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Glacial Relations:

Thawing the Relationship Between Science and Tradition

Madeleine C. Lomax-Vogt

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Under the Supervision of:

Chair: Dr. Robert Stein

Committee Members:

Dr. Christopher Churchill

Dr. Andrew Eklund

Dr. Emrys Westacott

Abstract

This study investigates the relationship between climate scientists and indigenous peoples by establishing a connection between climate scientists, indigenous peoples, and glaciers. Implementing policies that incentivize anthropological field training for scientists who interact with indigenous peoples has the potential to reduce tension between scientists and indigenous peoples by providing a common ground for the sharing of ideas. Cooperation between different groups can produce a fuller picture of the impact of a warming Earth and encourage respectful, multidisciplinary studies that provide clearer pictures of the local and global impact of climate change.

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Introduction

The remarkable multidisciplinary atmosphere at Alfred University has afforded me incredible opportunities to explore a variety of perspectives and ideas. I was already a decent writer when I arrived in Alfred. It would have been easy to become a Political Science major; after all, I have a deep love for American politics. However, I chose to study science. It challenged me to develop a new set of skills that differed vastly from the subjects in which I was already proficient. I have not felt bound to think purely as a scientist since I elected to major in chemistry. My interests have migrated away from pure science and have coalesced into a amalgamation of science, politics, policy, and anthropology.

Last summer, I had the opportunity to work at The Ohio State University in a chemistry laboratory. My research entailed the analysis and characterization of nanoparticles using inductively coupled plasma mass spectroscopy (ICP-MS). One day I might analyze a series of replicate solutions, while the next day I would report the data and explain their significance at a group research meeting. The work was exciting and invigorating, and by the end of my internship I felt confident in my laboratory skills.

Near the end of my internship, my research advisor, Dr. John Olesik, and I spoke about my future plans. He hoped that I would consider OSU for graduate school, as he was interested in keeping me on as a graduate student in his research group. I hesitated, however. I was not particularly happy with my life in his lab. The work was monotonous, the days long, and the rooms windowless; I didn't want to spend the next five years of my life wondering if the only sunlight I would see during the day was on my walk to work.

Sensing my hesitation, Dr. Olesik took me to the Byrd Polar Research Center (BPRC), located on OSU's West Campus. During his first few years at OSU, Dr. Olesik's laboratory was

located at BPRC before being relocated to a building on the main campus. During his time there, he got to know Dr. Lonnie Thompson, a Principal Investigator at BPRC, whose work has revolutionized the field of ice core paleoclimatology, especially in tropical and subtropical ice fields. Dr. Thompson collects ice core samples from glaciers and ice caps. He uses the ice samples to study the paleoclimate history of the Earth, which is critical in understanding the how climate works.

I had previously met one of Dr. Thompson's collaborators, Dr. Paolo Gabrielli, at a research group meeting with Dr. Olesik. Together, the four of us toured the facility, which includes a state-of-the-art analytical lab, a clean room, and a cold storage facility for the cores. The cold storage facility is kept at -40 degrees Celsius (and Fahrenheit), and holds around 3000 meters (~2 miles) of glacial ice. The facility is impressive, to say the least.

However, the most memorable part of my visit to the center was our discussion after the facilities tour. As we talked about Dr. Thompson's research, he began to describe some of his more interesting experiences out in the field. One story in particular stuck with me. I am unable to record his words verbatim, but the following is my recollection of Dr. Thompson's story:

> During an expedition to a glacier in Papua New Guinea, Dr. Thompson collected ice cores for his research. The indigenous people, initially perturbed by his drilling equipment, became very upset when Dr. Thompson's group began to drill out ice samples. In their culture, you see, the glacier was the head of their god. As one might imagine, the indigenous peoples were not only upset at Dr. Thompson's presence, but also that he was taking ice from someone sacred to them.

In Dr. Thompson's words, he was "stealing the memories of their god."

Dr. Thompson finished his story with a laugh, and acknowledged the validity of their statement. His attitude was not dismissive or malicious – he did not intend to upset the

indigenous population during his visit. Instead there was a disconnect between the two groups that resulted in conflict.

After our visit, I found myself constantly thinking about the implications of Dr. Thompson's visit to Papua New Guinea. As the world becomes more connected, negative interactions between groups of people have the potential to poison future interactions between groups that in former times would have remained happily ignorant of one another's presence. These increasingly complex networks have created infinite new opportunities for conflict and miscommunication.

The implications, however, are secondary to my true interest in Dr. Thompson's tale. More than anything, I could not stop thinking about what an incredible story I had just heard. People are storytellers. Stories allow us to engage with one another through the sharing of experiences. They give our lives meaning and let us explore new ideas and speculate without danger or conflict.

This quality makes a story an incredibly effective method of communication. Stories let us discuss the same information from different perspectives be they scientific, normative, or cultural.[1] We are able to convey complex ideas by making them seem familiar and personal. In an interview with National Public Radio, Dan Kahan asserted that people test new information against their preexisting world views (Joyce).[2] Kahan is a member of the Cultural Cognition Project, a "group of scholars interested in studying how cultural values shape public risk

1. Raul P. Lejano, Joana Tavares-Reager, and Fikret Berkes, "Climate and Narrative: Environmental Knowledge in Everyday Life," *Environmental Science & Policy* 31 (2013): 61. doi:10.1016/j.envsci.2013.02.009.

