It Costs Something to Learn Something: Property Rights, Information Costs, and the Struggle at Fish Lake

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We all know that it costs something to learn something. Books cost money, reading takes time, universities charge tuition, and archival visits and fieldwork are expensive. There are also costs associated with holding on to what you've learned: file folders need to be stored, hard drives and magnetic tapes become demagnetized, computers need to be replaced (frequently), and people are forgetful. Some skills—like speaking a new language or rock climbing or computer programming—require years of practice to master. Once you begin to take these kinds of information costs into account, however, there are surprising consequences for both doing and understanding environmental history.

In this chapter, I discuss the struggle over a large, undeveloped copper and gold deposit at Fish Lake in the Chilcotin region of west-central British Columbia. Beginning in the 1960s, various companies tried to develop an open-pit mine at Fish Lake, only to find themselves embroiled in disputes with other companies over development rights, with the federal government and anglers over a fishery, with environmentalists over conservation, and with First Nations over land claims. Asking what kinds of things each of these groups knew, how they acquired their knowledge, and why they were motivated to learn particular things gives us one productive strategy for investigating the past.[1] That is to say that these questions are useful precisely because they can be

answered with the sources that we have and because they lead to further questions. What is more, keeping information costs in mind turns out to be a good way to be *reflective,* to think about your own research as you are doing it. As you study a topic you will constantly find yourself making decisions about what to learn and what not to. Which books on your preliminary bibliography are worth reading in full? Which should you skim? Is it worthwhile to sift through a large number of search results online or should you try to reformulate your query? Does it make sense to learn enough about a given environmental science to be able to read the scholarly literature in that field? How much fieldwork can you afford to do? Should you visit an archive that doesn't seem to have many sources for your topic? Is it worth staying another day at an archive to look through some boxes that you haven't seen yet?

Getting Started

I first heard about the Fish Lake case while I was doing fieldwork in the Chilcotin in the summer of 2002. I had deliberately chosen to study the location because it was familiar, close to where I had grown up. In order to write the environmental history of a place, you really have to know the environment, and I figured I would finish my dissertation sooner if I didn't have to learn about someplace completely new. I also had relatives in both Victoria, where the provincial archives are located, and in Williams Lake, where the regional archive is. Staying with family would greatly reduce the costs of doing research in BC. My brother, who had worked in the Chilcotin region with a team of surveyors, had showed me around and introduced me to his former employer. I took the opportunity to ask the surveyor about environmental conflicts, and he told me that there was controversy about a proposed copper mine at Fish Lake. He did not know many of the details and I hadn't yet come across the story in my archival work. Besides, I had to return to Boston for the school year, more than 3,000 miles away.

Some literatures about a place are more local to that place than others. What I mean by this is that there are some kinds of sources—like postcards, pamphlets, small-press local histories, flyers, newsletters, regional trail and wildlife guides, and so on—which are much easier to find in the place itself than anywhere else. As I travelled in BC, I made sure to stop at tourist information centres, local libraries, second-hand stores, and motel lobbies to collect these kinds of sources. In our profession they are collectively known as *ephemera,* stuff that doesn't last very long and is liable to get thrown away unless someone makes a special effort to preserve it.[2] Other kinds of sources—like government documents, legal decisions, public securities information, satellite photographs, and scientific literature—are much more likely to be found in some other place than the one that you are writing about. One of the ironies of studying the Chilcotin was that in some ways I was much better positioned to do so in Boston, where I had access to the Harvard and MIT Libraries, than I would have been had I lived much closer to the Chilcotin itself.[3]

By the time that I began to work on my dissertation, the World Wide Web was already booming and it was clear to me that digital sources would offer unprecedented advantages to historians who developed the skills to work with them. I made sure to enter in a bibliographic database a reference to each source that I discovered. I also bought a desktop scanner with a sheet-feeder, and scanned all the photocopies that I brought home. The Adobe Portable Document

Format (PDF) allows you to keep both an image of each page, which is easy to read, and an automatically extracted and hidden text layer, which is easy to search. I then installed a search engine on my own computer that allowed me to search through the full text of all of the sources that I had collected.[4] In this volume, Alan MacEachern describes the historian's process of skimming through records looking for something of significance. Like every historian, I did a lot of that kind of skimming, much of it in front of my own computer. With my digital archive and search engine, I was also able to go back and find things that I had skimmed over without making a note of. Every scholar worries about some disaster wiping out his or her research. I could back up not only my notes and writing, but also my filing cabinets. I sent data disks to relatives for safe keeping, and travelled with a digital copy of all of my paper files. This scheme, of course, involved a tradeoff of costs. For greatly increased access and security, I had to be willing to spend a bit of time and money to create a digital archive. In retrospect, it turned out to be a very wise investment, making it much faster for me to finish my dissertation and revise it for publication as a book.

As I studied the geological literature about the Chilcotin, I began to come across references to mineral surveying at Fish Lake. People who want to extract mineral resources face a difficult problem: it is impossible to completely know the three-dimensional characteristics of the earth's crust, much of which is covered by forests, lava flows, and glacial drift. As a result, geological surveyors study outcrops, take core samples, make inferences from surface features, and make local measurements of gravity, radioactivity, and magnetism. They also use their knowledge of the region's geological history to try to predict what they will find under the surface.

