COMMUTING

Issue 02 The Society for the Diffusion of Useful Knowledge August 2018

Dana Prieto, *This end up fragile* (from the series *1:10000*), 2018. Cardboard boxes, mail parcel tags, packing tape, ceramic vessels, wooden boxes. COURTESY THE ARTIST.

commute (v.)
mid-15c., "**to change, transform**," from Latin *commutare* "to often change, to change altogether," from *com-*, intensive prefix, + *mutare* "to change"; "to change, go, move"). Sense of "**make less severe**" is 1630s. Sense of "**go back and forth to work**" is 1889, from *commutation ticket* "season pass" (on a railroad, streetcar line, etc.), from *commute* in its sense of "to change one kind of payment into another" (1795), especially "**to combine** a number of payments into a single one." "**Reduce** (especially a sentence of death) to another less severe one."

The Society for the Diffusion of Useful Knowledge is a serial broadsheet publication produced by the Blackwood Gallery, University of Toronto Mississauga, as part of *The Work of Wind: Air, Land, Sea*, a site-specific exhibition, public program, and publication series designed to expand perspectives on climate change through artistic practices, cultural inquiry, and political mobilization.

The Work of Wind: Air, Land, Sea

Exhibition: 14–23 September 2018
Books: September 2018, June 2019, September 2019
Public Programs: June 2018–April 2019
Broadsheet Series: June 2018–April 2019

The Work of Wind: Air, Land, Sea aims to foster a deeper public awareness of the complex entanglements of ecologies of excess, environmental legacies of colonialism, the financialization of weather, contemporary catastrophism, politics of sustainability, climate justice, and hopeful resilience. It sets out to develop durable visual-cultural literacies and invites publics to create new encounters in the common struggle for a future. The project flows across the city of Mississauga and is distributed locally, nationally, and internationally through a three-volume book series co-published with K. Verlag and *The Society for the Diffusion of Useful Knowledge*, an innovative public program and publishing platform.

***The Society for the Diffusion of Useful Knowledge* (SDUK)**

In order to productively collide with the present crisis, we recognize that ideas cannot be constrained by disciplines. *The Society for the Diffusion of Useful Knowledge* (SDUK) composes and circulates an ecology of knowledge based on the relationship and antagonism of "useful" ideas. The name of this innovative platform is borrowed from a non-profit society founded in London in 1826, focused on publishing inexpensive texts such as the widely read *Penny Magazine* and *The Library of Useful Knowledge*, and aimed at spreading important world knowledge to anyone seeking to self-educate. Both continuing and troubling the origins of the society, the Blackwood Gallery's SDUK platform circulates research, ideas, and debates from a range of exigent discourses and practices, including those among the visual arts, environmental humanities, public policy, political economy, sustainable design, science and technology studies, extinction studies, and the major scientific and cultural debate of a generation—the Anthropocene.

The **SDUK** broadsheet series brings together contributors from diverse fields in the sciences and humanities, students and faculty from across the University of Toronto Mississauga, community organizations and activists, policy makers and policy agitators, artist researchers and speculative thinkers, all to advance new forms of literacy around climate change discourse.

The Work of Wind: Air, Land, Sea
Curated by Christine Shaw
Presented by the Blackwood Gallery in partnership with the University of Toronto Mississauga, the City of Mississauga, and K. Verlag.
2018–2019

The Society for the Diffusion of Useful Knowledge is developed in collaboration with The Climate Change Project (City of Mississauga, Environment Division).

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1:10000

Dana Prieto

1:10000 is an interdisciplinary project stemming from an artistic exploration and geopolitical research on the social and environmental impacts of Canadian mining in Global South communities. The work is currently focusing on territories surrounding Bajo la Alumbrera mine in the municipality of Belén, Catamarca Province, Argentina.

The project involves the creation of a series of ceramic vessels built with clay from Belén and Hualfín (p. 4), territories largely contaminated with arsenic, cadmium, mercury, and sulphuric acids from Canadian mining. The vessels will be later gifted to the CEO and Corporate Social Responsibility executives of Yamana Gold and Goldcorp (cover), both companies currently operating the Bajo la Alumbrera mine.

How to Read this Broadsheet

This SDUK broadsheet takes **COMMUTING** as its theme. Alongside the most familiar usage of "commuting" (moving to and from work), the contributions in this issue touch on many aspects of circulation, migration, and change that are flowing across and rumbling below the surface of the Earth. As this publication platform traces the diffusion of knowledge, this issue in particular explores the shifts, displacements, and movements we must consider in an age of rapid global change in order to commute the Earth's death sentence. We know you open this broadsheet with many questions, interests, and curiosities already formed, so here are a few places to start:

In seeking a fuller picture of what human consumption habits do, many are asking: "**How are local environments impacted by the global circulation of goods?**" Artist projects by Dana Prieto (p. 1, 3, 4) and Sydney Hart (p. 16) trace the effects of commercial flows (Canadian mining operations in Argentina and the opening of the St. Lawrence Seaway, respectively) on landscapes, humans, and non-humans. A contribution from Canada's Waste Flow (p. 23) identifies waste's trajectories and provides opportunities to think beyond the landfill.

Those who are often caught in in-between movements to school, work, and home may wonder: "**How do our daily migrations come to bear on our relationships to each other?**" Contributions by Stanka Radović (p. 18), Fraser McCallum (p. 20), and the City of Mississauga's Climate Change Project (p. 25) ponder commuting culture's realities and technologies, while profiles of CultureLink, Ecosource, Great Lakes Water Walk, the Southern Ontario Centre for Atmospheric Aerosol Research, Toronto and Region Conservation Authority's Multicultural Connections Program, and Walk + Roll Peel highlight other kinds of movement-making and -building.

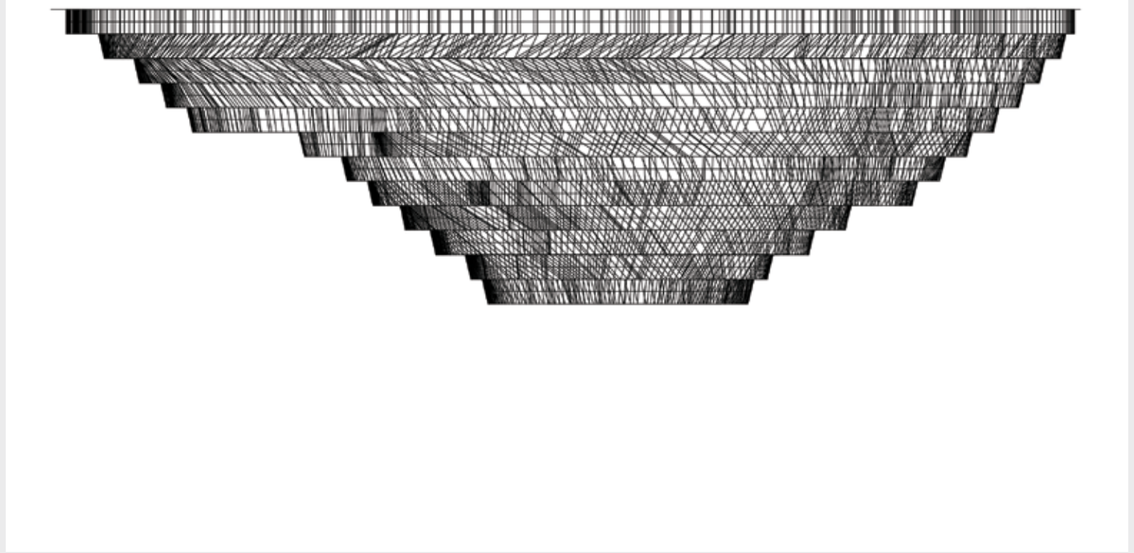
Here on the shores of the Great Lakes, it is our responsibility to ask **what is held in histories of water.** Natasha Naveau's artist project ᶯbbᒥᐅᐁ ᑭᑐ (p. 14) centres the waters of the Humber River in placemaking, Andrea Muehlebach (p. 17) offers propositions for moving beyond the ownership of water, and Harvey Shear (p. 24) outlines a brief history of the Lake Ontario Waterkeeper.

The question of "**where we are seeing the effects of over-accumulation, of the desire to have *more*?**" is taken up in an excerpt from Matt Hern and Am Johal's *Global Warming and the Sweetness of Life* on Fort McMurray and the Alberta tar sands (p. 5), and in D.T. Cochrane's "What is The Market?" (p. 21). Both texts highlight a need to rethink what it means for an economy to balance itself out.

Finally, "**How can we harness our knowledge of natural systems and cycles to predict, adapt, and imagine?**" Satellite images annotated by Kent Moore (p. 7, 13, 19) illustrate the complexity of the climate system, and an artist project by Karolina Sobecka meditates on the social dimensions of cloud formation (p. 8). Michelle Murphy's "Afterlife and Decolonial Chemical Relations" (p. 10) explores how we might grapple with the life cycles of contaminants as they are bound up with the bodily effects of colonization.

Each of *The Society for the Diffusion of Useful Knowledge* broadsheets ends with a glossary—a tool not only geared to untangling the vocabularies of art and science, but also to building and evolving a set of key concepts. While each issue of the broadsheet can be read individually, we are attentive to how these publications and the issues they address might begin to form a network of ideas. This issue's glossary entries expand on those explored in Issue 01: *GRAFTING*, and we encourage you to read across previous (and future) broadsheets.

Dana Prieto, *1:10000 Bajo la Alumbrera*, 2018. Glazed black stoneware with soil contaminated by Bajo de la Alumbrera mine, wooden box, gold leaf engraving. COURTESY THE ARTIST.



Dana Prieto, *3D Model of Bajo de la Alumbrera mine [elevation]* (from the series *1:10000*), 2018. COURTESY THE ARTIST.

Fort McMurray: Dene, Woodland Cree, and Chipewyan territories

Matt Hern and Am Johal

Matt Hern and Am Johal travelled (with graphic journalist Joe Sacco on the first trip) to Fort McMurray, Alberta several times, as well as Lubicon and Janvier territory; their related book Global Warming and the Sweetness of Life: A Tar Sands Tale *was released in March 2018 by the MIT Press. The following is an excerpt of their trip to Fort McMurray and their visit to MacDonald Island Park (aka Mac Island), Canada's "largest community, recreation and leisure centre."*

Hang around Mac Island for a few hours and you'll see rivers of families pouring in and out. Mothers in hijabs shepherding rambunctious kids to their swim lessons. Latinx families chatting away in Spanish as they head to the library. East African teenagers carrying hockey bags. All happy vignettes of Canadian immigration and diversity. One relative newcomer to town, Ana Maria Mendez, had originally been a curator in Peru before landing in Fort Mac with her husband, where she was now working as Manager of Arts and Culture at Mac Island. Her infectious personality gave her a real advantage as she worked with others to skillfully repurpose an empty hallway in the cavernous rec center into an art gallery and exhibition space. Focusing mostly on local artists, the gallery also has a deeply international orientation given the diverse global makeup of the town. She has overseen more than seventy art exhibitions and countless public events, administers a dance program, and is involved in other public art projects in town. She has done all this having only immigrated to Canada in 2009.

It's not just Mac Island; the whole town defies easy portraits. It really is a family town, and a young, prosperous family town at that. Sixty-nine percent of people in town are married (compared to forty-seven percent nationally). Only twelve percent of the town is over fifty-five years old. Almost forty percent of households have kids under the age of six. And more than seventy percent of households make $150,000 or more.[1] These stats are a bit of a distortion because huge numbers of workers fly straight into the camps and straight out, barely registering on any census data or local population surveys. Those folks bring their bodies in and take their commitments out with them when they leave, invisible to the town's deeper workings; but left behind are a significant number of people, maybe even a majority, who are not planning on going anywhere anytime soon.

Declarations of love and fidelity to the town are easy enough when times are bumping. But these stats we just cited are from late 2014 and early 2015, when everything was humming along. We were first there just as the real oil slump was starting, and while we could sense a lot of latent fear and anxiety then, most of it was still speculative, a lot of "Ha ha—yeah, holy shit, it's not good, but it'll pop right back up" sentiments. But prices kept dropping through 2015 and stayed volatile and low through 2016 and 2017. The cheerfulness of the town turned resentful and bitter as layoffs started coming, overtime dried up, debts started piling up, and marriages showed cracks. As Bernard the Roughneck, a patch worker who has emerged as a pseudo-grassroots public booster of pipelines, put it: "Alberta—we feel like that guy that always buys a round at the bar for everyone, and the one time we don't have that cash, no one is willing to buy us a round."[2]

We have no better idea than anyone else: maybe 2018 or 2019, or maybe further down the road, oil prices will leap back up and all will be forgiven. Maybe they'll plunge right down to $10 a barrel. Or maybe, perhaps even probably, we have entered into long period of volatility. Long-range investors, such as managers of pension funds, are no longer viewing oil and gas as a stable investment. Major foundations like Rockefeller and many others are actively divesting from fossil fuels and establishing fossil-free funds as investment vehicles.[3] The continuum of volatility is built into the DNA of capitalism, and creative destruction is part and parcel of its operating principle. Capitalism attempts to absorb the extreme swings of global warming into its own logic as a justification for its own repetition. Capitalism reproduces volatility in the climate just as much as in markets.

Through 2016 and early 2017 the world was awash in oil. Production and consumption continued to plow along at spectacular levels, in part owing to OPEC's willingness to open the taps and let their members produce as much as possible, and with any luck push the extreme or unconventional producers—the shale, the tar sands, the frackers of the world—out of business. It was an old-school price war, and OPEC (led by Saudi Arabia) was hoping that by flooding the market with cheap oil, they would be able to capture enough market share to suppress competitors sufficiently to keep them under control. This strategy is so effective because OPEC, and particularly Saudi oil, can be produced so much more cheaply than unconventional sources.[4]

Eventually, prices have to head back up. At least, that's what we heard one night at the bar when a petroleum engineer convinced us that all would be well soon. We had been spending a lot of time at that bar in downtown Fort Mac and we got introduced to a youngish guy who worked for Suncor and was very eager to talk to us.

He was generous with his time, and we really appreciated his willingness to talk with us. Let's call him Brad. He looked the part: twenty-eight years old, but could have passed for forty-five. Pastel polo shirt. Stylish hair. Very happy to trade golf tips back and forth with Joe. Finished his engineering degree in 2010, looked around for a while in Ontario, couldn't find anything; so he made his way to Alberta and quickly found himself in the Mac. He intimated that he was making piles of cash, but never said how much, and we never asked. The man was thrilled, *ebullient* about how things had worked out for him (especially financially), and he was eager to share his investing strategy: "Invest everything, like all of it, like *every* last bit, in oil." He had paid off his house and was taking all the surplus capital he could find and was reinvesting it back in the industry. Prices were low, so all the better, he reasoned. "Q2 2016, it is going to be right back up again to $80. Just watch." We took some careful notes.

We probed him about global warming and the kaleidoscopic environmental and social reverberations of the tar sands. Brad is a smooth one. He said all the right things: "Sure it's an issue, but the Alberta tar sands are rigorously regulated by multiple layers of government. And we welcome that regulation because we want to be as

conscious and environmentally sensitive as possible." His logic was straightforward: Foreign oil is dirty and unmonitored and supports authoritarian governments. Coal is worse for the environment. And really, if you look at it, the tar sands, even at their worst, are just a drop in the bucket. He easily answered all our questions, happily untroubled by much doubt.

Honestly, it was hard not to believe him. The three of us left that conversation thinking Brad had performed brilliantly in his able defense of his industry and adopted hometown. He had painted a picture of oil powering our world for generations, with a mostly benevolent, or at least willingly regulated, industry that would continuously improve safety and emission standards while Canadian liberal tolerance would lead the way. And every major political actor, provincially or nationally, across the ideological spectrum, agrees with Brad. As he said: the oil is there; it must be taken out for our collective economic well-being. Recently elected Canadian governments—Rachel Notley's NDP in Alberta and Justin Trudeau's Liberal majority running Canada—are seemingly progressive and yet both leaders and parties are entirely behind the oil industry, lobbying hard for pipeline building and fossil fuel export expansionism (while at the same time ushering in tepid but well-marketed climate change policies). The state is very firmly on Brad's side. The state sure isn't going to leave those barrels of oil in the ground.

