected the Canadian state. At the outset of ARDA, CLI and CGIS helped sustain the belief that rationality in resource management was eminently achievable, despite the recognized magnitude of the task. Optimism was bolstered by alignment between the resource-management efforts of the Canadian government and shifts in the academic world, particularly in the discipline of geography. Establishing better data and better technology was believed to hold transformative potential among Canadian resource managers as among academic geographers. CLI and CGIS were built through new professional relationships that extended across governments both federal and provincial, private industry, and the academic world. These relationships also bridged differences of perspective related to jurisdictional divisions and resource sectors. To those involved in CLI’s development, the structure of Canadian federalism and the siloed nature



of natural-resources management made the project “a daring and formidable task!”<sup>123</sup> To those focused on CGIS, the challenges were different but no less daunting at a time when it was still commonplace for Canadians to wonder if computers could be trusted.<sup>124</sup>

Despite various twists and turns, both CLI and CGIS outlived ARDA, the legislation that prompted their development. By the 1970s, the CLI had found a community of users among resource-management professionals. A decade later, CGIS successor efforts were shuttered by the federal government, even as CGIS itself gained renown as a notable technological innovation. Today, scholars and practitioners of various disciplinary or professional persuasions regularly employ GIS in analyses that account for both space and time, and also engage in lively debates over the opportunities and challenges of GIS-driven work.<sup>125</sup> Further, some Indigenous peoples and communities have adopted GIS technologies as a means of recording their historical and contemporary patterns of engagement with lands and resources.<sup>126</sup>

Over a period of decades, both CLI and CGIS have taken on significance beyond the parameters of Canadian rural development and resource management. It is these contexts, however, that explain the origins of these innovations. In turn, the affordances of CLI and CGIS—what was included in and left out of the synoptic perspective they offered—speak to rural development in Canada under the auspices of ARDA. As part of a rural development program oriented to rational resource management, CLI and CGIS were to help expose what federal-government policy-makers saw as failures of development, insofar as these occurred within the southerly landscapes that CLI included. In part through the creation of CLI and CGIS, failures of development were recast as problems that could be solved by the state, through policies and practices that were to help lagging rural areas catch up with urban-industrial modernity.

Tina Loo’s recent argument for a reconsideration of the synoptic scale is constructed in relation to successes in the field of wildlife conservation made possible, at least in part, by “seeing synoptically.”<sup>127</sup> Using the synoptic scale responsibly, as Loo clearly favours, demands that we reckon with the ways antecedents of contemporary synoptic tools incorporated the purposes of their producers. Or, to incorporate William Rankin’s terminology, that we seek to understand the particular geo-epistemology at play. CLI and CGIS offered perspectives locked on their moment of creation, making it possible to detect deviation from a national standard but failing to incorporate explanations of different pasts or to accommodate the prospect of local ambitions inconsistent with the urban-industrial ideal—or to elaborate on the role of state policies and practices in producing patterns of inequality. CLI and CGIS were transformative accomplishments with respect to resource management and computer technology. At the same time, CLI and CGIS contributed to naturalizing patterns of inequality the state had participated in creating and normalizing urban-industrial modernity as the goal to which all regions and communities should aspire.

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## The Global Repercussions of the 1947 Symposium on Fish Populations in Toronto: Scientific Networks and the Over-fishing Question

Jennifer Hubbard

**Abstract:** *A relatively small, contentious, and long-forgotten meeting, the 1947 Symposium on Fish Populations, had enormous and decades-long repercussions for global fisheries policies. Convened in Toronto by Archibald Gowanlock Huntsman, former director of the Atlantic Biological Station, it drew together leading North American fisheries biologists and professional fishermen. By exposing the lack of agreement on, or understanding of, the nature of overfishing, this meeting made it difficult for later scientists to challenge pro-industry fisheries policies. The published proceedings, in-demand by a tight network of fisheries scientists across North America and the North Atlantic, guaranteed this meeting's disproportionate and unfortunate impact.*

**Résumé :** *Une réunion relativement petite, controversée et oubliée depuis longtemps, le Symposium de 1947 sur les populations de poissons, a eu des répercussions énormes durant des décennies sur la politique mondiale de la pêche. Organisé à Toronto par Archibald Gowanlock Huntsman, ancien directeur de la Station biologique de l'Atlantique, il a réuni des biologistes des pêches et des pêcheurs professionnels de premier plan en Amérique du Nord. En exposant le manque d'accord ou de compréhension sur la nature de la surpêche, cette réunion a rendu difficile pour les générations de scientifiques suivants de défier les politiques de pêche proindustrie. Les procédures publiées, en demande par un réseau serré de scientifiques halieutiques en Amérique du Nord et dans l'Atlantique Nord, ont garanti l'impact disproportionné et malheureux de cette réunion.*

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**Keywords:** A.G. Huntsman, fisheries, overfishing, fish populations, MSY

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TWO SCHOLARS HAVE RECENTLY OBSERVED that “Science is never just about science”, and “Fishing has always been about more than just catching fish”.<sup>1</sup> It follows from Ted Binnema’s and Carmel Finley’s expositions of the political dimensions of science and resource management, that fisheries science is particularly messy, affected by multiple agendas and external contingencies. Indeed, Finley argues that American geopolitical policies used loosely constructed ideals in fisheries biology to influence international scientific management policies, while warping the fisheries economy through massive shipbuilding subsidies to assist client states like Japan. In turn, this led to other nations ramping up subsidies for industrialized fisheries. At the 1955 UN International Technical Conference on the Conservation of the Living Resources of the Sea, the US diplomatic agenda, not science, became the foundation of the dominant post-war ‘paradigm’ of fisheries management.<sup>2</sup> This paradigm upheld exploiting fisheries at the highest possible—and yet supposedly sustainable—levels, to

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generate a 'Maximum Sustainable Yield' (MSY).<sup>3</sup> MSY in theory justified catching the maximum possible annual catch for each commercial fish population that would ensure that the fishery could be sustained at a similar high level in the future.

While in practice it was impossible to determine a sustainable maximum catch without actually exceeding that level—measurable after the fact by falling fish catches—American fisheries biologists apparently shared a conviction that MSY was scientific and achievable, and swayed other nations' scientists to their views. However, Finley's argument, that American policies were foundational for globalized overfishing and shambolic 'conservation' measures, should not allow other nations' scientists and policy-shapers off the hook. Ideas and ideals such as MSY cannot gain ground without an existing receptive intellectual milieu. In the case of MSY, that milieu was developed by a small, but highly influential, international network of British, Scandinavian, Canadian, and US scientific experts. It flourished in post-Second World War conditions, which embedded fisheries policies within the greater framework of industrialized resource extraction that marked the international race for modernity amongst developed nations.<sup>4</sup> The focus on post-war reconstruction and development superseded the earlier prioritization of the conservation of fisheries and other resources. It is within this context that a largely-forgotten international gathering, the Symposium on Fish Populations, was held in Toronto in January of 1947. Many participants arrived at this meeting armed with conventional pre-Second World War conservation ideals. This meeting shook their certainty in their concepts of 'overfishing', jolted their confidence in their ability to clearly link reduced catches to overfishing, and undermined support for effective conservation measures. The intellectual tremor amongst this small gathering, spread through the tightly woven international fisheries science network, was to contribute to a global tsunami of overfishing through the through subsequent restrictions on scientists, scientific research, and policies that favoured resource protection.

Much of this outcome was the intent of the man who convened the meeting, professor of fisheries biology and former director of the Atlantic Biological Station, Archibald Gowanlock Huntsman. Huntsman believed that fisheries biologists had a mandate to assist fishermen rather than support vague conservation goals.<sup>5</sup> Huntsman's intent was not to scientifically support a fisheries free-for-all that would lead to the collapse of fish stocks, but rather to see if a gathering of leading fisheries biologists could pin down the definition and indicators of overfishing for a commercial fish population. Huntsman was reacting against the emergence of fishing equations that would supposedly enable biologists to use catch statistics to model the demographics of fished populations, so as to estimate their condition and ability to withstand certain fishing levels. He did not trust such models, seeing them as turning away from biology. Instead, he wanted to arrive at a general recognition of the need for sound biology, based on life-histories, field studies, good evidence and



*Figure 1: Archibald Gowanlock Huntsman. University of Toronto Archives.*

reasoning. In fact, the meeting exposed leading fisheries scientists' high levels of uncertainty regarding their ability to gauge the status of the populations under investigation. The unforeseen outcome of the meeting, given the exposure of their scientific weakness, was that some of his more tangential ideas fell on fertile soil, none moreso than his equating of fished populations to managed forests. According to him, 'senile' fish were like fully-grown trees, which therefore add nothing further to the biomass and revenues, and become worthless unless harvested. In an era which valued fish populations purely according to their economic value, with no regard for their ecological context, such ideas, ironically, meshed well with emerging American economic justifications for making the determination of MSY for each commercial fish population the goal of fisheries science. Huntsman and the Symposium on Fish Populations helped to sway fisheries biologists towards attitudes that would enable the outcomes of the 1955 UN International Technical Conference on the Conservation of the Living Resources of the Sea.

To illustrate how far-removed post-war fisheries science became from the ideals upheld in the interwar period, it is necessary to look at the work and ideas of William F. Thompson (1888-1965), the most influential American fisheries biologist in the 1930s and 1940s. He trained under Charles Henry

Gilbert (1859-1928), a zoology professor and eminent early US fishery biologist. Thompson's first important investigations, beginning in 1914, focused on the Pacific halibut fishery. His intensive investigations of *Hippoglossus stenolepis* in British Columbia resulted in seven landmark papers.<sup>6</sup> He founded and became director of the California State Fisheries Laboratory under the California Fish and Game Commission in 1917. In 1924 he relocated to Seattle to direct the investigations of Pacific halibut for the International Fisheries Commission, founded to address the British Columbian fishing industry's concerns that the Pacific halibut catches were in serious decline. His research convinced the Department of Marine and Fisheries and US Pacific states to restrict the halibut fishing-season so as to sustain the fishery. Increases in catch rates thereafter convinced many scientists and politicians that overfishing had been the cause of declining catches before Thompson's regulations were in place. They concluded that fisheries restrictions had successfully conserved and preserved the fisheries.

In 1937, while continuing to lead the International Pacific Fisheries Commission, Thompson was appointed director of the International Pacific Salmon Fisheries Commission, and he also served as director of the School of Fisheries at the University of Washington from 1943 to 1947, before moving to head the university's Fisheries Research Institute from 1947 to 1958. Thompson's dedication to conservation through restricting the intensity or duration of fishing activities remained undiminished. His thinking was highly influential for the work of British fisheries biologists Edward S. Russell and his protégé Michael Graham, who were directors of the Fisheries Laboratory at Lowestoft from 1921-1945, and 1945-58 respectively, and who developed early iterations of fishing theory models in the 1930s based on Thompson's example.<sup>7</sup> Both, like Thompson, remained committed to the recognition that overfishing was real and had serious consequences for the economics of fishing, if not for the fish populations themselves.

Given these attitudes, it seems astonishing that some of Thompson's most prominent and important students championed fisheries practices that were instrumental in the overfishing and depletion of the world's major fisheries, through promoting fisheries exploitation as a tool of American Cold War diplomacy. These students included Wilbert Chapman, who never shared Thompson's views, but also the more scientifically-important Milner Bailey Schaefer (1912-1970), who worked for the Bureau of Fisheries, and then the Inter-American Tropical Tuna Association. Schaefer developed one of the three main mathematical models used by fisheries biologists from the 1950s onward to estimate the size of commercial populations, the effects of fishing, and to project what the maximum levels of fishing effort should be in future years. Schaefer's "Surplus Production Model" was preferred by Pacific fisheries scientists and managers. I argue here and elsewhere that the 1947 Symposium on Fish Populations was instrumental in shaping Schaefer's Surplus Production model. Schaefer championed catching the fish that were 'surplus' to a population's

reproductive requirements for sustaining a given population level, lest they be lost to the human economy and thus wasted.<sup>8</sup> Another of Thompson's students was William C. Herrington, who was instrumental with Wilbert Chapman and Milner Schaefer in designing American Cold War fisheries policies, and helped design the US abstention principle, which aimed to give Americans and their allies free and untrammelled access to the world's fisheries. The abstention principle opened the fisheries of national inshore waters to all nations, unless the nation could show evidence for scientifically managing the fisheries in these waters, as could the US in the case of its Bristol Bay salmon fisheries.<sup>9</sup>

Amy L. Toro has argued that Herrington's about-face—to the point that he criticized the North Pacific Fisheries Commission as being too narrowly focused on conservation—was due to the positions he held after the Second World War. He served as Chief of Fisheries of the Natural Resources Section of the Supreme Commander for Allied Power (SCAP), which governed Japan in the war's immediate aftermath, and from 1951 onward as the Special Assistant for Fisheries and Wildlife in the Department of State, where he was responsible for formulating resource policies. This political trajectory forced him to recognize that fisheries management had to balance economic, political, and social as well as biological conservation needs.<sup>10</sup> Herrington in Toro's account is like a fish being swept along by currents more powerful than he is. To some extent this is true, since the politics of modernization and development had, in general, overtaken and banished earlier policies that aimed to enshrine protective resource conservation for all kinds of natural resources. I argue here, instead, that outside of these policy currents, the Symposium on Fish Populations fundamentally reshaped the thinking and beliefs of many fisheries biologists—by challenging the foundations of their conservation practices and ideals—and helped to create the scientific and intellectual milieu that supported the emergence and spread of American Cold War fisheries policies.

The Symposium on Fish Populations was the outcome of the epistolary persistence of Archibald Gowanlock Huntsman (1883-1973), who demanded that his peers answer his question of how to define overfishing. Huntsman, who had a medical degree from the University of Toronto, was hired there as an instructor in 1907 and then as a professor of zoology in 1915. During summers from 1903 onward he was a visiting researcher at the Go Home Bay Biological Station on Georgian Bay and the peripatetic Atlantic Biological Station, both run by the precursor to the Biological Board of Canada.<sup>11</sup> After a permanent station was built at St. Andrews, New Brunswick in 1908, he was appointed its summer curator in 1911, 1913, and 1915-1919, and its first permanent director in 1919. He was 'removed' in 1934 because, without the authorization of the Biological Board, he rebuilt the station after a fire destroyed the main laboratory and library. Huntsman then was 'kicked upstairs' (as he liked to say) to serve as the Board's consulting director from 1934 to 1953; he also edited the newly-constituted Fisheries Research Board's publications from 1934 to 1949,

Huntsman's profound influence resulted from his roles as a provocative

thinker and as a teacher. Huntsman trained several generations of Canadian fisheries biologists, and was the most influential Canadian marine scientist during the interwar years. Huntsman's contributions as director of the Atlantic Biological Station were highly constructive, and included helping to professionalize marine science and hiring Canada's first professional oceanographer.<sup>12</sup> He liked to disagree with authority; he even challenged the scientist who trained him in the latest methods in fisheries biology during the Canadian Fisheries Expedition of 1914-15. He criticized the age determination method using the circular growth rings on fish scales, exasperating Johan Hjort, then the world's leading fisheries biologist, who had come from Norway to lead the expedition.