The kind of surveying that was done at Fish Lake required the expertise of a number of different specialists. (See Stephen Bocking's Chapter 16 in this volume for an excellent introduction to thinking about the role of scientific expertise while doing environmental history.) For example, in one study, an airplane with extremely sensitive magnetic detectors was flown back and forth above the plateau, recording deviations from the background magnetic field. These deviations, known as magnetic anomalies, are often a clue to the presence of magnetic minerals in the rock. In another study, researchers used a helicopter to dip down and snip off pine tree tops at regular intervals on a large grid. These samples were then passed on to the Geological Survey of Canada in Ottawa, where biogeochemists dried them, burnt them, and then tested the ash for concentrations of various metals like copper and gold. As trees grow, they extend their roots into soil, glacial drift, and bedrock, drawing water and nutrients up through their root system. They also extract minerals that aren't needed for growth, and these become concentrated in tree tops, twig ends, and bark. The researchers could thus use the concentration of metals in the tree tops as one measure of the concentration of minerals in the ground below. Other specialists dated the radioactive decay of chemical elements in rock samples, used devices similar to metal detectors to map features below the ground, studied the distribution of plants, and tested the composition of soils.

Each one of these studies—and there were literally hundreds of them—must have required a fair amount of money: to pay scientists, technicians, pilots, administrators, and other personnel; to buy, lease, or rent expensive equipment like helicopters, drilling rigs, and magnetometers; to pay for data processing, statistical analysis, report writing, and publication; and so on. Most of the studies were designed to answer basic questions about the mineral deposit: How big was it? What were its subsurface dimensions? What percentage of the rock was waste and what percentage a

valuable commodity like copper or gold? Were the metal crystals concentrated in a particular region? How much would it cost to mine it? Geological exploration is a pretty clear case where it costs something, actually costs a heck of a lot, to learn something. But who was paying for all this learning and why?

Most of the studies were funded by mining companies and/or the government. I was at a point where I felt like I understood the science of geological exploration and mining (at least well enough to make my way through the literature) but not the economics.[5] Presumably, the mining companies and the government hoped to translate their costly knowledge into profit, but how did this happen? Fortunately, the BC Ministry of Energy, Mines and Petroleum Resources had provided a large amount of information online, including historic mineral price data. When I compared mineral exploration activity at Fish Lake to the yearly average producer price for copper, I discovered an interesting pattern. New mineral exploration in the area was undertaken every time the price for copper rose, and it stopped every time the price fell. So prospecting was stimulated by the increasing value of mineral resources, but why should that be the case? Why should individuals or institutions be motivated to learn more about something as its value increases?

An Analytical Framework

Here the historian can make use of one kind of economic analysis, known as new institutional economics (NIE). This framework explicitly takes into account information costs, the costs associated with learning, measuring, negotiating, transacting, and so on. If we wanted to summarize NIE with a motto, we might say "it costs something to do something." New institutionalists use these transaction costs in their analyses of firms, contracts, property rights, and other socioeconomic phenomena. In the case of property rights, the reasoning goes like this.[6] Think of any entity as a bundle of attributes. A national park, for example, consists of water, rocks, vegetation, animals, microbes, and many other things. Some attributes of the park, such as its boundaries, are more easily determined than other attributes, such as the subsurface distribution of a particular metal. Each of the entities within the park has attributes of its own. A given beaver, for example, has attributes that are relatively easy to determine (at least for a wildlife biologist or trapper) like sex, age, weight, pelt condition, and so on. The same animal also has attributes that are difficult and expensive to determine, such as the details of its genetic makeup. According to NIE, the progressive costliness of learning means that every entity has attributes that will never be completely measured or known. Following from this, rights can never be exhaustive. Instead, they cover the use or ownership of particular attributes. You may have the right to camp in a national park, but you don't have the right to relocate wildlife to your own backyard. You have the right to start a campfire in a designated area, but you don't have the right to set fire to the underbrush. And so on. One might think that parks managers don't have the right to trade or donate wildlife from the parks, but as Alan MacEachern shows in Chapter 11 of this volume, the reality of the situation is a bit more complicated.

To return to Fish Lake, the copper and gold content of the deposit was estimated from samples but could not be known with certainty (short of digging the whole thing up, which might easily lead to disastrous financial loss). In the 1980s, two mining companies owned some rights to the

property at Fish Lake. Neither company knew exactly how valuable its rights were. As the value of copper rose, both companies were willing to spend money to obtain more information about the attributes of the Fish Lake property. If one of the companies had been unwilling or unable to spend money on exploration, the other company would have been in a position to exploit the advantage that any additional information gave it. If one company found out that there was less copper in the deposit than was generally believed, it could sell its own rights for more than the rights were worth. If, on the other hand, it discovered there was more copper in the deposit than other people thought, it could buy rights at a discount. Either way, information could be turned into money. This was true for not only the two companies involved, but also any individual or institution that was willing and able to allocate enough resources to learn something about the property that wasn't generally known.

So under the NIE theory, property rights aren't exhaustive or constant. They can change as different attributes become known to various stakeholders. Property rights are a function of the resources that people commit to protect them, the resources that other people commit to capture them, and the resources that the government allocates to protect a given distribution of rights. Note that this theory sets questions of legal or moral rights to one side, which is not to say they are unimportant. As we will see, they resurface later.