The Canadian economy is so deeply wedded to the oil industry that the routes to disentanglement are bewildering: The energy sector makes up roughly ten percent of Canadian gross domestic product.[5] Energy accounts for roughly one-quarter of Canada's exports.[6] It's a lot more pronounced than that in Alberta, where "the energy sector makes up nearly thirty per cent of the Alberta economy. Direct revenues from energy royalties account for more than twenty per cent of the provincial government's revenue base—and that's before we even get started on the big slice of the corporate and personal income tax pie that the sector delivers."[7] Even those estimations don't reveal the full depth of the extractive sector's direct and indirect economic influences: "One-third of all Toronto Stock Exchange-listed companies are resource related, and another third are financial with heavy exposure to the resource sector."[8] Virtually *everything* is directly or indirectly (via transportation or plastics or whatever) bound up with extractive fuels, and this is true in every part of the globe, to greater or lesser extents.[9]

So is it true, as Brad says, that we have no choice? Is the only option just to double and triple down on oil and gas and hope for the best, because there really are no alternatives, or the alternatives are basically unthinkable? That's exactly the language politicians the world over use, because the (short-term) consequences of anything else are considered to be too brutal.

Maybe those choices are being made for us by the erratic economics of oil. The volatility of the Canadian dollar is largely attributed to the oil and gas sector. When oil prices are high, the dollar becomes artificially inflated and negatively impacts manufacturing and tourism. When oil prices are low, the dollar crashes. And when prices stay low, the oil and gas industry sheds workers across the world at a startling rate. Stories blanket the media landscape of layoffs from North Dakota to Alaska, Russia, Venezuela, Alberta, and everywhere in between. Economic projections in every jurisdiction are repeatedly battered by cheap oil. Industry is spinning hard, hoping that the new realities of extractive economics are somehow positive, giving us a chance to tighten belts, increase competitiveness, redouble R&D. Governments chirp about how economies now have an opportunity to "rebalance" and "rebrand," to shift to more stable and dependable revenue sources, that global warming is really a great opportunity for capital.

This brings us back to the relationship between tradition and change, and the proposition that *this changes everything*. What has to change is the incipient, roiling, twitching anxiety that informs our colonial relationships with development and progress, locking us all into highly limited sets of possibilities. Affirmative routes forward cannot simply resist and ultimately mirror extractivist ideologies; they must articulate and construct something new, something else. Those visions have to be able to speak directly to the hundreds of thousands of employees who are dislocated by oil sector shocks, and everyone who is thrown back and forth by the capriciousness of global capital: rolling in cash now, scrambling and buried in debt tomorrow. Alternatives to development cannot be nostalgic; they have to be able to overcome corporate promises of yet another F350 truck, one more casino-themed vacation, and a house that's just a little bit bigger.

Those affirmative visions have to surpass the dispiriting, constant hustle for more and *still more*, with compelling renditions of resurgent social relations. An ecological future has to answer the seductive promises of capital, to imagine our lives and land beyond profit, beyond domination. If we can find ways to relate with the other-than-human world that are not saturated with exploitation, then new articulations of sovereignty and alternatives to sovereignty start presenting themselves, and new forms of life become believable. That sounded right to us, but we needed to see and smell and taste that more clearly. How can that vision be forged into a believable argument, an argument that a tar-sands worker with a shitty mortgage, a family, and no job back home might take seriously? How can land rematriation be articulated as a fulcrum for a better world for all of us? We needed to get out of the Mac to clear our heads, to look for other ways of thinking about these questions. So we clambered back into our dusty, mud-ravaged SUV and headed west across the province, aiming for Lubicon Territory.

1 Peter Scowen, "From Boom Town to Family Town: Meet the Real Fort McMurray," *Globe and Mail*, 12 June 2015, http://www.theglobeandmail.com/news/alberta/meet-the-real-fort-mcmurray/article24915022.

2 Bernard is a Vancouver-raised millennial trying to pay off student loans by working in the tar sands: "Please, not just for me, but the guys who have kids and are losing their marriages." Quoted in Elizabeth McSheffrey, "'Put Me Back to Work' Pleads Struggling Kinder Morgan Pipeline Supporter," *National Observer*, 23 August 2016, http://www.nationalobserver.com/2016/08/23/news/put-me-back-work-pleads-struggling-kinder-morgan-pipeline-supporter.

3 Rockefeller Brothers Fund, "Divestment Statement," *Rockefeller Brothers Fund*, 3 March 2017, http://www.rbf.org/about/divestment.

4 In 2016, the tar sands, with some variance from project to project, needed oil prices to stick somewhere above US$50 a barrel to break even and prices well above that to make profits. See Yadullah Hussain, "How High Break-Even Costs Are Challenging New Oilsands Projects," *Financial Post*, 22 January 2015, http://business.financialpost.com/news/energy/how-high-break-even-costs-are-challenging-new-oilsands-projects.

5 In 2014, its direct contribution to GDP was 9.8 percent: https://www.neb-one.gc.ca/nrg/ntgrtd/mrkt/vrvw/archive/2014/index-eng.html.

6 See the National Energy Board's statement that in 2014 energy accounted for $128.7 billion CAN in exports: https://www.neb-one.gc.ca/nrg/ntgrtd/mrkt/vrvw/archive/2014/index-eng.html.

7 David Parkinson, "Panic Time: As Oil Goes, So Does Canada's Economy," *Globe and Mail*, 15 October 2014, http://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/panic-time-as-oil-goes-so-does-canadas-economy/article21116012.

8 Dale Jackson, "How OPEC Is Likely Ruining Your Retirement," *Globe and Mail*, 29 October 2015, http://www.theglobeandmail.com/globe-investor/how-opec-is-likely-ruining-your-retirement/article27016937.

9 "According to market research by IBISWorld, a leading business intelligence firm, the total revenues for the oil and gas drilling sector came to [USD] $5 trillion in 2014. This sector is composed of companies that explore for, develop and operate oil and gas fields. It is also sometimes referred to as the oil and gas exploration and production industry, or simply as E&P. Since the 2014 estimates for global gross domestic product range between [USD] $77 trillion and [USD] $107 trillion, the oil and gas drilling sector makes up between 4.6% and 6.5% of the global economy." Investopedia, http://www.investopedia.com/ask/answers/030915/what-percentage-global-economy-comprised-oil-gas-drilling-sector.asp; see the original report here: https://www.ibisworld.com/industry/global/global-oil-gas-exploration-production.html.

Clouds and Complexity: Viewing the Earth from Space

Kent Moore

Satellites have been used for over 40 years to provide data and images of the Earth's surface and atmosphere. These images are from a pair of NASA polar-orbiting satellites, Terra and Aqua, that fly the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument. These satellites provide coverage of the entire globe, unlike geostationary satellites that image only the tropics and mid-latitudes. As a result, polar-orbiting satellites are an important source of data on the high-latitude climate system.

MODIS provides images at a number of different wavelengths that can be combined together in such a way as to mimic what the human eye would see. Thus clouds, snow, and sea ice appear white, while the ocean is dark and vegetation is green. It can be a challenge to distinguish between snow-covered surfaces, sea ice, and clouds, but over time subtleties appear that allow one to make a distinction.

Polar-orbiting satellites image the Earth in narrow swaths and some of the images show multiple swaths, resulting in the appearance of seams. The time between swaths is approximately 90 minutes, and these seams are of interest as they document the dynamic nature of the Earth's cloud cover. The repeated coverage that these satellites provide allows scientists to document the changes that are occurring as the Earth warms. This is especially important for the Arctic, a region undergoing dramatic changes at an accelerated rate compared to the rest of the Earth.

As these examples show, "true-colour" satellite images provide a wealth of information on the climate system, as well as striking views of its beauty and complexity.

All images are from the NASA Worldview website (https://worldview.earthdata.nasa.gov) with additional processing by Professor Moore's group in the Department of Chemical and Physical Sciences at the University of Toronto Mississauga.

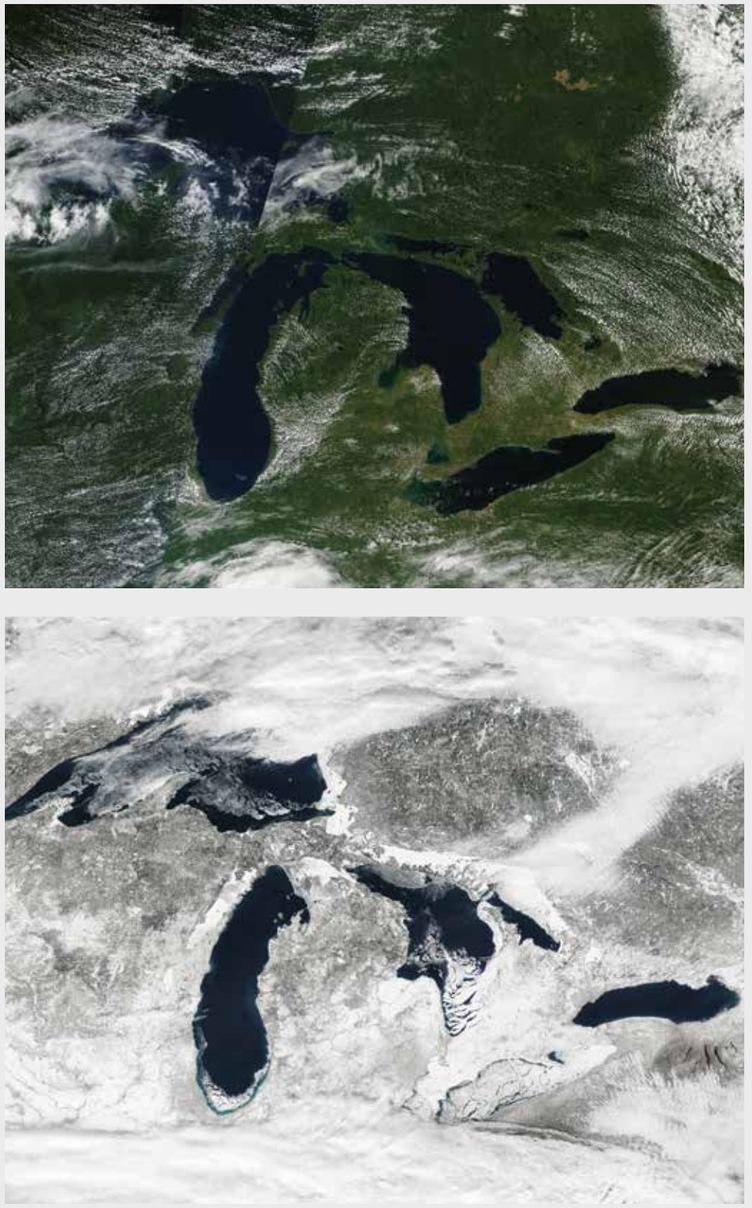


Figure 1

The Great Lakes regions experience dramatic changes between summer (upper) and winter (lower), and summer brings warmer temperatures and a verdant green landscape. Lake temperatures are typically cooler than nearby land, and as a result, clouds tend to develop over these warmer surfaces. They typically resemble puffy cotton balls, and are known as fair weather cumulus clouds. Winter's colder temperatures result in the presence of snow and lake ice across the region—Lake Erie and Georgian Bay tend to be ice-covered, while Lake Ontario is usually not. During the winter, clouds tend to be associated with large-scale weather systems known as extra-tropical cyclones.

A memory, an ideal, a proposition

Karolina Sobecka

In this project, three clouds that changed the world are re-assembled. The material composition of the original clouds is re-constituted, and the conditions necessary for the cloud formation are applied.

The clouds created for this project are models of: a cloud that formed in the past (a memory), a cloud that formed in a lab (an ideal), and a cloud proposed to be created (a proposition). These particular clouds have transformed how we think about climate, technology, and the human command over nature. By examining their material composition and the conditions in which they formed, the project aims to re-think the reality of the geological and social transformations they paved the way for.

Clouds fundamentally acquire characteristics of the ground below them. Particles at the centre of cloud droplets are traces of natural and human activity. Every cloud is thus a material memory of one unique assembly of what David Gissen calls "socio-nature." To paraphrase Gissen, each cloud is more than a sum of gasses, matter and forces: it "contains within it the tragedies and successes of the social transformation of nature that exist wherever human experience appears."[1]

Cloud A (a memory)

Date: 5 April 1815

Location: A volcano known as Mount Tambora erupted in Indonesia, producing a cloud that formed initially over the entire country, then spread along the equator and later to the North and South Poles, covering the globe with a single continuous veil suspended in the stratosphere for months.

Chemical composition: The cloud condensation nuclei in Cloud A are pulverized rock particles emitted from Mount Tambora during the volcano's eruption. They were made of black, glassy, biotite-bearing ne-trachyandesite, a highly unusual rock type. Forty-two cubic miles of this rock was emitted into the atmosphere, along with 55 million tons of sulfur dioxide gas that combined with hydroxide gas in the stratosphere to form sulfuric acid, which condensed into tiny droplets.

Conditions: The concentration of atmospheric CO_2 was approximately 280 parts per million (ppm), what today is considered a pre-industrial level. In 1815, at the brink of Industrial Revolution, that coal output soared: Britain alone produced 23 million tons.

Effects: The immediate effects of the cloud were widespread and lasted several years. It created an agricultural disaster, with food riots and epidemics breaking out throughout Europe. Red and brown snow fell throughout the year in Europe and Asia. The weather presented "the appearance of vast & dreadful desolation" (as Mary Shelley notes in her journal) and inspired many expressions of anxiety and dread, including the literary creations of Frankenstein and Dracula. The use of carmine by artists increased, a reflection of the increased frequency of scarlet sunsets. A century and a half later, scientists discovered that Cloud A caused a climate anomaly, reflecting sunlight back into space and cooling the globe by 0.7–1.3 °F.

Cloud B (an ideal)

Date: 1946

Location: The cloud formed in a "cold box" at the General Electric Research lab in Schenectady, New York. The GE cold box soon became a cornerstone of cloud research, which eventually turned into "Project Cirrus," a weather modification program conducted in collaboration with the Office of Naval Research and the Air Force.

Chemical composition: One hundred grams of dry ice seeded the first cloud created in the GE lab. "Ice-nucleating" particles, such as dry ice, induce water to condense into cloud droplets, and to freeze at higher than normal temperatures, producing precipitation. On 13 November 1946, Dr. Vincent Schaefer and Dr. Bernard Vonnegut (the brother of novelist Kurt Vonnegut) successfully induced rain in a cloud —"an unsuspecting cloud over the Adirondacks"[2]—and the results were dramatic enough to warrant the creation of a program for modifying the weather. The Cloud B model uses Pseudomonas syringae bacteria, biological ice-nucleation particles whose role in cloud formation has only recently been discovered.

Conditions: In 1946, the atmospheric concentration of CO_2 was approximately 309 ppm. In the post-war atmosphere of techno-optimism, the US was entering a period marked by unprecedented economic growth and a new human capability to wield atomic energy, a technology powerful enough to have an impact on the entire planet.

Effects: Cloud B captured the excitement of the moment, promising to control the weather—and to fulfill the dream of meteorological researchers and military leaders alike. The full command of natural resources through technological means seemed to be just around the corner. But clouds outside of the cold box proved impossible to master. Within a few years the discovery of chaos theory described a fundamental limit on predicting and controlling natural systems.

