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Scientific Governance and the Cultural Politics of Climate Change Adaptation in the Peruvian Andes

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Scientific Governance and the Cultural Politics of Climate Change Adaptation in the Peruvian Andes

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by

Courtney Evelyn Cecale

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ABSTRACT OF THE DISSERTATION

Scientific Governance and the Cultural Politics of Climate Change Adaptation in the Peruvian Andes

by

Courtney Evelyn Cecale

Doctor of Philosophy in Anthropology

University of California, Los Angeles, 2020

Professor Jessica Cattelino, Chair

Based on 18 months of ethnographic fieldwork in the Peruvian Andes, this dissertation examines climate change adaptation as a site and source for the (re)production of global vectors of power through cultural, political, and economic fields. It argues that while climate activists link issues of social justice to the protection and management of environments, neoliberal institutions additionally are finding ways to durably fortify their own domains of power and influence in these processes. Further, this dissertation examines how ideologies of Science, as a purportedly neutral, antipolitical way of managing the world, render invisible and compound the existential threats already facing climate-impacted campesinos and Indigenous Quechua communities. I examine these issues through multiple fields: through the lens of uneven and racialized labor, through the cultural production and management of value objects at risk, and through the transformation of lived, porous spaces, into natural laboratories. This project engages with fields of STS,

Anthropology, Geography, and Critical Development Studies, emplacing new arms of racial capitalism in “local” climate projects.

The dissertation of Courtney Evelyn Cecale is approved.

Hannah C. Appel

Christopher J. Throop

Christopher M. Kelty

Susanna B. Hecht

Jessica R. Cattelino, Committee Chair

University of California, Los Angeles

2020

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Vita

Courtney Evelyn Cecale is a Ph.D. Candidate in the Department of Anthropology at UCLA studying the cultural politics of climate change adaptation. As a graduate While at UCLA, she also worked as a researcher at the Center for the Study of Women and the Luskin Center for Innovation in partnership with the National Park Service. From her research, she has published a handful of academic articles, given invited talks in multiple countries, and presented at over a dozen conferences. Her work won the Society for Psychological Anthropology's Condon Prize for Best Graduate Student Paper, was featured in major news outlets such as National Geographic, and was awarded research support from the University of California Office of the President, the Department of Education, UCLA's Graduate Division, and the Department of Anthropology. Additionally, Cecale served as a mentor in the Community College to PhD Program, mentored students in in sustainable design challenges, and taught classes she designed in three departments across campus. She will begin the next stage of her career Fall of 2020 as an Assistant Professor in the Anthropology Department at the University of North Texas.

INTRODUCTION

"Como 'ayuda' comienza a llegar recuerda, es una caricatura del amor cuando se quiere apañar con limosna lo que se debe por justicia."
"As 'help' begins to arrive remember, it is a caricature of love when you want to give in charity what you owe for justice." -- St. Oscar Romero

"All systems of oppression are adaptive; they can withstand and adjust to challenges and still maintain inequality." – Robin DiAngelo

Getting a Mountain Stomach

At a 16,000' rocky mountainside campsite in the Peruvian Andes, I waited with a group of scientists, students, a citizen scientist, and high alpine service workers around a portable camp stove for water to boil. It was the night before a climbing expedition, where two teams would summit the peak, Maparaju (17,474') – and probably be the last people ever to do so. The glacier was crumbling, through melt it had lost its aesthetic climbing value, and it was becoming too dangerous. As the water boiled, something strange happened that I had never witnessed on a research expedition before. The normally clear water from the nearby glacier meltwater stream was changing color in the pot. As it boiled, it turned from a crystal clear blue to a rich, dark and cloudy orange in the pot. There was no reason to suspect any sort of contaminant. We were too high up for something upstream to affect the quality, right at the glacier source. But owing to climate change, glacial water was increasingly blending with rock flour suspensoids, making it more mineralized and hard to drink. Just a few days earlier, on our way up, we measured a stream below with a pH balance of just below 3, near the acidity of lemon juice. This marked a bad sign for water quality to come, as glaciers melt to extinction in the next 15 to 20 years.

Convinced it was probably safe to consume (also because we really did not really have a choice), we drank the water, and settled in for the night to get enough sleep before our 2am start time. But I woke up at midnight with intense stomach cramps. I spent the morning in camp with the high alpine service workers, who began to haul heavy gear down ahead of the climbers. I asked them if anyone else was sick and River, a high alpine mountain cook, laughed, patting and shaking his own stomach: "You are getting your mountain belly! You are a real mountain worker now." It was a joke, of course, but when I pressed River about how he really felt, he said he sometimes felt something after the water, but he tried not to drink it. He told me that I would learn when to drink, and when to be thirsty.[1] Again, a joke, but after spending time with him on multiple expeditions, and moving into a home with members of his family, I learned he was telling at least a half truth about himself: he knew what would hurt his body in high altitudes, and how to avoid it.