From the little that I knew at that point of the events at Fish Lake, this theory of property rights seemed to make reasonable predictions. It explained why the government and mining companies were paying so much to learn about the Fish Lake region (especially as metal prices increased), and it suggested that other stakeholders might be motivated to commit their own resources to learn more about it, too. I could imagine where controversies might arise, but I didn't yet have much evidence for controversy. I clearly needed to know more about what had happened at Fish Lake.

Historians often find themselves in this position: needing information that is probably in a distant archive. One possible course of action is to wait until you are able to travel (and can afford it), then visit the archive. This is expensive and time consuming. Most seasoned researchers will first contact the archivist to ask about the holdings; occasionally, archivists can send photocopies for a fee or arrange for microfilm or fiche to be borrowed through interlibrary loan. Sometimes they can recommend a local researcher who will look through the material for you, again for a fee. The Cariboo-Chilcotin Archives, however, were a small room in the Williams Lake Public Library. They were only open by appointment, and although the library staff was friendly and helpful, the archives lacked the kinds of finding aids or systematic organization that a better-funded institution would enjoy. Fortunately, my parents live in Williams Lake. They were willing to go to the archive, search for stuff on Fish Lake, and mail me photocopies of it. I ended up with a large file of newspaper clippings that way, which I scanned and added to my own digital collection.

In many archives, this kind of aggregation of clippings is known as a vertical file. Vertical files exist because librarians and archivists take the time to read through the news and save stories on topics that are of local interest. In so doing, they greatly lower the information costs for their users. Reading through the clippings took me less than an hour and gave me the outlines of a historical narrative. Reading through decades worth of newspapers looking for items about Fish Lake would have taken me hundreds of times as long. Travelling to Williams Lake, Quesnel, and 100 Mile House to read old newspapers would have taken even longer.

A Contest of Stakeholders

The newspaper articles provided me with plenty of evidence for conflict at Fish Lake and dozens of new leads. One thing that I learned was that mining companies, in their efforts to defend their own property rights and to secure investment capital, were forced to release information for which they had paid a great deal.[7] This made it much easier for other stakeholders to enter the fray. Some companies began mineral exploration on properties adjoining Fish Lake. When I eventually wrote my account of the case, a significant portion of the narrative was dedicated to the efforts made by mining companies to capture and clarify property rights, with one company, Taseko Mines, emerging victorious after years of legal and financial wrangling. As information about the Fish Lake deposit and the potential open-pit mine became available to the public, other groups of stakeholders found new uses for it. Sport anglers, for example, were dismayed to find that the plans for the mine required that Fish Lake itself be drained. The BC Ministry of Environment, Lands and Parks and the federal Department of Fisheries and Oceans shared the anglers' concern. Conservationists wanted to include the region around Fish Lake in a proposed park. The Xeni Gwet'in Tsilhqot'in First Nation included Fish Lake in the area claimed by its Nemiah Aboriginal Wilderness Preserve, a move that was supported by a number of environmental organizations.

As different groups of stakeholders tried to influence the future of Fish Lake, they chose to learn different kinds of things about the area. Aboriginal land claims were buttressed by archaeological studies that showed that the ancestors of First Nations had been using the region for millennia. The provincial government, in search of a reasonably equitable allocation of natural resources that would also be profitable and (ideally) renewable, surveyed aquatic and terrestrial ecosystems, atmosphere, culture, land use, and earth sciences. Taseko Mines set up a meteorological station to record temperature, precipitation, snowfall, and snow pack, so that environmental data would be available when the mine facilities were being designed.

The economic theory of property rights suggests that some rights will always lie in the public domain, waiting to be captured by anyone who is willing to commit enough resources to do so. Although Taseko Mines had legal title to Fish Lake, the company's actions suggest that it was at least tacitly aware that the fate of the region would be determined as the outcome of a contest of stakeholders. The company conducted an extensive public relations campaign, inviting members of the public to visit the exploration site and emphasizing the number of high-paying union jobs that the mine would create. Management also discussed the project with representatives of the First Nations, gave site tours to senior representatives of the major environmental organizations in BC, and courted allies in the city of Williams Lake. Taseko could not have foreseen that the project would be stalled by some rainbow trout.

In 1987, the World Commission on Environment and Development released a report that defined sustainable development as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs."[8] This agenda was adopted internationally, and served as one of the contexts for mining-related development in BC in the early 1990s. It was especially important to the NDP government elected under Mike Harcourt in 1991. The following year, the province adopted a new strategic land-use planning framework for crown land that tried to balance the interests of various stakeholders in a process

of shared decision making based on the collection of standardized data. (Standardizing data is one well-known way of lowering information costs.) An independent commission, the Commission on Resources and the Environment (CORE), was established to incorporate sustainability, an ethic of land use, a process for conflict resolution, planning at the regional level, and community consensus. The Cariboo-Chilcotin, long a site of intense land-use conflicts, was chosen as one of three regions to undergo the CORE planning process. During more than 100 CORE meetings held throughout the region, 24 sectors formed to represent the interests of different groups, including agriculture, forestry companies, local governments, placer and hard-rock miners, tribal councils, and multisector alliances representing conservation, backcountry tourism, and even one to protect the interests of "all beings." Even within a given sector there was often conflict; different tribal councils, for example, had interests in different land claims. On the plus side, CORE gave a voice to more stakeholders. On the minus side, by allowing such a diversity of interests to be represented, the process fragmented stakeholder positions, as different individuals and institutions found things they especially liked or disliked about various proposals. This fragmentation prevented opposing stakeholders from uniting to put up concentrated resistance to projects, like the mine, that involved significant resource extraction.