Cloud C (a proposition)

Date: 2018

Location: Eight miles above the ground, Tucson, Arizona

Chemical composition: One hundred grams of calcium carbonate is proposed to be sprayed into the stratosphere as part of the first field test in Solar Radiation Management research. SRM proposals aim to counteract global warming by shielding the Earth from the sun by creating aerosol clouds in the stratosphere. The project was green-lighted in November 2016, and will be conducted in the next eighteen months, after years of controversy over the proposal. Different particles will be tested during the research, including diamond dust and sulfates, which mimic material emitted during volcanic eruptions.

Conditions: By 2018, atmospheric concentration of CO_2 will be approximately 410 ppm, a dramatic increase from pre-industrial levels, and strong evidence of human disruption of the climate system. The climate crisis, and the failure to address it over the preceding decades, has triggered the turn to emergency measures exemplified by this geoengineering test. The position of the scientific community and political leadership has slowly shifted to giving serious consideration to climate engineering proposals, despite the enormous controversy around them.

Effects: The effects of geoengineering research are difficult to predict. The physical impact on the atmosphere is expected to be entirely benign. But it is the social impacts of going down the geoengineering path that are a greater cause for concern and debate.

1 David Gissen, *Manhattan Atmospheres: Architecture, the Interior Environment, and Urban Crisis* (Minneapolis: University of Minnesota Press, 2014).

2 Joe Chew, *Storms Above the Desert: Atmospheric Research in New Mexico 1935–1985* (Albuquerque: University of New Mexico Press, 1987): 21.

Alterlife and Decolonial Chemical Relations

Michelle Murphy

It has been raining all day and into the warm winter night in downtown Toronto—Tkaronto in Mohawk. The water splashes off the office towers of Bay Street (Canada's Wall Street), is collected by a storm sewer system overtaking buried streams, and then washes out into the vastness of Lake Ontario. Office towers and other urban surfaces are covered in a thin, greasy film that attracts persistent organic pollutants like polychlorinated biphenyls (PCBs).[1] These travel in global circulations of particulate clouds, encountering office towers whose oily films act like massive pollution-collection devices. The patter of droplets on urban glass rinses the PCBs into a chemically concentrated rainwash that returns them to the lake, a legacy dumping ground of PCBs from an era of mid-century industrial exuberance.

Lake Ontario is the last lake in the eastward flow of Great Lakes water. Each lake becomes more and more industrialized along the way, passing by Canada's petrochemical refining corridor, the (de)industrialized zone of Detroit, and the steel mills of Hamilton. The Great Lakes form the largest basin of fresh surface water on the planet, holding some 84 percent of North America's fresh surface water. The lower Great Lakes lie in Anishinaabe and Haudenosaunee territories, severed in half by two settler nation-states, the United States and Canada. The water is not still; it is indifferent to borders, cycling through the atmosphere, splashing off office towers, and returning to nourish humans, animals, and plants. We, humans and nonhuman beings, the lake and the city, all depend on its many forms and movements.[2] More than this, we are part of the water. We are part of its tributaries. And, since the mid-twentieth century, we have become a part of PCBs too.

Analyzing urine, blood, and breast milk, twenty-first-century global biomonitoring studies have concluded that all people alive today contain PCBs within them;[3] industrially produced chemicals like PCBs have become a part of human living-being. The pollution of the water has joined the molecular fabric of our bodies. I can make statements like this only because of the work of an array of disciplines, such as toxicology, epigenomics, environmental chemistry, and so on, as well as due to decades of environmental justice community knowledge-making. The study of industrial chemicals compels a posture of working with and against technoscience.

Two technoscientific epistemic habits run through almost all the work materializing chemical exposures. The first habit involves portraying chemicals as discrete entities, as isolated molecules, often represented through abstract structural diagrams. Such diagrams are only ever models of chemicals, designed with engineering and industrial needs in mind.[4] The worlds built with chemicals are imagined and systematized through this functionalist bent, which purposively pushes aside complex reactivity with living- and nonliving-being. The structural representation of discrete molecules—such as polychlorinated biphenyls—is built into the naming system used to describe them and the ways toxicology has historically studied them: one by one, as isolated entities of purely technical qualities without context. We have inherited a restrictive technical understanding of the nature of industrial chemicals from corporate forms of technoscience, as well as from a longer history of chemistry as an industrial discipline.[5] This confining sense of chemicals is built into the design of state environmental regulation in the United States and Canada, where industry lobbyists work hard to make sure that corporate-produced data is used to track and produce uncertainty about exposures. The extensive cloud of synthetic chemical relations, whether emitting from factories, extraction processes, infrastructures, or commodities, is externalized by capitalist ledger books that structurally will not count side effects, fallouts, or discards. Today, this pervasive rendering of chemicals as disconnected functionalist molecules (as opposed to complex bundles of extensive relations) seems self-evident.[6] It is difficult to talk about chemicals in any other way, regardless of your politics. As a result, the infrastructure of chemical relations that surround and make us largely resides in the realm of the imperceptible.[7] We might feel some of our chemical relations and the pain they cause, but the fullness of our chemical relations ends up being largely conjectural.

The second epistemic habit is shaped by the first. Because it is so rare for our chemical surround to be documented, technoscientific research that seeks to contest the presence of synthetic chemicals in the world tends to proceed by detecting and measuring the damage chemicals do to bodies. (Ethnography and the social sciences, more broadly, often seek to bear witness to the evidence of damage.) Focused on collecting the data of damage, much hegemonic North American environmental biomedical research surveils and pathologizes already dispossessed communities. It is hard to perceive the infrastructures of chemical violence in the world at the same time that research attends to molecular manifestations in bodies and communities already living in hostile conditions. Despite often antiracist intentions, this damage-based research has pernicious effects, placing the focus on chemical violence by virtue of rendering lives and landscapes as pathological. Such work tends to resuscitate racist, misogynist, and homophobic portraits of poor, Black, Indigenous, female, and queer lives and communities as damaged and doomed, as inhabiting irreparable states that are not just unwanted but less than fully human.

Refusing this economy of research, the Indigenous feminist scholar Eve Tuck has called for "suspending damage" as a refusal to participate in damage-based research that amplifies the burdens of settler-colonial and racist violence.[8] This refusal constitutes a challenge to environmental justice habits. It marks an invitation to find other ways of shining critical light on the infernal entanglements of settler-colonial capitalism as expressed through chemical relations, and at the same time a call to direct creative energy toward decolonial possibilities.

How to refuse the chemical as an isolated entity and also not re-enact body-centric damage narratives? In a posture of both collaboration and refusal, a decolonial feminist tactic might offer alternative objects of concern for each other and toward decolonial futures. This task of generating alter-concepts of care and responsibility might proceed by calling forth alter-modes of collaboration and study that simultaneously aim at world-building and dismantlement.[9] How to give words that might refuse the hegemonic sense of what chemicals and life are, that might be adequate to confronting the ubiquitous condition of chemically altered living-being, a condition that is shared, but unevenly so, and which divides us as much as binds us, a condition that enacts and extends colonialism and racism into the intergenerational future? I am looking for words, protocols, and methods that might honour the inseparability of bodies and land, and at the same time grapple with the expansive chemical relations of settler colonialism that entangle life forms in each other's accumulations, conditions, possibilities, and miseries.

The Native Youth Sexual Health Network in Toronto has been one guide, with its collective and resurgent practices of visioning Indigenous reproductive justice. A basic lesson from Indigenous reproductive justice is that "violence on the land is violence on our bodies."[10] What happens to the water is what happens to its relations. This includes you too. On the Great Lakes, chemical violence always also involves relations to settler colonialism and white supremacy that non-consensually inhabit bodies and territories, repeatedly concentrating and distributing harms and benefits. Even the ordinary acts of driving, buying, working, fishing, or sheltering are entangled in a long arc of extractive colonialism. So a decolonial feminist sense of enmeshed land and body entails affirming more consensual ways of being together within these extensive, non-innocent chemical entanglements.

In orienting toward decolonial futures, I have tried to work with the concept of *alterlife* as a prompt. Alterlife names life already altered, which is also life open to alteration. It indexes collectivities of life recomposed by the molecular productions of capitalism in our own pasts and the pasts of our ancestors, as well as into the future. It is a figure of life entangled within community, ecological, colonial, racial, gendered, military, and infrastructural histories that have profoundly shaped the susceptibilities and potentials of future life. Alterlife is a figuration of chemical exposures that attempts to be as much about figuring life and responsibilities beyond the individualized body as it is about acknowledging extensive chemical relations.

Forms of alterlife are systematically and brutally harmed and even exterminated in chemical relations; at the same time, alterlife includes being in the mess of consumption, subsistence, and side effect, being in the contradictions of existing in worlds that demand chemical exposures as the conditions for eating, drinking, breathing. Forms of alterlife might include chemically altered metabolisms, capacities to digest human-made substances, or bodily phenotypes that develop in responsiveness to both chosen and unchosen chemicals and pharmaceuticals. It is difficult to say when the condition of alterlife began; there are many possible and divergent starting points for tracing the ways that human-produced chemicals have materially altered living-being, even as there are many ways of questioning the very category of *human*. Moreover, before capitalism and before humans, life was already altered by chemical relations between organisms and their conditions, so that the potential to become alterlife precedes its historical emergence. Thus, it is not enough to theorize alterlife as merely changed bodies that are altered by chemicals. Nor is it enough to theorize life as clusters of non-individual symbiotic beings, as research on symbiogenesis, microbiomes, and holobionts tends to do.[11] Studying alterlife requires bursting open categories of organism, individual, and body to acknowledge a shared, entangling, and extensive condition of being with capitalism and its racist colonial manifestations. It asks that we situate life as a kind of varied enmeshment and enfleshment in infrastructures—as well as in water as a distributed being. It is thus an entrapment in and a response to each other's life supports and conditions. Such concept work is a tactic for taking back phenomena from the epistemologies that have consistently erased the constitutive violence propping them up.

Polychlorinated biphenyls (PCBs) are good companions for conceiving alterlife. They are the classic persistent chemical: PCBs (always plural, because there are 209 different ways of attaching chlorines to biphenyls) tend to be quite inert, resistant to temperature change, and insoluble in water. They are slow to break down, biomagnify in the food chain, and concentrate in fatty tissues. Once the industrial exuberance is gone, the PCBs remain, extending racism in time. Polychlorinated biphenyls have spread into the airs, waters, and soils of the entire planet. The manufacture of PCBs in North America was banned in the late 1970s (and globally with the Stockholm Convention in 2005), and yet they are still circulating the Earth in water cycles and atmospheric dust clouds. Past PCBs are archived in lake sediment, waiting to be stirred up and reanimated. As such, PCBs are a rare example of a highly regulated and monitored industrial chemical (amid the millions of such substances that are not) that has also comprehensively infiltrated the planet. Like radioactive isotopes, PCBs stand as an example of the temporal and geographical extensiveness of chemical relations.

Polychlorinated biphenyls not only persist; they are also endocrine-disrupting. In fact, PCBs have a shape similar to human thyroid hormones, which allows them to participate in the metabolism of the body exposed, including the regulation of gene expression, which in turn reorders metabolism.[12] Moreover, because PCBs can alter gene expression in inheritable ways, the metabolic effects of PCBs can carry over into future generations, so that the alterlife PCBs have helped to make continues—not just because PCBs are incessant in our waters but also because their metabolic activations can cascade intergenerationally across bodies.[13] This makes Monsanto, which manufactured most of the world's PCBs, a grand-kin of sorts, a toxic relation inscribed into energy infrastructures, white privilege, Indigenous dispossession, anti-Blackness, water, and metabolism.[14]

Polychlorinated biphenyls are ongoing. While the manufacture of PCBs was banned, PCB use has been grand-parented. They still remain within the transformers and capacitors that make up the aging electrical grid. When people in Toronto switch on a light, we are entangled in PCBs' expansive relations. Concentrated exposure to PCBs on the Great Lakes is the legacy of an unregulated industry built on stolen Indigenous land that purposively pushed, buried, and dumped its chemical violence into poor, Black, and Indigenous communities, a violence that would then overflow such that racism would become a planetary presence. Civil-rights organizing against the anti-Black dumping of PCBs in Warren County, North Carolina in the 1970s gave us the term *environmental racism*.[15] The community in Anniston, Alabama living around the first Monsanto factory to manufacture PCBs has engaged in a multigenerational struggle against anti-Black environmental violence.[16] In the Great Lakes watershed, generations of the Mohawk Akwesasne First Nation have resisted the erasure of the chemical violence caused by PCBs that are intimately tied to the stealing of their land and the injury of their fish relations, which have been categorized by the state as inedible for decades.[17] The concept of alterlife asks for an unflinchingly pessimistic acknowledgment that these chemical relations are racist, harmful, even deadly, and that it is up to you to take on the ways that you are caught up in killing (even if they are killing you too, just more softly).[18]

This collective work conceiving of alterlife and chemical relations has largely happened while I have been living in Toronto on Anishinaabe and Haudenosaunee territories, as a Métis person of white skin who also descends from white settlers. The Métis are a post-contact Indigenous people who made home centered in the Red River area of what is now called Manitoba, and who were often entangled in the fur trade. In the 1880s the Métis took up armed resistance to Canada's claims to their land, and many were dispersed westward as they were confronted with ongoing colonial violence. Some Métis ancestors were active agents of colonialism, working with the Hudson's Bay Company, and in the twentieth century many white Métis became more and more assimilated into settler colonialism. Being Métis is complicated, not least because it

is non-innocently entangled with whiteness. So, I confess that alterlife is also an autobiographical category about traumatic and non-innocent relations with settler colonialism and capitalism. Alterlife embraces impure and damaged forms of life, pessimistically acknowledging ongoing violence, living within and against the worlds technoscience helped make. Alterlife is resurgent life, which asserts and continues nonetheless. Living in Toronto, I am a guest and a settler, caught up in the chemicals and water, non-innocently making relations and suspending damage. Alterlife acknowledges that one cannot simply get out, that this hurtful and deadly entanglement forms part of contemporary existence in this moment, in the ongoing aftermath. And yet the openness to alteration may also describe the potential to become something else, to defend and persist, to recompose relations to water and land, to become alter-wise in the aftermath.

As part of the Week of Action Toolkit created on the occasion of the launch of their *Violence on the Land, Violence on Our Bodies* report, the Women's Earth Alliance and the Native Youth Sexual Health Network included a set of stencils created by the Métis artist and activist Erin Marie Konsmo. The stencils portray lungs holding within them the violent infrastructure of extractive colonialism. "Violence from Fracking is Violence on Our Bodies," one reads. A second: "Violence from Pipelines is Violence on Our Bodies." A third: "Violence from Logging is Violence on Our Bodies." The campaign invites people to hold the images over their chest and to take a picture to post on social media—with the hashtags #landbodydefense and #environmentalviolence—resulting in poses of Indigenous women, two-spirit people, and youth mapping the extensive infrastructural relations of settler-colonial capitalism inside them. It teaches that life forged in ongoing chemical violence is also life open to becoming something else, which is not a nostalgic return, but instead the defending of sovereignty starting here, within oneself and each other, here in the damage now. There is no waiting for a better condition. The alter-wise of alterlife is a non-deferral of the decolonial, seized now, despite its impossibility.

In downtown Toronto, there is a notable concentration of PCBs in the infrastructure of office towers that house finance capital. Finance capital leaks PCBs.[19] I imagine another stencil with a set of lungs inside of which a pair of tall glass towers contain the infrastructures of finance, which in turn fund the pipelines, the open pits, the start-ups, the boxes of property, the war machines, the missing and murdered women, girls and two-spirit people. Breathe in. With each inhalation, the extensive relations of finance capital are pulled into your lungs, passing through membranes, attaching to receptors, rearranging metabolism, altering gene expression. Breathe out. With each exhalation, you are reconnecting to the greater fulsomeness of our relations. Breathe in, feel the fragility of white privileged life for the few around you. Breathe out.