2. Christopher Joyce, "Belief In Climate Change Hinges On Worldview," NPR, February 23, 2010. http://www.npr.org/templates/story/story.php?storyId=124008307.

perceptions and related policy beliefs. (Cultural Cognition Project).[3] He argues that creating an environment that allows – but does not require – people to be open-minded can improve communication between groups that typically struggle to communicate effectively, such as climate change deniers and scientists.[4]

My research intends to bridge the gap between scientists and indigenous people by using common interests and ideas to encourage discourse and the exchange of a variety of perspectives and stories. Glaciers are of particular interest to my research as they represent an interesting intersection between science and tradition. A glacier can be a god for one person, a source of data for another. How, then, do you reconcile the two views? There is no one good answer, but there are steps that we, as scientists, can take to improve these interactions.

Climate Change and Glacial Ice

Climate change is often regarded as a global issue, one that affects the world as a whole. We talk about global temperatures, increased carbon dioxide levels, legislation and party lines, infrastructure, and sustainable technology. Very little discussion, at least within the mainstream media and scientific community, focuses on local cultural impact. The conventional science-based climate change debate emphasizes the quantifiable changes of a warming planet while it remains essentially ignorant of the effects that climate change has on the social structures of many indigenous peoples around the world.

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3. "Cultural Cognition Project," *The Cultural Cognition Project*. Accessed April 25, 2017. http://www.culturalcognition.net/.

4. Christopher Joyce, "Belief In Climate Change Hinges On Worldview," NPR, February 23, 2010. http://www.npr.org/templates/story/story.php?storyId=124008307.

One area of particular interest to climate researchers is glacial ice. Glacial ice functions as a climate archive. Much like the rings of trees indicate age and weather, layers of glacial ice can tell scientists many details about the past climate, such as air temperature, past atmospheric circulation, and even nuclear activity.[5] Given accelerated glacial retreat, scientists hope to archive as much ice as they can in an effort to preserve crucial data before the glaciers melt away. Many glaciers are projected to disappear as early as 2030.[6]

While this archival project responds to an impending global catastrophe, it does not address the effects of climate change on the local level. In particular, it disregards cultures that assign social significance to what science deems the "natural world." Anthropologists have recorded numerous accounts of indigenous peoples who live in close proximity to glaciers. These communities are on the front line of a changing world. Glaciers are special in their sheer size and force. The rate at which they are shrinking is alarming to the cultures that have fully integrated glaciers into their worldview.

Climate change is not a problem that will be solved quickly. It will take time and cooperation between diverse groups of people, including scientists and indigenous peoples. Part of the challenge of climate change is the sheer complexity of the problem. The Earth's climate is incredibly complicated and varied. The changes that we are witnessing now are a result of the intricate, interlocking processes that control the climate's physical changes. Thrown out of balance by human activity, the Earth's climate is fluctuating in unexpected ways, which take the

5. Bethan Davis, "Ice Core Basics," *Antarctic Glaciers*, September 1, 2015, accessed February 15, 2017. http://www.antarcticglaciers.org/glaciers-and-climate/ice-cores/ice-core-basics/.

6. Orrin H. Pilkey and Rob Young, *The Rising Sea* (Washington, DC: Island/Shearwater, 2009), 26.

form of more extreme global weather patterns, such as drought and rainfall, rising sea levels, and altered ocean currents.[7]

These climate variations have led to an overall warming of the Earth. Between 1901 and 2005, the Earth's global temperature increased by 0.65 +- 0.2 degrees Celsius, or approximately 1.5 degrees Fahrenheit.[8] This warming effect has forced humans to change the way they plan coastal cities, as rising waters threaten businesses and residents. However, reactions to the changes have been slow and fraught with difficulty. Governments around the world have gone to great lengths to preserve present conditions by constructing seawalls, artificial beaches and islands and permitting further housing construction along receding coast lines.[9]

As global temperatures rise continue to rise, scientists are scrambling to protect climate records, particularly those found in glacial ice. Glacial ice documents the past. Some such records date back one million years.[10] Scientists extract glacial core samples by drilling and removing long cylinders of ice. Within their layers, the ice cores record snow accumulation rates, melt layers, past air temperatures, atmospheric circulation, and dating horizons, such as volcanic activity. Scientists use all of these components to construct models of Earth's past climate. The models can help scientists model future climate change as they unravel the many complex relationships that shape how the climate responds to new stimuli.

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7. William James Burroughs, *Climate change: A Multidisciplinary Approach* (Cambridge: Cambridge University Press, 2007).

8. Ibid.

9. Orrin H. Pilkey, and Rob Young, *The Rising Sea* (Washington, DC: Island/Shearwater, 2009), 5.

10. John Higgins, "Atmospheric Composition 1 Million Years Ago from Blue Ice in the Allan Hills, Antarctica," *Proceedings of the National Academy of Sciences* (2015), accessed February 15, 2017. doi:10.1073/pnas.1420232112.