Hjort saw his scientific mission as expanding and modernizing Norwegian fisheries, and brought his modernizing mission to Canada. Hjort felt no need to dwell on the problem of overfishing, especially since he had discovered that fluctuations in fish catches were mainly due to the variable success of different year classes in surviving as eggs and larva to grow to sizes big enough to be fished commercially (known by fisheries scientists as 'recruitment'). While fishermen might blame a poor fishery on overfishing, Hjort interpreted variable catches in the light of natural and sometimes quite extreme population fluctuations, or variable migratory patterns owing to changing environmental conditions.<sup>13</sup>

With this introduction to fisheries science, it is not surprising that Huntsman saw no need to focus on overfishing as a cause of depletion. In any case, the Canadian Atlantic fisheries were only sparsely industrialized compared with the British and German fisheries, or North American Pacific fisheries, so conservation was not a priority in Atlantic Canadian fisheries policies.<sup>14</sup> On top of this, Huntsman's mentor had been 'Professor' Edward Ernest Prince (1858-1936), who became the Biological Board's director by dint of having been appointed Dominion Commissioner of Fisheries in 1893. Prince had trained under and assisted Professor Carmichael M'Intosh, the director of the marine biological station at St. Andrews, Scotland and the scientific expert for the Royal Commission on Trawl Nets and Trawl Fishing of 1883. The commission found no evidence that trawling was harming the inshore fisheries, based on M'Intosh's finding that fish eggs floated, and hence could not be harmed by bottom trawling. Both M'Intosh and Prince shared Huxley's conviction that the pelagic sea fisheries were inexhaustible given the sheer fecundity of mature female fish, each spawning hundreds of thousands or even millions of eggs. Prince brought this teaching with him to Canada.<sup>15</sup>

Unsurprisingly, with his intellectual heritage firmly rooted in Huxley and Hjort, Huntsman rejected the possibility that overfishing could be a real problem. Huntsman's views remained firm despite his engagement with leading North American and European oceanographers and fisheries biologists, some of whom had very different ideas about overfishing.<sup>16</sup> A founding member of the North American Council on Fisheries Investigations, he carried out a vigorous correspondence with England's F. S. Russell and Michael Graham at



the Fisheries Laboratory in Lowestoft, and Henry B. Bigelow, the first director of the Woods Hole Oceanographic Laboratory, whose research encompassed problems in fisheries oceanography. Huntsman, in fact, had the key connections that enabled him to form an important nexus of the existing network of Canadian, American, Scandinavian and British fisheries scientists who were at the forefront of their field and who shaped the science and informed the policies based on their findings.

Following his eviction as director of the Atlantic Biological Station, Huntsman was a scientist in search of an agenda, and in this era his work can sometimes be seen in a less-than-flattering light, especially given our knowledge that he was on the wrong side of history concerning the possibility of commercial overfishing. His later scientific contributions included his work on the life-cycles of salmon and salmon migrations. Ironically, his own research proved—despite his firmly rooted opposition to it, expressed during a rather abrasive debate with Pacific, Scottish and Norwegian salmon experts—the theory of salmon homing migrations. In 1941 his own salmon-tagging programme retrieved the first evidence that salmon migrate over tremendous distances before returning to their home streams, when a salmon tagged on the Margaree River in Cape Breton was captured by a scientist on the far side of Newfoundland, who sent its tag information back to Huntsman. This same salmon was later recaptured on the Margaree River.<sup>17</sup>

In addition to this, Huntsman battled emerging methodological developments in fisheries science. He disagreed with the focus of Thompson in Seattle, Russell and Graham at Lowestoft, and G. L. Kesteven in Australia, all of whom were developing mathematical formulations to estimate a commercial species' recruitment, growth, population size, natural mortality rates, and the proportion of fish removed by a fishery each year. Their goal was to find what Graham called the maximum steady yield, while at the same preventing fisheries depletion through overfishing.

Huntsman's opposition to mathematically-based fisheries population biology had a number of roots. Frankly, he did not have the mathematical capability or training to use calculus-based fishing equations. However, as he correctly maintained throughout his life, biologists simply knew too little about fish behaviour, life histories, and the impact of the environment on their survival to produce models that actually had any correspondence with reality. To base fisheries policy on these models he viewed as being preposterous: he argued this move would "crystallize" the scientific approach too soon.<sup>18</sup> His own shortcomings aside, however, he foresaw that fisheries biology would become less hospitable to biological research and more the province of mathematicians or the mathematically-inclined, who would base findings on parameters such as catch statistics and the age and length of captured fish. Correctly, he understood that it was hard to get accurate age determinations using fish scales, so getting an accurate understanding of the status of fish populations was unlikely.<sup>19</sup> Fisheries biology would become highly problematic

if it became the realm of desk-bound experts, who would use catch statistics to model the effects of fishing and estimate fish populations, without sufficient field research to understand their full biological context. They would lose touch with a visceral understanding of the fisheries and sources of traditional ecological knowledge—and would ignore the need to investigate how intensive fishing and environmental circumstances might actually affect real fish.<sup>20</sup>

One of Huntsman's strengths was his appreciation of the need for fisheries biology to incorporate new insights coming from field ecology. While Huntsman experienced universal failure in his attempts to introduce new terms and fields into the science of ecology—including “thanatology”: the study of the natural environmental limiting factors, behaviours, life-cycles and predation, that cause individuals in a species to die;<sup>21</sup> and biapocrosis, which he defined as “the response of an organism as a whole to what it faces where it lives”<sup>22</sup>—his attempts show his sensitivity to the limitations of his era's fisheries biology.

Despite his highly justifiable criticisms of the narrowing mathematical and management focus in fisheries science, Huntsman's scientific Achilles-heel remained his frank disbelief in the possibility that overfishing could seriously deplete the populations of a commercial species. To fortify his position that overfishing had never, in centuries of fishing, been scientifically documented—and that therefore claims for cases of overfishing were not scientifically proved—he convinced the Fisheries Research Board at its end-of-December annual meeting in 1941 to set up a Committee on Depletion. The purpose was to have a small committee prepare a brief report on how fisheries depletion should be defined and understood by scientists and fishermen alike. Besides Huntsman, the committee also consisted of A.W.H. Needler, director of the Atlantic Biological Station, R.E. Foerster, director of the Pacific Biological Station, and J.R. Dymond, the head of the Royal Ontario Museum of Zoology, who was also a Board member.<sup>23</sup> Needler predicted failure at the very outset: the committee would never come up with a definition of depletion that would achieve widespread acceptance.

Thus began a voluminous correspondence. Huntsman hounded his colleagues, hoping to get them to adopt specific terms he had coined to indicate different types of depletion. He coined words like ‘anoecia’—to indicate high mortality rates of spawning fish in certain areas; ‘dysgeny’—to indicate the death of large masses of eggs at certain stages of development; and ‘dysmegethy’—fish in a population not reaching the appropriate size.<sup>24</sup> One of Huntsman's dearest, but ultimately futile, wishes was to have one of the scientific Latin or Greek terms he coined adopted by mainstream ecologists. His attempts indeed led Needler to riposte at the Symposium on Fish Populations, that ‘an ecologist is a person who calls a spade a geotope.’<sup>25</sup>

The issue that these scientists were trying to address, however, was a real one, complicated by the juxtaposition of economic and biological considerations. As Foerster commented, the words ‘overfishing’ and ‘depletion’ were being used by some to indicate fishing that was leading to the extinction of the species, while

other fisheries biologists used these terms only to indicate a decline leading to a fishery's loss of economic viability. Foerster preferred the clarifying terms 'economic depletion' and 'biological depletion'. He wanted to delink 'depletion' from 'overfishing' since a depleted condition could arise without overfishing.<sup>26</sup> Dymond, however, argued that none of these terms were justifiable in light of the fact that 'under some economic conditions a slight depletion might make fishing unprofitable' but that economic conditions in themselves also might make a fishery unprofitable without depletion, if the price people were willing to pay dropped below the price at which a species could be fished.<sup>27</sup>

The Committee was disbanded in 1944 with the members unwilling to attach their names to a two-page article prepared by Huntsman, simply titled "Fishery Depletion" which was published by *Science* in its June 1944 issue.<sup>28</sup> Huntsman had also tried to get the committee to sign an article for publication in a popular trade magazine, like *Canadian Fishermen*. Dymond objected, commenting: "I wonder whether the fishermen to whom your article is addressed need to be persuaded that it is unwise to restrict fishing" since, as far as he could see, "the purpose [of Huntsman's argument] is quite obviously to cast doubt on the necessity for restricting fishing."<sup>29</sup> Several committee members concluded that since it would be so difficult to say when overfishing was occurring—or if depletion had occurred—the best practice would be to set quotas for a fishery and adjust these quotas in the light of experience.<sup>30</sup>

Despite their failure to agree with Huntsman's arguments, however, committee members agreed the exercise had unveiled the shortcomings of frequently used terms and exposed their inability to scientifically establish how human fishing activities affect a commercially-fished population's status at any given time.<sup>31</sup> The use of reason more than amply punched holes in claims that lower catches and catch rates were a clear sign of depletion, as was recognized by fisheries scientists elsewhere following the publication of Huntsman's *Science* article.<sup>32</sup>

Huntsman continued to complain that he had not been able to find a single case of a fishery becoming exhausted or extinct due to overfishing.<sup>33</sup> Since Huntsman's small committee had failed to reach a consensus, he decided to contact fisheries scientists and managers across the United States and Canada, including W.J.K. Harkness, director of the Ontario Fisheries Laboratory. Besides asking for concrete scientific evidence for a single case of the biological exhaustion of a species through overfishing, he also dragged them into his arguments for the need for a universal definition of overfishing. American scientists drawn into Huntsman's semantic net included: A.S. Hazzard, of the Institute for Fisheries Research in the Michigan Department of Conservation, who commented that Huntsman's 'ideas...crystalize the thinking of quite a few of use who have been interested in the supposed depletion of our fisheries';<sup>34</sup> Dr. T. H. Langlois, director of the Franz Theodore Stone Laboratory at Put-in-Bay, Ohio; Dr. W. E. Ricker of the Department of Zoology at Indiana University; Dr Paul W. Needham, Director of Fisheries for the Oregon State Game

Commission; John Van Oosten of the Fish and Wildlife Service of Michigan, Daniel Merriman, director of Yale University's Bingham Oceanographic Laboratory; and William C. Herrington, who was then in charge of the US Bureau of Fisheries' North Atlantic fishery investigations, based in Cambridge, Massachusetts. W. E. Ricker gamely proposed 11 different conditions possibly described as depletion that might develop within a fishery or fished population.<sup>35</sup> Huntsman convinced most of these scientists and the former Committee on Depletion members to form a new committee, which on May 10, 1945 he titled the Group on Fishery Depletion.

### The Symposium

Huntsman challenged the members of the Group on Fishery Depletion to define overfishing and depletion, and to come up with a single scientifically-documented case of the complete exhaustion of a fishery in North America. Very quickly, the daunting task of using correspondence for the ensuing debate became apparent. The Group on Fishery Depletion initially was composed of five American and four Canadian members; even as coordinated by Huntsman, who practically seems to have been able to write letters in his sleep, the task was too unwieldy. On October 3, 1945, Daniel Merriman suggested that an efficient and clear exchange of ideas would "not materialize through the medium of written propositions without first getting together."<sup>36</sup> From this, the idea of the Symposium on Overfishing was born.

Huntsman organized the two-day event, held on the 11<sup>th</sup>-12<sup>th</sup> January 1947 in the zoological section of the Royal Ontario Museum. To facilitate maintaining the veracity of scientists' comments and discussion, he had the entire conference recorded phonographically and the later proceedings typed out.<sup>37</sup> Of the forty-five participants, scientists from the United States and across Canada represented the Fisheries Research Board of Canada and fishery laboratories on the Great Lakes, Algonquin Park, and elsewhere. Some of the American scientists who had hoped to attend could not come because of the constraints of time and distance. There were faculty and students from the University of Toronto and faculty from other Canadian universities. The two members of the Royal Ontario Museum included J. R. Dymond, an original member of the Committee on Depletion, who helped Huntsman organize the conference. Also present were representatives of Ontario's Department of Lands and Forests. Finally, but not least, members of the Ontario Federation of Commercial Fishermen attended, some of whom entered the discussion. Huntsman's high regard for fishermen motivated his invitation to these men; he remarked after one of their comments that he wished fishermen would write down what they know, since they knew a lot more about the behaviour of fish around fishing equipment than did scientists. He later asked one participant, fisherman Carl F. Kolbe, for a critique and feedback on a draft of a paper that he was to give at the 1949 United Nations Economic and Social Council meeting 1949.<sup>38</sup>

Nine participants presented papers. Huntsman's opening paper dealt with

assessing fished populations; T. H. Langlois discussed North American attempts at fisheries management; J. R. Dymond described European marine fish population investigations; M. D. Burkenroad disputed Thompson's claims that the Pacific halibut recovery was due to fisheries restrictions; Daniel Merriman and H. E. Warfel gave a joint analysis of the winter flounder fishery and the population of winter flounder over the history of the New England fishery; A. W. H. Needler described methods for estimating the intensity of fishing efforts; and R. E. Foerster discussed the prospects for Canadian fisheries management. The final paper, given by W. C. Herrington, discussed various fishing theories and examples of factors that limit fish populations.

In a joint paper by W. E. Ricker and R. E. Foerster, Ricker described how to compute fish production.<sup>39</sup> Ricker was then at the University of Indiana, but his career straddled the US-Canadian border: he had worked with Foerster before on Cultus Lake salmon investigations, and he later became director of the Pacific Biological Station in Nanaimo, British Columbia. Ricker used the meeting to introduce his work on a series of fishing equations that he later elaborated into his spawner-and-recruitment model, used to manage the Pacific Salmon fisheries in subsequent decades, and still in use to this day. It is noteworthy that the discussion after his paper was virtually non-existent: Huntsman asked one question, on whether or not it was necessary to carry out tagging experiments on each fished body of water to get accurate estimates of production, which Ricker agreed would be useful but argued that general principles would likely emerge.<sup>40</sup> This argues that few of the scientists present had the mathematical experience to deal with this new approach to assessing fish populations.

There is no space here for a full description of the various papers, nor the discussions and arguments that followed. As with the Group on Fishery Depletion and the earlier Committee on Depletion, the meeting failed to create a consensus, but all participants agreed that it had been a valuable exchange of information and views. However, ideas introduced at this symposium had global reverberations, influencing how scientists thought about fish populations and developed subsequent fisheries policies. Huntsman's and Burkenroad's papers perhaps did the most to shake biologists' complacency in their ability to diagnose overfishing.

Huntsman presented seven different scenarios that could be interpreted (or in some cases, misinterpreted) as overfishing. He emphasized the importance of studying fish behaviour, and in particular, what he termed "zoapocrisis" (the fish's "response as a whole to what it faces where it lives" as related to movement and survival).<sup>41</sup> Herrington was highly critical of Huntsman's claim that intensive fishing had not caused a decline in over-all productivity in the North Sea, and that the Eastern Canadian and U.S. herring fisheries had resulted in an increased overall catch of smaller fish. In an argument that resonates today more than ever, he commented:

If you accept for the moment the argument that intensive fishing is not causing a decline in overall productivity in the North Sea, I think you should bear in mind that if you deplete a desirable species and an undesirable species takes its place there is still a loss as far as human needs are concerned. For instance, on Georges Bank if haddock were decreased and a less desirable species took its place, there would be an over-all loss even through the total poundage of all species landed remained the same.<sup>42</sup>

Huntsman's argument in this case was not to become particularly influential, since a number of fisheries biologists already shared Huntsman's ambivalence on overfishing. However, unlike other fisheries scientists, who drew analogies between the fisheries and annual agricultural harvests, and likened fish harvesting to cropping, Huntsman equated old, 'senile' fish (his term) to mature trees in a managed woodlot: they do not grow significantly once they have reached a certain age.<sup>43</sup> He argued this condition is no more desirable in the fisheries than it is in forestry management: too many mature fish compete with younger fish for limited resources, restricting the total biomass. A more productive fishery would result if these fish were removed, giving juvenile fish more food and resources to grow faster.