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1 Andre J. Simpson, Buuan Lam, Miriam L. Diamond, D. James Donaldson, Brent A. Lefebvre, Arvin Q. Moser, Antony J. Williams, Nicolay I. Larin, and Mikhail P. Kvasha, "Assessing the Organic Composition of Urban Surface Films Using Nuclear Magnetic Resonance Spectroscopy," *Chemosphere* 63, no. 1 (2006): 142–52, https://doi.org/10.1016/j.chemosphere.2005.07.013.

2 Zoe Todd, "Fish, Kin, and Hope: Tending to Water Violations in *amiskwaciwâskahikan* and Treaty Six Territory," *Afterall* 43 (2017): 102–107, https://doi.org/10.1086/692559.

3 Stockholm Convention on Persistent Organic Pollutants "Global Monitoring Report," United Nations Environment Programme, 2009, http://chm.pops.int/Implementation/GlobalMonitoringPlan/MonitoringReports/tabid/525/Default.aspx.

4 Evan Hepler-Smith, "'Just as the Structural Formula Does': Names, Diagrams, and the Structure of Organic Chemistry at the 1892 Geneva Nomenclature Congress," *Ambix* 62, no. 1 (2015): 1–28, https://doi.org/10.1179/1745823414Y.0000000006.

5 Bernadette Bensaude-Vincent and Isabelle Stengers, *A History of Chemistry*, trans. Deborah van Dam (Cambridge, Mass.: Harvard University Press, 1996).

6 Natasha Myers, *Rendering Life Molecular: Models, Modelers, and Excitable Matter* (Durham, N.C.: Duke University Press, 2015).

7 Michelle Murphy, *Sick Building Syndrome and the Problem of Uncertainty: Environmental Politics, Technoscience, and Women Workers* (Durham, N.C.: Duke University Press, 2006).

8 Eve Tuck, "Suspending Damage: A Letter to Communities," *Harvard Educational Review* 79, no. 3 (2009): 409–28, http://hepg.org/her-home/issues/harvard-educational-review-volume-79-issue-3/herarticle/a-letter-to-communities_739. See also Eve Tuck and K. Wayne Yang, "R-Words: Refusing Research," in *Humanizing Research: Decolonizing Qualitative Inquiry with Youth and Communities*, ed. Django Paris and Maisha T. Winn (Thousand Oaks, Calif.: SAGE, 2013), 223–48.

9 Thank you to Nick Shapiro for refining this point.

10 Women's Earth Alliance and Native Youth Sexual Health Network, "Violence on the Land, Violence on Our Bodies: Building an Indigenous Response to Environmental Violence," Week of Action Toolkit, 6–10 June 2016, http://landbodydefense.org/uploads/files/VLVB%20Week%20of%20Action%20Kit%202016.pdf.

11 Scott F. Gilbert, Jan Sapp, and Alfred I. Tauber, "A Symbiotic View of Life: We Have Never Been Individuals," *Quarterly Review of Biology* 87, no. 4 (2012): 325–41, https://doi.org/10.1086/668166.

12 Hannah Landecker, "Postindustrial Metabolism: Fat Knowledge," *Public Culture* 25, no. 3 (2013): 495–522, https://doi.org/10.1215/08992363-2144625.

13 Rebecca M. Steinberg, Deena M. Walker, Thomas E. Juenger, Michael J. Woller, and Andrea C. Gore, "Effects of Perinatal Polychlorinated Biphenyls on Adult Female Rat Reproduction: Development, Reproductive Physiology, and Second Generational Effects," *Biology of Reproduction* 78, no. 6 (2008): 1091–1101, https://doi.org/10.1095/biolreprod.107.067249; Pavel Langer et al., "Increased Thyroid Volume, Prevalence of Thyroid Antibodies, and Impaired Fasting Glucose in Young Adults from Organochlorine Cocktail Polluted Area: Outcome of Transgenerational Transmission?" *Chemosphere* 73, no. 7 (2008): 1145–50, https://doi.org/10.1016/j.chemosphere.2008.06.067.

14 Vanessa Agard-Jones, "Bodies in the System," *Small Axe* 17, no. 3 (2013): 182–92, https://doi.org/10.1215/07990537-2378991.

15 Eileen McGurty, *Transforming Environmentalism: Warren County, PCBs, and the Origins of Environmental Justice* (New Brunswick, N.J.: Rutgers University Press, 2007).

16 Ellen Griffith Spears, *Baptized in PCBs: Race, Pollution, and Justice in an All-American Town* (Chapel Hill: University of North Carolina Press, 2014).

17 Elizabeth Hoover, "Cultural and Health Implications of Fish Advisories in a Native American Community," *Ecological Processes 2*, no. 4 (2013): https://doi.org/10.1186/2192-1709-2-4.

18 This phrasing was inspired by Stefano Harney and Fred Moten, *The Undercommons: Fugitive Planning and Black Study* (London: Minor Compositions, 2013).

19 Miriam L. Diamond, Lisa Melymuk, Susan A. Csiszar, and Matthew Robson, "Estimation of PCB Stocks, Emissions, and Urban Fate: Will Our Policies Reduce Concentrations and Exposure?" *Environmental Science and Technology* 44, no. 8 (2010): 2777–83, https://doi.org/10.1021/es9012036.

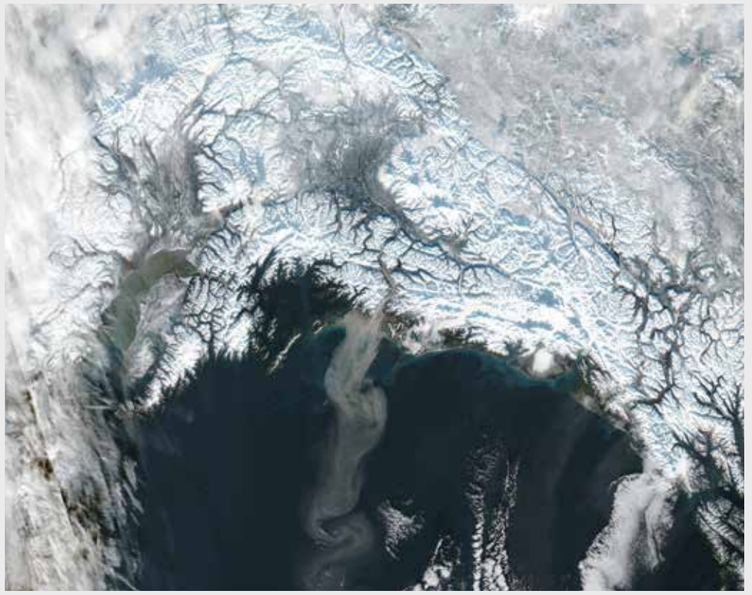

Figure 2

The Gulf of Alaska is a region of contrasts between the high mountains that surround it and the waters of the gulf. In this image from November 2017, the complex topography of the region is highlighted by the differences in snow cover between the mountaintops and the surrounding valleys. A plume of glacial dust can be seen extending from the mouth of the Copper River valley, one of the largest in the region. These plumes are the result of high winds that blow down the valley, and are an important source of nutrients for the highly productive marine ecosystem of the region.

Figure 3

A nor'easter moves up the eastern seaboard of North America on 4 January 2018. These extra-tropical cyclones typically take on a "comma" shape, the result of the counter-clockwise winds associated with these storms. Ahead of the storm, the transport of warm air northwards results in extensive cloud cover that resembles a comma. Behind the storm, cold air streams out over the warm waters of the Gulf Stream as well as Lake Superior, leading to the distinctive linear cloud bands indicative of the transfer of heat from ocean or lake surface to the atmosphere. Over the land, a band of snow can be seen extending northwards from Georgia, in stark contrast to the green vegetation to the south and west.

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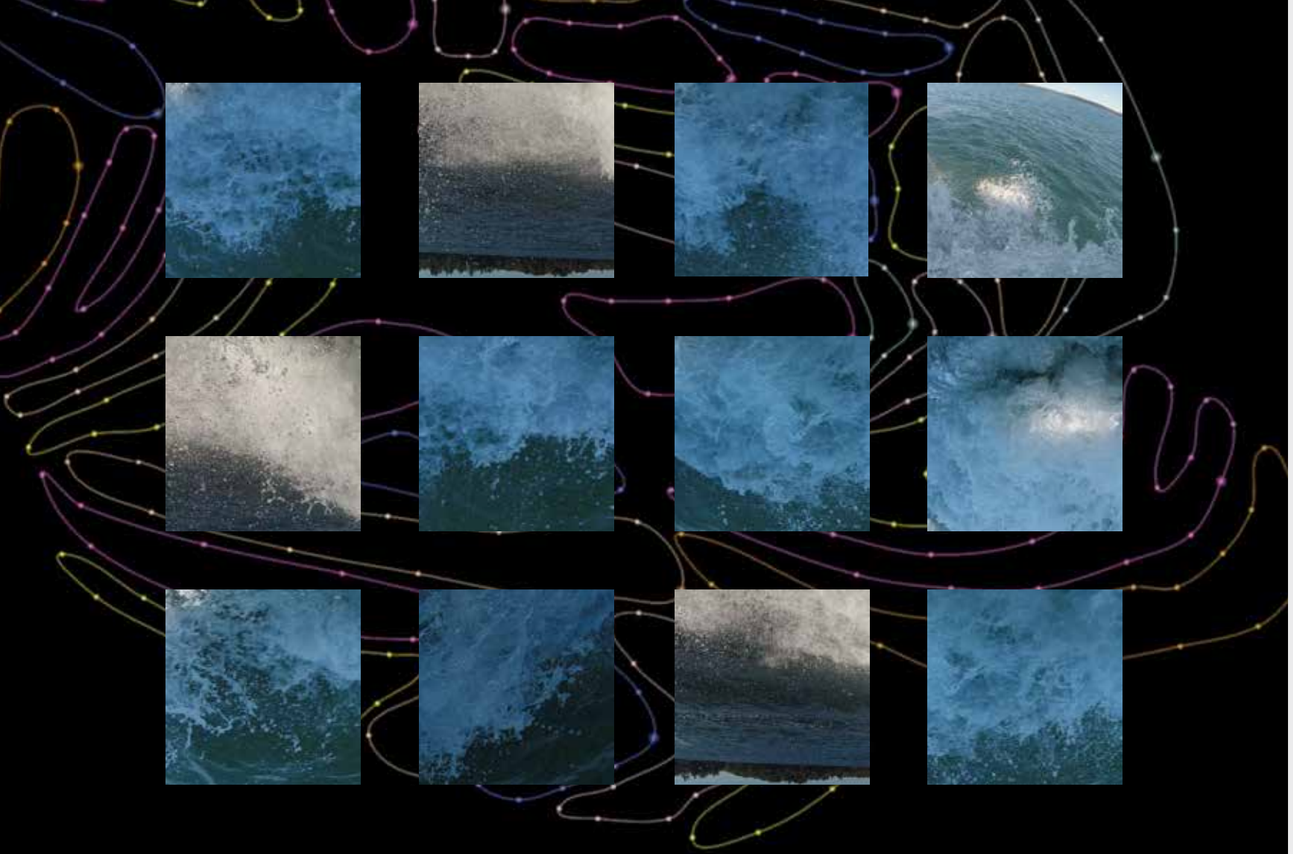
Shkakamikwe Kido
It Comes Through The Land

Natasha Naveau

Language is integral to conveying and maintaining knowledge of the perspectives on and relationships to land and each other—it can enable verbal forms of placemaking that affirm Indigenous presence in this territory. Placemaking is not just about rebuilding the traditional, or establishing modern-day versions of Indigenous structures. It's about the time, effort, and relationships that are built while relearning ways of knowing, embracing cultural practices, and engaging with the land, water, plant, and animal nations.

These images (from two projects, *Shakamikwe Kido* and *Beyond Acknowledgement*) intersect at a place that looks deeply at this engagement—spaces of common ground where history and relationships were forged—and explore how centring the water has been vital to understanding it as the constant observer and connector of all beings in this territory. Personally, undertaking these projects has brought me closer to the land and water in a way that many have experienced before—healing wounds from intergenerational trauma, and reconnecting to the Earth that continually supports us in both material and unseen ways.

The layering and fragmentation of documentary imagery emerged from the process of learning about the histories of Tkaronto and its waterways. Through the temporality of video, my work strives not only to reveal the movement and life of spaces but also convey the intersection of identities and nationhoods rebuilt with land and water at the centre. *Gabekanaang-ziibi* (or *Cobechenonk*)—before it was named the "Humber River"—is an Anishinaabemowin word conveying instructions about this waterway to "leave the canoes and go back." *Gabekanaang-ziibi* is a major portage and trade route for the many Indigenous nations who travelled, harvested, and settled here for centuries before European settlement. As a pathway or meeting place, the Humber River holds much memory of this place, as well as structures, such as a teaching lodge, that attest to the histories of this region. The more visibility and presence structures like this have, the less Indigenous nations are deemed invisible in these spaces, and the more dialogue and knowledge transfer can take place. And these foregrounded histories can become opportunities to understand what an ethics of engagement with this land is, as relayed in treaties within this territory like the Dish With One Spoon Treaty: the dish symbolizes the land, and the spoon is how we interact with the land. It's a treaty about sharing the land and promoting an ethics of responsible use—forcefully keeping in mind to make sure there's enough left for those who come after.



St. Lawrence Crossing

Sydney Hart

Inspired by the zebra mussel and its role in bringing obscured histories to light, *St. Lawrence Crossing* forms part of an investigation into how the creation of the Saint Lawrence Seaway for ocean-going vessels has radically re-shaped perceptions of the Saint Lawrence River. Inaugurated in 1959 through a partnership between the US and Canadian federal governments, the Seaway is a massive infrastructure project that significantly changed the course of the river to open freight routes between the Great Lakes and the Atlantic Ocean; this greatly intensified commercial flows through the region, and thereby extended processes of colonial dispossession for communities on its path, such as Kahnawá:ke. Along with their container cargo, ocean-going vessels unwittingly carried the zebra mussel, introducing the species into North America, where it spread across lakes and rivers, clogging pipes and disrupting water treatment plants. The mussels' rapid proliferation, however, has also clarified the Saint Lawrence's waters (through the straining actions of their filter feeding), making parts of the riverbed newly visible from above, and revealing the ruins of houses flooded by the Seaway seventy years ago. The traces of such changes, through which federal governments see waterways as mere links in a global economic supply chain, suggest the importance of non-human actors in helping to represent bewildering ecological changes that states would rather hide far offshore. A reminder of the unintended consequences of containerization in maritime trade, and the hubris of federally sanctioned infrastructure projects—what more can the zebra mussel show us?

Sister Water

Andrea Muehlebach

One of the most precious legacies of the thirteenth-century Franciscan order, writes Italian philosopher Giorgio Agamben, was the Franciscans' heretical attempt to live a life in a world that would "never be substantiated into an appropriation. That is to say: to think life as that which is never given as property but only as common use."[1] The Franciscans were part of a group of religious movements seen as heretical by the Church because they proposed a new type of life in common; a life that hinged on no one claiming ownership over any possessions. They thus renounced everything except use itself, since use was necessary to survival and human life. Because the Franciscans attempted to realize a practice outside of private property, the Church thought they were practicing an animal form of life, analogous to the lives of little children "who do not own but merely use the property of the father," or madmen "who all lack the disposition to possess."[2]

One trace left of this heretical worldview is a song composed by Francis of Assisi, "Canticle of the Sun." They say that it was first sung by Francis and two of his brothers as he lay dying, praising a wide panoply of relations: Brother Sun, Sister Moon, Brother Wind, Brother Fire, Sister Mother Earth, and Sister Water, who is depicted in the song as "useful, and humble, and precious, and pure."[3] The song raises profound challenges today as it asks what it would mean to think of the world outside of the paradigm of the private and the proprietary, and to think of it instead as inappropriable.