By 1994, Taseko Mines was close to beginning construction on the mine at Fish Lake. That summer, however, the BC Ministry of Environment, Lands and Parks objected to the company's proposal to drain Fish Lake and use the former lake site to dump more than 2 million metric tons of waste rock and tailings. Under the federal law of the time, it was illegal to "carry on any work or undertaking that result[ed] in the harmful alteration, disruption or destruction of fish habitat."[9] Since the lake was home to a self-sustaining population of unique rainbow trout, the law clearly applied. Taseko Mines responded by offering to stock barren lakes to create new fishing spots. It offered to provide a heritage fund to enhance fisheries. It offered to buy a private lake and put it into the public domain. There was no way, however, that the company could mine the deposit without draining Fish Lake. The federal government strengthened its own objections to the project by making Fish Lake subject to a Canadian environmental review process as well as the provincial one. Without federal fisheries approval, the CORE process became stuck. Around this time, the project director of Taseko Mines commented bitterly, "We've spent $41 million on studies. Some environmental group can call up and scuttle those millions of dollars for a $1.25 phone call."

The rainbow trout in Fish Lake were rapidly becoming more valuable, and, as a consequence, various stakeholders began to spend money to learn more about the attributes of the fish and their habitat. Taseko Mines studied the nearby Nuntsi lakes, hoping to find potential habitat that the Fish Lake trout could be moved into. The company tested pH (a measure of acidity), electrical conductivity, water chemistry, and biological productivity. By all these measures, the company argued, some of the Nuntsi lakes were just like Fish Lake, and the rainbow trout should thrive there. The federal Department of Fisheries and Oceans did not find Taseko's arguments persuasive. At the time, Canadian scientists were lobbying the federal government to protect habitat as the key way of protecting biodiversity. This in turn gave management of Taseko Mines a new idea. Suppose the company could show that the rainbow trout had been introduced to the lake in the 20th century as part of a stocking plan? That would greatly weaken any arguments that the trout

were contributing to the biodiversity of the province. Never mind the fact that the archives of the provincial Ministry of Environment, Lands and Parks did not have any record of the lake ever being stocked. Taseko Mines hired an environmental consulting company to do a genetic study of the Fish Lake trout.

Toward the end of 1995, Taseko Mines decided that the last thing it wanted the Fish Lake copper deposit to be associated with in people's minds was fish, so the company officially changed the name of its property to Prosperity Gold. The provincial ministry didn't like the new direction that Taseko Mines was taking. The ministry argued that genetic techniques were limited, and that even if the Fish Lake trout were genetically indistinct from other trout in the province, the fish wouldn't be expendable. Furthermore, the ministry thought that the fact that the lake was an isolated system meant that it offered unique opportunities for fishing. The following year, however, Taseko Mines received some bad news from its environmental consultants. The results of the genetic study showed that the trout in Fish Lake were genetically unusual, and that the population had a unique origin. Rather than being stocked in the 20th century, the ancestors of the Fish Lake trout had migrated into the lake following the end of the last Ice Age, when temporary meltwater channels allowed fish to swim into drainage basins where they would later be stranded. The fish were then genetically isolated from other trout populations in the province.

The legal status of aboriginal land claims was also changing in the 1980s and '90s, giving the Tsilhqot'in First Nations much firmer ground to oppose projects of which they did not approve. In 1996, the Tsilhqot'in National Government sent Taseko Mines a letter demanding that the company vacate the Fish Lake area and restore it to the condition that it was in before the company began what the First Nations called "illegal explorations."[10] Refusing to meet with company officials, the Tsilhqot'in cited the landmark cases of *Sparrow* and *Delgamuukw* as the legal bases for their demands. The *Sparrow* case, decided by the Supreme Court in 1990, ruled that Section 35 of the Constitution limited the federal government's ability to put into effect laws or policies that might infringe on aboriginal rights. In the *Delgamuukw* case, the Supreme Court eventually ruled in 1997 that aboriginal title did exist in BC, and that it was a right to the land, and not merely to traditional practices of hunting, gathering, or fishing. In cases where First Nations held the title to the land, they could exclude others from it, use it for pleasure or business, and extract resources. Neither case, however, clarified which lands in BC were covered by aboriginal title. That would have to be negotiated in treaties, or settled in the courts, one case at a time. Following the *Delgamuukw* decision in 1997, the Tsilhqot'in National Government sent a letter to the provincial government demanding that BC "cease and desist from further processing of land-related tenure application and all processes involved with alienating lands and water."[11] Although the Tsilhqot'in wanted to prevent mining operations, their immediate target was the forest industry, which had, between 1984 and 1994, generated nearly a half a billion dollars in revenue for the provincial government in the Cariboo forest region alone.

Taseko Mines continued to push the project forward, in spite of opposition from the federal government, environmental groups, and the First Nations. But gold prices were near a 12-year low by the fall of 1997, and shares in gold-mining concerns were doing poorly. By the end of the year, the company faced the one thing that could surely halt the Prosperity project indefinitely. The economies of Thailand, Malaysia, Hong Kong, Korea, and Japan had all suffered sharp downturns.

