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ICE AS A COUNTER-ARCHIVE:

Permafrost, Archival Melt, and Climate Futures

IN AN ARTICLE ON THE POSSIBILITIES of an anthropology of stone, Hugh Raffles points out that most inanimate objects are anything but lifeless.[1] His assertion contests the lack of life typically attributed to inanimate objects in the Western philosophical tradition. He writes: "a stone can endure, it can change, it can harm, it can heal...it can carry your memories and your dreams....It can reveal the history of the universe."[2] So, too, can permafrost.

Like stone, ice in our circumpolar environments inspired images of permanence and death in the Western colonial traveller's imaginary. Frederick Cook, during his 1908 expedition to the North Pole, wrote: "we were the only pulsating creatures in a dead world of ice."[3] Nearly a hundred years before Cook's expedition, John Franklin and George Back surveyed the Mackenzie River from its Arctic Ocean delta to its hinterlands in today's Northwest Territories. Franklin and Back named the eastern low-lying tundra, characterized by permafrost, "the Barrens," because they not only saw it as empty but as also lacking elements necessary to sustaining human life.[4] Of course, the British colonial vision of frozen, unproductive, untillable land was not Back and Franklin's alone. In Canada, a country founded on the practices of settler colonialism, the limited agricultural potential of permanently frozen soil kept settlers outside of the Mackenzie River basin for a very long time. Territory beyond the Arctic Circle was understood "as 'useless' to the extension of agriculture." [5] Consequently, the Dominion government had little interest in the Mackenzie basin until the discovery of oil near Fort Norman in 1920.[6]

However, frozen soil can, in Raffles' words, "reveal history" [7]—and certainly, in the circumpolar world, ice and permafrost were never still or lifeless partners. They responded, moved, and changed to human action but also presented danger to travellers when they thawed too early, or froze too late in the winter. In this article, I will examine how the arrival of the petroleum industry in northern Canada, along with its governmental and academic counterparts, provoked responses from polar environments. Specifically, I investigate the responses characterized by permafrost, a mixture of frozen earth, water, and sediment that continuously covers 24% of the northern hemisphere at our highest latitudes and can sometimes be thousands of feet deep. In many instances, permafrost has taken nearly one million years to form.[8] Today, permafrost is understood as capable of revealing information about climates long ago, and predicting our climate futures. However, through twentieth century extractive projects, permafrost responded to petroleum industry employees, scientists, and government officials and they, in turn, responded to it. Together, these actors crafted narratives about permafrost and allowed for the formation of permafrost as a climatic archive.

Describing three historical moments I will discuss how, under the auspices of extraction projects, permafrost's relentless thaw and freeze cycles continuously aided in the creation of new understandings of this frozen soil. Its thaw and freeze cycles were not only integral to the development

of large-scale oil drilling and mining but have also resisted it in important ways. These three historical moments are not meant to be a chronological causal account of the idea of permafrost—in fact, these three moments are deeply layered. Although each moment presents a different understanding of permafrost, these differing ideas can also be held simultaneously. Thus, this article is intended to reveal how changes to definitions of nature are mutually constitutive of not only extractive possibilities but also broader society.

Though their work often diverges, Ann Stoler[9] and Arlette Farge[10] both remind us that all archives are constructed—they do not simply exist in an untainted form. Archives are sometimes swept up and collected, but most often produced by, and subjected to, the hegemonic knowledges of a particular historical period. The permafrost archive, squarely the product of Western science and industry's interactions with a frozen environment, is no different. However, permafrost, I argue, is also a living archive and does not reveal a wholly unified application of Western scientific logic. I will also suggest that permafrost should be thought of as a *counter-archive*[11]—that is, an archive that is planetary in scope, resists being emplaced *within* archives, and is "an incomplete and unstable repository."[12] Through a succession of understandings of permafrost mutually constituted by permafrost and its human collocutors, permafrost now reveals a critical historical record in its geological depths. The research presented below is the result of a year of archival research at the Glenbow Museum in Calgary, AB, and ethnographic fieldwork in the Mackenzie Valley.