The point of the expedition up the mountain and onto the glacier was scientific research. A group of 12 people climbed one of the tallest peaks in the Andean mountain range to collect data on how black carbon might be impacting the vitality of the glacier. In other words, scientifically produced knowledge might reveal how localized pollution might be landing on the glacier surface and increasing its already rapid melt time. Additional studies were collected as part of a research team, monitoring the health and vitality of ecosystems clearly already impacted by climate change. The data would eventually be shared with the public, but more strategically, it would quickly be shared with the National Institute for Glaciers and Mountain Ecosystems (INAIGEM). INAIGEM was created by the Peruvian Ministry of the Environment in 2014 to research, design and manage climate change adaptation in the Andes. The troubles of climate change were being met with science.

[1] Full discretion, it took time for me to learn. There were expeditions where I daydreamed about the helicopters in the Himalayas

Meeting climate change with an international team of committed foreign scientists and a well-funded national climate research institute, sounds somewhat dreamy coming from a nation where the very existence of climate change is politically, economically, and culturally challenged. Annually, scientists and climate experts march[2] in the street for recognition, holding signs that read signs that read "Listen to Scientists!," "Trust Scientific Facts, Not Alternative Facts," "Let's Be Rational," and "Ice Has No Agenda." Some are incredulous that scientists and climate experts are not natural managers of some sort of adaptation or mitigation process, signs reading: "I can't believe we have to do this!" and "I can't believe I am marching for facts." But as this dissertation will show, adaptation driven by scientists and experts can still (re)produce troublesome effects.

This dissertation sits in the complexity of this dilemma. On the one hand, understanding the climate crisis and better preparing for what is to come with reliable scientific knowledge could save millions of lives. As I highlight in Chapters 2 and 3, scientifically produced data can help predict disasters, and model potential ecosystem collapse to find ways of bolstering and preserving it. But on the other hand, scientists (both foreign and Peruvian) also write into adaptation schemas additional peripheral aspects of their cultural baggage. In some cases, this has looked like recommendations to weave resilience and private markets together to form sustainable economic development that mirrors economic systems in the Global North. It has looked like shoring up environmentally harmful mining infrastructure in climate affected parts of the country to protect the Economy. And it has looked like aid in the form of green investments from major finance corporations, which help restructure national debts to build things like carbon markets (all of which is elucidated more fully in Chapter 4). It has also looked like tapping into existing, exploitive labor markets, created over centuries of uneven international relationships, to make the work of science

[2] Such as the Climate March and the March for Science (though there are many more)

possible. All of which has been justified by liberal logics of governance that see the monolith of Science as a rational and antipolitical way of organizing the world. I will dive deeper into all of these into my dissertation, but I name them now to highlight, that while activists around the world weave social justice into adaptation projects, the actual institutional project of institutional adaptation reflects and reproduces different goals: ones that fortify a specific type of cultural, political and economic life. I want to make clear that I am not suggesting that what is happening in Peru is a case of careless, greedy, or indifferent mismanagement. But rather, this project interrogates what adaptation means on various scales to overlapping communities, revealing the inertia of institutions and the power of political, economic and cultural formations.[3]

National Context

In June of 2010, inventor Eduardo Gold launched an experiment to save the rapidly disappearing glaciers in the Peruvian Andes. Gold, and a team of helpers, hauled and packed sawdust and paint cans to the top of the formerly glaciated Chalon Sombrero (15,600') mountain. He packed the material over bare rocks, then splashed white liquid over everything, staining the mountaintop. In an interview with the Reuters Foreign Affairs Correspondent, Damien McElroy, Gold explained: "A white surface reflects the sun's rays back through the atmosphere and into space, in doing so it cools the area around it too…In effect in creates a micro-climate, so we can say that the cold generates more cold, just as heat generates more heat." By making the area colder, Gold hoped to not only preserve any remaining glacier, but to bring back what was lost. The slow

[3] This project additionally speaks to the current moment of the 2020 Covid-19 economic crash, as members of the US Democratic Party seek out Green New Deal solutions to save otherwise crumbling capitalist systems. I feel enormous trepidation about what it means to fortify economic systems through climate investment, even though I recognize the value that could be produced. It is not a long term solution to the larger, global problem at hand, and like in Peru, it will likely be led by the same people, experts in their field, who created the mess to begin with. What is given up with this type of compromise?

melt of the glacier fed the valleys and rivers below for hundreds of years, and their disappearance was a threat to all life in the region. The idea was so exciting and promising that it was named one of the 100 Ideas to Save the Planet by the World Bank, and it won a $200,000 prize[4].