The demand for copper and gold dropped, and producer prices fell with it. Mines across the province were revising profit margins, downsizing, closing. As the Asian markets changed for the worse, the provincial economy did too. Worldwide, the falling price of gold threatened the economic feasibility of 40 percent of all gold mines. The company weathered the economic downturn, however, and continued to study the ore deposit and its environs. A new provincial government was elected in 2001, one much more supportive of resource extraction. Nevertheless, in 2003 the company decided to set aside the Prosperity Project and concentrate on projects "with near-term feasibility." At the end of 2006, stakeholders in the Chilcotin were still struggling with one another over the fate of Fish Lake.[12]

Costs and Rights

The fact that a proposed mine could create such controversy was due, in part, to the external costs of mining: the social and environmental costs that would be paid by everyone, and not borne solely by the mining companies. These costs are a factor in any large-scale resource extraction industry and are not specific to the Fish Lake project. Nevertheless, it is important to understand what was at stake for people who did not stand to make money directly from the mine. External costs of mining are incurred at every stage of the process, from preliminary exploration to management of the site after the mine closes.

Impacts from mining exploration are funnelled in such a way that many large areas are diffusely affected while fewer and smaller regions come under increasing pressure. Preliminary surveying might start with airborne studies, which are relatively benign (other than the disruptive noise of planes or helicopters). These surveys sometimes lead to legal alienation of some of the land: claims are staked, vegetation and surface soils stripped, lines cut and roads built, trenches dug and holes drilled, samples extracted for bulk testing. Local habitat is disrupted and new roads give hunters and anglers more access to wildlife. Runoff from poorly built roads can load streams with sediment, which kills fish and other organisms. The sites that seem most promising for mining are further disrupted with bulldozing and drilling. Sometimes sample drills hit reservoirs of natural fluids, like brine or natural gas, which are brought to the surface and wash into local streams. In the places where mines are actually created, these become nodes in a reworked landscape that includes transportation routes, the infrastructure needed to generate and deliver large amounts of energy, piles of waste rock and ponds for tailing, and mills, smelters, and refineries.

The most significant long-term environmental impact of a new mine is the creation of waste rock and its potential for polluting fresh water through a process called "acid mine drainage." Waste rock and tailings accumulate as ore is extracted, crushed, ground, and passed through various flotation steps. Technological advances in mining multiply this waste as it becomes more profitable to mine low-grade ore. Since the grade of the Prosperity deposit was estimated to be around 0.22 percent, more than 99 tonnes of waste would be produced for each tonne of copper. The problem is that waste rock contains acid-generating sulphides and heavy metals. When stored above ground, the sulphides are exposed to air and water, and react with them to form sulphuric acid. Sometimes when the water becomes acidic enough, a naturally occurring bacterium *(Thiobacillus ferroxidans)* finds the habitat to its liking, and begins to oxidize sulphides

to sulphuric acid, too, greatly accelerating a process that is otherwise fairly slow. Acid production can go on for decades or centuries, seeping into the water and polluting it. Although the federal and provincial governments have regulations to prevent pollution from mining and to manage the impact of mine waste, budgets are usually too limited to effectively monitor and enforce compliance with the law. Information costs in yet another form.

Since minerals are a non-renewable resource, when the ore gives out, the mine has to shut down. The local community suffers most from the boom and bust of mining activity. The workforce is often brought in from outside the community, especially for the highest-paying, highest-skilled jobs. Housing shortages often result from the influx of people. When metal prices drop, workers are laid off. Mine closure can turn a vibrant community into a ghost town, something that has happened repeatedly in BC in the past 150 years. Miners suffer from many occupational hazards. When the mine is finally closed and disturbed areas are reseeded or replanted with vegetation, the new growth sometimes fails. Often the costs of cleanup are passed on to the taxpayers.

In the struggle over Fish Lake, debate continually focused on what economists call "social costs." When the actions of one individual or group impose costs on another, who should pay? In a classic paper, Ronald Coase argued that if transaction costs are zero, which is the assumption of standard economic theory, then, regardless of the initial assignment of rights the two parties will negotiate an arrangement that maximizes wealth.[13] According to Coase, what are traded on the market are not physical entities, like many economists assume, but rather rights to perform certain actions. Here is an example that may make the idea more clear. Suppose that a mine is built that will cause $1 million damage to a sport fishery downstream. The damage can be prevented if the company spends $800,000 on a tailings impoundment. Suppose further that the managers of the fishery can also prevent the damage by diverting one of the streams at a cost of $200,000. It is clearly more economically efficient for the fishery managers to prevent the damage than for the miners to do so. So the mining company should be willing to pay the fishery managers any amount up to $800,000 to take care of the problem, and the fishery managers should be willing to take any amount over $200,000 to do so. In the world of zero transaction costs, the company will build a mine and not bother with the expensive tailings impoundment. The fishery managers will divert the stream and receive some payment between $200,000 and $800,000 from the mining company. Coase's point, however, was that transaction costs are never zero. In our example, neither the mining company nor the fishery managers could know exactly how much damage the mine would cause or how much it would cost to abate it. To enter into any kind of legal arrangement before mine construction began would be costly, as it would be to take legal action after the fact. Coase was saying that we should study the real world, where we can't know the future effects of our actions, where it always costs something to learn about the past or the present and we can't know everything, and where it also costs something to negotiate, to enter into legal arrangements, to monitor and enforce them, and to make exchanges. In the real world, it always costs something to do something.