In response to glaciers' increasingly rapid retreat, scientists are collecting as many ice core samples as possible. Jean Jouzel, a climatologist and a former vice chair of the Intergovernmental Panel on Climate Change (IPCC) stated, "In the coming decades, or even centuries, this ice archive will be invaluable – be it for entirely unprecedented scientific discoveries or for understanding local changes in the environment."[11] The glaciers will tell stories about Earth's past climate for years to come, assuming scientists can collect data before it melts away.

Indigenous Peoples and Glaciers

Melting glaciers have created a subtle tension between climate scientists and indigenous peoples. While scientists generally have little trouble obtaining permits from governments for legitimate expeditions, indigenous peoples have little say in what the scientists do on their lands. For example, the Tlingit of the Yukon have in the past remained resistant to outside interaction. In one encounter in 1960, Frederica de Laguna, an American anthropologist and ethnographer who did extensive research about the Tlingit, reported that many Tlingit would not speak with her and that they were "so suspicious and hostile that work with them would have been difficult or unproductive."[12]

11. David Nield, "Scientists Are Trying to Build a Colossal 'Library of Ice' Before It All Disappears," *Science Alert,* August 5, 2016, accessed February 15, 2017. http://www.sciencealert.com/scientists-are-trying-to-collect-a-library-of-ice-before-it-disappears.

12. Vivian F. Martindale, "Lingítx haa sateeyí, We Who Are Tlingit: Contemporary Tlingit Identity and the Ancestral Relationship to the Landscape." Master's thesis, University of Alaska Fairbanks, 2008, 113.

The Tlingit tell stories of glaciers who listen and speak to human travelers. Glaciers are sentient persons who interact with the Tlingit as surely as the Tlingit interact with them. Breanne Mork, a Tlingit woman whose ancestral lands are near the glaciers, wrote, "In my culture it is disrespectful not to live on the land that was given to them. Given to us."[13] The Tlingit live on and with the land and treat it with due respect and care.

However, not all visitors to Tlingit land have the same relationship to the land as the Tlingit do. The famous conservationist and glaciologist John Muir was an early explorer of Tlingit land. Muir, a staunch environmentalist and advocate for wilderness preservation, was once described as "the archetype of our oneness with the earth."[14] The Tlingit, however, might not agree. Mork discusses John Muir and his relationship with Glacier Bay:

> I think that John Muir didn't realize the damage he caused by bringing in tourists. It's like now he is the grandfather of Glacier Bay. But we had many grandfathers before him. Muir wanted to protect it but to take it away from the people that were there first. They take them [the Tlingits] out of their environment, is a whole different thing. I don't think he understood. My ancestors depended on their land and environment to survive: it was their home.[15]

Muir made the arrogant assumption that he knew how to care for Glacier Bay better than the people who have lived there for centuries. He treated the land as if he owned it and disregarded the relationship that the Tlingit had already established with it.

Unfortunately, during a later expedition, Muir brought scientists along who wished to study the glacier. Muir and the scientists did not respect the traditions and values of the Tlingit and proceeded to take samples from the land, including ice from the glacier. Mork continues:

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13. Ibid.

14. Ibid.

15. Ibid.

> They broke off a piece of ice from the glacier. They found out everything they could about the bay. After this, there was a huge earthquake. A glacier went and shattered. It broke off. It caused huge pieces of ice to block the entrance to the bay. For a lot of years after that, the ships couldn't get close to the glaciers. The glaciers did not want them to come back into the bay. It was mad. I know the Glaciers listen. Whatever they did was disrespectful.[16]

For the Tlingit, the glacier is the physical manifestation of a god, even as the Eucharist is a physical manifestation of Jesus to Catholics. What the scientists did to the glacier was akin to someone taking a biopsy from Jesus without prior consent. This idea is almost laughable when regarded from a Western[17], perspective, and very few people – if given the chance to take a sample from the Son of God – would do so without considering the many repercussions of that decision.

Tlingit mythology encourages the Tlingit people to be unhesitatingly respectful of their glacier; in the stories, it is a person. Glaciers, according to the Tlingit, do not like loud noises or people who cook with grease. Frederick Schwatka, an early Arctic explorer, noted that his Tlingit guides "firmly resented even our whispering, so fearful were they of its consequences" and said that they "must not fry grease in our pans…or the ice of the glaciers will tumble in as we cross and kill us all."[18] While the prohibition on cooking with grease might seem superstitious to outside explorers, it is a matter of respect and fear to the Tlingit. Schwatka, however, dismisses these fears in his journal, saying they "must be accounted for wholly by superstition."[19]

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16. Ibid.

17. For the purpose of this paper, "Western" is used to mean "non-indigenous."

18. Julie Cruikshank, "Glaciers and Climate Change: Perspectives from Oral Tradition," *Arctic* 54, no. 4 (2001): . doi:10.14430/arctic795.

To call this belief a superstition, however, misinterprets the Tlingits' respect and reverence for those persons with whom they share the world. Climate change has complicated that relationship. At present, indigenous people have had to alter festivals and rituals to account for retreating glaciers. During the Qoyllur Rit'i festival in Peru, Quechua pilgrims make a long, dangerous journey up Mount Asuangate to honor the *Apu,* local mountain deities. The glacier, called Ausangate in local lore, is a particularly powerful *Apu,* and resembles the Western idea of Mother Earth.[20] The rituals of this pilgrimage, however, have changed as the ice melts. After a long, candlelit journey, pilgrims formerly carved out large chunks of glacial ice infused with healing properties to promote fertility in their fields, health, and strong children.[21] Glacial retreat, however, has forced locals to change their ways as their god dies. Rather than taking ice, pilgrims collect small bottles of water and light smaller candles in an effort to lessen the stresses affecting the glacier.