Although it was popular internationally, the idea failed to gain wider traction across the country – a country where the largest cache of tropical glaciers in the world (over 70% of all tropical glaciers on earth) were rapidly melting and disappearing from global climate change (MINAM 2019). Even though protecting glaciers from melt could save entire ecosystems and the lives of millions who live entangled with them, expanding this project (and more "local" projects like it) on a wider scale was decidedly unfeasible to the Peruvian government, major finance organizations, and NGOs. The work of painting thousands of mountaintops was too labor intensive. There were no investors interested in financially supporting this project because it produced no fiscal returns, the way carbon capture might. These projects, if successful, would only benefit people who live near salvaged glaciers – and there was no scientific evidence yet that it would. There was, however, evidence that the paint and sawdust from this experiment ended up contaminating some of the water supply below. The experiment failed.

The Minister of the Environment, Antonio Brack, critiqued the project, calling it "nonsense" (McElroy 2010). He was interested in projects that he said, "[had] more impact in mitigating climate change," instead of smaller-scale, localized solutions like Gold's. The Ministry of the Environment's climate resilience strategy over the following years reflected these goals. In place of investing in smaller, experimental, locally oriented projects, the Ministry would find ways of pairing climate change with broader goals for the nation. According to their mission statement, they would focus on: "initiatives that contribute to the adaptation and mitigation of climate change,

[4] I have no idea if this money was ever actually paid out. I have no reason to suspect it wasn't, but I know that the project started before the funding ever arrived with the expectation that money would be paid back at a later date.

and those that enhance our natural capital, preventing the loss of forests; We strengthen the protection and sustainable use of biological diversity, through bi-business and eco-business and work with the local population" (MINAM 2014). The Ministry of the Environment was decidedly interested in pursuing scientific solutions to climate change in partnership with and bolstering the private sector.

In the last decade, the Ministry of the Environment laid out the country's National Strategy on Climate Change, a document that bound Peru's climate commitment legally, stated plainly the need for adaptation, but more importantly, the focus for the nation would be on carbon sequestration in the Amazonian forests, the development of renewable energies and transportation systems, and the improvement of efficiency in industries. The stated goals of the government were to build connections to mitigation markets that could generate income for the country (whoever that is), and to participate in the climate movement through science, advanced technologies and development. But while there are promises to include "relevant stakeholders" (MINAM 2018), "local" problems are still not exactly the main strategic focus – even if caused and exacerbated by international forces. Project's like Gold's are almost never funded[5], unless by an outside agency like an NGO or by foreign scientists whose research interests align with community concerns. Because of this, foreigners have played a large role in determining the shape of adaptation

[5] While strategically not investing in mitigation or adaptation projects that were small-scale, or too local for the Ministry of the Environment, the state in various forms also began ramping up public, grandiose performances of their commitment to helping people survive climate effects. I watched a governor hold an event after passing a new decree, declaring water to be a human right (with no direct plans for how to help the rural region access it, or keep it from being contaminated by foreign corporations granted access by the same caring civil servants). The government founded the National Institute for Research on Glaciers and Mountain Ecosystems (INAIGEM), based in the hard hit region below the Cordillera Blanca. There were countless public townhalls to share information, promising to be eventually lifesaving. But people were still feeling the extreme climate effects, with little to no formal help mitigating them. Science was not yet solving any existing or emerging problems. What's more, climate finance and the participation in large scale green Economic markets became the clear primary goals.

infrastructure, raising questions about democracy and borders in the international adaptation nexus.

Adaptation, Inequality & Vectors of Power

This project centers near and around the Huascaran National Park, where extreme climate effects threaten the lives of hundreds of thousands of people. It highlights how international interconnections and governing agencies hundreds of miles away in Lima are impacting the development of climate change adaptation infrastructure in "local" locales. To set the scene, this dissertation focuses on the region encompassing the glaciated Cordillera Blanca mountain range, grassy canyon and *puna* alpine meadow spaces, as well as the villages, towns and cities located below – all of which are connected by the glacier meltwater rivers that run through them. A United Nations Education, Scientific and Cultural Organization (UNESCO) World Biosphere Reserve, the park contains some of the highest mountain peaks the world's tropical zone (Byers 2000) -- with dozens reaching above 17,000 feet – hundreds of glaciers, glacial lakes, and glacial meltwater streams that feed the water needs of people living below. Along the high altitude borders of the park, there are small villages that border (and sometimes extend within) the charismatic mountain range, where pastoralists and agriculturalists make use of the flat planes to raise families, cultivate community, and take care of land and livestock. Below them are larger communities – some with hundreds, if not a thousand inhabitants – with more centrally-connected infrastructure: paved roads, electricity, and in some cases, household water. In this zone, economic lives blend between wage labor and agricultural supplementation. And more towards the bottom of the mountains, in the valley below the park on the east side, lays the regional capital, Huaraz. In the city, there are over 100,000 inhabitants, a booming economy, local government, the Institute for Glaciers and Mountain Ecosystems (also referred to by INAIGEM, the organization built to tackle climate

change for the entire country through research), and infrastructure resources such as waste removal, running water, and electricity in nearly every establishment[6]. This dissertation takes place across these space. While climate change adaptation is institutionally studied, planned, and policied at INIAGEM in the center of Huaraz, the effects of these projects sometimes ripple out, up, into the communities around the city, influenced by scientists from foreign countries in the Global North. I argue that climate change adaptation is emerging as a new site and source for the continued (re)production of global vectors of power, compounding the hardships of already climate affected people.