As I have shown elsewhere, Huntsman's ideas about the negative impact of 'senile' fish became influential, or even standard. For example, it was reproduced in a paper given by Eric M. Poulson, the secretary of the International Commission for the Northwest Atlantic Fisheries, to a global audience at the International Technical Conference on the Conservation of the Living Resources of the Sea held in Rome in April and May 1955.<sup>44</sup> This Living Resources of the Sea conference was of crucial importance because it enshrined the highly destructive policy that saw managing the fisheries at levels lower than a maximum sustained yield (MSY) as being wasteful,<sup>45</sup> and included arguments that mature fish were economically worthless and took up potential resources from faster growing younger fish.<sup>46</sup>

One of the fishermen present, Carl Kolbe, succinctly stated the heart of the problem with identifying conditions in which overfishing is occurring: "...you can only fish down to a level which is profitable, *whereas a change in natural conditions can take the fish down to any level whatsoever* [italics mine]."<sup>47</sup> Throughout the meeting, Burkenroad sided with Huntsman in favouring natural population cycles as the main explanation for apparent fisheries depletion. He clashed with William C. Herrington, the future architect of the American abstention principle, who was at that time a firm disciple of W.F. Thompson's fisheries science. Indeed Burkenroad and Herrington ended up disagreeing on most points regarding each other's papers.

Burkenroad's paper on his investigations of North Carolina's fisheries offered a rebuttal of the supposed outcomes of Thompson's International Pacific Halibut Commission's record. Thompson and his organization claimed to have managed the recovery of the Pacific Halibut fishery through severely restricting the fishing season. Burkenroad provided statistical evidence to back up his contention that a natural surge in the halibut population—which he argued experienced a 34-year cycle in abundance—and not fisheries restrictions, were

mostly responsible for the recovery of the Pacific halibut. Indeed, the catch increases were significantly greater than could be accounted for by simple restrictions. He argued that:

When a naturally fluctuating population reaches a dead low, it may be expected to increase in abundance thereafter. When a scarcity occurs, it is a stimulus to study of the fishery, and regulation of it. Consequently, one should expect to find regulations applied at low points in natural periodicities. Therefore, one would as a general rule find increases in abundance following regulation, even in fishing had nothing to do with the scarcity. An increase in abundance is thus not by itself critical evidence for a causal connection between the regulation and the increase.<sup>48</sup>

Needler commented that he saw Burkenroad's arguments being reduced to two main arguments that questioned the soundness of Thompson's research group's conclusions. Firstly, "the catch-per-unit-of-effort changed so much, fell off so much, that it would indicate reduction in the abundance of halibut several times greater than in the actual catch." Secondly, Thompson's restrictive measures had "saved a certain amount of halibut" but that calculations incorporating halibut natural mortality and growth "Still don't produce enough more halibut in the sea to account for the increase". He concluded, "I don't know any of the detailed data, but if these two propositions are sound it would certainly indicate that there are a number of other factors which are just as important as the fishermen."<sup>49</sup>

Given that Herrington was a student and protégé of Thompson's and quite convinced that Thompson had fixed the fishery, he was not happy with Burkenroad's conclusions. He urged Burkenroad to employ a finer-grained analysis of smaller areas where depletion was more evident. He argued that Burkenroad was not looking at the most heavily fished areas. Burkenroad admitted that the large-scale analysis he had already carried out had taxed his (presumably very limited) mathematical capabilities, but insisted that his findings were sufficient to cast doubt on the efficacy of Thompson's fisheries restrictions. Herrington also disputed Burkenroad's use of Thompson's estimate of a 10 per cent fishing mortality rate: "Whether or not somebody else uses it in making an estimate doesn't justify you in using it if you don't think it is correct." Burkenroad argued: "You yourself named that 10 per cent fishing rate. If you and Thomson are going to use that in coming to the conclusion that the fishery has been responsible for the decrease in abundance then it is legitimate for me to use it in an analysis of our conclusions."<sup>50</sup>

Herrington's paper, "Limiting Factors for Fish Populations: Some Theories and an Example" contended that "the management of a fishery usually is possible only through control of mortality caused by human activities in order to bring spawning stock and competitive stock into the most productive relationship" which required knowledge of recruitment and fishing mortality and population relationships.<sup>51</sup> He defended the benefits to be gained by building up a spawning stock through fishery restrictions. But Burkenroad remained unimpressed by Herrington's data, noting that he had no information

on the interactions between Georges Bank haddock stocks, their predators and their food-prey, and concluded:

It appears to me that what he has done today is to assume his original hypothesis as if it had been proven, and then to reconcile it with the more recent contradictory evidence by assuming changes in the food crops. In other words, he didn't get the expected increase in young when his spawning stock went up to what was thought to be the optimum level, and his explanation is that the amount of food produced by the ground has fallen off.<sup>52</sup>

Herrington and Burkenroad continued to spar, each asserting that the other had failed to provide evidence to support their explanations and conclusions.

Burkenroad's ultimate concern was revealed during the discussion after Ricker and Foerster's paper: "the price to the fisherman has been raised by management, because there is no evidence that it is the regulation that has improved the catch-per-unit-of-effort. The public is paying a higher price, relative to the availability of the fish."<sup>53</sup> It is important to highlight that economic considerations were consistently present in the discussion of overfishing at the Symposium. Huntsman, for example, commented that in 1947 they were repeating conditions that had followed the Great War, when wartime conditions during what fisheries scientists called the "Great Fishing Experiment" virtually ended fishing. The fish caught increased in both quantity and size. Most people saw that catches had rebounded, and included many larger fish. Most people saw that as a good thing, but Huntsman queried whether increased post-war fishing actually compensated for fisheries revenues lost during the war. He doubted it.<sup>54</sup> This is another example of how he and several other participating scientists challenged the conventional wisdom of Thompson, Russell, Herrington, and others.

Herrington's paper, the last of those presented, also received a large number of critical comments from other scientists present, including from Pacific Biological Station scientists A. L. Tester and J. L. Hart; Hart commented, regarding one of Herrington's data series, "I don't know how seriously Mr. Herrington is presenting his information on pilchards. I don't feel satisfied that the relationship between availability and abundance of spawners is close enough to warrant the assumption which I think he made."<sup>55</sup> Hart allowed Herrington's brief response to slide, since by this point the participants were weary and ready to finish their business.

F. E. J. Fry was more conciliatory throughout. Fry, a University of Toronto zoology instructor, two years later would introduce to fisheries science the new (and now universally used) tool of virtual population analysis. Toward the end of an earlier discussion, he remarked: "It's a little hard for a mere neutral person to get a word in edgewise. It would seem to me, listening to the managers and non-managers in the course of the last day and a half, the one thing you have not gotten down to is the actual application of the principle of limiting factors" that come into play when one or another limiting factor is reached. These include the possibility of "one fishery reducing the stock below



the minimum and thus getting it into this limiting range where it is going to affect the next year's crop. However, in this other fishery that is not so."<sup>56</sup> In other words, the circumstances encountered in two different commercial fish species and their fisheries might be quite different. Fry also stated that he found similar population curves (regarding a correlation between the size of the spawning stock and population recruitment) in lake fish to those discussed in Herrington's presentation on Georges Bank fish populations.<sup>57</sup>

### Aftermath

Energized by the symposium, both Burkenroad and Huntsman began a correspondence with W. F. Thompson, challenging the International Pacific Halibut Commission's interpretation of the effects of fishery restrictions on the populations of Pacific halibut. While Thompson replied with good grace to Huntsman's earlier efforts, Huntsman's persistent unwillingness to accept Thompson's evidence for a reciprocal relationship between fishing effort and population eventually got under Thompson's skin. In one handwritten missive, Thompson wrote "Maybe biologists just don't see that the constant [in his equation] is a necessary part of the reciprocal relationship. My mathematics friends do, automatically. And they see that I am defining this constant, which is wrt [with regard to] the legally, or otherwise, limited catch. Also that I am studying the derivations from the reciprocal relationships..."<sup>58</sup> However, Huntsman's arguments, like Burkenroad's, were based on the impossibility of clearly interpreting the upswing in the Pacific halibut catch as being caused solely by fisheries restrictions—a biological, not a mathematical, argument.

Burkenroad would go on to challenge Thompson in a series of published articles, beginning with his article "Fluctuations in abundance in Pacific Halibut" in the Symposium proceedings, and most notably with a 'book review' of a paper by Thompson that attempted to rebut Burkenroad and Huntsman.<sup>59</sup> Thompson's increasingly contemptuous responses and Burkenroad's refusal to be swayed marked the most famous scientific dispute in the history of fisheries science prior to the Cod Crisis of the 1990s.

The Thompson-Burkenroad debate has been the subject of a number of articles by fisheries scientists who have used a historical focus to rehash the debate. It should really be known as the Thomson-Burkenroad-Huntsman debate, since Burkenroad and Huntsman extended it into separate articles in 1953 in the *Journal du Conseil international pour l'Exploration de la Mer*.<sup>60</sup> While Thompson was widely considered at the time to have won the debate, and Skud in 1975 found the evidence lay in favour of Thompson, more recent evaluations find that the information and data available do not actually lead to a clearly defined conclusion. Natural population fluctuations and environmental effects can both be invoked to explain not only historical, but also current fluctuations in fisheries catches.<sup>61</sup>

Another of the Symposium's outcomes is that it likely inspired the ideas of the influential economist, H. Scott Gordon, who began the new field of

bioeconomics with his paper about fisheries economics. Gordon's interest in fisheries grew from by his service, while still an undergraduate, as a summer intern in the Department of Fisheries in Ottawa, his appointment doubtless due to the focus of the new Deputy Minister of Fisheries, the economist Stewart Bates (who served from 1947 to 1954).<sup>62</sup> The Symposium's discussion often dwelt on the economic aspects of fisheries policies; moreover, Gordon's paper showed familiarity with Huntsman's thinking not just on economics but on fish populations and ideas about overfishing. In fact, many of Scott Gordon's arguments completely echoed those made by Huntsman during the symposium, including Huntsman's demonstration that intensive fishing in the North Sea had not diminished its productivity. This deepens my conviction that Scott Gordon was influenced by the published Symposium proceedings. Scott Gordon's "The Economic Theory of a Common Property Resource: The Fishery" (1954) was an enormously influential article that was foundational to bioeconomics and was instrumental in bringing economists into the field of fishery management in Canada, Great Britain and elsewhere.<sup>63</sup>

Beyond this, the Symposium seems to have fuelled the trend among scientific fisheries experts to support large-scale, indeed global, industrialization of the fisheries,<sup>64</sup> a trend mirrored in the industrialization of natural resource extraction or production in many other sectors, including agriculture, in this period. For example, while William Herrington was very much W. F. Thompson's disciple at the Symposium on Fish Populations, the Symposium led him to question his stance on conservation measures. Seven years later, he devised the abstention principle, with the goal of helping Japan rebuild its economy and turn it into a strong American ally during the Cold War. It is almost unbelievable that this highly cynical fisheries management model could have been produced by Herrington, given his convictions on display at the Symposium. From the Symposium's recorded proceedings it is probably fair to say that Herrington's arguments were the most consistently challenged, which surely had its effect on his later thinking. At some point Herrington had to have experienced some reversal of his ideals, and the concerted disagreement amongst participants as to the reality of overfishing, its definition, and its management, must have softened his firm convictions concerning the impact of intensive fishing. Also, as I have argued elsewhere, it is very likely that M.B. Schaefer's surplus production model for establishing MSY fishing levels was influenced by Huntsman's ideas that old fish were surplus to production—unnecessary and even useless for the fishery itself and for conserving the fishery. The full implications of the negative impact of Huntsman's idea can only be understood in the light of science findings after the cod crisis that mature female fish ('big old fat fecund females,' or 'boffs') are critical to ensuring the reproductive resilience of long-lived fish species such as cod, halibut, and redfish.<sup>65</sup>

The Symposium's repercussions extended far beyond its influence on its participants and their subsequent actions, due to the publication of the symposium's proceedings. The Symposium influenced many scientists who, at

that time, were the most important shapers of fisheries conservation policies. This occurred at the very least within the English-speaking world, and likely beyond, due to the close networks of scientists in this field. While fisheries biology was to experience a huge post-war expansion, in the 1940s and 1950s, it still had a relatively small membership. Moreover fisheries biologists enjoyed close international linkages due to the field's trans-oceanic focus, and the resulting international cooperation in fisheries research through new organizations such as the International Commission for the Northwest Atlantic Fisheries (ICNAF), founded in 1949, and older organizations such as the International Council for the Exploration of the Sea. Daniel Merriman, as director of the Bingham Oceanographic Collection, oversaw the publication of the organization's Bulletin in which the Symposium proceedings appeared. Following a visit to British research stations in the summer of 1948, he was able to inform Huntsman that "everywhere I went in England the Symposium volume was much in evidence. Everyone was reading it, and it created considerable discussion."<sup>66</sup> In 1949 Merriman told Huntsman "Our symposium has had considerable influence...The demand [for reprints] has been tremendous both here and abroad, and requests continue to arrive in almost every mail."<sup>67</sup> Beyond this, Huntsman had Merriman send a copy to Donovan. B. Finn, who had served as the Deputy Minister of Fisheries from 1939 to 1947.<sup>68</sup> Finn (1900-1982), a Fisheries Research Board of Canada scientist, left Canada to serve from 1947 until 1965 as the director of the Fisheries Division of the Food and Agriculture Organization (FAO) of the United Nations. The FAO founded several dozen international fisheries commissions for scientifically managing fisheries around the world, including ICNAF, and continues to oversee and coordinate these commissions. In addition, the International Technical Conference on the Conservation of the Living Resources of the Sea, held in Rome in April and May 1955, was conducted through the auspices of the FAO.

American moral and political suasion was crucial for formulating MSY as the goal of international fisheries management, under the umbrella of the FAO and its many international scientific fish commissions. The work of Chapman, Herrington and other American fisheries scientists, however, was not in itself sufficient for enabling the post-war fisheries policies that frequently led to disastrous results. The specific geopolitical goals formulated by US government agencies, for which MSY was a useful tool, were designed to assist the US attempt to sway international opinion away from the Soviet Union. By promoting prosperity as an outgrowth of capitalism, however, American goals and policies meshed well with the European and UN focus on rebuilding war-torn nations around the world, assisting the growth of national economies and the development of impoverished nations, and promoting global food security through increased productivity.

The 1947 Toronto Symposium on Fish Populations, although largely forgotten, led to the sharing of ideas and theories that were to disturb the seemingly settled understanding of fisheries depletion due to overfishing, and

that rippled through fisheries research stations, academic institutions, and fish commissions around the world. The Symposium reassured fisheries biologists that reduced catches could be interpreted as resulting from natural cycles and normal environmental causes. The Symposium at the same time led scientists to question the evidence—and softened their support—for the conclusion that fisheries restrictions had enabled heavily fished populations to rebound. Ideas promoted by Huntsman and Burkenroad, and others at the meeting, prepared the way for the global acceptance of MSY as a policy for progress and development, and in general helped to amplify post-Second World War industrializing ideals.