These real-world costs arose time and again in the struggle over the future of Fish Lake. None of the stakeholders had any knowledge of the relevant future costs of their actions. How much would habitat destruction cost in the long run? What would be the future value of a genetically unique population of rainbow trout? What would biodiversity be worth in the future? What

would copper or gold be worth in the future? How much would it cost Taseko Mines if the Tsilhqot'in people gained rights to the land? How much would it cost the Tsilhqot'ins or other stakeholders if the company built the mine? How much environmental damage would the mine cause in the form of acid mine drainage? What would be the impact on other important industries in the area, like forestry, salmon fishing, ranching, or tourism? Were there other, richer undiscovered bodies of ore in the area? Were the rainbow trout the only genetically unique species that would be disturbed or eradicated? Were there archaeological sites that would have to be protected?

One of the distinguishing characteristics of environmental history is that it starts from the premise that human actions and environmental constraints are mutually determining and historically specific. Indeed, this is often taken to be the definition of the discipline. The key environmental entities in the struggle at Fish Lake, the copper and gold deposit and the rainbow trout, both had natural histories of their own. This meant that their valuable attributes were contingent on the sequence of events that led to them being in the same place in the Chilcotin in the late 20th century. To know those attributes, people had to reconstruct those histories. The natural history of the ore deposit unfolded in geological time; that of the trout in glacial time. Human activity at Fish Lake unfolded on a number of time scales, ranging from millennia to days. Each of these histories played a role in the dispute. By focusing on the contest of stakeholders in a particular place and adopting their temporal frames of reference, it becomes possible to see things that might have been obscured if the analysis were limited to a single time scale. As the lines between natural history, prehistory, and history blur, the nuances of place become more clear.

Finding a Stable Interpretation

So how do you know when you've finished your research? Information costs play a role here, too. Before the widespread digitization of sources and metadata, the scope of historical projects was often set by the holdings of one or a few archives.[14] Someone working in a particular area was expected to have a relatively thorough knowledge of relevant material in local, regional, and national archives. Because the survival of sources is a haphazard affair, extant documents often ended up far from their point of origin. Some historians specialized in searching for and digging up these castaways; the rest accepted the fact that transaction costs were generally too high to find and make use of them.[15] Likewise, the historian was expected to have read the relevant secondary literature, but relevance was understood to be delimited by the holdings of the largest nearby library. Within these parameters (and other traditional ones, like firm date ranges) the historian was expected to have exhaustive knowledge of his or her topic. Other scholars could monitor this knowledge by studying the historian's footnotes and bibliographical apparatus. Did he or she work in multiple archives? Cite sources in multiple languages? Consult a range of different kinds of sources? Verify claims by checking them against other accounts? Then, as now, footnotes served as a way of reducing the information costs for other scholars who wished to assess the evidentiary base, and thus the reliability, of the author's work.[16]

This ideal of exhaustive reading was never attained in practice and no longer makes any sense at all. When I started working on my dissertation, I rather naively assumed that I would have a hard time finding sources because few books had been published on the history of the Chilcotin

region. I did a Google search for "Chilcotin" and got about 2,000 hits. I went through all of them, finding many online sources that I never would have thought to look for otherwise. Since these were already in digital form, it was very easy to add them to my own digital collection. I also found references to publications, people, places, groups, activities, and events that I could do more traditional kinds of literature searches for. I soon realized that I could find much more material about the Chilcotin than I could ever read. Four years later, while writing this chapter, I did a Google search for "Chilcotin" and got 549,000 hits.[17]

Historian Roy Rosenzweig suggested that we may soon be confronted with a "profound challenge." "What would it be like to write history," he asked, "when faced by an essentially complete historical record?" Widespread digitization of existing sources and the rapid proliferation of "born-digital" sources (things like e-mail and text messages, computer software, digital photographs, video recordings, and sound files) situate the historian in what Rosenzweig called a "culture of abundance."[18] Instead of trying to read everything, you stop doing research when your interpretation stabilizes. Louis Menand puts it beautifully: "You stop when you feel that you've got it. The test for a successful history is the same as the test for any successful narrative: integrity in motion. It's not the facts, snapshots of the past, that make a history; it's the story, the facts run by the eye at the correct speed."[19]

We started with a straightforward principle: learning is costly. From that idea, we were able to generate both substantive questions, ones that help us to understand the people of the past, and methodological implications, ones that help us to go about our research. Since it doesn't make sense to try to be exhaustive, it is important instead to monitor your research practice, to ask what is working and what is not. It is also important to approach historical research as an apprenticeship. Always try to work with people who know more than you do, get their feedback, and plan to keep rewriting until you get your interpretation right.

Digital History

At the same time, if you do continue in the historical field—or for that matter, in any research-related field—you should realize that your research practice will be very different than the practice learned by your teachers in the last century. Your generation is the first to face an almost unprecedented abundance of easy-to-acquire online sources. This may strike you as an impediment: your mentors will be learning the necessary new skills right alongside you (when they learn them at all). But actually it is a great opportunity. It means that you will be finding, integrating, and analyzing sources in ways never before imaginable to historical researchers, and developing new historical questions and answers as a result. And it means that you will be able to benefit from the work of other digital history researchers and use the tools that they create, but only if you're willing to invest some time and patience in learning how to do so. An information cost once again.