Around the world, as climate activists link issues of social justice to the protection and management of changing environments, powerful institutions additionally are finding ways to durably fortify their own domains of influence, including those formations that (re)produce inequalities. In the case of the Peruvian Andes, this fortification is done through projects of Science, purportedly neutral projects of research and information generation. It is this tension that is the focus of my dissertation. While on the one hand the knowledge and resources of scientific experts may prove to be essential to surviving climate futures, there is nothing inherent to Science that ensures scientific governance will answer burning climate justice. Moreover, the fortification of value objects that constitute The Economy and Politics, do not solve climate change problems for people already excluded from and harmed by these institutions – even if they are driven by well-intentioned scientific experts. Climate change adaptation projects are now emerging as new modalities through which inequalities are (re)produced in Peru, disproportionately impacting poor campesinos and Indigenous Quechua people, who are already reeling from the effects of climate change – a problem they did not create.

[6] Primarily, people work in service, mining, tourism, and food industries.

Generations of radical thinkers helped to parse out the details of the ways global vectors of power have transformed, adapted, and became aligned with colloquially innocuous goals such as development, sustainability, and progress (Frank 1967, Cardoso 1979, Santos 1970, Harvey 2005, Rodney 1972, Wallerstein 1979, Larrian 1989, Galleano 1971, Robinson 1983, Marcos 2000). Arturo Escobar wrote, "For thirty years, research and strategies to 'develop' the area have centered on large-scale development interventions, such as the expansion of oil palm plantations, mining, and large port development. Against this backdrop, poverty, inequality, and violence have deepened. To say the problem facing the region—and other parts of Latin America—is lack of development is fundamentally flawed… we should dare to reverse the picture: to entertain the idea that the problem of this region, is not underdevelopment but, in fact, excessive development." Excessive development in Peru arrived in historical waves with neoliberal austerity, the stripping of environmental protections, the redistribution of rural resources to the capital, and the making of obscenely wealthy politicians (many of which are now incarcerated for corruption). Escobar writes that these initiatives were a form of cultural imperialism that poor countries had little means of declining politely (Escobar 2001, see also Gustavo Esteva). As climate change adaptation emerges as a form of aid, these processes echo these same historical trajectories, reproducing global schemas like racial capitalism through promises of unbiased and expert-driven help, constraining and designing possibilities like a needle into grooves on a record.

This is made all the more complicated by the cultural, economic, and political construction of a scientific fact. While climate change produces a wide host of issues, the facts produced about the problem, help in part to define its outcome. As Alison Wylie writes, "what counts as a 'fact' in any relevant sense is (understood to be) determined by contextually specific interests: individual, micropolitical interests, as well as class interests, broadly construed" (Wylie 1996,

320). The issues that the climate scientists that I worked and that state institutions are studying and investing in, are not random. Scientists are not investigating a lack of water because of mining contamination, the selected problem is technical, one of a melting glacier that exists in nature, whose only interaction with social, political and economic life would emerge through an outburst flood (or from the actions of carbon emitters in foreign countries in the Global North) or natural mineral contaminants. Foucault argues that "the battle for truth is not for some absolute truth that can be discovered and accepted, but is a battle about the rules according to which the true and false are separated and specific effects of power are attached to the true" (Foucault, in Rabinow 1991). Truth is not just about what is happening or not happening (like the political battle ground around climate change in the United States), but also what is relevant, and what should be done about it. According to STS thinkers such as Sheila Jassanoff, these truth making processes become enmeshed with political, economic, and cultural life. In this dissertation, I highlight how scientific truths (and the pursuit of them) about climate change have become an important cultural, economic and political battleground. In liberal societies, power is based on ideologies of consent and ruling through knowledge (or convincing) – this project looks at the production of the knowledge that is guiding the reproduction of racial capitalism through climate change adaptation.

Climate Context

To understand why I was studying climate change adaptation in Peru, it is critical to explain what is happening, climate-wise, in the region. As decades of research now shows, climate change is already deeply underway affecting systems, processes and people across the planet. Although atmospheric teleconnections have always existed on international — even global — scales, climate change raises new questions about how best to manage those interconnections. This section

highlights major features of those interconnections, moving through various scales, to provide context to the rest of my dissertation.