We know, of course, that the Franciscan tradition runs counter to centuries of proprietary thinking about the world as full of individual, private possessions. Take John Locke, one of the first theorists of "possessive individualism,"[4] who provided the philosophical basis for the transmutation of the commons into private property, specifically in the New World. Locke gave water as an example which, when "running in the fountain be everyone's," but when taken out with a pitcher belongs only to "who drew it out." After all, "his labor hath taken it out of the hands of nature, where it was common, and belonged equally to all her children, and hath thereby appropriated it to himself."[5] Here, Locke is incapable of developing a theory of use that exists outside of the paradigm of individual ownership, incapable of envisioning an individual embedded within a group with whom she might want to share that water. Locke's philosophy became the foundation for much of Western liberal thought, which holds that things only become useful when taken from the commons and transmuted into private property. For Locke, whatever is not taken and appropriated is merely wasted.[6] He provided the reasoning upon which the establishment of private property regimes in both the Old and the New Worlds hinged—a process we know to be violent to the core. After all, the word "private" is derived from the Latin *privare*: to deprive or bereave.

And yet today, as the world is confronted with apocalyptic scenarios of water scarcity and pollution, some feel compelled to ask: Is it possible to think about use without appropriation? In Canada, it is Indigenous peoples who are posing these questions most powerfully and insistently: Is it possible to think of water as something we use but do not possess? Is it possible to treat water as a relation?

This is more than abstract philosophy, and more than a Canadian question. In 2011, Italian citizens soundly rejected the privatization of water through a national referendum initiated by one of the largest social coalitions ever seen in the country. Deeply indebted to the Catholic imaginative universe and buoyed by autonomist Marxist theorizing on the commons, many activists in this movement drew on water's vitalism, juxtaposing water as life to what they called neoliberalism's "culture of death," and water's sacrality to its desacralization through commodification. Many also drew on the "Canticle of the Sun" by referring to water as sorella acqua (Sister Water), asking "How can you sell your sister?" In a historically unprecedented move, 27 million Italians rejected the commodification of water and insisted that it be conceptualized as a *bene comune*—a common good. At stake was a new vision of property distinct from both public (state) and private (corporate) ownership. Instead, water was a commons to be held for future generations and for life itself, and thus in need of special constitutional protection.

For now, however, the centuries-old Lockean compulsion towards appropriation has the world in its grip. A huge global capital liquidity is intersecting with the growing anticipation that water is rapidly emerging as one of the most lucrative commodities on the planet. Public water works are prime targets for the "new water barons" who have, at least in larger urban areas in middle-income countries, rushed to invest in water. One of Citigroup's top economists announced in 2011 that the water market will become hotter than the oil market: "Water as an asset class will eventually become the single most important physical commodity-based asset class, dwarfing oil, copper, agricultural commodities and precious metals."[7] Global Water Intelligence (GWI) is a good example of this trend.[8] A self-described "unchallenged leader in high value business information for the water industry" and the "ultimate strategy and navigation tool for the global water market," GWI is an online monthly round-up of the most important water-related news for global investors. GWI is updated daily and tracks "hundreds of desalination, reuse, water treatment plants, waste water treatment plants and utility projects from conceptual stage to contract award," while also providing "full progress and status reports including plant capacity, project structure, expected cost, relevant submission dates and full client contact details." It carefully scours world political developments to discern the laws and policies that might "unlock" water infrastructures and ready them for future investment: Is Chile's new government backing the reforms to water utility regulation? How to interpret the

language of a $1.4 billion environmental bond bill introduced in Massachusetts late last week? GWI does not even attempt to veil what is at stake: A global war over water about which intelligence must be collected. Water here is explicitly a resource to be grabbed, not a part of the commons to be protected; an asset to be appropriated, not a relative demanding our care.

This year, GWI awarded trophies to new members of the "Leading Utilities of the World" network. Among them was Stefano Venier, CEO of the Italian Hera Group. Hera is the third largest of four major Italian water corporations ("the four sisters of water"—*le quattro sorelle dell'acqua*—as a recent Italian news report sarcastically referred to them[9]) leading the way towards the steady privatization of Italy's public water utilities and rapidly becoming what the report calls the four new "masters of Italian taps" (*padroni dei rubinetti italiani*). The referendum in Italy, it seems, merely slowed down what appears as inexorable.

But this, to me, is a question rather than a fact. What if more of us were to think heretically about using things without appropriating them? What if more of us were to think about water as a sister—a relative who can never be owned? There are those who already think and live in the world beyond appropriation. Our task is to listen, learn, and think alongside and with each other as we attempt to build, expand, and maintain these relations.

1 Giorgio Agamben, *The Highest Poverty: Monastic Rules and Forms of Life*, trans. Adam Kotsko (Stanford, California: Stanford University Press, 2013), 7.

2 Ibid., 112.

3 "Canticle of the Sun," http://www.sacred-texts.com/chr/wosf/wosf22.htm.

4 See C.B. MacPherson, *The Political Theory of Possessive Individualism* (Oxford: Clarendon Press, 1962).

5 John Locke, *The Second Treatise of Government* (Indianapolis and Cambridge: Hackett Publishing, 1980 [1689]), 20.

6 Ibid., 29.

7 Jo-Shing Yang, "The New 'Water Barons': Wall Street Mega-Banks Are Buying up the World's Water," GlobalResearch, 21 December 2012, https://www.globalresearch.ca/the-new-water-barons-wall-street-mega-banks-are-buying-up-the-worlds-water/5383274.

8 Global Water Intelligence, https://www.globalwaterintel.com.

9 Roberto Giovannini, "Le quattro sorelle dell'acqua: Ecco i padroni dei rubinetti italiani," *La Stampa*, 7 July 2017, http://www.lastampa.it/2017/07/07/scienza/le-quattro-sorelle-dellacqua-ecco-i-padroni-dei-rubinetti-italiani-IT6QgaAqBQ81mvga1ULv9K/pagina.html.

Changing Together

Stanka Radović

I ask my students to share the first image that comes to mind when they think about "commuting." Most of them describe their annoyance at the physical inevitability of others. The stubborn humanity of our fellow travellers forces us to reflect on all the permutations of living socially. When I remark that most of their images tend to be negative, my students recall other stories. One is of a group of people stuck in a subway tunnel during a power outage. They are helping a passenger suffering from claustrophobic anxiety to overcome a panic attack by telling stories of their own past experiences with enclosed spaces. For a moment they become a community. When power is restored and the train moves again, they retreat into their own lives and the magical moment of connection seems almost unreal. Another student tells us that she closes her eyes and connects with her God. She is meditating, unaware of others, transcending the space and time of her commute.

Rare moments of togetherness and more frequent moments of isolation dominate these stories. Both conditions have been central to urban studies. Cogently reflecting on the new "S.U.V. model of citizenship" for example, cultural geographer Don Mitchell argues that we are increasingly privileging our "right to be left alone" and think of public spaces as allowing free and unobstructed passage to citizens who just float on, captured in their individual bubbles of privacy. This "floating bubble" view of citizenship denies the shared character of urban and natural environments by precluding unscripted interactions and limiting our modes of social engagement. Yet, ideally, "[c]ity spaces are those spaces where the public comes together in its diversity, and where, presumably, the interaction of *difference* helps create the possibility for democratic transformation."[1]

Already in 1903, in his famous essay "The Metropolis and Mental Life," German sociologist Georg Simmel addressed this inevitable and often tense negotiation between "the individual aspects of life and those which transcend the existence of single individuals" in the city.[2] As a mode of self-preservation, we develop "a protective organ" of egoism, showing indifference to other people's specificity and a general sense that the world is populated by calculable quantities rather than emotional beings. Diversity and difference, so crucial to urban life, are thus flattened into a manageable series of types and patterns so that we become effectively indifferent towards distinctions between things.[3] Nature, which supports our urban existence, is also erased from view and becomes a product of social practices rather than a site of radical difference in its own right.

If a commute is a journey, usually to and from one's place of work or study, we end up focusing on its destination. Everything along the way is a potential obstacle, a distraction, a nuisance. We have no time or energy for the journey's unfolding because that journey is itself a tunnel between our starting and end points. We swing between these two points like a pendulum, so well captured in the German word for "commute"—*Pendelfahrt*. According to the urban sociologist Henri Lefebvre, commuters, and drivers in particular, are concerned with steering themselves to their destination, seeing only what they need to see for that purpose.[4] They privilege an abstract, linear, and predominantly visual relation to their surroundings. Spaces they inhabit or move through become "instrumental spaces," subordinated to a single strategic aim. This results in "the removal of every obstacle in the way of the total elimination of what is different."[5]

If the rational calculations of our commuting necessitate a constant reduction of difference into sameness, I am compelled to think about the way obstacles on our commute, and our reactions to them, reveal who we are and what else we might become. Because of the unexpected disruption of our set trajectory—a delayed train, a broken power line, a lane closure, a snow storm, a pedestrian or a cyclist (who themselves might be commuters!)—the seemingly transparent world around us turns opaque again. We strain to relate it back to what we have planned. But the break in our urban patterns reveals most accurately the city we are in: the contours of its humanity, its norms and regulations, its centres and margins—and, in the end, the unforeseen possibilities of our alternative perceptions and interactions. The commute might become, for instance, an occasion to welcome, rather than dread, the presence of strangers in our life, remaining open to their difference, realizing again and again that we owe them the same respect they owe us. The urban reciprocity.

Commuting is a strange word with an etymological story of its own. It comes from the Latin *commūtāre*: *com* meaning "together" and *mūtāre*, to change. This signals that the commute, most often described as a vaguely annoying encounter with unfamiliar others on our way to somewhere else, holds the possibility of our changing together along the way. Instead of being the festival of anti-social disrespect for our physical and social environment and an occasion to reject all those others who might threaten or irritate us with their difference (and sometimes even their mere existence), the commute is an opportunity to think socially about shared spaces, shared responsibilities, and shared trajectories in the city. Our responsibility extends to the wellbeing of other people we do not know or even approve of, but it also involves the environment itself. Marginalized spaces, from abused natural environments to derelict urban spaces, also demand our attention and remind us of the dangers of our environmental indifference as we consider only the efficiency of our trajectory. Yet our lives depend on the deeply interwoven character of all environmental existence—urban and natural. We tend to remember this mostly because of the disruptions and restrictions in our path. These allow us to see more clearly the shortcomings of the world we are making and therefore all the ways we could make it better.

I am thinking, in the end, of my student's story about the subway train momentarily suspended in a dark tunnel waiting for the power to return, and a group of commuters telling stories to help her overcome her fear of enclosed spaces. The disruption of linear progress and the emotional turmoil it triggers draws out people's capacity to care for one another. In another context, Tennessee Williams expressed this best: "I have always depended on the kindness of strangers." To commute well, one has to recognize that kind stranger and become one in turn, respectfully engaged in the process of changing together. Our awareness of the shared and fundamentally social nature of living space makes it not only possible but also necessary that we assume responsibility for others—and for otherness itself—at all times, and not only during visible crises. This is also the spirit of commuting, which in its parallel etymology, means to ease or alleviate. If much of urban experience feels to us like a sentence, condemning us to isolation from our social and natural environments and even from ourselves, we might then seek to commute it by considering alternative forms of connection with both the human and non-human worlds we inhabit. These alternatives would have to privilege the quality of the journey itself, rather than its destination.

1 Don Mitchell, "The S.U.V. Model of Citizenship: Floating Bubbles, Buffer Zones, and the Rise of the 'Purely Atomic' Individual," *Political Geography* 24 (2005): 86.

2 Georg Simmel, "The Metropolis and Mental Life," *The Blackwell City Reader*, ed. Gary Bridge and Sophie Watson (London: Blackwell Publishing, 2002), 11.

3 Ibid., 14.

4 Henri Lefebvre, *The Production of Space*, trans. Donald Nicholson-Smith (London: Blackwell Publishing, 1991), 313.

5 Ibid., 371.

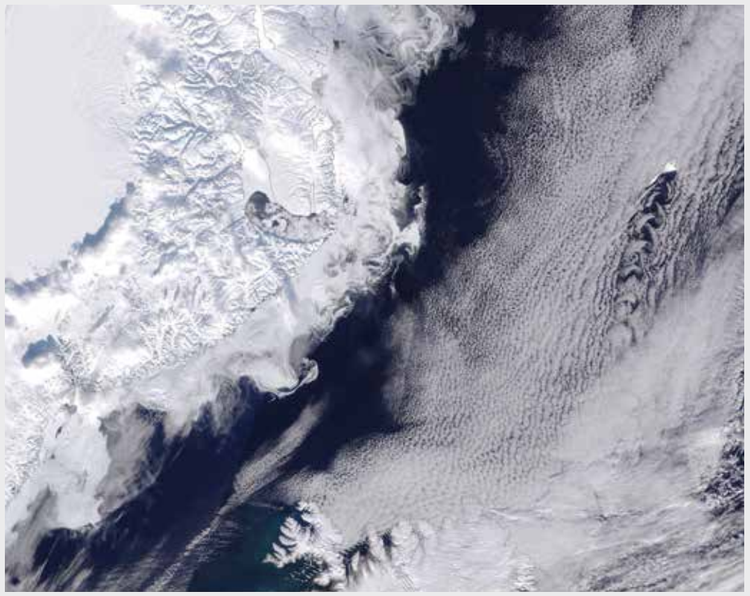


Figure 4

A winter's view of the Denmark Strait. Complex swirls of sea ice are present along the east Greenland coast. Onshore, the mountains of the coastal region stand in juxtaposition to the smooth glaciers of the central ice cap. Offshore, a band of clouds can be seen extending south towards northern Iceland. Jan Mayen, a volcanic island that rises to a height of 2,000 metres, obstructs this flow, resulting in a striking pattern in the clouds known as a von Kármán vortex street.

Figure 5

Spring along the west coast of North America. Winter snow can still be seen along the coastal mountains of British Columbia and Washington State, as well as the volcanoes of the Cascades and the Sierra Nevada. Offshore, a band of stratiform clouds with complex embedded structures hugs the coast of Oregon and California, sometimes spilling inland into regions of low topography. Over the high plains, thunderstorms have formed—the result of warm surface temperatures.

The Right to Charge

Fraser McCallum

As electric cars grow in popularity, their use has necessitated a renegotiation of drivers' notions of ownership, common property, and responsibility in everyday city spaces like parking lots, community centres, and shopping malls. Identifying charging infrastructure as a crucial barrier to entry for would-be consumers, electric vehicle (EV) advocates are arguing for the "right to charge"—that is, the ability of EV owners to install charging stations in privately owned lots (such as condo parking garages), and to access convenient public charging.[1] The cost and spatial requirements of EV charging necessitates considerable reviews to transportation infrastructure and policy.

The use of a "rights" framework for electric vehicle charging indicates how deeply car culture is entrenched both in urban infrastructures and in personal expectations of mobility. The all-encompassing nature of car use is termed "automobility" by social scientists, demarcating a field that studies the arrangement of built space, work, social life, and identity around personal vehicles.[2] As sociologist Harvey Molotch puts it, automobility is "intimately bound up with an aesthetics of movement, technology of rolled steel, a teen's rite of passage, drive-in malls, insurance provisions, freeway maps, tract houses, cup holders, the Beach Boys, first dates, traffic courts, strings of gas stations."[3]

While Molotch's references are dated (and gas stations are joined by charging stations), the conventional understanding of automobility as inherently tied to oil is being reformed by consumers who now proudly drive without tailpipe emissions. One unforeseen implication of this shift, however, is that Greater Toronto and Hamilton Area EV owners report driving further and more often than conventional car users.[4]

In principle, increased use of zero-emissions vehicles does no environmental harm, if the electrical grid on which it relies is emissions-free. In Ontario, the grid is largely powered by nuclear energy and hydroelectric dams. Both are claimed as low-emissions by energy providers,[5] but their environmental consequences should be seen for their diffuse effects beyond emissions alone. Dams often dramatically reshape rivers and lands for power generation, with profound implications for nearby inhabitants and the environment.[6] Nuclear energy is best understood using life-cycle analysis, where comprehensive accounting of production, generation, and waste products show it to be far less clean than its newer counterparts such as solar, wind, and biomass.[7]

Life-cycle analysis puts the greenness of electric vehicles under equal scrutiny. The impact of EVs is concentrated in their production and recycling, due to the rare earth metals used in their batteries and electronics.[8] With these resources overwhelmingly extracted from and disposed of in Southeast Asia, the toxic pollution created from their manufacture and disposal is geographically remote from their benefits in Ontario.[9] When greenhouse gas emissions are taken singularly as an indicator of sustainability, many of the impacts of industrial production are left unaccounted for.