In order to make the best use of digital sources and tools, you will need to learn some of the basics of web programming. There certainly isn't enough room here to teach you how to program, but I can briefly describe a few examples of how programming can help you with historical research right now.[20] For more information about getting started with these and many other techniques, see my weblog "Digital History Hacks."[21]

First, programming can help you compile a bibliography at the beginning of your research. When wading into any topic, it can take time to figure out which books are considered important in the field, which ones you should read first, which ones you shouldn't bother reading at all. Suppose you're working on a project on the environmental history of the Columbia River. You read Richard White's 1996 *Organic Machine* and discover that he cites Leo Marx's 1964 *Machine in the Garden*. You look it up and add it to your list. Wouldn't it be nice to be able to find other books that have material about the Columbia and that cite *Machine in the Garden?* If you are working with paper copies, you are pretty much limited to following citations in one direction only: backward in time. But you can do far more if you have access to a large collection of digitized books. Using the Amazon website, for example, you can find all of the books in its database that cite *Machine in the Garden,* regardless of when they were published. Then make a list of books returned by a search for "Columbia River." Compare the lists to find books that appear on both, such as Richard W. Judd and Christopher S. Beach's 2004 *Natural States*. Furthermore, Amazon can tell you which key phrases commonly appear in the text of a few books, but are rare in the overall database. The phrase "Columbia Basin" occurs in *The Organic Machine* and also in an edited book called *Bioregional Assessments*.[22] The title of the latter book suggests that it might be a useful source for your environmental history, but without the ability to search inside the book you wouldn't know that it had information about the Columbia River region. Amazon can also tell you which books are purchased together, leading you from *The Organic Machine* to Donald Worster's 1992 *Rivers of Empire*. All of these searches are done thanks to someone else's (Amazon's) computer programming. Piggybacking on that organization's work to reduce your own information costs makes a lot of sense. Recognizing the possibilities of computer programming may lead you to doing some of your own: writing a program to follow the citations, key phrases, and customer recommendations of the Amazon database can allow you to create detailed bibliographies for any subject in fractions of a second.

Second, programming can help you to harvest online sources. Imagine that you want to make intensive use of a large collection, such as the 24-volume *Dictionary of Canadian Biography* (DCB), published since 1966 and now online.[23] The website includes a search engine, so that you can look through the entire DCB for a particular person or group. (This tool wasn't available to DCB readers for more than three decades. Instead, people had to look things up in the indexes that accompanied each volume.) Suppose, however, you are interested in studying the DCB itself, to see how the kinds of people profiled in it changed over time. It's a safe guess that there are more biographies of 18th-century fur traders than 20th-century ones. But what about Catholics, or soldiers? Once you learn how to program, it is relatively easy to write a "spider," which visits a webpage, downloads a copy to your computer, and then follows each of the hyperlinks on that page in turn. As it reaches a new page, the spider checks to see if it has a copy of the page or not. If not, it saves a copy and extracts all of the new links, following each of those in turn. In a few minutes, such a program can automatically build a copy of a website with thousands of pages, like the DCB. (If done constantly and on a vast scale, spidering can create a dynamic map of most of the web; this is how search engines like Google compile their indexes.) Having downloaded the DCB, you can write other programs to process the text. You could discover, for example, that about 20 percent of the biographical subjects who died in the early 1700s were members of the armed forces,

while only 4 to 5 percent of those who died in the 1890s were. No one reading the published *Dictionary of Canadian Biography* may have noticed that fact in its first 40 years, or, if they had, would have been able to prove it without hours and hours of work. And this is just one, quick finding that you can make now that you have the DCB downloaded.

Third, programming also allows you to take on more sophisticated projects, like writing a custom search engine. In the previous example, I described how you might download the DCB to use for your research. The information in the DCB can help you with searching. Here's how. If you type "Frobisher" into Google, two-thirds of the first few pages of hits are about the 16th-century explorer.[24] You won't have nearly as much luck if you try to Google "Radisson," however, because that is also the name of a large hotel chain. Instead, you can pass Pierre-Esprit Radisson's DCB entry through a program that determines the frequency of every word.[25] This will allow you to locate half a dozen or so key phrases that are common in Radisson's biography but relatively rare in the DCB overall. You can then try searching for Radisson's name in conjunction with each of these key phrases. If you write a program to automatically extract key phrases from the DCB, try various searches and aggregate the results, you have the makings of a custom search engine, one that is more sensitive to the nuances of Canadian historical biography. As with the Amazon example, this program builds on the prior work of many other programmers.

Fourth, programming can help you to present and analyze information in new and different ways. For example, you can create a "mashup" to combine information from different databases on the fly. As a historical researcher, it is very useful to know exactly when and where things happened. You could pass the DCB, for example, through a program that identifies dates and place names. You could then provide a website where the places are plotted on a dynamic map, and the dates on a timeline. When you click on a location on the map, it shows you all of the passages in the DCB that relate to that place; when you click on a date in the timeline, it shows you the entries that mention that date. As in earlier examples, your work builds on the work of others. Your mashup serves as glue, binding together information and web services to create a unique custom application that helps you and other people with historical research.

There are information costs in learning how to program, to be sure, just as there are in learning to express yourself in another language. Programming requires practice and patience, an investment of time and energy. But you will be amply rewarded by your growing ability to take on research questions that would be too difficult, too immense, otherwise. Programming is not yet being taught in most history departments. The first generation of historians to master these skills will completely change the information costs for everyone else, not to mention the landscape of historical knowledge itself.