1. The Climate Crisis

Life on earth exists thanks to a delicate balance between the sun, our planet, and the gaseous atmosphere between them. Thanks to a combination of gravity and proximity, our atmosphere produces near perfect living conditions for earth's inhabitants: it's not too hot, nor too cold, variation produces seasons, currents, and complementary climactic zones. Our atmosphere does all of this by trapping just enough heat on earth, like a gentle gaseous blanket. With any major changes to the atmosphere, the earths balanced ecosystems and relatively stable climate zones would be dangerously disrupted.

A change in atmospheric conditions, would result in a changing relationship with our closest star neighbor, the sun. Sunlight heats our planet through infrared radiation, which excites molecules into motion that we feel as heat. Our atmosphere protects us from the full effects of heat generated by the sun, which burns at over 10,000 degrees Fahrenheit, by filtering out the most dangerous forms of radiation in the ozone layer[7] while still trapping the perfect amount of heat to keep life afloat.

Most of the heat and solar radiation that the earth receives is absorbed by the planet (48%), keeping us warm. Although some of it (29%) bounces away, and radiates back into space in the form of infrared waves. This process of trapping and mitigating heat throughout the atmosphere prevents the surface temperatures from plunging in the night time shade, and roasting the earths surface during the day. The everyday markers for this process (namely, weather and climate) are

[7] The destruction of the ozone layer was a major concern in the late 20th century, and led to successful campaigns against certain types of pollutants that would destroy it.

normally cyclically impacted by seasonal and orbital variation, but in recent centuries, broader patterns of warming by trapping more solar radiation as heat, have begun to produce worrying impacts on these earthly systems.

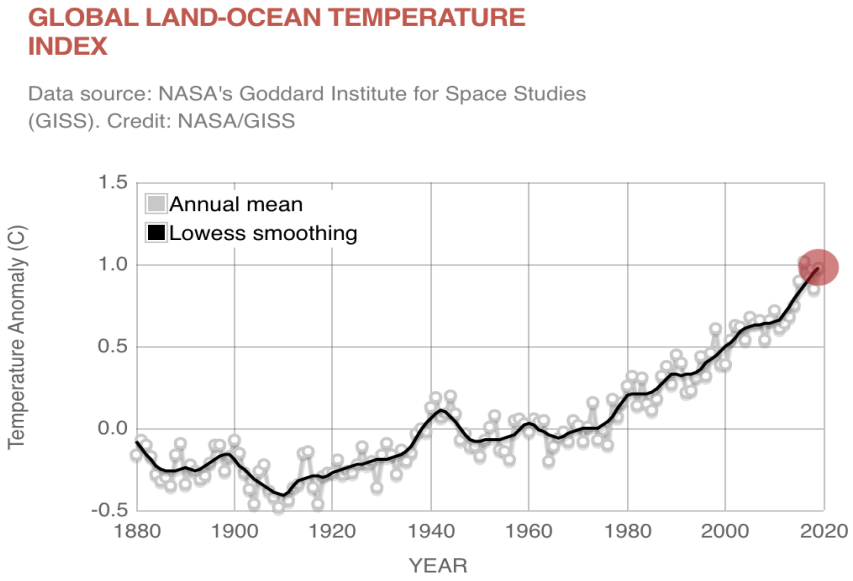

Figure 1 Chart highlighting rising heat indices, public domain NASA

As seen in the last five years have been the hottest years on record[8] (NASA), and these trends are anticipated to continue, posing existential risks to all life on earth. This data was produced through multiple different techniques: Scientists have been measuring the land-surface air and sea-surface water temperatures since the 1880s, and compiled an extensive global database. This data was collected across multiple locations, at different latitudes and elevations, to reflect the diversity of potential change across the planet, and is corroborated by multiple major research centers such as the National Aeronautics and Space Administration (NASA), the National Oceanic

[8] Measured as the earth's global surface temperature

and Atmospheric Administration (NOAA) and the National Center for Atmospheric Research (NCAR).