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## Endnotes

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- 22 A.G. Huntsman, "Method in Ecology: Biapocrisis", *Ecology* 29:1 (1948): 30-42: 30.
- 23 For brief biographies of some of the Canadian scientists who were involved in this discussion and the subsequent Symposium on Fish Populations, please see Kenneth Johnston, *The Aquatic Explorers: A History of the Fisheries Research Board of Canada* (Toronto: University of Toronto Press, 1977).
- 24 A.G. Huntsman, letter to the members of the Committee on Depletion, 1 April 1942. Huntsman Collection, University of Toronto Archives, B1978-0010 Box 69 File 6. I am sure that the date is a coincidence, despite Huntsman's very dry sense of humour.
- 25 Symposium on Fish Populations, p. 17.
- 26 Letter from R.E. Foerster to A.G. Huntsman, 25 February 1942. University of Toronto Archives, Huntsman Collection, B1978-0010 box 69 file 6.

- 27 Letter from J.R. Dymond to A.G. Huntsman, 6 February 1942. University of Toronto Archives, Huntsman Collection, B1978-0010 Box 69 File 6.
- 28 See, for example, the letter from J.R. Dymond to A.G. Huntsman, 21 January 1944. University of Toronto Archives, Huntsman Collection, B1978-0010 box 69 file 6.
- 29 Letter from J.R. Dymond to Huntsman, 19 January 1944. University of Toronto Archives, Huntsman Collection, U of T Archives, B1978-0010 box 69 file 6.
- 30 In 1944, there was no quota management in the finfish fisheries in North America. The only finfish fishery under restrictive management of any kind in Canada was the Pacific Halibut fishery, where Thompson's International Pacific Fisheries Commission had sharply reduced the fishing season from eight months to just one month.
- 31 Letters from R.E. Foerster to A.G. Huntsman, 27 January 1944, and W.J.K. Harkness to A.G. Huntsman, 28 October 1944. University of Toronto Archives, Huntsman Collection, U of T Archives, B1978-0010 Box 69 File 6.
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- 37 The use of a phonograph, the recordings to later be used by a stenographer for transcribing the proceedings, is indicated in A.G. Huntsman's introductory comments for the Toronto Symposium on Fish Populations. Sadly there is no trace of these recordings at the University of Toronto Archives. This information is missing from the published Symposium proceedings, as are several perhaps sarcastic interjections, and a few scientifically risky observations made during the discussion. See the mimeograph of "Symposium on Fish Populations, Royal Ontario Museum of Zoology, January 10th and 11th, 1947", University of Toronto Archives, Huntsman Collection Acc. B1978-0010 Box 69 File 8.
- 38 "Discussion", *A Symposium on Fish Populations held at the Royal Ontario Museum of Zoology, Toronto, Canada January 10 and 11, 1947: Bulletin of the Bingham Oceanographic Collection, Peabody Museum of Natural History, Vol XI, Article 4* (New Haven, Connecticut: Peabody Museum of Natural History, Yale University, 1948), p 29; Letter from Huntsman to Carl F. Kolbem 18 January 1949. University of Toronto Archives, Huntsman Collection Acc. B1978-0010 Box 23 File 4.
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- 40 "Discussion", *A Symposium on Fish Populations held at the Royal Ontario Museum of Zoology, Toronto, Canada January 10 and 11, 1947: Bulletin of the Bingham Oceanographic Collection, Peabody Museum of Natural History, Vol XI, Article 4* (New Haven, Connecticut: Peabody Museum of Natural History, Yale University, 1948), p. 211. For more information on Ricker, who became one of Canada's most important fisheries biologists in the post-war period, see David L.G. Noakes, ed., *Bill Ricker: An Appreciation* (A.H. Dordrecht, The Netherlands: Springer, 2006).
- 41 A.G. Huntsman, "Fishing and Assessing Populations", *A Symposium on Fish Populations held at the Royal Ontario Museum of Zoology, Toronto, Canada January 10 and 11, 1947: Bulletin of the Bingham Oceanographic Collection, Peabody Museum of Natural History, Vol XI, Article 4* (New Haven, Connecticut: Peabody Museum of Natural History, Yale University, 1948), p. 22.

- 42 “Discussion”, *A Symposium on Fish Populations*, p. 25.
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- 49 “Discussion,” *A Symposium of Fish Populations*, p.125.
- 50 “Discussion,” *A Symposium of Fish Populations*, pp.123-5.
- 51 William C. Herrington, “Limiting Factors for Fish Populations: Some Theories and an Example” *A Symposium on Fish Populations held at the Royal Ontario Museum of Zoology, Toronto, Canada January 10 and 11, 1947: Bulletin of the Bingham Oceanographic Collection, Peabody Museum of Natural History, Vol XI, Article 4* (New Haven, Connecticut: Peabody Museum of Natural History, Yale University, 1948): 229-279: 249.
- 52 “Discussion,” *A Symposium of Fish Populations*, p.279.
- 53 “Discussion,” *A Symposium of Fish Populations*, p.225.
- 54 Huntsman, “Fishing and Assessing Populations”, pp. 7-10.
- 55 “Discussion,” *A Symposium of Fish Populations*, p.281.
- 56 “Discussion,” *A Symposium of Fish Populations*, p.227.
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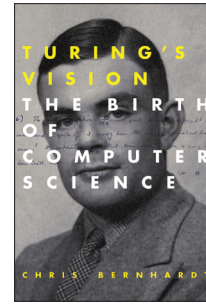
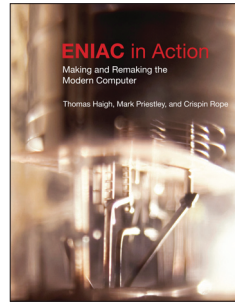
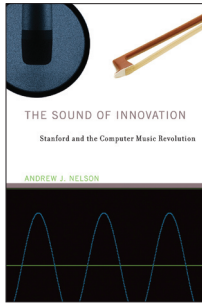
- 64 The best analysis of the development and abuses of industrialized fisheries and the role of scientists in that development, apart from Carmel Finley's compelling oeuvre, is Alan Longhurst's *Mismanagement of Marine Fisheries* (Cambridge: Cambridge University Press, 2010). See especially his introductory discussion "From certainty to doubt in fishery science" pp. 1-15, and his description of global fisheries pp. 134-154.
- 65 I am indebted to Carmel Finley for drawing my attention to this science. For a fuller treatment of the history of such scientific ideas in fisheries science, see Alan Longhurst, *The Mismanagement of Marine Fisheries*, and Jennifer Hubbard, "Fisheries Science and its Environmental Consequences", *Oxford Research Encyclopedia of Environmental Science* (May, 2017), <http://environmentalscience.oxfordre.com/view/10.1093/acrefore/9780199389414.001.0001/acrefore-9780199389414-e-370>.
- 66 Letter from Daniel Merriman to A.G. Huntsman, 29 September 1948. University of Toronto Archives, Huntsman Collection, Acc. B1978-0010, box 69 file 8.
- 67 Letter from Daniel Merriman to A.G. Huntsman, 10 September 1949. University of Toronto Archives, Huntsman Collection, Acc. B1978-0010, box 23 file 4.
- 68 Letter from A.G. Huntsman to Daniel Merriman, 27 September 1948. University of Toronto Archives, Huntsman Collection, Acc. B1978-0010, box 69 file 8.



## Book Reviews / Comptes rendus

# Past Calculations: New Histories of Computing Technology

by David Theodore, McGill University



Andrew J. Nelson. *The Sound of Innovation: Stanford and the Computer Music Revolution*. Cambridge, MA: MIT Press, 2015. 236 pp. \$36 USD. ISBN 9780262028769

Alison Gazzard. *Now the Chips Are Down: The BBC Micro*. Cambridge, MA: MIT Press, 2016. 260 pp. \$38 USD. ISBN 9780262034036

Thomas Haigh, Mark Priestley, and Crispin Rope. *ENIAC in Action: Making and Remaking the Modern Computer*. Cambridge, MA: MIT Press, 2016. 360 pp. \$38 USD. ISBN 9780262033985

Chris Bernhardt. *Turing's Vision: The Birth of Computer Science*. Cambridge, MA: MIT Press, 2016. 208 Out of print. ISBN 9780262034548

Imagine for a moment a computer. Now imagine you're going to use it to get something done. Anything. Make a proof in mathematics; book an airline

ticket; compose, record, or play music; calculate artillery trajectories. Can you do what you want to do without considering the technical details? Do you have to know how a computer works to get that work done? The answer, for most of us most of the time, is “no.” We don't have to know what goes on inside the black—or beige—box. However, *someone* has to know—otherwise, computing couldn't help us do anything at all.

The same conundrum holds for scholars telling the history of the computer. Most of the time, what we really want to explore concerns the roles computers play in our lives. We want to study how computation fits into social, economic, political, and cultural history, and to understand the people involved: the computer designers and architects, the coders and software programmers, the engineers and sales teams and, of course, the users. But some of us also want to know about the contingencies and

exigencies delineating the hardware and software. We want a tale of technology organized around technical and mathematical concepts and the physical characteristics of the machines themselves. How do these two stories, the social and the technical, mesh?

The idea of merging these two approaches under the aegis of the technosocial came of age with Paul Edwards' 1996 book *The Closed World:*

*Computers and the Politics of Discourse in Cold War America*, published by

MIT Press. Edwards proposed links between the development of digital computing and a wide range of other

fields, including artificial intelligence, cinema, and politics. Moreover, he approached "the computer" simultaneously as a technical artifact, as a location of social and political practices, and as a metaphor. This made computers fair game for literature and media studies, and opened up ways of integrating computers into an array of scholarly work. In short, even though the history of computing has maintained its own themes, questions, and literature, it has, at the same time, overflowed its own boundaries.

Indeed, the inevitable has happened. The tension between the technical and the social is now slightly old-fashioned. Scholars have enlivened the literature by engaging new concepts in technology studies, by positing nuanced sociological frameworks for analyzing hardware and software engineering, and by developing (and critiquing) the hypothesis that since the digital computer first appeared we

have been living in a networked, digital age. The computer artifact remains connate to the field, yet it is no longer the protagonist of the story. It's no accident, for instance, that one of the most cited history of computation articles is Jennifer Light's 1999 essay "When Computers Were Women." Its popularity manifests a widespread scholarly desire to intertwine the computer (and its cognates the digital,

the digital age, and so on) with non-technical topics, themes, and disciplinary conventions.

Edwards' publisher, MIT Press, has been a catalyst for the technosocial turn. A

penchant for promoting book-length studies of computing might be expected from a press linked to an institution itself intertwined with all things digital. It is not surprising, then, that the MIT Press catalogue manifests the vivaciousness and breadth of the field. Yet it is an expanded field. One sign of how much computers are now inextricable from disparate scholarly approaches is that the four recent books reviewed here appear in four different series: Platform Studies; Science, Technology, and Society; the Inside Technology series; and the History of Computing series. At their best, these histories detail the emergence of new scholarly approaches in which the complexities of hardware and software are inextricable from concepts, scientific objects, and social goals.

Take for instance Alison Gazzard's *Now the Chips Are Down*. Published in MIT's Platform Series, edited by Ian Bogost and Nick Monfort, the book

**...even though the history of computing has maintained its own themes, questions, and literature, it has, at the same time, overflowed its own boundaries.**

dives into the history of the short-lived BBC Micro. This personal computer was built by Acorn Electronics and sold in Britain from around 1982 to 1986 as part of the British Broadcasting Company's Computer Literacy Project. The Micro is a perfect protagonist for the series. Bogost places platform studies as the media studies equivalent of looking at computer architectures. Authors in the series rely on technical analyses of both hardware and software, but with an eye to seeing how creativity and culture connect to devices. Video game platforms are especially useful for understanding how the mixture of popular computing and creativity evolved both for game designers and producers and for players.

Gazzard foregrounds the way communities formed around the Micro, moving deftly between the executives of a media company (the BBC), the decision-makers at a hardware company (Acorn), and institution-specific users, mostly students at British schools, but also television audiences. One part of her project is to limn some of the roots of virtual communities, beginning with the BBC's Teletext-based attempt to supply computer content at a distance. The idea was that hobbyists could use so-called telesoftware to download games or educational programming (typically at night given the slow transfer rates) and allow home computer enthusiasts to exchange programs. Overall, Gazzard makes a convincing argument that multi-platform computing was prefigured by the Micro. Gazzard also links the Micro to the Domesday project, a pioneering collaborative project that integrated the Philips Laserdisc player for multimedia

files. And she includes an insightful discussion of how the Micro led to other computer projects, especially today's ever-popular Raspberry Pi.

If Gazzard makes a platform the hero of her story, Chris Bernhardt centres *Turing's Vision* on a publication. The book celebrates British mathematician Alan Turing's famous 1937 paper "On Computable Numbers, with an Application to the *Entscheidungsproblem*," which, as Bernhardt's subtitle calls out, is a key document of the "birth of computer science." This article introduced the Turing Machine, a simple theoretical model meant to help study ideas of computability. Turing argued that if a computation is impossible for his theoretical machine, it would also be impossible for a physical computer. Famously, he was able to show that the decision problem (*Entscheidungsproblem*), a challenge about algorithms issued by mathematician David Hilbert in 1928, could not be solved by a computer.

Bernhardt pitches his book for computer science undergraduate; he believes, as a bedrock educational principle, that it is important for students to know about founding principles and founders of their discipline. He explains Turing's paper eloquently, teaching the reader in a sequence that clearly comes from having successfully taught this material many times. The only downside for scholars is the hagiography. Bernhardt enshrines Turing's life and the paper's place in the history of ideas in the potted form you might expect to find say, outlining the life a composer in the notes of an opera program. No matter. Turing's life—radical mathematician,

war hero, gay martyr—has made for easily accessible engaging dramatic renditions: Andrew Hodges’s 1980 biography *Alan Turing: The Enigma* and Hugh Whitmore’s 1987 play “Breaking the Code,” to name only two. Bernhardt’s book is ideal not only for the target audience, but also for historians and STS scholars who may be newly introducing themselves to the history of computation. It is well suited to any non-mathematically oriented reader who wishes to gain a clear understanding of computational concepts. They will need to find the critical historiography elsewhere.

Andrew J. Nelson’s *The Sound of Innovation* moves computing history onto the terrain of management and institutional history. For Nelson, neither the artifact nor the social construction of computing is the focus. Instead, he gives a close account of the origin and development of an institution, Stanford University’s Center for Computer Research in Music and Acoustics. Nelson makes an intellectual argument for the mutual support of industry, musical composition and performance, and academic research, all based on the varied interests several actors invest in and around particular digital technologies. He frames his study around three ideas: radical interdisciplinarity, open innovation, and the commercialization of university research. Specifically, the central technology that made CCRMA viable was frequency modulation synthesis (FM), a technique invented by composer John Chowning. Yamaha Music Corporation licensed FM in 1975, and used it as the basis of the DX7 synthesizer, one of the all-time

best selling musical instruments. FM synthesis, also the technology at the core of cellphone ringtones and multimedia soundcards for personal computers, remains one of Stanford’s most profitable licences. And profit is key to Nelson’s account: digital technologies develop simultaneously with the institutions and humans who design, deploy, and promote, and profit from them.

Nelson’s book reveals an interesting moment in historiography. In his telling, some of the ideas around computing—innovation, simulation, interdisciplinarity—are imitated in the way that he writes the history of computing. He argues that the relationship between music performance, academic training, and entrepreneurial development—mediated, specifically, by computer technology—is a formula that other business and research centres interested in innovation can learn from. He includes the ups and downs of the CCRMA’s long life—it opened in the 1960s and is still a major player—but nevertheless he assesses the institution’s longevity and influence as an unequivocal success. This enthusiasm for technology does not seem well modulated, especially compared to engaged critiques of Silicon-Valley boosterism from the likes of Alexander Galloway (*Protocol: How Control Exists after Decentralization*, 2006) Evgeny Morozov (*The Net Delusion: How Not to Liberate the World*, 2011) and Tom Slee (*What’s Yours is Mine: The Dark Side of the “Sharing Economy,”* 2015).