I.) Permafrost's Thaw and the Shattering of Pipeline Dreams in the 1930s and 1940s: *Permafrost as Problem*

When University of Chicago geology graduate Ted Link showed up in Imperial Oil's Toronto office in early 1918, he thought he had been accepted for a job in South America.[13] Instead, he was offered a position doing exploratory work in northern Canada's Mackenzie watershed—the first exploratory work to be done by an oil company this far north. His diaries reveal an understanding of wilderness concordant with the familiar colonial narratives of North America's West—a masculinist and racialized account of nature. He wrote of his battles with rivers, his adventures with bush pilots, and his disdain of the "very filthy and poor specimens at the [Indian camps]."[14] Link was taken in by the aesthetic perfection of crude and had few human interests beyond that. For Link, the "films of oil display[ed] beautiful arrays of constantly changing colors" [15] and the "heavenly bituminous smell" [16] were idealized through the orderly and systematic exploration of a petroleum corporation: Imperial Oil.

"We've hit a gusher just outside of Fort Norman,"[17] Link wrote on a fateful day in 1920 when black crude emerged from what he called "that precious little hole in the frozen crust of the earth, 1800 miles from civilization."[18] Imperial Oil thus established the world's northernmost drilling site, and the Canadian government simultaneously signed a hastily drafted land settlement with the Dene people of this region—Treaty 11—in January of the following year.[19] The early years of oil exploration and extraction meant that corporate geologists, like Link, assumed an even more prominent position in matters of governance not only because of his knowledge of the north's geology and resource wealth, but also because he provided consultations for infrastructural programs in the region. His vast infrastructure knowledge came from a time of crisis in Imperial Oil's early years in the Mackenzie Valley—as soon as work began on establishing systematic extraction sites, permafrost problems arose in exponential fashion. Permafrost's cyclical heavings caused every built structure to sink. Powerlines, drilling platforms, roads, and even houses were useless after one season.[20]

Permafrost is frozen year-round, save for an active layer (anywhere from 10 cm to 3 meters deep) at the very top that thaws in the long Arctic summer days and freezes again in the autumn. These natural thaw and freeze cycles impacted every aspect of industrial projects in the North. Furthermore, the thermal output of houses, drilling platforms, and roads would again cause cycles of thawing and refreezing throughout the long winter. Imperial's geologists haphazardly remedied permafrost's reactions but failed to overcome what became known as "the permafrost problem."[21] Because Imperial Oil could not provide reliable housing, it could not attract needed labourers. Ad campaigns were launched in the 1930s, 1940s, and 1950s to attract families to permanently settle in the area around the oil finds now called Norman Wells. But the basic problem of shelter kept families away and relied on the labour of intrepid bachelor men.[22]

Even more problematic for Imperial Oil was trying to build pipelines on permafrost. In the 1930s and 1940s, Link called permafrost "the most serious impediment to pipeline building in the north."[23] The Second World War proved to be a watershed moment in permafrost's revolt against encroaching pipeline infrastructure. In 1942, at the behest of American military planners fearful of Japanese attacks on Alaskan Oil tankers, Imperial Oil began one of the most ambitious pipeline building projects of the day—linking up the oil fields of Norman Wells with the Alaska Highway at an oil refinery in Whitehorse in the southern Yukon. 40,000 soldiers and construction workers radically transformed the Mackenzie watershed, clear-cutting millions of trees and ripping up permafrost with excavators to make way for the CANOL (or Canadian Oil) pipeline.[24] Four-inch pipe was laid either directly on the ground or on wooden shelves buried into the top layer of soil in the summer. However, the pipeline was no match for permafrost—heaving permafrost cracked the poorly-placed pipe and created constant oil spills. Within a year of its opening in 1944, the CANOL pipeline was shut down, deemed a waste of money, and completely incapable of transporting the needed crude. The failure of the CANOL project and its engineering difficulties drew the attention of the Canadian government. While Imperial Oil demanded less regulation in the north due to the grave difficulties faced by the petroleum industry, the government of Canada sought to involve itself more in northern development because, in its view, official government scientists were more capable of engineering permafrost solutions than Imperial Oil's rag-tag frontier geologists.[25]

Thus, the early years of extractive industry with permafrost were combative. The subjugation of permafrost was assumed and industrial projects proceeded in the same manner as those at latitudes farther south. In this first historical moment we see not only the attempted taming of permafrost but also, in moments of infrastructural failure, a new opening. Permafrost was poorly understood and had to be constituted as an object of knowledge in order to allow pipelines to smoothly move oil out of the North. This first moment was a critical step in what would later become not only an object of knowledge, but a (counter)archive.