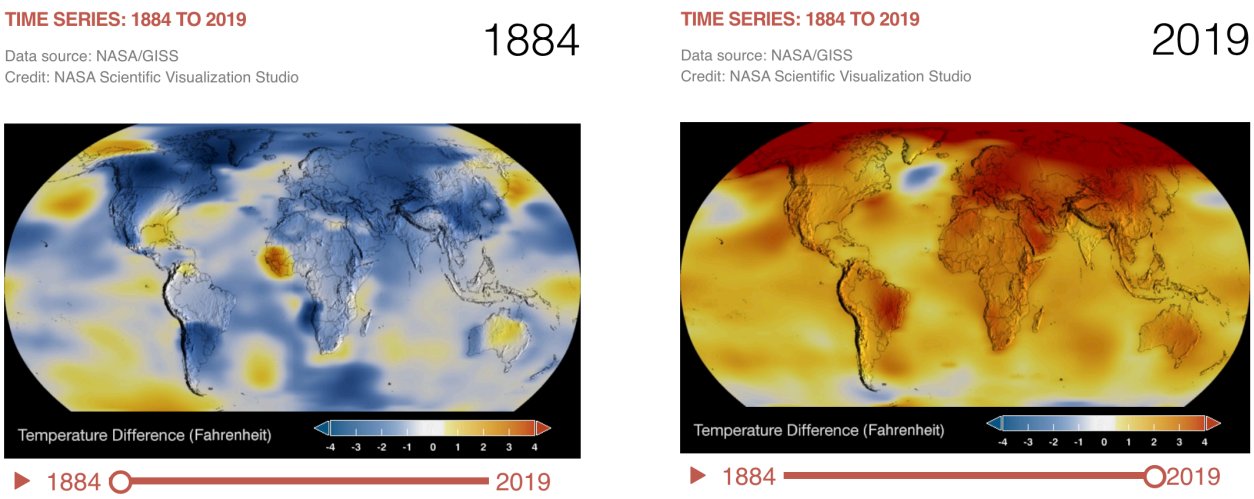

Figure 2a& 2b Distributed warming patterns

Warming across the planet does not mean an even rise in temperatures across all regions. In the above images by NASA, the greatest differential is taking place along the poles. Some places are experiencing greater temperature differentials than ever before — Antarctica was 65 degrees Fahrenheit this past February. This aspect of climate change, global warming, is one of the many symptoms of climate change. While often used interchangeably with *climate change*, *global warming* refers to the heating of the world's climate systems as a result of heat-trapping greenhouse gasses throughout the atmosphere. The pattern of global heating correlates to the increased presence of greenhouse gasses in the atmosphere: namely, carbon dioxide and methane. These gasses trap more of the sun's heat in the atmosphere, and rupture the delicate, lightly-shifting balance that we've existed in for millions of years. This leads to both hotter days as well as heatwaves and generally more days of high heat per year; the ten hottest years on record (since the 1880s) have all happened in the last ten years[9]. The change has directly resulted in the deaths of

[9] In addition to dramatic rises in ocean temperatures across the world

hundreds of thousands of people from heat stroke, dehydration, heart failure, stroke and other heat-related illnesses. India Times reported over 1000 deaths from heat in just one year alone in Karachi, Pakistan, with jobs emerging to preemptively dig trenches for all of the expected dead (Anand 2016). Across the world, these issues are expected to predominately affect low-income urban neighborhoods and community of color already vulnerable to environmental hazards. Based on data models, the global surface temperature is conservatively projected to exceed 1.5 degrees by the end of the century, making conditions even worse.

Yet heat is just part of the broader climate change problem. Some places may be drastically impacted, even if they are not experiencing wildly differential temperatures. For instance, the Pacific Tuvalu Islands have been mostly claimed by rising sea levels, yet they have experienced minimal warming. As the planet warms, interconnected systems change in response (hence *climate change,* instead of just *global warming)*. The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (UNFCCC 1992).

One major source of these changes is the alteration of atmospheric jet stream patterns. Polar jet streams tend to keep cooler air in polar regions, and warmer air to the south. But as more air warms across the planet, these patterns become less reliable. These jet streams change course, and dip further south, they bring cooler air further south, and allow warmer air to travel further north. These patterns result in some of the extreme weather events seen in the media, such as unprecedented snowstorms[10] and heatwaves in the poles. The new trajectories of the jet streams

[10] Political skeptics like to use the presence of large snow events as evidence that the world is not warming, but understanding the disruption in the normally strong polar vortex during winter months helps to clarify that this is actually part of the climate change problem.

create wavy patterns, trapping already large storms over water sources and allowing them to grow into dangerously large storms. Hurricane Harvey over Houston was the perfect example of this. Harvey was disastrous for at least two[11] reasons: 1. Warmer air tends to be able to hold more water vapor before the process of condensation happens, allowing for megastorms to develop, and 2. Harvey was held in place for five days over Houston and nearby waters owing to new patterns in wavy jet streams. This resulted in the greatest single storm rainfall on record in the U.S. (Climate Reality 2018, Di Liberto 2017, Harden 2017), more than five feet of rain, billions of dollars in destruction, and the loss of 68 lives.

Many of these gases are produced naturally: through the body during respiration and defecation, from environmental events such as volcanoes and fires, from human activities such as plant cultivation and decomposition. Through cycles, these gases have been absorbable back into the earth in a variety of ways, keeping levels mostly balanced. And for millennia these activities and occurrences produced no harmful effects – the atmosphere is quite large, after all. But new ways of managing the environment, of producing wealth, and relating to each other as humans[12] have produced more greenhouse gases than ever before[13] since the industrial revolution. The boom in fossil fuels directly correlates with the increase of global temperatures over time through land degradation, water pollution, and emissions. Higher concentrations of greenhouse gases trap extra energy and heat in the atmosphere, working in small increments to produce large effects — nitrous oxide, carbon dioxide, and methane all block energy from escaping into space — and we are