If *The Sound of Innovation* adds a new plotline, *ENIAC in Action* self-consciously revisits one of the

foundational stories of the technosocial narrative. Thomas Haigh, Mark Priestly, and Crispin Rope reevaluate ENIAC's renown as the first "general-purpose programmable electronic computer." The authors take that designation as an entry point into the machine's history, instead of the triumphant conclusion. They re-examine the idea of the digital computer as a war machine. One of ENIAC's first jobs, after all, was to simulate atomic fission for the physicists working on the Manhattan Project. The authors also add sections on the life of the machine after it was shut down, both tracing the re-use of the machines physical parts and its reception in scholarly, popular, and technical literatures. In their retelling, Haigh, Priestly, and Rope demonstrate how the ENIAC is not one thing, but an aggregate of object and idea, assembled, disassembled, changed, and cannibalized.

The authors renew the stories and methodologies of computer history relying instead on consolidation and nuance—which is pretty much the sweet spot for a study of computing. In a scholarly and professional world that fetishizes innovation, resisting the urge to present a rethink as a revolution is salutary. In the introduction the authors state that they aim at a "re-integration of technical detail into history influenced by the perspectives of science studies, labor history, institutional history, memory studies, and gender history" (14). That's a tall order, but the book achieves it. For the authors are well aware of the limitations and advantages of the genre (academic monograph). For instance, they enlist a familiar array of frameworks derived

from Science and Technology Studies (mostly Bruno Latour's idea of science in action), social constructionist models, and platform-studies, and add up-to-date references to computer history scholarship. The authors have wide swathes of secondary literature seemingly at their fingertips, and carefully tweak it with incremental updates based on both old sources newly considered and new documents. What makes the book sophisticated, in particular, is the integration of technical material with an astounding quantity of archival research.

In all four of these books somehow the physicality of computing machines remains absent from the story. Indeed, it's a critique, not merely of these particular books, but also of some of the unnecessarily imposed limitations of scholarly publishing more generally—limitations felt most strongly in the history of computing/digital history. Scholars of material culture and the "visual turn" in the humanities just don't seem to have made much headway in computer history. In *ENIAC in Action*, the authors include hand-drawn flow diagrams as well as re-drawn diagrams that they analyze in the text. There are also some striking photos of machines, such as a US Army photo of the ENIAC set up in Aberdeen in 1948. These images help convey the texture of computing. But the others are woefully under-illustrated. The exception proves the rule. Likewise, why no sound for a book on computer music? If ever a book needed hyperlinks to websites: a book about computer music without any associated audio means that the authors have also not made the "sound studies turn." Why so little "code," given

the importance to code raised in media studies. They miss important chances to give readers a better idea of the experience of computing.

So how might these books map the field of computer history today? Albeit conservative, these four books manifest the vivacity of computer history today. They demonstrate how the expanding scholarly literature has forged a range of answers to the historiographic problems posed by the technosocial research-industrial complex that computing emerged from. It is at the same time surprising that while these texts collectively cover so much ground, they nonetheless show how much

exploration still needs still to be done. The relevance of the scholar press's imprint is remarkable, here, too, that points to good editorial work at MIT Press. Gazzard's work on the Micro is a fine addition to Platform studies, and Nelson's text on computer music at Stanford hints at the complexity of the computer in the history of the university. Graduate students or scholars coming to the field of computation will find Bernhardt's work on Turing's ideas very helpful. And *ENIAC in Action* is definitive enough to move scholarly interest away from the quest for "firsts" and on to more thoughtful analyses—at least for a while.

Lynne Heasley and Daniel Macfarlane. *Border Flows: A Century of the Canadian-American Water Relationship*. Calgary: University of Calgary Press, 2016. 336 pp. \$34.95. ISBN 978-1-55238-895-2 (Paperback)

Borders are back. Britain has begun exiting from the European Union, and Trump is moving ahead with his wall. Both projects illustrate the continuing appeal, for some, of sovereignty: controlling territorial exits and entries. But both ignore the flows of nature and society. Birds fly, water runs, and winds blow across borders; so do people, goods, and ideas whenever they can. Yet borders still matter. And thus the paradox: borders are invisible and permeable, yet historically consequential.

This book presents close analyses of this paradox, as experienced in the waters and landscapes of the border regions of Canada and the United States. The editors, both at Western Michigan University, have brought together in this nicely constructed volume an international cast of historians and other scholars. Their geographic interests are diverse, extending to the Pacific coast's Salish Sea, the Columbia and other western rivers, Midwestern border forests, the Great Lakes and St. Lawrence River (of course), and (unexpectedly) the Northwest Passage. (Unfortunately, as happens too often in such collections, the Atlantic region escapes attention.)

A few authors examine the legal and political frameworks of these border regions. The Great Lakes receive special attention: Dave Dempsey, and Noah Hall and Peter Starr discuss

in complementary chapters fitful movements towards cooperation on exploiting, allocating, and, more recently, conserving the Great Lakes—presenting histories, in effect, of efforts to balance stewardship and sovereignty. Emma Norman and Alice Cohen provide a parallel analysis of the Salish Sea, demonstrating the ecological and political implications of the boundaries that separate not just two nations but Indigenous territories and hydrologic regions. Andrea Charron's analysis of the Northwest Passage is also helpful, although she devotes too little attention to the Indigenous dimensions of northern sovereignty.

This border includes some of the continent's most manipulated ecosystems, and several authors explore the re-engineering of rivers and lakes for power and water production. Matthew Evenden provides a helpful overview, Dan Macfarlane examines American and Canadian power projects at Niagara Falls, Frédéric Lasserre profiles schemes (fantasies, really) to export water from Quebec, and Jeremy Mouat considers the Columbia River Treaty. Together these chapters illustrate the diverse intersections of political ambitions and conflicts, high modernist ideals, and local environments and social contexts.

Border ecologies also receive attention. James Feldman compares the contiguous forests of the Boundary Waters Canoe Area Wilderness in Minnesota and Ontario's Quetico Provincial Park; these similar ecosystems provide a kind of natural experiment that illustrates the consequences of divergent social and managerial histories. Nancy

Langston demonstrates the capacity of environmental history to tell complex stories, by exploring the transformation of Lake Superior ecosystems and the collapse of lake trout populations (sea lamprey weren't the sole culprit). And in perhaps the book's most thoughtful essay, Joseph Taylor returns to the Salish Sea, using the ecology of toxic chemicals to consider the meanings of diverse kinds of borders – including those that separate ourselves from nature.

The volume concludes with a few more personal reflections, rooted in particular places. These brief essays test other borders—between scholars and citizens, objectivity and experience—presenting interesting counterpoints to the more “academic” chapters.

The theme of border regions as hybrid phenomena recurs. The

ambiguous overlapping of natural and human boundaries is often encountered. Boundaries can be presented as “natural,” even as they reflect particular social conditions or interests. Such presentations exemplify the political roles of scientists in these regions: while describing the organization of nature, they also assert the primacy of their own analysis. Another continuing theme is the necessity of examining borders at several scales – from the international to the local – while acknowledging that their regions transcend whatever scales we choose to impose on them. And finally, the paradox of borders is constantly present: we insist upon them in ordering our activities, yet our interests and impacts often express indifference.

*Stephen Bocking, Trent University*



Melinda Baldwin. *Making Nature. The History of a Scientific Journal*. Chicago: The University of Chicago Press, 2015. 328 p. 45.00 \$. ISBN 978-0-2262-6145-4

Dans cette version plus étendue de sa thèse de doctorat, Melinda Baldwin retrace l'histoire de la prestigieuse revue britannique *Nature*, tout en évaluant le rôle historique qu'elle a joué pour la communauté scientifique et son impact dans l'évolution des sciences. L'auteure s'adresse aux lecteurs de *Nature* et aux journalistes scientifiques, mais aussi aux chercheurs et aux historiens des sciences et des institutions. Chargée de cours au Département d'histoire des sciences de l'Université Harvard, Baldwin s'intéresse notamment à l'histoire de l'évaluation par les pairs, thème présent dans cet ouvrage. L'approche est résolument historique et le cadre d'analyse est fondé sur une structure surtout chronologique, axée autour des rédacteurs en chef et du contexte historique et scientifique de leurs périodes respectives. Il y a peu de données quantitatives présentées dans l'analyse, qui est davantage une interprétation qualitative centrée sur les moments forts de l'histoire de la revue et les principaux contributeurs. En plus des sources secondaires, Baldwin s'appuie sur deux principaux *corpus*, soit la correspondance personnelle des rédacteurs en chef et des contributeurs de la revue, ainsi que sur le contenu de la revue elle-même, notamment les éditoriaux et le courrier des lecteurs, qui jouent un rôle important dans sa démarche interprétative. D'emblée, l'auteure déplore l'absence d'archives institutionnelles, ce qui limite les

possibilités d'analyse du processus éditorial. Ce *hiatus* dans les archives la pousse ainsi dans des zones moins conventionnelles de l'analyse des périodiques et des institutions.

La thèse développée tout au long de l'ouvrage est celle de la centralité de *Nature* dans la communauté scientifique. L'auteure insiste sur son rôle de forum où se définit collectivement la notion de scientificité. Ceci l'amène à discuter de plusieurs questions historiographiques, en particulier celles touchant à l'internationalisation du champ scientifique. L'ouvrage aborde aussi la professionnalisation des sciences, de même que celui des « patterns » de publication de certains chercheurs de renom comme Ernest Rutherford. Baldwin met également en évidence le rôle central du rédacteur en chef dans l'orientation d'un périodique. Par exemple, elle démontre que l'appétit de la controverse chez un rédacteur en chef comme Norman Lockyer va positionner rapidement *Nature* comme une revue de débats scientifiques. Le livre se divise en huit chapitres qui, sans déroger à l'ordre chronologique, évitent l'écueil de correspondre exactement à la nomination de chacun des rédacteurs ayant dirigé *Nature* de 1869 à aujourd'hui. Les deux premiers chapitres se concentrent sur la fondation et le développement du modèle initial de *Nature*, mettant l'accent sur la transition rapide d'une revue de vulgarisation accessible aux amateurs à une revue scientifique spécialisée. Cette transition est associée à un changement de garde dans les principaux contributeurs de la revue, les éminents darwinistes du « X Club » se voyant graduellement remplacés par des scientifiques plus attachés à la

publication rapide de leurs travaux qu'à la diffusion des connaissances dans le public érudit. Ensuite, avec les chapitres trois et quatre, Balwin expose plusieurs débats ayant pris place dans *Nature*, avec pour objectif de montrer comment la revue a contribué à définir la légitimité scientifique en Grande-Bretagne, puis sur le plan international. Le contexte international est d'ailleurs plus présent dans les chapitres cinq, six et sept (moments forts du livre), alors que les débats dans la revue sont teintés par les enjeux scientifiques et politiques qui secouent le milieu du vingtième siècle, tels que les relations avec l'Allemagne nazie ou l'Union soviétique. On y met aussi en lumière le déplacement de l'axe du champ scientifique vers les États-Unis, avec les tiraillements que cette situation va générer dans l'identité de la revue et son rôle désormais central dans la communauté scientifique internationale. Enfin, le dernier chapitre fait le bilan de la modernisation de la revue en insistant sur les controverses scientifiques, notamment celle sur la « fusion froide ».

Au regard de l'appréciation générale de l'ouvrage, soulignons qu'il dépasse le simple parcours chronologique et hagiographique qui caractérise parfois les monographies portant sur une institution, ce qui est d'autant plus important dans le cas d'une revue incontournable comme *Nature*. De plus, Baldwin réussit le pari d'inscrire son récit dans le contexte historico-scientifique sans que le lecteur ne perde de vue la position centrale de la revue dans son analyse. Elle développe des axes de discussion intéressants comme l'internationalisation des sciences, le rôle de la guerre froide dans la coupure

avec la communauté scientifique soviétique et surtout, la controverse scientifique comme catalyseur de l'influence d'une revue. Néanmoins, sur le plan rédactionnel, la structure pourrait parfois être plus formelle, notamment dans les fins de chapitres, où la synthèse et l'élargissement de la discussion sont quelque peu escamotés. Également, le manque de données quantitatives et d'analyse systématique des articles affaiblit la thèse de la centralité de *Nature*. Par exemple, l'ouvrage ne contient pas d'analyse de la proportion d'articles publiés selon les domaines scientifiques et il pourrait y avoir davantage de comparaisons systématiques avec les autres périodiques. On laisse aussi de côté l'analyse bibliométrique de citations, qui aurait été un bon outil pour évaluer la prééminence de *Nature* dans la définition de la scientificité. Le choix de cas emblématiques est certes une alternative, mais qui laissera parfois sur leur faim les lecteurs férus de démonstration plus formelle. L'ouvrage de Melinda Baldwin est par ailleurs très utile pour comprendre l'évolution de *Nature* en tant que forum de discussion des scientifiques: l'objectif général est atteint en ce sens. L'absence d'archives éditoriales limite toutefois la portée de l'ouvrage en ce qui concerne l'histoire de l'évaluation par les pairs. Enfin, l'obligation d'explorer d'autres avenues aura permis de mettre à nu certains mécanismes touchant le rôle de la revue dans les controverses scientifiques et leur résolution : c'est sans doute là que réside le principal apport de l'ouvrage.

*Pierre-Luc Beauchamp,*  
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Robert Lacroix et Louis Maheu. *Les grandes universités de recherche : Institutions autonomes dans un environnement concurrentiel*. Montréal : Presses de l'Université de Montréal, 2015. 325 p. 34,95 \$. ISBN 9782760633957

Dans cette étude comparative, Robert Lacroix (ancien recteur de l'Université de Montréal) et Louis Maheu (professeur émérite et ancien doyen de la Faculté des études supérieures de l'Université de Montréal) tentent de « mieux comprendre ce qui fabrique, sous divers horizons nationaux, le destin des universités de recherche » (10). Pour ce faire, les auteurs définissent en quoi consiste une université de recherche, présentent comment ces dernières se répartissent à travers le monde, analysent les facteurs systémiques qui contribuent ou nuisent à leur performance et, finalement, suggèrent un modèle explicatif qui sous-tendrait la production de recherche universitaire.

Le premier chapitre raconte l'émergence de l'université de recherche, basée sur un modèle Humboldtien d'unification de l'enseignement et de la recherche et qui atteint son apogée aux États-Unis avec la création de facultés des études supérieures (*graduate schools*). Les auteurs closent ce chapitre par une définition proposée par la Fondation Canergie mais qu'ils considèrent applicables à tous les contextes. Le deuxième chapitre décrit en détail les classements internationaux du *Times Higher Education* et de l'*Academic Ranking of World Universities*. Le troisième

chapitre porte sur la répartition internationale des grandes universités de recherche. Les auteurs présentent un premier modèle explicatif basé sur cinq facteurs socio-économiques : population globale, taille de l'économie, richesse relative du pays, proportion de la population active possédant une formation universitaire longue et « densité économique ». Prenant en compte ces facteurs, le nombre d'universités dans les top-400, top-200, top-100 et top-50 et en comparant six pays avec les États-Unis, les auteurs concluent que le Japon sous-performe, l'Allemagne surperforme dans le top-400 mais sous-performe dans le top-50, la Grande-Bretagne et l'Australie surperforment à tous les niveaux, la France sous-performe sauf dans le top-400 et le Canada performe très bien à tous les niveaux.