The fact that the loss of the glacier follows a prophecy of the locals complicates the situation in Peru:

> Little by little you, [*Apu* Ausangate], will become gray until you have turned completely black. And when you have changed into a mountain of black cinder, on that day will come the final judgement.[22]

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19. Ibid.

20. Elizabeth A. Allison, "The Spiritual Significance of Glaciers in an Age of Climate Change," Wiley Interdisciplinary Reviews: Climate Change 6, no. 5 (2015): . doi:10.1002/wcc.354.

21. Ibid.

22. Ibid.

Given the accuracy of this prediction, scientists should not dismiss the observations of the Quechua. The Quechua have seen their demise, and it is fast approaching. Local farmers cannot farm without glacial runoff, and native customs and beliefs must change to account for the death of a god.

Indigenous Peoples and Scientists

A Western, non-indigenous approach to climate change is often founded on a more objective and less personal view point of view than that of an indigenous person. For a Western scientist, climate change is a problem to study and observe. While a scientist might have a personal story or connection to climate change, they probably have a less intimate connection to the problem. For an indigenous person, climate change affects traditions that stem from long reliance upon the environment for independence and survival. Over time, they have found ways to conserve and manage resources, which has resulted in much more intimate, detailed, and descriptive accounts of climate change, accounts that encapsulate a deep respect and love for the world they inhabit.[23]

Some scientists have, in the past, engaged in local customs and rituals when collecting ice cores. Dr. Lonnie Thompson, a glaciologist once described as "the closest living thing to Indiana Jones,"[24] participated in a lengthy ceremony that included "chanting, smoking cigarettes, drinking high-test alcohol, chewing coca leaves, and sacrificing a blindfolded white alpaca" to

23. Enrique Salmon, "Kincentric Ecology: Indigenous Perceptions of the Human-Nature Relationship," *Ecological Applications* 10, no. 5 (2000).

24. K. Krajick, "Glaciology: Ice Man: Lonnie Thompson Scales the Peaks for Science," Science 298, no. 5593 (2002): , doi:10.1126/science.298.5593.518.

mollify the indigenous Aymara people while on an expedition in Peru.[25] This type of behavior, while admirable, is certainly not the norm. In fact, few scientists work with local indigenous societies beyond hiring them as expedition guides.

That is not to say, however, that scientists are oblivious to the discomfort they can bring to indigenous peoples. Dr. Pablo Gabrielli, a glaciologist at the Byrd Polar Research Center, has witnessed tension between indigenous peoples and the local indigenous nations. For example, strikes by indigenous people who work for mining operations around one of the the glacial core sites Gabrielli visited in Peru interfered with his research. The locals blocked the road with large rocks to interfere with mining operations due to labor disagreements, and the scientists had to wait for the locals to resolve their dispute with the company before they could continue to do research.[26] In such cases scientists are at the mercy of local politics, but their interactions are indirect.

At other times, the locals have reacted to the scientists' presence directly. During a later expedition, also to Peru, the locals put rocks in the road to protest the scientists' presence at the Quelccaya Ice Cap, despite the fact that scientists had visited the location annually. Gabrielli explains, "There was not sufficient warning that we were coming. This emphasizes, once more, how important it is to anticipate people, even if we go there every year."[27] Even though fairly frequent interaction might suggest familiarity and comfort, indigenous peoples still find outside interactions jarring.[28]

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25. Ibid.

26. Dr. Paolo Gabrielli (research scientist) in discussion with the author, April 2017.

27. Ibid.

Gabrielli's interactions with locals have led him to believe that, in some cases, he feels that tension results from a lack of communication: "It's important to anticipate the people, our intentions, what we do to involve them, and to let them know that we do these things not against their interest in particular."[29] Gabrielli feels that the locals may not understand why scientists are interested in persons who are so deeply embedded in their everyday lives, such as a god-glacier. Gabrielli says their frustration may stem from questions as straightforward as "Why do they come here? What do they want?" or even the question, "Are we missing something that they may want, they may steal, that we don't even realize is so precious for us?"[30] It is important to note that indigenous anxiety may stem from fearing scientists know about the material wealth of their land, but it can also result from anxiety about the reaction of their glacier-god as scientists interact with it.

Scientists who study climate change undoubtedly appreciate ice for what it can tell them about the Earth's past, but one must also consider what glaciers tell us about humanity's past. Indigenous peoples have long lived around glaciers, resulting in belief systems rich in stories about glaciers. In these stories, the glaciers are not inanimate chunks of ice; they have personalities and needs, just as humans do. Indigenous people respect and revere glaciers. Their relationship with nature is more personal and symbiotic than that of a scientist, even though both have strong connections with the Earth.[31]

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28. Ibid.