[11] Far more if we consider the socio-environmental conditions

[12] See entire history of colonialism, the industrial revolution and the development of fossil fuel dependency technologies across the world

[13] How do scientists know that it is fossil fuel related, and not correlated with other phenomenal? There is no correlation between solar activity and our warming planet. Total solar irradiance has actually declined since the 1960s (NASA/JPL-Caltech. Data instead highlights correlations between human activity and rising temperatures.

dumping 110 million tons of man-made, gaseous pollution from burning fossil fuels into the atmosphere every 24 hours (Climate Reality 2018). Since the industrial revolution, the production of polluting gasses has risen more than 30% from the burning of fossil fuels (crude oil, coal, and natural gas), which far exceeds levels from the past 800,000 years (see chart below). The dates from the carbon chart below also correlate to the ancient and historical record tracing temperature back through time, though as you can read below, these are unprecedented times. In what should be a reversion to more ice age features, we are instead experiencing hotter temperatures than ever before, while also measuring higher incidences of atmospheric pollution than ever imagined.

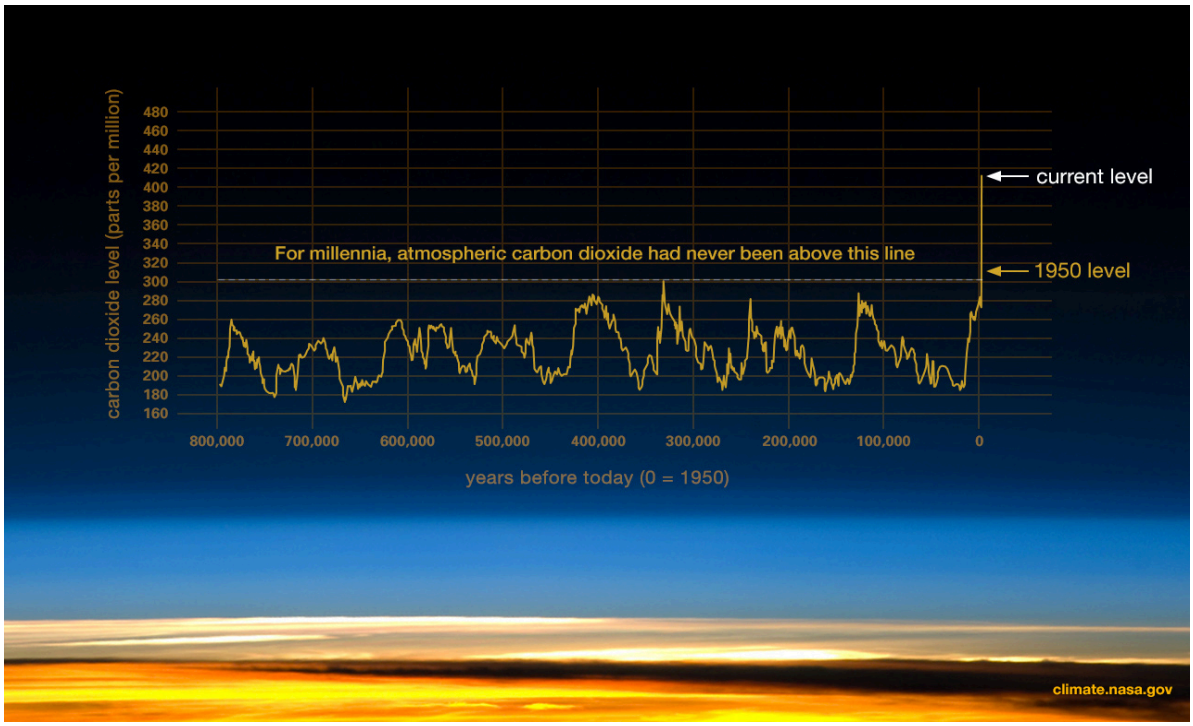

Figure 3 Graph based on the comparison of atmospheric samples contained in ice cores and more recent direct measurements, provides evidence that atmospheric CO2 has increased since the Industrial Revolution, public domain NASA

Environmental justice activists and anthropologists have long argued that this is not simply a human problem, but a problem of select groups of people making choices that impact typically marginalized communities. While popularly designated *the Anthropocene*, scholars have since

pushed back on the notion that all humans should be held nominally responsible for the great extinction currently underway. If not all humans benefit from the same environmental exploitation that created this global mess, then: "naming this crises after the species hides the social, not geological, histories of exploitation at the root of the problem" (Luciano 2015). Jason Moore writes, "The Anthropocene makes for an easy story. Easy, because it does not challenge the naturalized inequalities, alienation, and violence inscribed in modernity's strategic relations of power and production" (Moore 2014, p. 2). Moore explains that humanity is not a collective actor, and on the contrary, the accumulation of capital has been central to producing these deleterious environmental effects. Environments were transformed through labor, seeking value extraction. He proposes the idea of the *capitalocene* to replace that of the anthropocene in order to account for responsible processes and actors. Other theoretical models were created as well, such as the *anthrobocene* which accounts specifically for the extreme wastefulness in contemporary capitalism, ultimately resulting in Donna Haraway arguing for a systems approach, where systematically linked patterns that threaten major system collapse after major system collapse" are all actually intertwined with one another historically, in order to understanding the production of climate impacting forces (Haraway 2015).