2) Permafrost's Thaw Becomes an Object of Study in the 1950s, 60s and 70s: *Permafrost as Ecosystem*

Moving swiftly in the wake of the CANOL disaster, the Canadian government distinctly took on the problem of permafrost as a *civil engineering problem*. A Permafrost Division was established in 1950 within the federal Division of Building Research, which was integrated into the Department of

Defense the following year.[26] The construction of a Northern Research Station at Norman Wells institutionally bound together Imperial Oil with both government scientists and military administrators. This research triumvirate perseveres through to the present day—many northern scientific research stations are also military bases where research is carried out by both academia and industry.

Understanding permafrost as a researchable civil engineering problem allowed for new cross-governmental collaborations to be formed. Many of these collaborations were seen as crucial to thawing dominant Cold War geopolitics. For example, in 1960, the Calgary Herald reported on an "historic Arctic meeting" where more than 1,000 delegates, including many Russian scientists and government officials, met in Calgary.[27] The forum was jointly organized by the Federal Government and the Alberta Society of Petroleum Geologists (ASPG), which was then largely composed of Imperial Oil geologists. Dr. Gussow, head of the ASPG, opened the summit by declaring that "Canada is handicapped by its climate...and pointed out that Russian maps on display at the auditorium are far more complete and detailed than those of Canada....We have a great deal to learn from our Russian friends. They have done a great deal of good work in the Arctic."[28] The move towards more collaborative scientific research was also reflective of a desire to view northern ice systems and landscapes in a more holistic way.

Permafrost's troublesome nature not only directly created collaborations across the Cold War divide, but also across the divides shaping Canada's north—especially between white industrial elites and colonized First Nations. In 1974, the Government of Canada commissioned the Mackenzie Valley Pipeline Inquiry, also known as the Berger Inquiry after its head justice Thomas Berger, to investigate the impact on a pipeline that would run through the Mackenzie River Valley of the Northwest Territories.[29] The pipeline development was especially spurred on by the discovery of oil on Alaska's north slope seven years earlier.[30] Hearing testimony from diverse groups with an interest in the pipeline, Berger concluded that the Yukon and the Northwest Territories were too susceptible to environmental harm and that the energy transportation corridor thus created would require an immense infrastructure of roads, airports, and settlements to support it. Berger also suggested that a number of sanctuaries and protected areas be created for threatened and endangered species.[31] Most significantly, Berger emphasized the need to settle Indigenous land claims *before* proceeding with any development,[32] for he predicted that "the pipeline, if it were built now, would do enormous damage to the social fabric in the North."[33]

While the Berger report doomed the Mackenzie Valley Pipeline, it did also create the momentum for a full pursuit of land claims settlements in the Territories and good governmental will towards Indigenous self-determination.[34] As well, the report created a strong precedent for community input into industrial development projects.[35] Perhaps most importantly, the Mackenzie Valley Pipeline Inquiry asserted local and Indigenous knowledge and management traditions.[36] With the Berger Inquiry, the new northern scientific establishment created in the wake of the CANOL disaster expanded to include representation from the Northwest Territories' First Nations. The co-management of resources culminated in 1998 with the Mackenzie Valley Resource Management Act, which formally acknowledges Indigenous knowledge and incorporates it into resource management.[37] However, Federal and Territorial regulatory bodies were not the only ones to begin integrating Indigenous knowledge into their work—so, too, were industry and the scientific establishment, who would often hire Indigenous labourers for exploration and field work.

It is not unusual in environmental anthropology and history to point out the often contradictory views of nature held by state science and by Indigenous people, the latter often categorized as Traditional Knowledge (TK), or Traditional Ecological Knowledge (TEK). Some scholars have even argued that there is a fundamental incompatibility between scientific resource management and Indigenous knowledge and values.[38] However, it is equally important to point out that these contradictory cosmologies have also acted complementarily when it comes to resource extraction. Representatives of the Canadian northern research infrastructure of the 60s and 70s, as well as local Dene experts, both worked together to narrativize one parallel understanding of *permafrost as ecosystem* out of separate cosmologies,.[39] This was to be an important contribution of both science and Indigenous knowledge to the debate over pipeline development.