A large part of EV advocacy and enthusiasm follows a logic of substitution: trading combustion engines for batteries. While movement away from combustion engines is welcome in principle, exaggerated claims of EV greenness, and the increased driving habits they foster, highlight the fact that personal consumption decisions are not systemic changes. As such, policy documents published by Mississauga and Peel governments unequivocally assert the need for greater mass transit and active transportation options to reduce traffic and pollution in the region, questioning the scalability of continued car use for the existing road network.[10]

A more cautious approach to the rise of electric vehicles should take note of how they reinforce car culture, rather than shift it; EVs substitute tailpipe emissions for other kinds of pollution that are geographically distant, and they potentially increase automobile reliance. As such, electric vehicles should be seen alongside public transit and active transportation as one small part of the challenge to decarbonize transportation. An equally important step will be the cultural shift that revisits our commonly held assumptions about mobility.

Part two of a serial column by a member of *The Society for the Diffusion of Useful Knowledge* team on the physical and material traces of climate change and environmental violence in the region.

1 Josh Tzventarny, "Enabling Electric Vehicle Charging in Condominiums," Canadian Condominium Institute Toronto and Plug'n Drive, http://www.plugndrive.ca/wp-content/uploads/2017/05/Enabling-EV-Charging-in-Condominiums.pdf.

2 John Urry, *Mobilities* (Cambridge: Polity, 2007).

3 Harvey Molotch, quoted in John Urry, *Climate Change and Society* (Cambridge: Polity, 2011), 57.

4 Plug'n Drive, "Driving EV Uptake in the Greater Toronto and Hamilton Area," 10 May 2017, http://www.plugndrive.ca/wp-content/uploads/2017/10/EV-Survey-Backgrounder.pdf.

5 "Clean Air. Made in Ontario," Ontario Power Generation, https://www.opg.com/generating-power/Pages/generating-power.aspx.

6 See, for instance, http://makemuskratright.com.

7 Benjamin K. Sovacool, "Valuing the Greenhouse Gas Emissions from Nuclear Power: A Critical Survey," *Energy Policy* 36, no. 8 (2008): 2950–2963.

8 Felipe Cerdas, Patricia Egede and Christoph Herrmann, "LCA of Electromobility," in *Life Cycle Assessment*, ed. M.Z. Hauschild et al. (Switzerland: Springer, 2018).

9 Plug'n Drive, "Electric Vehicles: Reducing Ontario's Greenhouse Gas Emissions," May 2015, http://www.plugndrive.ca/wp-content/uploads/2017/07/Electric-Vehicles-Reducing-Ontarios-Greenhouse-Gas-Emissions-A-Plugn-Drive-Report.pdf.

10 *The Long Range Transportation Plan Update* (Region of Peel, 2016); *Living Green Master Plan* (City of Mississauga, January 2012); *Strategic Plan* (City of Mississauga, April 2009).

What is The Market?

D.T. Cochrane

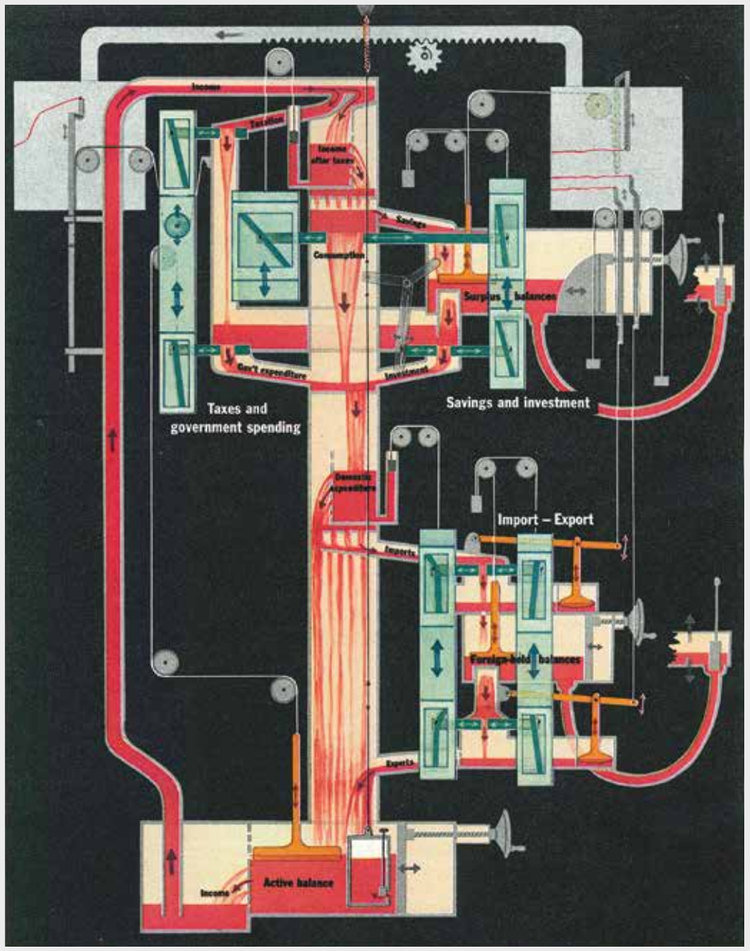


Illustration of Irving Fisher's hydraulic model by Max Gschwind for *Fortune Magazine*, March 1952, 101.

"Leave it to The Market."

We frequently hear variants of this refrain from pundits and politicians: following the immutable laws of supply and demand, the Market will generate the best possible outcome. However, this mythical Free Market does not describe how actual markets function. Rhetoric about the Market misrepresents both the innumerable structures that support and maintain them,[1] and the necessary interventions to prevent and correct their associated harms, such as worsening inequality and environmental degradation.

The discipline of economics has normalized structures of unequal exchange in its formal models, where unencumbered exchange among equal individuals generates an outcome deemed both just and efficient. Whether market participants are twenty-somethings newly living on their own or the Coca-Cola corporation, the theory tells us that they both enter the market as atomistic utility maximizers, meaning neither has any power within the market and both are driven by self-serving desire. From the competition between these powerless equals, prices for all goods emerges. Despite the prevalence of indisputable corporate power, it is absent from the theory. This theory is so dominant in economics that it is rarely named, although it is often called "neoclassical," or more descriptively, "marginalist."[2]

Much of the focus of contemporary economics is on trade-offs: how much of this thing would you give up for that thing? The Market is the place where individuals make such trade-offs. I trade my labour for these goods. I trade this food for that service. On and on and on. Within the marginalist framework, individuals—assumed to be the best judges of their own well-being—will continue making trade-offs at the margin until the achievement of what economists call Pareto optimality, after one of marginalism's foundational thinkers, Vilfredo Pareto. At the Pareto optimum, no one can be any better off without making someone else worse off. While you might want more corn, you aren't willing to give up any of your gold necklaces to get it. When we achieve this state, we are, the theorists tell us, in an equilibrium where everyone is as well off as possible.

The concept of equilibrium is the theoretical counterpart to the margin. Trade among individuals rebalances the system until a utility-maximizing equilibrium is achieved. If there is some sort of disturbance to the system, such as a new technology or a new source of inputs, then markets will redistribute things until we achieve a new equilibrium.

To illustrate this equilibrating process, Irving Fisher, another of marginalism's foundational thinkers, used a hydraulic model.[3] He connected a series of irregularly shaped cisterns together with hoses and rods to visualize how goods get distributed and redistributed among consumers. With the addition and subtraction of water from the system, a new equilibrium would be established where the utility of each consumer (container) was maximized.

While an ingenious visualization of the marginalist theory of the Market, Fisher's hydraulic model also unwittingly expresses how disconnected this theory is from actual markets. The water in Fisher's model performs its equilibrium-establishing role because it is isolated from the water cycle. Actual, globally connected water systems are far-from-equilibrium, driven by the Earth's atmospheric heat engine.[4] Melting glaciers, falling rain, and rising steam participate in the temperature differentials that keep the Earth's materials in geochemical circulation.

The global economy is also a far-from-equilibrium system, and markets are part of driving the social transformations that keep it out of equilibrium. Consider the cement market. Cement is one of the world's most important building materials. The most common variety, Portland cement, was developed in the mid-nineteenth century, and its consistent production techniques make it a highly standardized global commodity. At the same time, cement is bulky and expensive to transport, which keeps cement markets relatively local. Cement plants are costly to build, have large productive capacities, and can operative efficiently for a long time. This means one plant can satisfy a lot of demand, while the costs of entering a market are very high.[5]

One effect of this local-global tension is that cement prices diverge based on whether a market can be served by coastal transportation. Cement markets are strongly connected to both the pace and location

of urbanization. The supplier to a landlocked city that is growing too slowly to entice new cement plants has more price-control than one in a coastal city large enough to warrant multiple plants.

The geographical and geological realities of cement markets have led to many small, local producers, with a handful of global giants. One of those giants is CRH plc, which owns the cement plant in Mississauga. Previously, the plant was owned by another global cement giant, Holcim Ltd., which sold the plant as part of a 2015 merger with yet another giant, Lafarge SA. The sale of the Mississauga plant, along with Holcim's other Canadian assets, was in response to "competition concerns" expressed by Canada's Competition Bureau. According to the bureau, the sale to CRH served to "preserve competition in the supply of cement and related products throughout Canada."

The Competition Bureau exists because mythical Free Markets do not. High concentration of ownership in the cement industry would be worrisome for the users of cement, so the Bureau polices the redistribution of market power that occurs with mergers like that between Holcim and Lafarge. The regulations enforced by the Competition Bureau are just one set among many that bear on the cement market. Others include building codes that regulate material uses for reasons of health and safety. Yet others will pertain to carbon emissions, which are very high for the cement industry. All of these regulations exist because economies affect and are affected by the rest of society.

There is no Market to which things may simply be left. Because markets are always subsumed and penetrated by innumerable social relations, they will always require interventions and regulations. This will in turn provoke further changes, shifting the conditions of supply and demand—and thus altering prices.

A favoured phrase of the marginalists is *ceteris paribus*: all else being equal. Marginalist theory works by imagining that each small change has only an isolated effect, and the system easily settles back into equilibrium, as in Fisher's hydraulic model. However, like moving water molecules, market transactions are themselves forces of change with effects that ripple outward, transforming other markets, altering desires, shifting prices, redistributing incomes across spatial and temporal scales. These ripples then amplify and contract, feeding back into the originating market. *Ceteris* is thus never *paribus*; economies are always far-from-equilibrium, and actual markets bear no resemblance to the Market.

Part two of a serial column on the fundamental concepts of commerce and exchange as driving forces that propel climate change.

Issue 01: What is The Economy?
Issue 02: What is The Market?
Issue 03: What is Growth?
Issue 04: What is Innovation?
Issue 05: What is a Price?
Issue 06: What is Value?

1 See Karl Polanyi, *The Great Transformation: The Political and Economic Origins of Our Time* (Boston: Beacon Press, 2001).

2 For a critical analysis of contemporary, mainstream economic theory, see Ian Hudson and Robert J. Chernomas, *Economics in the Twenty-First Century: A Critical Perspective* (Toronto: University of Toronto Press, 2016).

3 See William C. Brainard and Herbert E. Scarf, "How to Compute Equilibrium Prices in 1891," *The American Journal of Economics and Sociology* 64, no. 1 (2005): 57–83.

4 A. Kleidon, "A Basic Introduction to the Thermodynamics of the Earth System Far From Equilibrium and Maximum Entropy Production," *Philosophical Transactions of the Royal Society B: Biological Sciences* 365, no. 1545 (2010): 1303–15, doi.org/10.1098/rstb.2009.0310.

5 For more on cement markets, see Hervé Dumez and Alain Jeunemaître, *Understanding and Regulating the Market at a Time of Globalization: The Case of the Cement Industry* (London: Palgrave MacMillan, 1999).

Canada's Waste Flow

1. *What is waste?*

From both local and global perspectives, waste is a relative term. Several phenomena, including dumpster diving, yard/car boot sales, vintage clothing stores, and the thriving garbage-picking industries in developing countries, point to the fact that one person's waste is another person's sustenance, livelihood, and/or treasure.

Moreover, in important ways, we never actually get rid of anything: things we discard are transformed into other things. In this way, nothing is ever finally waste. Landfill waste may be out of sight, but it is material that variously resists and transforms into other substances, such as leachate. So in asking the question "what is waste?" we critically consider what it means from cultural, economic, political, and material perspectives to identify certain entities as "discardable" and discarded.

The waste Canadians produce is typically characterized as solid, liquid and gaseous substances, including municipal, industrial, construction, industrial agricultural livestock manure, nuclear, mining, and electronic (e-waste). According to the latest statistics, Canada produced 645 million tons of oil sands waste (sand and fine tailings), 473 million tons of mining waste (mine tailings and mine waste rock), 181 million tons of agricultural waste (livestock manure), and 34 million tons of municipal solid waste.[1] This makes us the world's highest per-capita municipal solid waste producer.[2]

2. *What do we do with our waste?*

Despite recent efforts to divert waste through recycling, up to 95 percent of all global waste is buried in landfills,[3] and landfilling is the central means of disposing of waste in Canada.[4] Every province and territory in Canada has landfills, and in 2010, 30 percent of them had reached or surpassed capacity.[5] In response, increasing volumes of waste are moved between provinces, or exported to the United States, Mexico, China, and elsewhere.[6] By 2050, Canada will have produced well over 2.5 million cubic metres of nuclear waste, nearly 200,000 kilograms of plutonium contained in over 24.8 million spent fuel bundles.[7] The problems posed by nuclear waste toxicity—affecting not only nations producing nuclear materials, but nations considered suitable sites for permanent repositories—remain largely unaddressed and are far from solved.[8] Other forms of waste such as mining, agricultural, and e-waste are managed through landfilling, reprocessing, incineration, freezing, and other methods.

Canadian waste management focuses on the three Rs: reduce, reuse, recycle. Of these, reducing waste is most effective but receives the least attention because it requires a significant change in consumption patterns. Reusing waste materials is next in effectiveness, and receives some attention in the form of drop-off depots, designated curb-side exchanges, and the like. Recycling waste material is least effective and—depending on the material being recycled—bad for the environment, yet receives the most interest.

In asking "what do we do with our waste?" we are interested in finding out what material, political, economic, historical, and cultural decisions contribute to our current waste-management practices, and how these practices might change in the future.

3. *What is our waste future?*

In Canada, as elsewhere, waste is largely understood as a technoscientific problem amenable to technoscientific solutions. This points to a circular logic: engineering and science articulate the terms and parameters of waste problems such that each new problem tethers us to further solutions in the form of further technoscientific innovations. As such, most attention is directed towards more and better diversion strategies, better landfilling and repository technologies, better semiological technologies for warning the future, and the development of new waste-management technologies. These solutions, as such, are not undesirable. But waste also involves the politics and economics of consumption; intergovernmental and industry-government relations; urban-rural divides; health; labour relations; gender and waste economies (in the Global North, household waste-sorting is most often performed by women, and in the Global South increasing numbers of women and children engage in waste recycling activities in subsistence economies); science-public relations; risk; governance; and so on—a bewildering array of factors, considerably beyond the remit of engineering and science. Indeed, this raises profound socio-ethical issues about our "waste-maker" society, and in particular, the effects of capitalism's refusal to identify waste as integral to production itself.