C'est cette comparaison qui justifie le choix des quatre études de cas : les États-Unis, la Grande-Bretagne, le Canada et la France. La deuxième partie du livre, qui couvre les chapitres 4 à 7, décrit les systèmes universitaires de ces pays en suivant la structure suivante : survol historique, caractéristiques actuelles du système, acteurs en présence et gouvernance. Le chapitre sur le Canada décrit, par exemple, le rôle pionnier qu'ont joué les universités McGill et de Toronto, l'importance du financement fédéral et la concentration des activités de recherche et du financement dans 15 grandes universités (maladroïtement qualifiées de « multiversités »). Les auteurs proposent aussi une description fine des mécanismes de financement du rôle des étudiants gradués et doctorants,

de la gouvernance institutionnelle et du caractère distinct du Québec.

Le huitième chapitre huit utilise « les divers éléments descriptifs des quatre systèmes d'enseignement universitaire examinés pour dégager un cadre analytique élargi qui rende compte des facteurs et des conditions qui permettent à des universités de recherche de systèmes universitaires particuliers d'émerger parmi les meilleures sur le plan mondial » (249). Pour les auteurs, ces facteurs sont l'autocontrôle institutionnel, une faible régulation étatique et l'influence des marchés. Le livre se conclut par une discussion des « défis majeurs qui marqueront indéniablement le futur immédiat des universités de recherche » (277) et recommande aux acteurs politiques d'encourager la différenciation institutionnelle, la concentration du financement, l'accroissement du nombre de doctorants, la hausse des frais de scolarité et de limiter « l'orientation sectorielle du financement et l'exigence de résultats à court terme » (291).

Ce livre a eu un grand écho dans les milieux universitaires et dans les médias. Une version en anglais a aussi été publiée par McGill-Queen's University Press. C'est un ouvrage rigoureux en ce qui concerne l'histoire du développement des grandes universités de recherche et des systèmes d'enseignement supérieur qui les ont vus naître. Les auteurs s'inscrivent dans une mouvance novatrice qui imbrique l'analyse des facteurs institutionnels dans un contexte économique, politique et social plus large où interagissent une multitude de facteurs systémiques.

Les passages normatifs et prescriptifs ont toutefois moins de résonance que les passages descriptifs. Il est dit que cette étude repose sur « une démarche méthodologique qui soit à la fois rigoureuse et pertinente » (10). Or, trois failles méthodologiques nuisent à la puissance explicative du modèle proposé. Tout d'abord, les auteurs recensent avec exactitude les nombreuses critiques associées aux classements internationaux, notamment l'invalidité de certains indicateurs, l'avantage indu de l'anglais, la pondération arbitraire, etc. Ils décident néanmoins de poursuivre leur démarche en s'appuyant sur ces classements à cause de leur impact sur les acteurs du milieu. Soit, mais le choix des pays conduit inévitablement à conclure à la supériorité du modèle anglo-saxon. Si, au lieu de la France (dont la recherche de pointe se fait hors des universités), les auteurs avaient choisi des pays qui, par habitant et par institution, comptent plus d'universités de rang international, plus de publications et plus de citations – tel que la Suisse, les Pays-Bas, le Danemark et la Suède – leurs conclusions auraient forcément été différentes. Finalement, pour chaque étude de cas, les auteurs commettent des erreurs de raisonnement *a posteriori*, i.e. les universités choisies sont bien classées donc leurs caractéristiques expliquent ce classement. Il aurait été plus convaincant de formuler des hypothèses *a priori* et de les tester empiriquement ou, du moins, de s'appuyer sur des études de ce genre.

En somme, cet ouvrage permet de mieux comprendre l'évolution des systèmes d'enseignement supérieur

et l'importance des universités de recherche dans cette compétition internationale pour la production de savoir et l'accumulation des bénéfices économiques et symboliques qui en découle. Il est toutefois dommage que

les conclusions ne fassent que reprendre le crédo de certains administrateurs universitaires.

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Michael Riordan, Lillian Hoddeson, and Adrienne W. Kolb. *Tunnel Visions: The Rise and Fall of the Superconducting Super Collider*. Chicago: The University of Chicago Press, 2015. 448 pp. \$40. ISBN 978-0-226-29479-7.

No discussion of the Superconducting Super Collider (SSC) is free from the inevitable question of why it failed. In their introduction, the authors distinguish their history of the collider from those of Daniel Kevles and Stanley Wojcicki with their focus on laboratory culture, and particularly the examination of a failed project. It is an account of the attempt to build a particle accelerator that planned to achieve energies almost three times higher than CERN's Large Hadron Collider (LHC) today. In fact, the tacit comparison to CERN's success underlies the narrative – CERN's project was considered its main competitor throughout construction and up until the discovery of the Higgs boson. The authors argue that the SSC failed because American physicists and the Department of Energy (DOE) attempted to use outdated Cold-War era models of physics funding to push through a project of unparalleled scale that would have required greater international collaboration.

These threads of competition and tensions over international collaboration persist throughout the nearly two decades of political, economic, and scientific positioning to control the SSC. The history begins with the origins of the collider in the late 1970s, detailing the need to achieve higher energy interactions between particles in order to discover the last key pieces of the Standard Model.

Crucially, they needed to break into the TeV scale to discover the most massive particles, such as the top quark, the W and Z bosons, and of course, the Higgs boson that gives matter mass. The authors helpfully provide an appendix explaining the physics of these high energies particle interactions and the types of questions that can be answered by observing them.

The expected creation of the SSC grew out of the inexorable upscaling of physics beginning in World War II and continuing through the Cold War. New discoveries required ever-larger accelerators that to achieve higher energies, and the question was who would build it. When the early discussions amongst Americans for the next generation of accelerators developed in the late 1970s, they quickly developed definitive plans to build the bigger, more powerful devices. The same early designers knew the costs would be high. Even in the Cold War era of nearly unlimited federal support for fundamental physics research—virtually immune from public reactions on the pretext of national security—physicists recognized that the ballooning costs of the next big accelerator could be more than one country could shoulder. This unprecedented scale of the project in costs, management, and publicity fundamentally characterize what became the SSC and its ultimate failure.

As the SSC planning began in earnest in late 1983 under the Central Design Group, the earliest cost estimates placed the SSC at \$3 billion, using a cutting-edge design to reduce materials. This number was an order of magnitude greater than the largest accelerators in the US such as Fermilab

in Chicago, the Stanford Linear Accelerator Center (SLAC), or the Isabelle collider at Brookhaven. As the cost estimates rapidly grew to account for delays in developing the crucial superconducting magnets, funding the emerging bureaucratic structure, and the eventual adoption of a more conservative and thus more expensive design, the question of funding became of central importance. President Reagan eventually threw in his support of project in 1987 as a way to preserve American scientific prestige.

Beyond these initial challenges, the SSC project began to face increasing tensions with forces outside of the physics community. The site selection process was contentious; rather than choose an existing lab to expand, a bidding system was enacted to ensure fairness when creating a multibillion dollar boon for the state hosting the lab. Texas in the end won the process for its cost saving measures and promised financial support, beating out the existing lab structure at Fermilab. The highly publicized, and politicized, site selection began the most serious public scrutiny of the project, especially its rapidly growing costs. Additionally, the managerial structure of the project faced three key challenges: the lack of continuity with the original Central Design Group, physicists' lack of familiarity with managing multibillion projects, and the close oversight and control exerted by the DOE for much of the project's lifespan. Lastly, the lack of international support for the project stemmed from increasing financial commitments, especially to CERN's projects directly competing for high energy physics funding, and the nationalistic rhetoric that presented the

SSC as an American endeavor. As the total estimated budget approached \$10 billion, congressional support reversed, and the project became the target of cost-cutting measures. The SSC was officially terminated in 1993.

The authors have contributed significantly in a book containing nearly three decades of work. The project encompasses the dizzyingly bureaucratic array of institutions and individuals vying for collaboration and primacy. Their individual efforts to document the SSC, beginning at the time of the project's inception, combines their accounts with those of over one hundred scientists, politicians, government officials, industrialists, reporters, and others to provide an expansive view of the project. Kolb and Hoddeson both worked on documenting the SSC from the beginning, as Fermilab's archivist and historian respectively, and Riordan had independently studied the project before the three began collaborating in 1994. Amongst the greatest strength of this study is the clear identification and characterization of these competing forces and institutions at the heart of the project. As other reviews have mentioned, though, the conclusions of the authors are at times repetitive. This book offers a specifically science historical view of the SSC that is accessible to a broad audience, adding to Kevles' politically-oriented history and Wojcicki's account as a physicist on the project. *Tunnel Visions* captures the immense scale, planning, and tensions of modern physics laboratories as it traces the downfall of one of the largest scientific enterprise in history.

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Dan Bouk. *How Our Days Became Numbered. Risk and the Rise of the Statistical Individual*. Chicago: The University of Chicago Press, 2015. 294 pp. 40,00 \$. ISBN 978-0-2262-5917-8

L'étude socio-historique des phénomènes de quantification s'est concentrée jusqu'ici pour une bonne part sur le développement de la statistique publique. Dans cet ouvrage, Dan Bouk s'intéresse pour sa part aux formes de quantification associées au développement de l'assurance-vie et des corporations privées offrant ce produit financier, dans les États-Unis de la fin de la guerre civile à la Grande Dépression. Dans le contexte instable et perturbant d'une nation en voie d'industrialisation, nous dit Bouk, l'assurance-vie pouvait apparaître comme une réponse à l'incertitude et à l'insécurité. Mais sa mise en place supposait que les dangers auxquels étaient exposées les vies des Américains soient redéfinis, pensés, puis calculés en tant que « risques » susceptibles de marchandisation, transformant du coup les sujets de cette opération en « individus statistiques ». C'est à l'histoire complexe, multiforme et cahoteuse des enjeux, des conflits, des débats et des outils entourant cette marchandisation de la vie sous forme de risques — d'où la combinaison de la mort et des nombres dans le titre : « comment nos jours sont devenus comptés » — que nous convie l'ouvrage de Bouk.

La première partie de l'ouvrage (chapitres 1 à 4) est organisée autour des principales opérations par lesquelles les assureurs ont cherché à construire et estimer le risque et qui

sont désignées sous les vocables de « *classing* », « *fatalizing* », « *writing* » et « *smoothing* ». Ainsi, parmi les problèmes que posent ces opérations, on peut mentionner les suivants : Quand il s'agit de définir le risque (et les primes), l'attention doit-elle porter sur les individus et leurs particularités, sur les groupes au sein desquels on peut les ranger ou sur des moyennes générales établies à partir d'un très grand nombre d'individus? Dans quelle mesure les données relatives au passé démographique d'un groupe (par exemple, la vie des populations noires à l'époque de l'esclavage) peuvent-elles servir à prédire l'avenir de ce groupe? Comment recueillir, enregistrer, compiler et interpréter l'information recueillie par les agents auprès de millions de clients potentiels? Comment, enfin, traiter mathématiquement cette masse de données afin de fixer les primes, d'établir les dividendes et d'assurer aux firmes un taux de retour sur l'investissement? Dans les débats et les luttes que génèrent ces opérations, on voit s'affronter des groupes professionnels, par exemple des médecins initialement formés à l'examen des corps individuels et au pronostic vital à des actuaires raisonnant sur de grands groupes à l'aide du calcul des probabilités, mais aussi les firmes d'assurance à des régulateurs publics cherchant à limiter les pratiques discriminatoires ou prédatrices.

C'est d'ailleurs une intervention des régulateurs publics – l'enquête Armstrong tenue au tournant du 20<sup>e</sup> siècle dans l'État de New York et visant la « corruption » (salaires démesurément élevés des dirigeants,



formation de trusts financiers, versement de pots-de-vin aux législateurs, etc.) résultant du cumul de sommes d'argent astronomiques entre les mains des principales compagnies d'assurance-vie – qui contraignit celles-ci à réformer certaines de leurs pratiques et à réorienter partiellement leurs activités. La deuxième partie de l'ouvrage examine les nouvelles formes de « bio-pouvoir » (au sens de Foucault) mises en place dans les décennies suivantes et qui culminent dans la création du système national de sécurité sociale à l'époque du *New Deal*. Entretemps, les compagnies d'assurance s'engagent aussi bien dans la promotion de la santé publique, par exemple avec l'économiste Irving Fisher dont les compétences statistiques sont mises au service d'une croisade en faveur d'une vie plus longue et plus hygiénique, que dans les débats entourant les restrictions à l'immigration. Dans ce dernier cas, il est intéressant de noter que les assureurs défendent, sur la base des nombres qu'ils construisent, la position qui sera défaite – celle de l'ouverture des frontières – en s'opposant à toute discrimination entre groupes d'origine « blanche ». En même temps, leurs catégories étant structurellement fondées sur une distinction de couleur, une telle position ne pouvait que consolider la discrimination dont était victime la communauté noire aux États-Unis. Ainsi, même si une compagnie comme la *Metropolitan Life* assurait pas moins de 20% de la communauté afro-américaine, le fait que la race constitue un critère de classement des polices assurait que celles détenues

par des Afro-Américains seraient de qualité inférieure (plus chères ou moins avantageuses). Du point de vue de l'histoire des sciences, il est important de noter que, durant cette période, les compagnies d'assurance-vie, et particulièrement la *Metropolitan*, devinrent des lieux importants de la recherche statistique et démographique. Les masses énormes de renseignements compilés sur leurs clients constituaient un trésor incomparable, que des statisticiens d'envergure comme Alfred Lotka et Louis Dublin surent exploiter, développant du coup des concepts comme le « vrai taux d'accroissement naturel », fondé sur la prise en compte de la structure d'âge d'une population.

Avec l'avènement de la sécurité sociale, la construction du risque se déplace du terrain de la vie biologique à celui de la vie économique, à propos duquel il devient apparent qu'on dispose de beaucoup moins de données numériques. Mais l'importation des techniques développées dans le contexte de l'assurance-vie et l'approfondissement de la « statistisation » des individus permettront de franchir ce pas. Au début du 21<sup>e</sup> siècle, l'apparition de l'expression *Big Data* signale que cette statistisation et cette surveillance ont pris des proportions inimaginables il y a peu. L'ouvrage de Bouk, en historicisant et en contextualisant une période charnière dans l'histoire du calcul du risque, nous offre à cet égard un point d'appui pour penser ces développements plus récents.

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Marc Vallières. *Le Québec emprunte : Syndicats financiers et finances gouvernementales, 1867-1987*. Québec: Éditions du Septentrion, 2015. 432 p. 44.95 \$. ISBN 978-2-8944-8840-9

La dette publique est un instrument de construction et de développement des sociétés. C'est là, entre autres, une des conclusions auxquelles nous mène cet ouvrage qui se veut au départ un historique du rôle joué par les institutions financières dans les finances publiques de l'État québécois. L'auteur développe plusieurs niveaux d'écriture qui viennent satisfaire les appétits tantôt du féru d'histoire, à d'autres moments de celui qui aime la vie politique et, très souvent encore, celui de l'observateur des jeux financiers. Donc, on trouve largement matière à divers intérêts dans cette saga qui débute avec la confédération canadienne pour se terminer 120 ans plus tard en 1987. C'est une période que l'auteur juge suffisamment éclairante pour bien illustrer l'évolution et la maturation financière de l'État du Québec. Comme il est fréquent dans les ouvrages d'histoire, ce livre contient au moins trois niveaux de lecture : l'histoire de l'emprunt faisant défiler les événements successifs qui mènent à l'émergence du secteur financier québécois, l'histoire de l'affirmation de l'État québécois par la voie de la gestion de l'emprunt public et, finalement, l'histoire du rôle et de l'influence des syndicats financiers sur les politiques publiques. Cette dernière étant le motif et la raison d'être du livre.