Discussion Questions

1. In the story of Fish Lake, different stakeholders tried to influence the present by appealing to different narratives about the past. Do you think that these narratives count as "history"?
2. The events discussed in environmental history often unfold on a number of time scales. How do historians relate these different scales to one another? Does it make sense to say that something that happened 10,000 years ago can cause something that happened 10 years ago?

3. Think of an assignment that you completed recently. What were some of the transaction or information costs that you faced?
4. What is the difference between data and metadata? Can you relate this to the difference between primary and secondary sources? Why or why not?
5. When a search engine returns a half a million hits to a query, a simple consideration of information costs suggests that the researcher will be able to look at only a tiny fraction of the results. Does this mean that the order in which the results are presented is a potential source of bias? Discuss.
6. Could the digitization of historical sources lead to a point where we have *too much* information about the past? Why or why not?

Notes

1. William J. Turkel, *The Archive of Place: Unearthing the Pasts of the Chilcotin Plateau* (Vancouver: University of British Columbia Press, 2007).

2. I was inspired to do this by reading M. H. Dunlop's *Sixty Miles from Contentment: Traveling the Nineteenth-Century American Interior* (Boulder, CO: Westview Press, 1995). She collected a mass of present-day tourist literature to compare to the experiences of her historical subjects and "in the paper deluge of contemporary tourism" found that "many subjects around which the commentary of travelers in the interior once clustered reappeared . . . some reshaped, some partially submerged, some unaltered," p. 7.

3. It is now possible to assess the "locality" of any literature by using OCLC's Open WorldCat; http://www.worldcat.org is a freely accessible catalogue of more than 1 billion items held in libraries worldwide.

4. If you want to do this yourself, one option is Google Desktop at http://desktop.google.com.

5. When reading a subject in which you are not an expert, it is very handy to have good reference works. For the earth sciences, I relied heavily on Paul L. Hancock and Brian J. Skinner, eds., *The Oxford Companion to the Earth* (Oxford: Oxford University Press, 2000). A good introduction to economic techniques for historians is Thomas G. Rawski, Susan B. Carter, Jon S. Cohen, Stephen Cullenberg, Peter H. Lindert, Donald N. McCloskey, Hugh Rockoff, and Richard Sutch, *Economics and the Historian* (Berkeley: University of California Press, 1995).

6. This discussion follows the argument presented by Yoram Barzel, *Economic Analysis of Property Rights* (Cambridge, UK: Cambridge University Press, 1989).

7. This follows from the government's allocation of resources to protect a particular property rights regime. In this case, the information was released as required by Canadian and U.S. laws that govern securities and exchange.

8. World Commission on Environment and Development, *Our Common Future* (Oxford: Oxford University Press, 1987).

9. Canada, Statutes of Canada, R.S. 1985, c. F-14, *Fisheries Act*, 35 no. 1.

10. "Deadline Near for Prosperity," *Williams Lake Tribune,* September 26, 1996, n.p.

11. Stephen Hume, "Crown Land Lawsuits Loom," *Vancouver Sun,* January 17, 1998, n.p.

12. Sage Birchwater, "Tsilhqot'in Must Be Consulted on Prosperity: Xeni Gwet'in Chief," *Williams Lake Tribune,* December 5, 2006, n.p.

13. Ronald H. Coase, "The Problem of Social Cost," *Journal of Law and Economics* 3 (1960): pp. 1–44.

14. Metadata is data about data, including bibliographic information; notes on the format, content, quality or condition of the data; information about the circumstances under which it was collected or created; and so on.

15. For the "castaways," see Richard D. Altick, *The Scholar Adventurers* (Columbus: Ohio State Press, 1987).

16. The publication constraints of a reader like this one preclude the extensive footnoting that monographs allow. For evidence relating to the Fish Lake story, see William J. Turkel, *The Archive of Place.*

17. Search on December 2, 2006.

18. Roy Rosenzweig, "Scarcity or Abundance? Preserving the Past in a Digital Era," *American Historical Review* 108, no. 3 (June 2003): pp. 735–62.

19. Louis Menand, "The Historical Romance," *The New Yorker,* March 24, 2003. Thanks to Eric Rauchway for bringing this passage to my attention by quoting it in his blog.

20. If you'd like to start learning how to program, try the Python language. It is free, powerful, easy to learn, and available in PC and Mac versions. The language, beginner's tutorials, and tools are available online at http://www.python.org.

21. W. J. Turkel, "Digital History Hacks: Methodology for the Infinite Archive," http://www.digitalhistoryhacks.blogspot.com (accessed November 22, 2007).

22. K. Norman Johnson, Frederick Swanson, Margaret Herring, and Sarah Greene, eds., *Bioregional Assessments: Science at the Crossroads of Management and Policy* (Washington, DC: Island Press, 1999). To search for the phrase "Columbia Basin" go to http://www.amazon.com/phrase/Columbia-Basin (accessed November 22, 2007).

23. Available online at http://www.biographi.ca/EN/index.html.

24. At least they were when I checked on June 25, 2007. Since search engines are dynamic, results to the same search can and do change from day to day.

25. Such a program is available from the Canadian group TAPoR (Text Analysis Portal for Research) at http://portal.tapor.ca.

Further Reading

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