29. Ibid.

30. Ibid.

31. Vivian F. Martindale, "Lingítx haa sateeyí, We Who Are Tlingit: Contemporary Tlingit Identity and the Ancestral Relationship to the Landscape." Master's thesis, University of Alaska Fairbanks, 2008,

Science Diplomacy

Much of our knowledge of indigenous cultures comes from a Western perspective. Thus scientists conduct their interactions with indigenous peoples with a Western perspective in mind. While scientists do not study indigenous peoples directly, their interactions with them during an expedition are crucial. Past positive experiences between scientists and locals, such as the experiences of glaciologist and science policy advisor Hans Ahlmann, have proven beneficial to both communities. During Ahlmann's research in the Arctic and Scandinavia in the early twentieth century, he connected with locals. His field observations led to the first theories of "polar warming."[32] Ahlmann's relationship with local peoples and respect for local knowledge gave him a more social, if not necessarily accurate, picture of the changes affecting polar ice.

Ahlmann's early research identified warming trends, especially in the Antarctic. His work was not revolutionary; there were many glaciologists far more renowned within his scientific community. Ahlmann, however, approached his research in a novel way: rather than bring in other Westerners to help him with his work, Ahlmann employed locals as field assistants. He combined local knowledge with scrupulous preparation to help ensure the success of his expeditions. This approach contrasted sharply with that of explorers of the time whose planning was sloppy and who used Western equipment in Arctic environments.

Ahlmann will not be remembered for his contributions in the field of "polar warming," as he incorrectly concluded that humans do not play a role climate change.[33] However, his interest and respect for local knowledge, as well as a clear understanding of his limits as a scientist, made

32. Sverker Sörlin, "The Anxieties of a Science Diplomat: Field Coproduction of Climate Knowledge and the Rise and Fall of Hans Ahlmann's "Polar Warming"," *Osiris* 26, no. 1 (2011).

33. Ibid.

him a pioneer in the field of science diplomacy. Unfortunately, Ahlmann never really repaid the indigenous cultures for their assistance. While he did not disregard local knowledge in his papers, he was not explicit in how helpful it was to his research.[34] He was a pioneer in the sense that he used indigenous knowledge and connected with locals on expeditions, but he never fully credited indigenous peoples for their help.[35]

This common disregard for locals has, unfortunately, reduced the role of indigenous people on scientific expeditions. Many indigenous nations, while recognized in a general sense, lack the same protections and rights of the citizens of the developed states in which they reside. The United Nations has made an attempt to recognize indigenous peoples. On September 13, 2007, the General Assembly adopted the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). [36] Of the countries who voted on UNDRIP, 144 voted in favor of the Declaration while 4 voted against. The four countries who initially voted against the Declaration (Australia, Canada, New Zealand and the United States) have sizable indigenous populations living within their borders. All expressed concern about how they were expected to interpret the document. Those countries have since changed their votes in favor the Declaration. While UNDRIP is not a binding document, its adoption is an important step in the right direction for indigenous rights.

UNDRIP is "the most comprehensive international instrument on the rights of indigenous people," and it is intended to establish "a universal framework of minimum standards

34. Ibid.

35. Ibid.

36. UN General Assembly (GA), "United Nations Declaration on the Rights of Indigenous Peoples," October 2, 2007. http://www.refworld.org/docid/471355a82.html.

for the survival, dignity and well-being of the indigenous peoples of the world."[37] In its 40 Articles, the Declaration discusses a number of concerns shared between state governments and indigenous peoples, such as indigenous peoples' collective and individual rights (Articles 1-40); the role of the United Nations in promoting the implementation of the Declaration (Articles 41 and 42); the Declaration's nondiscriminatory application to both indigenous men and women (Articles 43-45); and an explanation of how the Declaration is consistent with other goals of the UN and a guide on how to interpret the Declaration (Article 46).[38]

The Declaration is particularly relevant to indigenous peoples living adjacent to glaciers for two reasons. First, Article 25 recognizes not only the importance of maintaining indigenous control and care of land, but also encourages future conservation:

> Indigenous peoples have the right to maintain and strengthen their distinctive spiritual relationship with their traditionally owned or otherwise occupied and used lands, territories, waters and coastal seas and other resources and to uphold their responsibilities to future generations in this regard.[39]

Indigenous peoples have "traditionally owned" glaciers – as much as indigenous person might consider living on the land to be ownership – for centuries. However, as glaciers melt, indigenous peoples' relationships with their glacial gods correspondingly shrinks.

Second, Article 32.2 states that:

> States shall consult and cooperate in good faith with the indigenous peoples concerned through their own representative institutions in order to obtain their free and informed consent prior to the approval of any project affecting their lands or territories and other

37. Ibid.

38. Ibid.

39. Ibid

> resources, particularly in connection with the development, utilization or exploitation of mineral, water or other resources.[40]

Scientists work with state governments to access glaciers located within indigenous lands. However these glaciers actually comprise part of traditionally indigenous lands.

A problem arises when scientists want to study those glaciers. Typically, a scientific expedition needs permits and permission from the host country to go on an international expedition. For example, scientists interested in exploring a glacier in Peru would contact Peru's National Forest and Wildlife Service (SERFOR), which is a part of the Ministry of Agriculture and Irrigation (MINAGRI).[41] This process typically takes a couple of months, and scientists must follow certain regulations, such as collaborating with a Peruvian scientist. Requirements, such as collaboration, help to ensure a fair transfer of knowledge within the larger scientific community that benefits both parties.