At the beginning of this paper, I mentioned Back and Franklin's travels in the early 1800s into the hinterland of the Mackenzie river systems through to the east of Great Slave Lake. The name, "The Barrens," still persists today in this region. While governmental wildlife biologists were studying potential pipeline interference on caribou migration with Dene hunters, permafrost's thaw and freeze cycle served to reveal another unexpected surprise that both the scientists and hunters interpreted in the same way. In the summer months, in the thaw of permafrost's active layer, a diversity of shallow-rooted flora grows in the long daylight hours: moss, crowberries, black bearberries, and certain types of lichen. It is precisely this diversity and relative abundance of plant life that draws caribou to migrate into the Barrens. Permafrost's thawed soil not only provides water and food for caribou, but also shelters them from predatory animals who dare not venture into the swampy bog-like conditions. Calving happens in relative safety before the autumn's freeze-up drives the caribou to find life elsewhere.

Scientists and hunters both "listened" to the freezing and thawing soil. The unique research collaborations created institutionally in the 1970s and 80s changed drastically how permafrost was received and envisioned. Scientists especially came to understand permafrost's constant cycles as an expression of movement—permafrost is not an inanimate thing but rather a constant surface in motion that releases nutrients and flora in the summer, captures their remains and nutrients in the winter, and releases them again in subsequent thaws, providing life to the Barrens. From the 1990s onwards, permafrost's microbial ecology became a critical object of study.[40] The vegetation on top of the permafrost also acted as insulator, preserving the permafrost in its frozen form. However, building projects in the North had not previously taken this into account, and so the stripping away of this crucial top insulating layer became their undoing when levelling ground—permafrost could literally breathe, expel things from itself, and take them back in year after year. Thus, the study of permafrost as an ecosystem, as a community of living organisms in relationship with their frozen environment, and as something understood to be *alive*, has fundamentally defined our relationship to the frozen soil in the present.

III. Permafrost's Thaw Releases a Historical Record in the Present: *Permafrost as Archive and Counter-Archive*

I walked alongside the huge chasm in the frozen ground with Alberto, an entrepreneurial gold prospector from Bogotá, Colombia. Alberto told me that he had been coming to the Mackenzie mountain range for over ten years. He scraped together a living with the small amounts of gold he

gathered every summer mining season. The high price of gold in recent years has made even gold dust mining a lucrative business in these northern regions. Once he mines the gold that he can, he sells the stake to oil and gas companies. To get at his gold, Alberto has to get down to the bedrock pockets where gold is more abundant. Between the top soil and the bedrock, however, is a thick layer of permafrost. For ten years, Alberto has been expediting his journey to the bedrock by spraying jets of water from a nearby river over the permafrost twenty-four hours a day and thus melting the permafrost, turning it into a muddy sludge that machinery can easily move away. However, this mining technique is not new. The usage of water, either as a jet or as steam, has been in place since the Klondike gold rush of the nineteenth century.

Alberto's partner, who joins him every summer, is an unusual one. Robert, a climate scientist from eastern Canada, benefits from his partnership with Alberto. As Alberto melts down the permafrost, he exposes its deeper layers thereby rendering them accessible to the research scientists' drill corers. As Alberto melts permafrost forcibly, Robert paradoxically seeks to answer questions about climate change in northern regions. To do so, Robert drills out ice cores, or permafrost cores to be more precise. Since the 1970s, geologists and other scientists have been obtaining core samples (cylindrical sections obtained by drilling) of natural substances to study them in labs. From 1987-1993, a massive ice coring project in Greenland's ice sheet (known as GISP2, or Greenland Ice Sheet Project 2), suggested that frozen substances and their ecosystems are not only very complex but might reveal knowledge about past climate dynamics. The Greenland Ice Sheet is over 2 miles thick and has been accumulating snow for hundreds of thousands of years at least. Thus, GISP2 began to use ice cores to understand not only present communities of life frozen in ice, but also the past.[41]