As such, our aim is to better comprehend society's fundamental and inextricable entanglement with technoscientific phenomena, and their risks. This entanglement between technoscience and risk is also the site of Canada's present and future ethical responsibility to current and future generations. Indeed, the twenty-first century marks a threshold where waste—as concept, as excess, as object—begins to issue an imperative that we refigure our relationships to waste within our communities. We must also begin to see waste as constituting our environments, and poised, we might say, to become an organizing, biospherical feature of global society. Canadians require opportunities to consider society's complex socio-ethical relations with waste in order to situate waste-management technologies in their wider context. Through a comprehensive examination of current and emerging waste-management technologies, our study aims to make an original and innovative contribution toward both practical and theoretical knowledge about the futurity of waste.

Our research program has already involved numerous projects, all of which link concrete waste issues (such as food recalls, mine tailing waste, recycling, and so on) to larger issues such as overconsumption, settler colonialism, intra- and extra-governmental relations, and public dialogue. For more detail on completed and ongoing projects, as well as publications and reports, see www.wasteflow.ca.

Overview of Canada's Waste Flow first published online at https://www.wasteflow.ca/about.

1 Statistics Canada, "Human Activity and the Environment: Waste Management in Canada," 2012, https://www150.statcan.gc.ca/n1/pub/16-201-x/2012000/part-partie2-eng.htm.

2 Statistics Canada 2012, 11 and 14; Conference Board of Canada, "Environment Report," January 2013, http://www.conferenceboard.ca/hcp/details/environment.aspx.

3 Kwon-Rae Kim and Gary Owens, "Potential for Enhanced Phytoremediation of Landfills using Biosolids: A Review," *Journal of Environmental Management* 91, no. 4 (2010): 791–797.

4 Statistics Canada 2012, 16.

5 Statistics Canada, "Households and the Environment," 2011, https://www150.statcan.gc.ca/n1/en/pub/11-526-x/11-526-x2013001-eng.pdf?st=d5Bx3lCa.

6 Josh Lepawsky and Chris McNabb, "Mapping international flows of electronic waste," *The Canadian Geographer* 54 (2010): 177–95; Statistics Canada, "Human Activity and the Environment: Waste Management in Canada, Annual Statistics 2005," 2010, http://publications.gc.ca/Collection-R/Statcan/16-201-XIE/0000516-201-XIE.pdf.

7 Low-Level Radioactive Waste Management Office, "Inventory of Radioactive Waste in Canada," March 2012, https://radiationsafety.ca/wp-content/uploads/2012/07/Inventory-Report-2012_EN.pdf.

8 Association for Regional and International Underground Storage. "International Waste Management Initiatives: Some History," http://www.arius-world.org/; Ian Holland, "Waste Not Want Not? Australia and the Politics of High-level Nuclear Waste," *Australian Journal of Political Science* 37, no. 2 (2002): 283–301.

A Brief History of Lake Ontario and Lake Ontario Waterkeeper

Harvey Shear

In May 2000, seven people died after drinking tap water contaminated with animal waste in the town of Walkerton, Ontario. The water source was a well located in an agricultural field that received cattle manure. During a period of heavy, prolonged rainfall, some of that manure seeped into the well. The well head had not been properly maintained. Furthermore, the water destined for the town was not regularly tested for bacteria by municipal staff and disinfected as needed, due to negligence on the part of the responsible officials. This caused public outrage; there was an inquiry with far-reaching recommendations on protecting Ontario's waters. One could say that the Walkerton tragedy and subsequent inquiry served as a wake-up call to educate the public at large about the importance of protecting our water sources. In 2001, with the support of Robert F. Kennedy Jr. and his global Waterkeeper network, Lake Ontario Waterkeeper was created as an independent charity dedicated to a swimmable, drinkable, fishable Lake Ontario.

Lake Ontario Waterkeeper is a Canadian charity that believes a healthier Lake Ontario is possible. What is needed is the right mix of sound environmental policy, transparent and informed decision-making, public education, and community-building programs. Their advocacy on the water health front also covers a myriad of broader concerns for the Great Lakes, including microplastic pollution, pipeline and nuclear plant regulation, waste management, and attention to endangered species such as the American Eel.

The necessity of an organization like Lake Ontario Waterkeeper testifies to the fact that, despite being one of the largest lakes in the world, Lake Ontario has felt severe effects within a scant 350 years of human development and industrialization. These have affected the chemical, physical, and biological integrity of the Lake, with major impacts on the many species that rely on the Lake.

Twelve thousand years ago, there was no Lake Ontario, just a two-kilometre-thick sheet of ice over top of everything that we now consider familiar. The climate warmed rapidly around 10,000–11,000 years ago, and the Laurentide Ice Sheet started to retreat. Lake Ontario began to form as meltwater filled in a large depression in the Earth's surface. The Lake changed shape many times over the intervening millennia, until it assumed its present shape around 4,000 years ago. As the ice sheet melted, plants and animals moved northward into a barren landscape uncovered by the retreating ice. Human settlement followed as Indigenous peoples followed wildlife and settled in areas to farm.

The human impact on Lake Ontario and its watershed was minimal, as Indigenous farmers practiced an early form of sustainable, nomadic agriculture, allowing the land to return to forest as villages moved on. Thus, consumption of fish and game always remained at healthy, subsistence levels.

In the mid-1600s, European settlers began to clear the land for permanent farms. As a result, streams became blocked with sediment from cleared lands; stream bank and shoreline erosion occurred on a large scale around the watershed. Fish migration up the numerous streams emptying into Lake Ontario was impeded because they had been dammed for the production of water power.

By the 1800s, Toronto, Hamilton, and Rochester had become important commercial centres because of the abundance of clean, free water and cheap land available to settlers. Soon enough, Lake Ontario began to see uncontrolled pollution from domestic and industrial sewage discharge. Typhoid and cholera outbreaks occurred, attributable to untreated sewage. The fishery in Lake Ontario collapsed because of overfishing, pollution, habitat destruction, and invasion by the sea lamprey.

Responding to growing concerns about water management and health, in 1909 the British and US governments signed the Boundary Waters Treaty to regulate disputes about the management of the shared waters from coast to coast, including the Great Lakes (with the British acting on behalf of Canada). Over the first half of the twentieth century, sewage treatment plants were built, drinking water was disinfected, and some industrial discharges were regulated. Nevertheless, by the late 1960s, pollution from nutrients in domestic sewage and agricultural runoff had turned Lake Ontario into an algae soup. Dead fish washed ashore every spring and summer, and beaches were unusable most of the summer. This untenable situation led the US and Canadian governments, in 1972, to sign the Great Lakes Water Quality Agreement, the purpose of which was to restore the chemical, physical, and biological integrity of the waters of the Great Lakes Basin ecosystem (including, of course, Lake Ontario). Since then, there have been three subsequent agreements, each designed to improve upon the previous one to address more complex issues. The 2012 Agreement is the most recent and comprehensive, dealing with habitat destruction, invasive species, climate change, newer pollutants such as hormone-mimicking chemicals, personal care products, and microplastics, as well as other issues that need to be managed to restore Lake Ontario to health.

"Fixing" Lake Ontario is neither simple nor a short-term project. It is a complex, multigenerational series of actions that requires the engagement of all citizens of the Lake Ontario watershed. While the two federal governments and their state, provincial, municipal, and First Nations partners have done much to reverse 350 years of damage, there is still much more to be done—some of which through not-for-profit organizations such as Lake Ontario Waterkeeper. Their role in public education is vital in addressing the challenges facing Lake Ontario, since citizen action is such an important adjunct to government action. The Clean Water Workshop, one of Waterkeepers' longest running and most successful initiatives, mentors university students with a passion for environmental law and watershed protection. This is an important initiative to engage young people in learning how to adopt practical solutions to complex problems that threaten the Lake. Another valuable project is the reporting of water pollution to Lake Ontario Waterkeeper directly. Citizens can play an active role in assisting governments in reducing and eliminating pollution through such projects. One thing that we have learned since the signing of the first Great Lakes Water Quality Agreement in 1972 is that engaging citizens is essential for the success of any restoration or protection project. Waterkeepers has provided a solid platform for citizens to learn about problems, develop ideas about how to deal with those problems, apply those solutions, recommend to governments that they be applied, and follow the response of the Lake to those solutions.

Reflecting on Sustainable Transportation

The Climate Change Project
City of Mississauga

The City of Mississauga is currently making a significant push to advance our thinking and strategic direction to realize the aspiration of becoming a city "where people can get around without an automobile."[1] The City has a series of major planning projects underway, including Mississauga Moves, the Cycling Master Plan Update, and the Transportation Demand Management Strategy. We are also listening to people's needs in ways we have never done before through our MiVoice rider panel and the Mississauga Moves website. We are working with Peel Region on unprecedented regional transit investments, such as the Hurontario LRT. Once completed, this light rail network will run twenty kilometres from Port Credit to Steeles Avenue, through Mississauga City Centre.

Through this work, we are seeing that Mississauga, when compared to its peers across the region, is in fact more multi-modal than we realized. Mississauga has approximately 1.5 cars per household,[2] which is fewer than the majority of municipalities in the Greater Toronto and Hamilton Area, including Brampton, Hamilton, York Region, and Caledon.[3] Transit ridership has grown by over twenty-five percent since 2011, and cycling rates are growing for both commuting and recreational travel.[4] Nevertheless, there is still work to be done.

Through our community consultation for Mississauga Moves and the Cycling Master Plan Update, we have learned that people recognize mobility as essential to a high quality of life—and although personal vehicle use remains high, the City as a whole is not as car reliant as we might think.

Mississauga residents want to take transit more, and would do so if it were better integrated in the region, provided more frequent service, and were more convenient. We have also heard that people want to bike and walk more—but the most significant barrier, especially to cycling, is feeling unsafe or uncomfortable. For cyclists, this sense of stress is largely related to sharing the road with larger vehicles. Many studies have shown a similar significance of "traffic stress" on cyclists in cities worldwide. It is therefore a recognized City priority to provide comfortable bicycle facilities within the road rights-of-way to encourage more people to cycle. Increasing the number of cyclists using a roadway network is one of the most effective ways to improve overall cyclist safety.

A successful cycling network is one that makes it possible for people to get to where they want to go (*Connected*), without significant detours (*Convenient*), and without exposing cyclists to conditions that are beyond their tolerance for traffic stress (*Comfortable*).[5] Therefore, bicycle network planning and implementation must consider cyclists' tolerance for traffic stress in order to figure out the changes—large and small—that can create a low-stress network.

We know that people want to take more trips on foot or by bicycle, but feel that safety is a major barrier. The City is working to address this need. Mississauga recently adopted the Vision Zero philosophy,[6] and will also be developing a Road Safety Plan. The Cycling Master Plan Update is premised on the philosophy that our cycling infrastructure must be built to prioritize safety and comfort, so that even the casual "interested, but concerned" cyclist is confident using the City's network.

There is tremendous potential to shift more trips to active modes. According to the 2016 Transportation Tomorrow Survey, eighty-seven percent of bicycle trips in Mississauga are five kilometres long or less, which is the generally accepted "bikeable distance."[7] On a typical weekday, approximately forty-four percent of all automobile trips in Mississauga are five kilometres or less. Many of these trips could feasibly be taken by bicycle.[8] The Cycling Master Plan outlines a proposed network with supporting actions that, if realized, will provide more residents the opportunity to ride their bike more often.

In terms of transit enhancements, Mississauga's busiest GO Train stations (Port Credit, Clarkson, and Malton) can expect some major changes when train service starts running every fifteen minutes in both directions by 2025 through the Regional Express Rail Program.

Throughout the summer, Mississauga Moves will be circulating the proposed vision statement and goals for our transportation system. This phase of public engagement will ask:

- Does the vision resonate with you?
- What aspects of these goals are most vital?
- What will success look and feel like?

Visit www.mississaugamoves.ca or email mississaugamoves@mississauga.ca to get connected with this project.

Part two of a serial column on the work guiding the City of Mississauga's Climate Change Action Plan.

1 *City of Mississauga Strategic Plan* (City of Mississauga, 2009), 33.

2 *Transportation Tomorrow Survey* (City of Mississauga, 2011), 25.

3 *Canadian Transit Factbook*, Canadian Urban Transit Association, October 2016.

4 *City of Mississauga Business Plan and Budget 2018–2021* (City of Mississauga, 2018), D-9; *City of Mississauga Business Plan Update* (City of Mississauga, 2012), F-4.

5 *Draft Cycling Master Plan* (City of Mississauga, April 2018), 7.

6 Vision Zero is a multi-national strategy aimed at reducing and ultimately eliminating all pedestrian, cyclist and motorist fatalities. On average, there are 960 collisions on Mississauga roads per year, according to municipal statistics, with 185 involving pedestrians. Of those, fifteen result in fatalities.

7 *Transportation Tomorrow Survey* (City of Mississauga, 2016).

8 *Draft Cycling Master Plan*, 18.

Local Useful Knowledge: Resources, Research, Initiatives

CultureLink's support programs for newcomers aim to foster crucial connections: between social and environmental justice, and between human and ecosystem health. For thirty years, the multilingual Toronto non-profit has assisted new immigrants and refugees with the challenges of migration by expanding their social communities and local Canadian knowledge, whether through one-on-one settlement assistance, employment workshops, intergenerational programming, local walking tours of neighbourhoods, first-time camping experiences, or "New Canadian Life," a weekly radio show of newcomer stories. CultureLink's Green Settlement principles—in place since 2008—aim to encourage the maintenance and growth of health-conscious and environmentally protective habits that may be overlooked in dominant North American lifestyles, and within the more immediate pressures of migration. In partnership with Cycle Toronto, CultureLink has developed a multilingual cyclists' handbook, the Bike to School Project, and Bike Host, a program that offers rental bikes and mentor-led tours to promote cycling as an active and economical mode of commuting. Nurturing sustainable habits within settlement services contributes to a more diverse environmental movement in Canada and expands the idea of "environmental citizenship" to include all residents in the collaborative path to a healthy future.

Founded in 1979, **Ecosource** is an innovative environmental education charity specializing in engaging, hands-on programs that focus on how all of us can become better environmental citizens. The organization provides action-oriented education about waste reduction, local food, and sustainability. Key to Ecosource's work is the belief that engagement between people of all ages is integral to community knowledge and resilience. Ecosource's programs engage a variety of audiences and issues: from whole-school waste reduction education and community gardening to youth-led conferences and collaborations with Indigenous knowledge holders. The latter partnership formed the basis for Ecosource's 2017 program "Travelling the Credit," where Mississauga-area youth learned ecological stewardship, history, and environmental knowledge from Indigenous leaders. In line with Ecosource's aim to empower youth, "Travelling the Credit" concluded with walking tours at local conservation areas led by program participants. Working with teachers, students, senior citizens, and people of various backgrounds and abilities, Ecosource inspires and empowers the community to become more environmentally responsible through creative public education.

With its first event in September 2017, **Great Lakes Water Walk** forms part of a series of Indigenous-led walks and actions aimed at celebrating, honouring, and protecting waterways across Turtle Island. At the inaugural Great Lakes Water Walk, Anishinaabe Elders led walkers eastward from Port Credit and westward from Scarborough to meet in Toronto, where a round dance and multi-faith water blessing was held. Acknowledging diverse responses to Canada's 150th anniversary, Water Walk organizers framed their event as a march for Indigenous and non-Indigenous peoples toward a future of peace, friendship, and mutual respect. At the head of each march, women waterkeepers carried copper pails, centering the longstanding use of copper for water vessels due to its antimicrobial qualities. In sharing this knowledge, along with the embodied practice of walking as a pedagogical tool, organizers of Great Lakes Water Walk foreground Indigenous traditions, and ensure their endurance in the Greater Toronto Area.