Scientists, however, are not required to communicate with indigenous peoples about their work. Requisite diplomacy stops with the national government. The lack of consultation with indigenous peoples is troubling and unhelpful. Local people should have a voice in how others use their land, whatever the reason. It is clear that indigenous peoples do not appreciate an outside government dictating land use within their lands. The Dakota Access Pipeline is an example of this antagonism. In response to efforts by the Energy Transfer Partners L.P. to build a pipeline on American Indian land, the Seven Councils Fires of the Sioux Nations have stated that, "While the Federal government chooses to disregard the laws made to govern themselves, we will respect those laws and continue to legally resist the destruction of homes, people, and

30. Ibid.

41. *Obtaining Research Permits in Peru* (Washington, D.C.: Amazon Conservation Association).

culture."[42] Collecting ice core samples may seem less destructive than building a pipeline, but an intrusion upon indigenous lands is wrong, regardless of the purpose. Scientific study without indigenous permission ignores the sovereignty of indigenous peoples.

Traditional Ecological Knowledge

There are certainly many options to accomplish a more cohesive bond between traditional knowledge and science. The key, however, is to understand the benefits and limitations of both traditional knowledge and scientific knowledge. Claude Lévi-Strauss, an anthropologist whose work heavily influenced structuralism and structural anthropology, observed that there are two very different ways to approach science: "The physical world is approached from opposite ends in the two cases: one is supremely concrete, the other supremely abstract."[43] With that in mind, the idea of using Traditional Ecological Knowledge (TEK) has come into vogue over the few years.

TEK, as defined by Fikret Berkes et al., is "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and

42. Nikita Biryukov and Daniel A. Medina, "Army Corps of Engineers to Grant Final Permit for Dakota Access Pipeline," NBCNews.com, February 07, 2017, accessed March 15, 2017. http://www.nbcnews.com/storyline/dakota-pipeline-protests/army-grant-dakota-access-pipeline-easement-n718081.

43. Fikret Berkes, Johan Colding, and Carl Folke, "Rediscovery of Traditional Ecological Knowledge as Adaptive Management," *Ecological Applications* 10, no. 5 (2000): . doi:10.2307/2641280.

with their environment."[44] As Berkes aptly point out, traditional knowledge often accrues incrementally through years of generational cultural learning and trial-and-error testing.[45] This is in stark contrast to a typical Western science education that emphasizes the scientific method of discovery and data collection.

TEK has a wide variety of applications, and can help improve a number of natural land management practices, such as resource management, habitat protection and renewal, and environmental ethics.[46] There are already areas where Western conservation and traditional conservation intersect. For example, the Tukano people of Colombia base their hunting expeditions on field observations made by shamans. They ensure the protection of species that need to be protected while culling species with high populations.[47] Western countries follow similar practices by restricting hunting to certain species at specific times of the year.

Integrating TEK into scientific expeditions must be done in a way that respects the needs of the scientists and the lives of the indigenous people with whom they interact. Fortunately, TEK relies on mechanisms already in place in the local culture. The mechanisms enable scientists and indigenous peoples to communicate using a hierarchy that progresses from "local ecological knowledge to social institutions, to mechanisms for cultural internalization, and to world views."[48] Each part of the mechanism plays a vital role in this communication, from the

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44. Ibid.

45. Ibid.

46. Ibid.

47. Ibid.

48. Ibid.

institutions that provide a forum in which cultures use local knowledge to an acceptance of that local knowledge as a legitimate world view.[49]

Scientists as Anthropologists

In general, there are two types of research utilized by researchers: structured and unstructured. Structured research anticipates concrete answers that have scientific explanations. This approach is most useful in a laboratory setting where it is easier to control outside factors. It makes sense if an experiment uses the scientific method as a basis of investigation, in that the scientific method encourages systematic observation and impartiality in analysis. However, this method is often ineffective when interacting with others, especially persons outside of the scientific community.

Scientists must interact with indigenous peoples when they are on an expedition, either directly or indirectly. There are established methods to guide those interactions. Anthropologists often rely on "unstructured research" to learn about the cultures they study. Unstructured research relies on anecdotal evidence which, at first glance, seems to fly in the face of a scientist's training. Unstructured research is at the mercy of catching those unexpected, subtle details that slowly appear over long term observation.

Unstructured research can be a conduit by which scientist begin to incorporate anecdotes into their scientific data. The key is to acknowledge the importance of anecdotal evidence. Scientists are taught that anecdotes should be disregarded, but anecdotes can be a valuable tool if used in conjunction with data. Therefore, scientists must strive to record oral histories that

49. Ibid.

chronicle climate change from a new, more inclusive perspective. This approach has the potential to balance the needs of scientists and indigenous peoples, as varied perspectives provide a better picture of current climate concerns.