Le récit de l'action concertée des syndicats financiers et de l'État (gouvernement et institutions) se déroule en trois mouvements qui

correspondent aux trois grands chapitres du livre : le Québec en tant que province canadienne encore sous l'emprise impériale, le Québec qui s'émancipe entre 1915 et 1960, puis le Québec contemporain, celui de la Révolution tranquille. Ces phases successives ont mené le gouvernement à s'émanciper d'une tutelle du marché financier britannique pour fréquenter les marchés européens et américains et, par la suite, contribuer à l'éclosion de la finance québécoise et francophone. Cependant, chacun des mouvements successifs permet d'entrevoir selon Marc Vallières une volonté d'agir différemment des autres gouvernements au Canada. Ainsi, entre 1867 et 1915, le Québec « ... sera le seul à sortir substantiellement du réseau de financement britannique et à le soumettre à une concurrence extérieure. » Ce qui devient alors un élargissement important des marchés financiers accessibles pour l'émission de plus en plus importante des obligations gouvernementales qui va de pair avec les investissements dans les infrastructures. Ces investissements constituent, d'ailleurs, le principal motif de l'emprunt public. Le second mouvement est celui de la période 1915-1960. C'est l'époque des deux guerres mondiales qui du point de vue de la finance internationale va permettre au marché américain d'émerger et de devenir le plus important pour le gouvernement et pour l'autre grande institution en devenir qu'est Hydro-Québec. On y prépare déjà le Québec moderne et contemporain. Les syndicats financiers, menés depuis le début par des chefs de file presque exclusivement

anglophones, commencent à faire de la place à des banques et à des firmes de courtage sous direction « québécoise et française » comme l'écrit l'auteur. Politiquement, le gouvernement du Québec, notamment avec l'arrivée au pouvoir de Maurice Duplessis en 1937, va chercher à s'affranchir de la mainmise des institutions financières anglophones qui dominent depuis toujours les syndicats financiers. C'était là une action d'inspiration nationaliste qui donnera éventuellement des retombées stratégiques au cours de la période suivante. Avec la révolution tranquille, le Québec cherchera à profiter de ses avantages stratégiques que sont d'une part, l'accès aux grands marchés financiers européens et américains et, d'autre part, l'émergence d'institutions financières francophones tant privées que publiques avec la création de la Caisse de dépôt et de placement. Cette dernière va permettre à l'État québécois de se libérer encore davantage des syndicats financiers notamment en ce qui concerne leur influence sur l'élaboration et la gestion des grandes politiques publiques. Les gestionnaires financiers du gouvernement deviennent de plus en plus conscients des abus des syndicats qui, par le jeu de l'achat et de la vente des obligations publiques, faisaient en sorte que le gouvernement payait pour se prêter à lui-même.

Cet ouvrage, en plus de son apport important à l'histoire des aspects les moins connus des finances publiques que sont l'endettement et la gestion de la dette met en lumière des faits indéniables de l'évolution des sociétés modernes et de leurs institutions publiques. Le premier est que la fiscalité

à elle seule ne pouvait permettre de recueillir tous les fonds nécessaires au développement économique, politique, social et culturel. Les grands projets, par exemple, n'auraient pu se réaliser sans le recours à l'emprunt. Il en résulte que les sociétés modernes comme l'est le Québec ont une dette importante et pérenne en raison d'une volonté de se développer et de grandir. L'État est en quelque sorte par ses projets l'accoucheur de certaines des grandes entreprises publiques. C'est un autre fait indéniable que laisse voir l'ouvrage de Marc Vallières que celui du lien entre la pratique du recours à l'endettement public et l'apparition et la maturation du secteur financier francophone et québécois. À l'instar de ce qu'a été Hydro-Québec pour les firmes de génie conseil. J'oserais dire que le géant qu'est devenu aujourd'hui la Caisse de dépôt et de placement du Québec, vu comme le gestionnaire de notre bas de laine, n'aurait pas vu le jour sans la problématique de l'emprunt public et sans la détermination de visionnaires comme l'a été Jacques Parizeau à briser la tutelle des marchés et maisons de notation de crédit.

Au terme de la lecture de ce livre, on aura appris ou confirmé, outre sa genèse et son importance actuelle, plusieurs autres choses concernant la dette publique. Entre autres, dans son récit, l'auteur nous montre le lien entre le parti politique qui gouverne et le choix des institutions financières appelées à se constituer en syndicat. Par exemple, le parti libéral avait une solide affinité avec la Banque de Montréal alors que les conservateurs et l'Union nationale privilégiaient nettement plus la Banque Royale. Les amitiés et les

relations personnelles y étaient pour beaucoup dans l'établissement de ces liens. Les principaux responsables des finances gouvernementales étaient, pour nombre d'entre eux, issus des milieux financiers et, on pourrait supposer qu'ils y retournaient après leurs séjours au service de l'État. Bref, la vision prédominante de la dette publique ainsi que les politiques de gestion de l'endettement gouvernemental ont été grandement

façonnées par les milieux financiers du moins jusqu'à ce que le gouvernement du Québec accède à la modernité et à la souveraineté que lui confère la constitution canadienne. En conclusion, cet ouvrage apporte un élément essentiel à toute discussion sur la dette publique au Québec, à savoir son histoire.

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Dominique Pestre, dir. *Le gouvernement des technosciences. Gouverner le progrès et ses dégâts depuis 1945*. Paris: La Découverte, 2014. 321 p. 42.95 \$. ISBN 978-2-7071-7504-5

Cet ouvrage ambitieux dirigé par Dominique Pestre, historien de la physique, trouve son origine dans le séminaire « La gestion du progrès et des ses dégâts » du Centre Alexandre Koyré, à Paris. De fait, « ce livre a pour point de départ la notion de gouvernement » (7) et toutes ses contributions font un usage intensif de cette terminologie pour cadrer leurs objets dans une perspective « globale » et « historique ». Elles s'appliquent à rendre visible la densité historique et l'architecture matérielle des entreprises de contrôle à l'échelle internationale, pour inscrire les évolutions « technoscientifiques », entendu au sens large des changements de pratiques liées aux nouvelles connaissances et aux possibilités technologiques, dans une profondeur à la fois temporelle et géographique. La suite de ce compte-rendu revient d'abord sur le projet théorique explicité dans l'introduction et en conclusion, puis propose une discussion croisée des contributions.

L'introduction rédigée par Dominique Pestre définit un programme de recherche. Il propose de dépasser une « relative insatisfaction » face à certaines perspectives empruntées par les études sur les sciences (STS) en privilégiant contre le souci descriptif des contextualisations, dont ce courant a pu abuser, un retour lucide et désenchanté des rapports de force. Tout en lui reconnaissant une capacité à rendre visible la diversité des

pratiques, Pestre lui reproche, au moins pour sa forme « mainstream », une trop forte insistance sur la « coproduction », une trop grande confiance dans la souplesse des formes sociales, et trop peu d'attention aux effets systémiques et structuraux. « Il faut garder la dimension d'horizontalité chère aux études sur les sciences, l'idée de la nappe et des flux de personnes et d'instruments qui font le social, mais rien n'autorise à oublier le poids central des formes verticales, des 'conventions' héritées et qui pèsent, ou de la pensée stratégie du contrôle » (11). Cette remontée des structures consiste surtout à prendre en compte les grandes dynamiques de fond qui traversent la seconde partie du 20<sup>e</sup> siècle, et qui encadrent et façonnent les usages des technosciences. L'entrée par la notion assez plurielle de « gouverner », entendu à la suite de Peter Millet et Nikolas Rose comme « la matrice historiquement construite à travers laquelle sont articulés tous les rêves, projets, stratégies et manœuvres d'autorités qui cherchent à orienter les croyances et les comportements des autres dans des directions désirées » (13), est au service de cette enquête sur les structures multiples qui sous-tendent les phénomènes de pouvoir. Dans la conclusion, très utile comme récapitulatif de ces transformations multi-niveaux sur plusieurs décennies, Pestre liste la multitude de ces tendances, celles de grandes ampleurs comme les transformations successives de l'économie mondiale, mais aussi celles plus sectorielles comme la transformation du secteur de la recherche biomédicale.

Mis à part la dernière contribution

de Pestre sur le néolibéralisme, qui correspond davantage à une clarification analytique de la notion, les sept autres chapitres, très denses historiquement, s'emploient à retracer le gouvernement du progrès sur une thématique délimitée avec l'ambition de saisir sa dimension globale. Ces thématiques sont celles des substances chimiques toxiques (Nathalie Jas), de la santé publique, avec un focus sur la lutte contre la tuberculose (Jean-Paul Gaudillière), de l'environnement, à travers la représentation du globe terrestre (Yannick Mahrane et Christophe Bonneuil) et du climat (Stefan Aykut et Amy Dahan), des politiques agricoles de la révolution verte (Lise Cornilleau et Pierre-Benoît Joly), de la gestion des ressources d'eau (Sarah Fernandez) ou encore d'un instrument de gouvernement central dans les interventions environnementales, l'analyse coûts-bénéfices (Soraya Boudia). Ainsi, plusieurs contributions se concentrent sur la genèse et le développement de dispositifs particuliers : c'est ainsi le cas de l'instrument d'analyse coûts-bénéfices dont on suit pas-à-pas sa diffusion de la RAND Corporation vers l'OCDE et dont on constate l'écart qui se creuse entre sa théorisation et ses usages concrets ou celui du concept de « révolution verte » visant à mettre l'innovation agronomique au service d'un renforcement de la productivité.

Chacun de ces thèmes est abordé à travers une scansion chronologique qui marque les évolutions et les ruptures. Cette dimension temporelle est plus ou moins au cœur du propos, suivant que la problématique abordée par les auteurs privilégie une narration

historique ou une problématique plus spécifique. Ainsi, Fernandez se concentre surtout à lister les politiques et les régulations autour de l'eau. À l'inverse, Mahrane et Bonneuil développent une analyse fortement problématisée sur le développement d'un « environnementalisme de marché » lié à un « nouveau régime de gouvernabilité néolibérale de l'environnement » dont la genèse débute par les premières alertes environnementales et d'une convergence entre les enjeux de croissance et d'environnement qui vont faire entrer les mécanismes de marché dans les stratégies de conservation. À chaque fois, la focale d'analyse saisit les grandes mutations internationales, les conventions, normes, interventions, qui dépassent les frontières nationales, à l'exception peut-être d'un souci particulier des États-Unis qui compte tenu de son rôle hégémonique se voient accorder un traitement particulier. Malgré cette échelle internationale, le niveau d'analyse s'attache à intégrer le niveau individuel des acteurs engagés dans ces multiples comités et les événements qui influent sur le cours de ces structures. L'existence de critiques et de résistances sont ainsi intégrées aux explications multi-niveaux que développent les auteurs, et plusieurs insistent sur les écarts qui peuvent se produire entre les objectifs affichés des dispositifs et les effets de ces tentatives de gouvernement, rappelant l'écart possible entre les annonces discursives et les transformations matérielles de l'ordre des choses.

La réunion de ces contributions constitue une somme très riche qui satisfait à l'ambition de

mettre en perspective historique des transformations à l'échelle internationale. La lecture de ces études de cas fait apparaître très clairement le rôle de certaines dynamiques – en premier lieu le développement des instruments de marchés et la privatisation des formes d'intervention – et des organisations récurrentes, que ce soit à l'échelle nationale l'Environmental Protection Agency (EPA), ou à l'échelle internationale avec l'ONU, la Banque Mondiale, et les ONG de protection comme le WWF. Les contributions rappellent aussi la nécessité d'intégrer une multitude de facteurs indépendants dans l'explication des transformations globales, ainsi que Pestre le souligne dans le cas du capitalisme : « les transformations du capitalisme, si on les prend dans leur épaisseur, dépendent de beaucoup trop de choses pour être comprises à partir d'une seule causalité » (266).

Quelques remarques peuvent être faites, qui n'enlèvent rien à l'importance de cet ouvrage. D'abord,

le lecteur trouve assez de peu de clarification sur la manière dont le global vient travailler le local, même si suivant les contributions cet aspect est abordé dans des cas concrets, et ce qui caractérise justement cette échelle globale en dehors du statut international des organisations engagées. Ensuite, il faut remarquer une focalisation assez forte sur le bloc occidental de cette histoire globale, qui ne s'intéresse pas aux formes de gouvernement où les États-Unis seraient absent. Enfin, si le projet théorique affiché en introduction souligne certaines limites des *sciences studies*, il évacue un peu vite les perspectives d'autres courant sociologiques qui conceptualisent ces structures et ces rapports de force. Ce faisant, l'ouvrage participe moins à initier un nouveau programme théorique qu'à contribuer à développer par des études de cas une histoire des régulations internationales de l'environnement et des technologies.

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Mourad Djebabla-Brun. *Combattre avec les vivres: l'effort de guerre alimentaire canadien en 1914-1918*. Québec: Les éditions du Septentrion, 2015. 477 pp. 39,95\$. ISBN 978-2-8944-8838-6

Du fait de la prolongation des hostilités, de la perte de régions agricoles en France et en Belgique et de la guerre sous-marine, du fait aussi de la dépendance britannique en vivres importées depuis plus d'un siècle, la position de fournisseurs de produits alimentaires du Canada devient stratégique en 1915. Même après l'entrée en guerre des États-Unis et en comptant avec les achats chez des neutres comme l'Argentine, le Canada reste le mieux placé pour fournir les Alliés en denrées de toutes sortes. Cela bien sûr doit être concilié avec le fait que si le pays a de l'espace cultivable à revendre, il est peu peuplé et fournit des contingents de soldats appréciables, ce qui diminue la main d'œuvre disponible et cause de l'inflation. Tel est le problème étudié ici.

Monsieur Djebabla-Brun donne une réponse impressionnante par l'étendue de la recherche. Il ne manque pas d'ambition : « Notre prétention est de combler un pan entier de l'historiographie canadienne de la Première Guerre mondiale en proposant une vision nouvelle et originale de l'expérience et des répercussions du premier conflit mondial au Canada, en particulier à la campagne (production agricole) et dans les assiettes des Canadiens (consommation alimentaire) » (14).

La matière est divisée en trois gros chapitres. Le premier, chronologique, présente les campagnes de production

année par année, de 1915 à 1918 (en 1914, la récolte est en cours). Ces pages sont particulièrement intéressantes pour le généraliste. Les premières interventions, autres que la propagande pour l'accroissement de la production, furent des prêts pour les semences (mars 1915) et la formation du Wheat Committee (novembre 1915). En effet, l'abondante récolte de cette année-là n'avait pas trouvé immédiatement preneur – l'encouragement à surproduire avait pleinement réussi –, si bien que, comme on avait négligé les moyens de transport, 60% des exportations durent transiter via les États-Unis. Le comité devait voir à ce que cette situation ne se reproduise plus et à ce que les achats alliés et la production canadienne s'équilibrent mieux. En 1916, ce fut l'inverse, une récolte de blé décevante; d'ailleurs, le sommet de 1915 ne sera plus approché du reste de la guerre. D'où pénurie relative et inflation. Inflation dont on ne s'était pas occupée jusque-là, ce qui fait qu'à partir de la seconde moitié de 1917, les prix de gros seront régulés par le nouveau Board of Grain Supervisors.