The **Southern Ontario Centre for Atmospheric Aerosol Research** (SOCAAR) at the University of Toronto monitors air quality and the impact of various sources of airborne pollution in the Greater Golden Horseshoe Area and beyond. Directed by Greg Evans, Professor of Chemical Engineering and Applied Chemistry, SOCAAR uses advanced instruments and facilities to study air pollution and its impacts, such as a combustion lab to study emissions from new vehicles and fuels, monitoring stations by large roads to measure traffic pollution, networks of smart sensors to study pollution exposure across cities, and a truck full of instruments for air sampling field work (MAPLE: Mobile Analysis of ParticuLate in the Environment). SOCAAR's interdisciplinary work identifies links between site-specific vehicular and industrial emissions, the composition of urban air, and the influence of airborne particles on human health and climate change. SOCAAR's research helps inform policy, and monitors changes in human and commercial behaviour to help navigate the invisible harms latent in our urban air.

By collaborating with language centres and community organizations, the **Toronto and Region Conservation Authority's** (TRCA) **Multicultural Connections Program** (MCP) seeks higher newcomer participation in environmental stewardship by lowering economic, cultural, and language barriers that may limit access to nature-based events and local knowledge. The MCP delivers free educational programs that cover a range of topics from the Great Lakes and water conservation to solid waste management, biodiversity, First Nations' pre-contact lifeways, and the impact of European colonization. In addition, the program uses TRCA's green spaces for Growing Pollinator Plants, an initiative that creates better environments for native bees. In response to the needs of the large numbers of new Canadian residents who settle in the Greater Toronto Area within TRCA watersheds, the MCP addresses the rapidly shifting demographics of a migrating world, while recognizing our responsibilities to the non-human world.

Walk + Roll Peel works to promote active transportation in the region through a broad-based plan aimed at sharing resources and building community around walking and cycling. Recognizing the need for clear, concise, and region-specific advice for active transportation, Walk + Roll Peel provides information covering all the varied concerns for vulnerable road users—from mapping trails and monitoring road conditions, to choosing a bike and efficiently carrying cargo. Jointly run by the Region of Peel and its three municipalities, the organization maintains listings of policy and planning documents, local events, and public consultations pertaining to active transportation. Walk + Roll Peel's online presence is supplemented by vibrant community events throughout the Region, including weekly community rides held by Mississauga and Brampton's Cycling Advisory Committees, the annual Tour de Mississauga, and the Mississauga Bike Challenge. With the wide scope of information provided by Walk + Roll Peel, the Region is well positioned to grow its numbers of sustainable road users—a plan of action that is crucial in conjunction with improvements to roads, trails, and transportation infrastructure.

Biographies

Canada's Waste Flow (CWF) is an interdisciplinary research program connecting people interested in the topic of waste to consider Canada's waste future. Directed by **Myra J. Hird** at Queen's University, researchers at CWF study the movement, processing, treatment, and after-effects of diverse waste streams, including by-products of mining, nuclear energy, biomedicine, and domestic waste. The **genera Research Group** is a university-wide initiative that brings together interdisciplinary scholars at Queen's University to generate and synthesize new and innovative research on waste, and to mobilize this knowledge to benefit Canadians and the global community.

Sydney Hart is a researcher, artist and PhD student in the Cultural Studies program at Queen's University, ON. His current research investigates how media infrastructures reflect inequalities in mobility, and focuses on air travel through North America. He has written criticism for publications including *Espace art actuel* and *Scapegoat Journal*, and recently created *Without Zebra*, a media art exhibition at Kingston's Art and Media Lab. Originally from Tiohtià:ke / Montréal, he is now based on unceded Coast Salish territories in Vancouver.

Matt Hern is a founder of Solid State Industries, teaches at multiple universities, and lectures widely. He is the author of *What a City Is For: Remaking the Politics of Displacement*, among many other books.

Am Johal is Director of Simon Fraser University's Vancity Office of Community Engagement and author of *Ecological Metapolitics: Badiou and the Anthropocene*.

Kent Moore is a Professor of Physics and Vice-Principal Research at the University of Toronto Mississauga. Moore has a PhD in Geophysical Fluid Dynamics from Princeton University, and his research interests include geophysical fluid dynamics, mesoscale meteorology, and polar meteorology. He has published over 160 peer-reviewed research papers and has played a leadership role in a number of national and international research collaborations focused on improving our understanding of the interactions that occur with the climate system. Professor Moore has also trained over forty undergraduate students, graduate students, and post-doctoral fellows who have gone onto varied careers in the financial services industry, government, and academia.

Andrea Muehlebach is Associate Professor of Anthropology at the Department of Anthropology at the University of Toronto Mississauga. She is the author of *The Moral Neoliberal* (University of Chicago Press, 2012) and is currently writing a book (*A Vital Politics: Water Insurgencies in Europe*) on struggles for public water in Italy, Ireland, and Germany.

Michelle Murphy works on decolonial feminist technoscience studies. She is the author of three books, the most recent being *The Economization of Life* (Duke University Press, 2017). She is director of the Technoscience Research Unit, which hosts a social justice technoscience lab with a specific focus on environmental and data justice. Murphy is a Professor of History and Women and Gender Studies at the University of Toronto. She is Métis from Winnipeg.

Natasha Naveau is an emerging documentary media maker based in Toronto. Her multidisciplinary academic experience includes a BFA from NSCAD, Halifax, with a focus on print media, and studying Commercial Photography in Vancouver; she is currently an MFA candidate in Ryerson's Documentary Media program. She has varied work experience, as well, behind the camera, editing and collaborating on narrative, reality-based, and non-fiction works. She comes from an eastern European and Chipewyan heritage, and was raised in an Anishinaabeg community. This has greatly influenced her work and interests, which tend to navigate conversations of identity and intersectionality, learning through culture, and our relationships to land and the environment.

Dana Prieto is a visual artist and educator born in Argentina and based in Toronto, currently completing her Master of Visual Studies at the University of Toronto. Her work explores intimate and socio-political entanglements of mundane objects and rituals seeking to unsettle modes of relating, producing, exchanging, and consuming in the Anthropocene. She has developed award-winning projects working within diverse communities in Toronto, Hamilton, Halifax, Buenos Aires, Rawson and Belize. Her work has been exhibited in Museo del Hambre, Little Sister Gallery, Idea Exchange, MAW NYC, Trinity Square Video, Xpace Cultural Centre, Sur Gallery, Blank Canvas and Harbourfront Centre.

Stanka Radović is Associate Professor of English at the University of Toronto. Her work explores space and urban environments in contemporary dystopian fiction, postcolonial literatures, and diasporic/migrant literatures, focusing on the interplay between social space and spatial imagination. Radović received her PhD in Comparative Literature from Cornell University. Her first book *Locating the Destitute: Space and Identity in Caribbean Fiction* (University of Virginia Press, 2014) examines the impact of colonial spatial hierarchy on postcolonial self-understanding in the writings of V.S. Naipaul, Patrick Chamoiseau, Beryl Gilroy, and Raphaël Confiant.

Harvey Shear is Professor of Geography at the University of Toronto Mississauga. He teaches undergraduate courses on world freshwater resources, ecology and economy, and the Great Lakes, and he is co-instructor for the Environment-Geography internship program. Shear has published numerous scientific papers on aquatic ecology and management, on ecological and sustainability indicators for the Great Lakes, and on the hydrology and nutrient regime in Lake Chapala, Mexico's largest lake. He also developed a set of sustainability indicators for the Town of Oakville as part of its Environmental Strategic Plan, which are also used in the Town's State of Environment Report.

Karolina Sobecka is an artist and designer working at the intersection of art, science and technology. Sobecka's work has been shown internationally, including at the Victoria & Albert Museum, National Art Museum of China, MOMA Film, ZKM, WRO Biennial, Zero1, Marfa Dialogues NY, and Science Gallery. She has received multiple awards and commissions, including from Creative Capital, New Museum, Rhizome, NYFA and Princess Grace Foundation, and Vida Art and Artificial Life Awards, as well as residencies at Banff, Eyebeam, Queens Museum and others. Sobecka is the founder of design studio Flightphase, has taught at Rhode Island School of Design, School of the Art Institute of Chicago, and University of Washington.

GLOSSARY
An entangled lexicon for a rapidly changing world

1. **Commons**: Spaces or things that are shared before, above, or in conflict with their enclosure as private property. Often describing elements such as water and air, the commons are invoked to suggest that Earth's resources are finite and shareable (on shared responsibility, ownership, and urban space, see Radović, p. 18; McCallum, p. 20; and The Climate Change Project, p. 25). In many societies, common goods have been inscribed in law (Japanese *iriai* law, for example, recognizes the forest as common space). Conversely, a "tragedy of the commons" occurs when a public resource is contaminated (see Shear, p. 24) or depleted by individual actions. **Privatization** occurs when commons held in the public trust by a government are sold to a private entity (see Muehlebach, p. 17).

2. **Dispossession** refers to the removal of rights, status, possessions, or land (either by formal or informal methods). In the Canadian settler-colonial context, Indigenous activists and scholars often highlight land as a central component of dispossession, but are equally attuned to its cultural and legal forms (see Prieto, p. 3, 4; Naveau, p. 14, 15; Hart, p. 16; and Shear, p. 24).

3. **Ebullient**: Boiling, bubbling up. Exuberant, buoyant, lively, enthusiastic—a pleasant quality in people, a disorderly one in liquids (see Hern and Johal, p. 5).

4. **E-waste**, or **electronic waste**, consists of discarded electronic devices or electrical equipment. Unlike other household waste, e-waste contains substances like mercury, lead, cadmium, and arsenic, and should be carefully discarded or donated in order to mitigate contamination (for more on waste management, see Canada's Waste Flow, p. 23). Also see McCallum (p. 20) for a discussion of often-overlooked e-waste impacts from the production and recycling of electronic vehicle components.

5. **Extractivism**: A relationship with the Earth where natural resources are harvested based on their desirability and value in global markets and turned into capital gain (see Prieto, p. 3, 4; Hern and Johal, p. 5; and McCallum, p. 20). Rooted in the capitalist logic of perpetual growth, extractivism nevertheless has to contend with the reality of finite resources (see Cochrane, p. 21), and remains highly controversial for its tendency to destroy Indigenous lands, exploit labour, and contaminate the environment.

6. **Futurity** refers to predictions and aspirations about the future, where divergent possible outcomes arise from current actions and/or inactions. As such, futurity is often used to examine and critique the present, and its plural form (**futurities**) allows for a consideration of multiple perspectives and possibilities. Future-oriented imaginings may draw on existing worldviews (see Murphy, p. 10; and Muehlebach, p. 17), or may be implicated in pragmatic or unpredictable outcomes of current realities (see Canada's Waste Flow, p. 23).

7. **Geoengineering**: technological intervention aimed at changing climate systems. **Cloud seeding** is a well-known example, where physical processes of cloud formation are altered (often through the addition of silver iodide to the atmosphere, shot from aircraft) to cause or prevent precipitation. Geoengineering includes tools proposed to fight climate change, such as carbon capture, climate cooling through cloud seeding, and outer space sun diffusion. Critics of geoengineering often assert that the gaps in our understanding of climate systems create risky conditions for intervention (see Sobecka, p. 8).

8. An incredible variety of processes generate **dust** on Earth. **Glacial dust**, for example (see Moore, p. 13), consists of sediment collected through the movement of water over thousands of years of glacial activity and deposited as glaciers recede. **Volcanic dust** includes fine rock particulate shot into the atmosphere after an eruption (see Sobecka, p. 8). **Fugitive dust** describes particles that mainly come from the Earth's soil (but not from a single specific source) which "escape" into the atmosphere.

9. **Leachate** typically refers to the often highly toxic liquid by-products resulting from the decomposition of waste (see Canada's Waste Flow, p. 23). Leachate storage is an ongoing consideration (as sequestering it and preventing groundwater contamination are paramount concerns), and creative, clean solutions are very desirable.

10. **MODIS** stands for Moderate Resolution Imaging Spectroradiometer, a technology used aboard NASA satellites to capture views of the Earth's surface every one to two days, in order to contribute to the study of Earth's dynamic processes (see Moore, p. 7).

11. **Multi-modal**: involving many different modes. The Climate Change Project describes the city of Mississauga itself as multi-modal (p. 25), which refers to the variety of options for people moving around the city. In the context of transport, tools like shipping containers (also described as **intermodal containers**) are lauded for their capacity to offer dimensional standardization for the transport of diverse goods; however, a shift towards containerization has also entailed drastic impacts on the environment and global trade (see Hart, p. 16).

12. **Particulate**: Microscopic, pollutive particles of solid or liquid matter that circulate in the Earth's atmosphere, and in human and animal bodies through inhalation (see Murphy, p. 10; Prieto, p. 3, 4; and Sobecka, p. 8). Particulate sources vary, from the natural to human-made, including vehicle emissions, dust storms, volcanoes, and power plants (see Canada's Waste Flow, p. 23). This term may also describe the nearly invisible plastic particles (termed **microplastics**) circulating in bodies of water throughout the globe (see Shear, p. 24).

13. **Reciprocity** denotes a relationship of exchange and mutual benefit, commonly referring to transactions external to the formal, money-mediated market (see Cochrane, p. 21). Reciprocity is based in social interaction, where peers negotiate their informal debts and credits to one another (see Prieto, p. 1, 3, 4; and Radović, p. 18). Reciprocity is used as a technical term in many different fields, from psychology to international relations, but common among them is the belief that relationships depend on an acknowledgment of mutual responsibility (see Murphy, p. 10; Naveau, p. 14, 15; Muehlebach, p. 17; and Shear, p. 24).

14. **Rematriation**: the practice of returning people, territories, ancestral remains, artifacts, property, and other articles of symbolic value to their original homelands and/or stewards (see Hern and Johal, p. 5). Rematriation shifts from ideas of **repatriation** (from the Latin *repatriare*—"to return to one's fatherland") in order to resist its patriarchal connotations. The concept of rematriation understands colonialism as an ongoing process and reality that must be resisted in the present day, rather than a purely historical occurrence, and is closely related to strategies of **decolonization** (see Murphy, p. 10; Naveau, p. 14, 15; and Muehlebach, p. 17; as well as the first issue of the *SDUK* broadsheet: *GRAFTING*).

15. **Reproductive justice** recognizes structural inequities in who has access to reproductive choices, including barriers based on race, class, gender, sexuality, ability, age, nationality, and legal status. Originating in racialized communities, the term views reproductive decisions within a web of interconnected economic, social, and environmental issues. Indigenous reproductive justice (see Murphy, p. 10) highlights how settler colonialism and extractivism (see Hern and Johal, p. 5) impose their destructive will on both land and bodies.

16. **Vitality** ascribes liveliness both to human and non-human beings, and thereby questions the nature of life and agency (see Naveau, p. 14, 15; and Muehlebach, p. 17). Formally theorized in the European post-Enlightenment field of **vitalism**, this notion contrasts strongly with a mechanistic understanding of life, where entities are seen as machines determined by biological or chemical processes. Vitality/liveliness also complicates the primacy of humans as thinkers and decision-makers, and opens us up to understanding the ways other beings shape our world (see Murphy, p. 10; Hart, p. 16; and Radović, p. 18).

17. **Waterways** are routes for travel by water, including rivers, canals, or seaways that provide access for ocean-going ships. The language of waterways emphasizes their relationship to navigation, shipping, and transport (see Hart, p. 16), and stands in contrast to other ways of describing bodies of water that encompass social, historical, health, climate, and ecological aspects of water (for more on these intersections, see Moore, p. 7, 13; Murphy, p. 10; Naveau, p. 14, 15; Muehlebach, p. 17; Shear, p. 24; and profiles of the Great Lakes Water Walk and the TRCA's Multicultural Connections Program, p. 26).