However, trained anthropologists typically spend years studying a particular culture, and their research often involves intense, long-term fieldwork. But Scientists who study glaciers do not have the luxury of fully integrating and understanding an indigenous culture with whom they interact. That said, the basic principles of anthropological research are worth consideration. Fieldwork typically involves:

1. *Long-term residence with the indigenous population*. Anthropologists strive to interact with indigenous peoples as much as possible during fieldwork. Generally, they like to interact directly with the peoples on a daily basis.
2. *Competency of the native language.* The most effective anthropological fieldwork is done in the native language of the indigenous peoples. This reduces translation error, and also enables the researcher to interact with the indigenous population more casually. However, learning a language is a lengthy process; researchers typically need at least a year to become competent.
3. *Indigenous participation in the research.* Anthropologists tend to integrate themselves into the populations they study. This approach lets them interact with the people, but the interaction is not necessarily reciprocated or possible. Some cultures may not be comfortable with an outsider participating in certain rituals. Alternatively, a researcher may not have the time to integrate into the culture fully, thus missing out on a true

indigenous experience if the indigenous peoples are open to a relationship with the researcher.[50]

Clearly it would be next to impossible for scientists to fully integrate anthropological research methods into their research. Additionally, glacial scientists' research does not focus on the people; it focuses on ice. However, scientists can certainly learn from their social scientist counterparts.

This idea of a "makeshift anthropologist" is not exactly new. A guide for missionaries published in 1964 advocated that missionaries receive a brief education in anthropology. "What is really required," writes Sister M. Cuthbert, "is that when students are assigned later to a particular mission they have been so trained that they know what to observe and in which areas of human relationship and behavior to be particularly sensitive and careful."[51] She advocates that students take a course with four concepts to help them prepare for their trip.

1. Communicate the basic concepts and principles of anthropology.
2. Have students practice and apply these concepts through either reading or watching films followed by discussion.
3. Have students objectively and critically discuss their own personal culture in comparison to the cultures they have already learned about.

50. Peter Metcalf, Anthropology: The Basics (London: Routledge, 2010).

51. M. Cuthbert, "Anthropology in Missionary Training," *Anthropological Quarterly* 37, no. 1 (1964). doi:10.2307/3317058.

4. Ensure, particularly during discussion, that students do not feel as though they are not done learning and adapting to new environments after the class is over.[52]

Cuthbert then lists a number of basic concepts that course should cover:

> culture, culture change, culture conflict, culture shock, enculturation, chain reactions, rites of passage, variable factors in concepts of family, home, authority, leadership, variable factors in value systems and in the understanding of the individual as a person, body image, health, religion and magic contrasted with science, social institutions, material culture, artifacts.[53]

Cuthbert proposes an educational plan to teach students the basics. The course is not intended to provide students with a complete anthropological education; instead, it is designed to teach students how to see from new perspectives.

There is no reason scientists could not complete a course like this. In this age of technology, interested parties could create an interactive online course that utilizes various methods of online teaching and communication such as using YouTube videos, podcasts, and online journal databases to convey information, as well as connect participants via Skype and online forums for discussion. Furthermore, experts across a variety of disciplines could design the course in a way that captures the challenges of fieldwork in a variety of disciplines.

The key component in a course on anthropology for research scientists is that it does not repeat the mistakes of past anthropological research. Many early anthropological methods, such as the ideas postulated by Cuthbert, resulted in estrangement between the anthropologist and the indigenous peoples they studied due to the fact that anthropology has, in the past, been a tool of

52. Ibid.

53. Ibid.

colonialism and appropriation of indigenous lands and ideas.[54] Scientists must remain aware of the ethics of anthropological research; the course must emphasize the importance of gaining the trust of indigenous peoples for collaborative research rather than appropriative research.

Such a course could help in many situations, as scientists are put into precarious positions as they attempt to navigate complex politics of foreign countries beyond their indigenous encounters. For example, Tibetans' lives are heavily restricted by the occupying Chinese government. Tibetans are treated very differently than Chinese citizens, to the extent that they are not allowed passports. When scientists wish to conduct research in Tibet, they must do so through the Chinese government. This relationship creates a tension beyond scientists and indigenous peoples. Visiting scientists must be cautious so as to not upset any party.

During an expedition to Tibet, Gabrielli described a more intimate, albeit tense, interaction with the indigenous Tibetans at an inn in Lhasa.

> We arrived in a village going to base camp, and there was a hotel, a relatively good hotel. We wanted to sleep there for the night and at the beginning it seemed that the hotel was full and there was no room for us but, after ten minutes, magically a room became available. Afterwards, we realized, basically, some Tibetan people occupying this room were to leave. This was extremely sad and kind of embarrassing. But, at the same time, we could not complain too much to our Chinese colleague in order not to offend him, to complicate our relationship with him.[55]

In this situation, Gabrielli was faced with two unpleasant options. Either take the room and displace indigenous Tibetans at the hotel, or insult their Chinese colleague whose presence made their research possible. Gabrielli ultimately chose to take room and continue research. This is not necessarily the best result for the indigenous peoples, but it may have been the lesser of the

54. Diane Lewis, "Anthropology and Colonialism," *Current Anthropology* 14, no. 5 (1973).

55. Dr. Paolo Gabrielli (research scientist) in discussion with the author, April 2017.

two evils, as Gabrielli speaking up may have exacerbated an already tense situation in which he had to consider the political tensions already at play.