Les second et troisième chapitres, thématiques, portent sur les années 1917-1918. Dans la deuxième partie, la moins intéressante, on nous explique la difficulté à concilier la demande de produits agricoles avec celle de plus en plus intense pour les hommes, y compris le dilemme de la conscription. Dans le troisième chapitre, on rentre vraiment dans le thème, car l'on y expose les politiques d'économie, c'est-à-dire l'appel des autorités à la diminution de la consommation intérieure et la lutte contre le gaspillage, ce qui implique notamment une action



de propagande visant les ménagères. Ceci, c'est étonnant, sachant que dans le Canada de la Première Guerre mondiale il n'y a pas de cartes de rationnement, même si, par exemple, le fédéral force les meuniers à produire une « farine de guerre » (388-393) pour économiser le blé. Car la politique en vigueur depuis le début de la guerre, confirmée en 1918, est d'augmenter la production sans rationnement. Or si, pour continuer avec l'exemple du blé, le prix de gros est maintenant contrôlé, il est fixé à un niveau élevé, à 2,21\$ le boisseau en 1917 et 2,24\$ en 1918, alors qu'il n'était que d'environ 1,07\$ avant 1916 (65). Ce prix élevé devait assurer l'intéressement à la production et de l'exportation.

Plutôt que de réguler la consommation de manière coercitive, l'on pratique la pédagogie et de la propagande, incitant les consommateurs à manger autrement. L'approche fonctionne assez bien avec le poisson, dont la consommation double grâce à l'expédition par wagons frigorifiques vers le centre du pays. On régule aussi la consommation dans les lieux publics, par exemple avec des jours sans viande dans les restaurants. Reste que globalement le gouvernement a opté pour l'incitatif plutôt que le normatif. Pour cette raison, l'inaction en matière de contrôle des prix du premier contrôleur des vivres (juin 1917) est contestée, ce qui force son titulaire à la démission en janvier 1918. Mais même après que l'organisation soit réformée le mois suivant, la politique ne change pas vraiment. Un vice fondamental était que ces contrôleurs ne pouvaient interférer avec les décisions du Board of Grain

Supervisors. Il n'y avait pas d'approche intégrée pangouvernementale. L'action des bureaux reste en-deçà des équivalents européens, d'autant qu'ils sont souvent à la remorque de décideurs américains comme Herbert Hoover. Ce sont les meilleures pages du livre.

Si les consommateurs se plaignent de hausses de prix indues, d'autres accusent les milieux de l'industrie alimentaire de profiter de la situation. C'était évidemment le sujet explosif déjà bien exposé par Michael Bliss dans son étude du cas Flavelle.

À long terme, l'expérience de 1914-1918 va conduire à une politique bien moins libérale en 1939-1945, avec rationnement et sacrifices considérables tôt dans la guerre, en maîtrisant l'inflation par une épargne plus forcée que dans le conflit précédent, tout en évitant les gros scandales. Vu dans cette perspective, l'expérience difficile du premier conflit mondial prend de l'importance. Djebabla-Brun est totalement dans le vrai lorsqu'il remarque « que l'administration fédérale était alors petite et inexpérimentée » (331), ce qui permet de comprendre le manque de coordination intra-gouvernementale et l'attitude réactive, dont on commence à sentir les limites en 1917. Le développement des prérogatives du fédéral à partir de 1917-1918 (on pense aussi à l'impôt direct) est l'héritage de cette gestion improvisée de l'économie de guerre.

Le sujet est immense, aussi l'auteur a fait le choix de privilégier l'action fédérale dans trois provinces, le Québec, l'Ontario et la Saskatchewan. Le choix de cette dernière s'explique par son rôle central dans la production de

céréales, et du blé en particulier : elle fournit 60% de la production nationale (35). Mais notre auteur s'occupe peut-être trop du blé, car la progression de l'avoine est remarquable et celle du bétail régulière et vigoureuse (je suis ici les tableaux de l'annexe 2), ce qui traduit en partie la nécessité d'époque de nourrir les nombreux chevaux sacrifiés à l'armée, et celle d'assurer une alimentation en protéines suffisantes des civils et militaires en Europe.

C'est d'une histoire politico-économique dont il s'agit ici et les sources consultées en font foi : d'abord des journaux et périodiques (et les résumés de la *Canadian Annual Review*), les brochures d'information du ministère fédéral de l'Agriculture et, pour ce qui est des archives, le Fonds Borden, ainsi que quelques références aux documents de la session et aux papiers du sous-ministre de l'Agriculture. Malgré tout, le poids des journaux parmi les sources étonne, s'expliquant peut-être par le fait que la propagande, qui demeure tout au long le point focal du livre, passait avant tout par la presse. La minceur

de la recherche bibliographique est frappante pour un livre aussi long. C'est ainsi que le principal ouvrage québécois sur le problème étudié dans le troisième chapitre, la consommation, celui de Marcelle Cinq-Mars, n'est même pas mentionné.

Les chapitres sont touffus, ce qui rend l'absence d'index gênante. J'ai l'impression que l'auteur était aussi zélé que peu dirigé. Au fond, on a ici le résultat d'un plan de recherche : tout. Les résultats eussent gagnés à être présentés selon un plan de rédaction plus serré, quitte à sacrifier 100 ou 200 pages de détails et de répétitions. Le livre, plein de renseignements utiles, souffre non seulement d'inflation, mais également d'une correction défailante, où les impropriétés abondent. Dommage que les difficultés de forme rendent peu digestes les découvertes de l'auteur, pas toutes originales comme il le prétend, mais bien documentées. Au final, la somme des renseignements impose le respect.

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David Kaiser and W. Patrick McCray eds. *Groovy Science: Knowledge, Innovation and American Counterculture*. Chicago: University of Chicago Press, 2016. 466 pp. \$27. 9780226372914 (paperback)

Anthologies are well-suited to bring together diverse analyses in understudied fields. At their strongest, they unsettle standard storylines, and cohere enough to mark a direction for new scholarship. This is certainly the case in the unique anthology *Groovy Science*, compiled by heavy-hitting historians of science and technology David Kaiser and W. Patrick McCray. In *Groovy Science*, Kaiser and McCray acknowledge that the American counterculture in the 1970s was not antiscience, as the countercultural icon Theodore Roszak opined, but were enamoured with certain kinds of science and technology—what they call the *groovy* kind. The editors clearly define what groovy science is not: it is neither militarized mainframes and missiles built in the large-scale government programs and corporate research lab, nor is it the pursuit of “sterile technocracy” and impersonal “Big Science” (2). *Groovy Science* reveals how the American counterculture not only embraced small-scale, everyday science and technology, but remade what it meant to do science and technology in America after the 1970s in the process.

The book consists of twelve chapters divided into four thematic sections. Kaiser and McCray’s introduction does a helpful job of bringing together the disparate chapters, and positioning them (sometimes cursorily) against Roszak’s portrayal. The best chapters in

the book come from larger manuscripts, and are thoroughly researched and richly footnoted. The conclusion, by American historians David Farber and Beth Bailey, does more to congratulate historians of science and technology for getting the 1970s ‘right,’ than it does to mobilize ‘mainstream’ American historians to think about the scientific worldviews of the American counterculture.

The first section, “Conversion,” traces the transformations in science and technology practices from Pentagon-backed research, when endless cash enabled the expansion of unwieldy government science programs, to more uncharted scientific ventures. Historian of science D. Graham Burnett shows how former military psychologist John C. Lilly’s qualms with his sensory-deprivation research haunted his work on interspecies communication, and eventually, consciousness. Historians Peter Neushul and Peter Westwick chart how Southern Californian aerospace engineers used their knowledge of space-age industrial materials to launch the revolution in “backyard-craftsman” surfboards. In one of the more informative chapters, historian of science Cyrus Mody pinpoints how the economic realities of the Vietnam War forced the Santa Barbara physics department to adapt low-budget curriculum, and develop civilian environmental applications and parapsychology.

The second section, “Seeking,” surveys the spiritual quests of countercultural scientists. Historian of psychology Nadine Weidman explains how humanistic psychologist Abraham Maslow’s revolutionary

theory of human nature appealed to the hippies *and* the Establishment. Though their aims were different, both were drawn to the scientific validity and legitimacy in the study of values and subjective experience. Historian of science Henry Trim identifies the contradictory nature of countercultural scientist John Todd's technologically backed environmentalism. Historian of medicine Wendy Kline documents how the classic midwifery text *Spiritual Midwifery* blended indigenous and medical knowledge, popularizing home birth as a radical alternative to hospital births.

The third section, "Personae," focuses on the gurus of groovy science, those that straddle the divide between scientific experts and countercultural rebel. Historian of science Michael Gordin presents the "antiestablishment science" (210) of the unlikely guru Immanuel Velikovsky, his disapproval by Establishment scientists, and his optimistic embrace by countercultural youth. Historian of science, and editor of the volume, W. Patrick McCray defines Timothy Leary's extravagant transhumanism as a blend of technological utopianism and personal improvement. Historian of science Erika Milam explores how *Playboy's* Hugh Hefner looked to ethology to understand the biological basis of masculinity outside of the family of man, and broadcasted it over the pages of *Playboy*.

The fourth section, "Legacies," identifies the roots of many countercultural ideals that have been absorbed by mainstream practices. Environmental historian Andrew Kirk argues that contemporary sustainability

and architectural design grew out of the experiments of a small group of countercultural designers inspired by Buckminster Fuller. Historian of technology Matthew Wisnioski examines how entrepreneurial journalism defined the virtues of scientific entrepreneurs, helping to remake struggling American engineers into hip experts of innovation.

Anthropologist Heather Paxton shows how countercultural goat farmers, and their unconventional blend of scientific knowledge and craft practices, once statements against mass consumerism, became mainstream.

While meticulous when it comes to the nuances in the different strands of American counterculture and science, unfortunately, McCray and Kaiser's efforts reify *who* can be a groovy scientist. Most chapters still feature white, male (apart from Kline's midwives and Paxton's cheese producers), counterculture scientists. Largely absent are the diverse stories that could help historians of science and technology effectively grapple with the significant changes in scientific practice in the 1970s. There are the numerous scholarly examples set in 1970s that might unsettle the caricatures of the Establishment scientist, including: Alondra Nelson's important work, *Body and Soul*, on the Black Panther party and free medical clinics; Michelle Murphy's more recent work on California feminists and reproductive technologies, *Seizing the Means of Reproduction*; or, even Steve Epstein's older classic, *Impure Science*, on AIDS activists in the 1980s and medical clinical trials. Adding these accounts to this volume would

allow two things: it would identify the tensions and struggles at work within the countercultures, helping to shed the fears of 'lumping' the editors stipulate in the introduction. It would also serve to expand the experiences that count in the history of science, galvanizing larger discussions between science and counterculture(s) that the editors hope for. Nevertheless, this anthology is an

important move towards understanding the changes in science and technology in the long 1970s.

*Groovy Science* will interest American historians and historians of science, technology, and medicine, as well as a general audience concerned with countercultural experiments or cultural histories of scientific practice.

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William Feindel and Richard Leblanc.  
*The Wounded Brain Healed: The Golden Age of the Montreal Neurological Institute, 1934–1984.* Montreal and Kingston: McGill-Queen's University Press, 2016. 632 pp. \$100. 9780773546370

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This exquisitely illustrated and information-packed book chronicles the first half century in the history of the Montreal Neurological Institute (MNI), an institution which, since 1934, has profitably brought together under one roof several medical specialties and scientific disciplines dealing with the brain, just as its founder had envisioned. That founder was neurosurgeon Wilder Penfield, a doctor who occupies a prominent place in Canadian medical history, and not surprisingly, a large part of this book is devoted either directly or indirectly to his work and legacy.

The title of the book is full of meaning and historical significance. It alludes both to an observation made by Galen and to a hope that deeply motivated Penfield's research and came to embody the *raison d'être* of the institution. But as far as titles go, it is also a bit unwieldy. The same can be said about the book as a whole: it is a rich and much needed exploration of the people and research associated with the MNI, but as histories go, it is ungainly, with flow and analysis having been sacrificed to an (impressive, to be sure) attempt at comprehensiveness and detail.

Relying on a large repository of archival material, published primary sources, and first person accounts (but not on history of medicine literature even when directly relevant), the

authors and contributors of the book painstakingly put together a detailed picture of the MNI. The book starts with a prologue that outlines Wilder Penfield's background prior to his move to Montreal, going perhaps into more detail than necessary for a book that focuses on the institute itself. It then covers Penfield's arrival at the Royal Victoria Hospital (RVH), his work there in the sub-department of neurosurgery along nurses, residents, and fellows, and his attempt to lay the foundations of a neurological institute. With local help, as well as financial support from the Rockefeller Foundation, the MNI was built a few years later across the street from the RVH, eventually connecting to the latter via a third-floor bridge, whose construction was quite contentious. In chronological fashion, the book describes the history of the institute over the subsequent decades and the tenure of its first three directors—Wilder Penfield, Theodore Rasmussen, and William Feindel. The chapters cover a dizzying variety of topics: from the features of the neurosurgical training programme to biographies of the visiting fellows; from descriptions of the surgical procedures, new technology, and neuropathological research to stories about the entertainment that followed the yearly Hughlings Jackson Memorial Lecture; from the activity of MNI's staff in England during the war to the institute's trainees' influence on the international scientific and medical scene. Transitions between all these subtopics are often eschewed in favor of dividing the chapters into many short subsections, a fact that gives the book the feel of a reference book rather than a typical work of historical narrative.

One of the most valuable contributions the book makes is to highlight the work of the support staff and the shorter-term doctors and researchers who came to the Neuro (as the MNI is fondly called to this day), rather than focusing exclusively on the names most famously associated with the institute—individuals like Donald Hebb, Herbert Jasper, or Brenda Milner, whose contributions certainly also get excellent representation in the book. The volume celebrates the outstanding work of generations of nurses, of hundreds of research fellows from all over the world, of psychologists like Molly Harrower-Erickson who spent a few years at the institute in the late 1930s, or Dorothy Russell, another woman who in the 1920s cut an unusual figure among neuropathologists also by virtue of her gender. Here, as elsewhere in the book, this reader would have liked to see deeper connections drawn to themes in the history of medicine, like the social and cultural context in which women doctors practiced at the beginning of the 20<sup>th</sup> century. Appealing to directly relevant literature (for instance, a few historians have written about Penfield) would have situated the Neuro even better in the debates and developments that shaped twentieth century medicine. More context and analysis would also have enriched some difficult topics the

book addresses, such as the suicide of Penfield's colleague William Cone.

The book concludes with a section containing four thematic essays written by contributors and covering disparate topics: the architecture of the institute, the history of neurochemistry at the institute, the research and treatment of multiple sclerosis, and William Feindel's professional sojourn in Saskatchewan. As a careful analysis of the process of building the institute, the first thematic essay is particularly fascinating, showing the extent to which Penfield was micro-managing the design, the political wrangling that almost thwarted the whole endeavor, and the inspiration for the architectural plans that make the building, inside and out, a gorgeous space in addition to a functional one.

This book is essential reference for historians interested in Canadian medical history or the history of any topic or person associated with the MNI. Surely, within the pages of this hefty and informative volume there is inspiration to be found for a hundred PhD theses. This volume will undoubtedly stimulate further historical research on a myriad topics associated with an important Canadian medical institution, one that in the past has not always received from historians the attention it so richly deserves.

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