Using permafrost cores, Robert seeks to understand how permafrost has acted and responded in the past, and how it is doing so today. Cores have allowed scientists, in attempting to answer the question "What is permafrost's ecosystem, from the very top active layer, all the way to the bottom, oldest layer?" to see that permafrost is in many ways more than just dynamic. If the scientists of thirty years ago were revolutionized by the thought that permafrost was a mobile, ever-changing surface, today Robert is driven by the notion that permafrost is an *active collector*. As permafrost thaws, nutrients and bacteria are released into the surface, which help vegetation to grow. As permafrost freezes, all of the leftover vegetation and bacteria, as well as tiny samples of water and air—atmosphere—are once again trapped in the permafrost. Permafrost's thaw and freeze cycles therefore have been collecting data for millennia. Consequently, air, organic matter and water become trapped with each accumulated layer of permafrost, and as the permafrost has grown thicker, the earliest trapped matter has fallen deeper and deeper below the surface. The farther scientists drill into permafrost, the further back they go into time. Every ice core reveals details about air, water, and organisms from successively older periods. The tiny pressurized pockets of air contained deep in permafrost's layers constitute some of the most important information—the trapped leftovers of ancient atmospheres. These layers tell Robert a great deal about climate thousands of years in the past.

"Today we can study the evolution and change of the Arctic climate at unimaginable timescales," a graduate student told me. "We can find out how permafrost responded in the past, and how it will respond in the future to climate change." For scientists today, permafrost has collected, ordered, and preserved a lost world of climate environments. With the right tools and effort, these permafrost cores present an opportunity to understand and model past and future climate change in inconceivable ways.

At first glance, permafrost today appears to be a perfect product of the cooperation between industry and science in the twentieth century. It appears to be an object that can be fully described and captured through appropriate metrics and that can reveal perfectly consistent, quantifiable pasts *and* futures. The rationality applied to permafrost is highly reminiscent of the scientific management conjured by James Scott's notion of "high modernism."[42] Permafrost is characterized by the same state-corporate rationale that underlies many highly centralized development projects (like river damming, urban planning, and modern agriculture)[43] and it is also treated as a knowable object. The flora, fauna, and air captured in permafrost's layers are interpreted by industry actors and scientists as certain facts, capable of revealing a 'true' and comprehensive understanding of the world around us. In that sense, permafrost reproduces the logic of archives under high modernist and colonial projects.

However, this colonial understanding of the permafrost archive is very incomplete. Firstly, it places a human-centred logic and scale at the centre of the permafrost archive. Such logic assumes that climate past and futures are ultimately revelatory about human outcomes and survivability. Yet, the human record in a permafrost core is very insignificant. In his *Theses on the Philosophy of History,* Walter Benjamin ends with a quote from an unnamed biologist who writes that, "In relation to the history of organic life on earth... the paltry fifty millennia of *homo sapiens* constitute something like two seconds at the close of a twenty-four hour day."[44] Benjamin's awareness of relative time-scales reminds us that the permafrost archive is a planetary one. In this first critical way, the permafrost archive refuses its place in the "colonial order of things."[45] The permafrost archive is then not only counter-archival, in that it forces consideration of a heterogeneity of participants, but it also forces the consideration of human/non-human evidence and brings into being temporal and planetary scales we rarely consider in building or planning human futures. With each deep layer, permafrost might bring together new constellations of life and environment to consider. In this way, the permafrost archive is counter-archival with its "kaleidoscope" qualities—it demands an incessant movement across scales so that "the big can be adequately rendered only by a permanent movement from the whole to some detail, then back to the whole."[46] It is also counter-archival in that it disrupts conventional anthropocentric narratives in favour of the full spectrum of life and matter around us.

Most critically, the permafrost archive is melting. The permafrost archive then becomes counter-archival in that it is not only provocative and unfamiliar but also fleeting. In many ways, permafrost cores are iconic of the partnership between human and non-human elements in the North. But they also index the longer history I have recounted here—the context of extractive (especially petroleum) industry in the creation of a permafrost archive for climate futures. Permafrost became a "problem" when it refused infrastructure in the early twentieth century. However, this industrial encounter with permafrost also set the ground for our current hydrocarbon society today. It is not unusual that contemporary climate researchers do their best work as a result of the forced melting of an invaluable archive. Their partnership with extractive industries is emblematic of permafrost's treatment in the twentieth and twenty-first centuries—one could say that permafrost's archive has been wrought by successive, yet complementary, cycles of conservation and exploitation. For us, the question remains: will permafrost survive long enough to live as more than a counter-archive "of the expectant and conjured—about dreams of comforting futures and forebodings of future failures?"[47]

NOTES

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