Funding and Focus

To remedy this tension between scientists and indigenous peoples, governments must incentivize multidisciplinary education and support expeditions that encourage an anthropological approach to scientific research while utilizing TEK. Rather than simply collect samples, scientists can also collect stories and observations that will provide valuable information about the changes our world is experiencing. Scientists have a unique opportunity to serve as ambassadors to indigenous nations during sample collection expeditions. A better understanding of anthropological research methods accomplishes two important goals:

First, scientists will respect the sovereignty of native peoples. Developed nations have a current pattern of shameless imperialist behavior. Indigenous peoples often have to fight for basic rights and recognition by the state. By approaching indigenous peoples in the way they would a state government, scientists would declare that they support indigenous land rights by making connections with voices often lost in unequal battles between native peoples and they states in which they reside.

Secondly, approaching indigenous peoples in the capacity of ambassador opens doors to new ideas and new perspectives. Indigenous peoples are experiencing climate change as intensely as those who live in developed nations, if not more so. Climate change affects traditions and beliefs, as well as a way of life. Indigenous peoples record these changes through

stories and observations of the natural world. While the stories are not necessarily scientific, they can still provide new details and ideas alter the way people address climate change.

Some universities have started implementing research policies to improve these relationships. The Alaska Native Knowledge Network (ANKN) and The University of Alaska – Fairbanks (UAF) worked together to establish guidelines for respecting cultural knowledge. The guidelines are meant to "assist Native people, government agencies, educators and the general public in gaining access to the knowledge base that Alaska Natives have acquired through cumulative experience over millennia."[56]

Researchers from UAF have established protocols to help increase communication and involvement during scientific expeditions. "Researchers," the document says, "are ethically responsible for obtaining informed consent, accurately representing the cultural perspective and protecting the cultural integrity and rights of all participants in a research endeavor."[57] They can do so by doing the following:

a. Effectively identify and utilize the expertise in participating communities to enhance the quality of data gathering as well as the data itself, and use caution in applying external frames of reference in its analysis and interpretation.

b. Insure controlled access for sensitive cultural information that has not been explicitly authorized for general distribution, as determined by members of the local community.

c. Submit research plans as well as results for review by a locally-knowledgeable group and abide by its recommendations to the maximum extent possible.

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56. "Guidelines for Respecting Cultural Knowledge," February 1, 2000, accessed April 29, 2017. http://ankn.uaf.edu/publications/knowledge.html.

57. Ibid.

d. Provide full disclosure of funding sources, sponsors, institutional affiliations and reviewers.

e. Include explicit recognition of all research contributors in the final report.

f. Abide by the research principles and guidelines established by the Alaska Federation of Natives and other state, national and international organizations representing indigenous peoples.[58]

These guidelines are particularly important because they were written with indigenous peoples, not just with indigenous people in mind. They mandate that indigenous people have a voice in the way scientists (and others) approach their communities, and they have established boundaries that demand the respect of visitors to their lands.

Unfortunately, researchers do not universally use these guidelines. However, scientists frequently apply for government grants to fund their research. The National Science Foundation (NSF), an independent agency of the United States government, has an annual budget of $7.5 billion and funds approximately 24 percent of all scientific research done by American colleges and universities. The NSF has funded projects that intend to integrate Western and indigenous knowledge, such as one project titled "Collaborative Research: Integrating Indigenous and Western Knowledge to Transform Learning and Discovery in the Geosciences" which intends to **"**create new partnerships between tribal communities and STEM institutions that promote the participation and inclusion of Native American scientists in the geosciences."[59]

58. Ibid.

59. "Award Abstract #1649186," National Science Foundation, accessed April 12, 2017. https://nsf.gov/awardsearch/showAward?AWD_ID=1649186.

There are already tried and true guidelines that the NSF could use in grant requirements, such as those established between UAF and ANKN. The NSF could establish similar guidelines for their grants that fund research in indigenous lands. Additionally, the NSF could require that scientists take a course, as outlined earlier, to prepare researchers to behave like anthropologists during expeditions. Doing so would set a precedent for indigenous involvement in all research, thus establishing a norm within the scientific community.

Conclusion

Scientists studying in the Glacier Bay region recently collaborated with ethnographers who study the Tlingit. Their study used complimentary knowledge to describe climate change in scientific and historical terms.[60] The history is not from a Western perspective; instead it comes from the Tlingit. Tlingit names and descriptions of natural landmarks and of changes in the area, in conjunction with scientific data, provide plausible models for the changes the landscape has undergone over thousands of years, such as the location and size of the local glacier throughout its lifetime.

The consequences of continuing to study climate change without considering multiple perspectives are becoming dire. Climate change will continue to change the earth, regardless of human acceptance of the problem or human ability to adapt to new climates. Unfortunately, the earth will lose voices as it continues to warm; key to this change, however, is listening to and documenting observations made both by scientists and indigenous peoples.

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60. Daniel Monteith, Cathy Connor, Gregory Streveler, and Wayne Howell, "Geology and Oral History—Complementary Views of a Former Glacier Bay Landscape," *U.S. Geological Survey Scientific Investigations Report 2007-5047,* 50-53.

Both views, scientific and traditional, describe climate change in equally important terms; the two are not mutually exclusive. Using both, one can observe the same phenomenon with vastly different vocabulary and scope, but come to convergent conclusions. It is easy to dismiss stories and myths, but data can provide only part of an incredibly complex picture. Myths and stories must be fully appreciated and incorporated into the way scientists approach climate change if their research is going to capture the complexity and interconnectedness of climate change adequately.

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