In addition to the fact that not all humans have equally benefited from the environmental entanglements that have cause climate change, not all humans are sharing the same burdens. Anthropologists Hans Baer and Merrill Singer have pointed to the ways that women and most of the global south are hardly to blame for climate change as "75% of the world's poor have no electricity, few consumer goods, and little to no time or money to spend on energy-guzzling leisure pursuits," implicating global class and gender politics in the climate change process as well. But the real rub lies in the fact that the wealthiest nations, who are responsible for generating the

greatest input of carbon emissions and greenhouse gases into the environment do not feel the effects of climate change with the same impact. Poorer nations, with fewer resources to respond, are "paying the heaviest price" (Baer and Singer 2014). While those who profit at major companies like ExxonMobil have the privilege of living in areas with clean air and potable water, ethnic minorities bear 69% of the toxic air risk from facilities owned by the company, and they are less capable economically and politically to adapt to the changing ecological forms that affect them such as increased drought. They colorfully explain further, "the era of the anthropocene is one characterized not only by the deep impresses of the human footprint, but by the unequal prints made by the expensive tailored shoes of the super-rich" (Baer and Singer 2014, p. 201).

Activists and scholars have highlighted the ways that people commit injustices against one another with land, ecologies, and atmospheric conditions as the weapon – these new emerging teleconnections are not entirely a new phenomenon. This particular form of violence, instead of being aggressively direct, allows nature to become a "vehicle through which injustice is visited on other people" (Gardiner 2011, p. 43). Examples of this include the *silent violence* identified by Michael Watts, *environmental racism* as described by Luke Cole, *the environmentalism of the poor* as described by Martinez-Alier, and varying forms of slow violence discussed by Rob Nixon and Veena Das. Silent violence traces the way that famines are socially produced, even when affected by natural disasters like droughts, owing to the fact that food insecurity is an extension of exploitive global capitalist forms (Watts 1983). Environmental racism is exhibited through the environmental hazards, toxic sites, pollution and other human-produced environmental conditions that disproportionately impact people of color and low income communities (Cole and Foster 2001). The environmentalism of the poor is characterized by analyzing and challenging the ways the poor are imagined to only see environments as economic ends. And the concept of slow

violence contrary to disasters, slow violence takes the form of gradual, often invisible hardship in the face of ecological destruction (this includes exposure to high levels of toxicity owing to routine forms of environmental injustices like extraction). All of these conceptual tools inform the way that environments have been intertwined with social, economic and political realms and demand further consideration when thinking through the varying impacts of climate change. Indeed, while climate change may be a new phenomenon in geologic history, "its genesis relates to a much longer relationship between human beings and the/ir environment" (Howe 2014, p. 237). So while some groups of people, like the inhabitants who have since had to abandon the Tuvalu Islands, have contributed least to the problem of global climate change, they are, unfortunately, the most affected by having to abandon all of their resources, their homes, and their entire way of living with one another and experiencing a longer historical trajectory of social relations connected through rendered invisible ties. So who should be held responsible and accountable for the spike in atmospheric pollution that is devastating lives across the planet?

Early evidence pointed clearly to the United States, Western Europe and Canada as the largest contributors to this problem, but in the last ten years, China has since become the largest atmospheric polluter[14]. But looking beyond the category of the nation, it is evident that certain sectors of industry are the largest producers of the problem, not necessarily the residents themselves. In a report generated by the Carbon Majors, just 100 companies were uncovered to have contributed to 70% of the world's greenhouse gas emissions since 1988. These companies have generated 923 billion tons of atmospheric carbon dioxide pollution, which is more than 52% of the global industrial greenhouse gasses since the industrial revolution (Carbon Majors). The largest contributors were all coal, oil and natural gas producers such as ExxonMobil Corp, the

[14] The United States lost the title of the world's greatest emitter in recent years, but if you look at the problem as an issue of compounding particulate matter, the US has still contributed the most matter over time.

Audi Arabian Oil Company, Coal India, China Coal, Royal Dutch Shell PLC, and Chevron Corp. The majority of emitters are wealthy people in wealthy nations, but these are the groups least likely to be affected by the dangerous climate changes currently underway. Their influence, however, raises questions about how to govern atmospheric teleconnections.[15]

2. Localized Effects

Peru:

It is predicted that in just a couple decades time, major regions of the Peru will become nearly uninhabitable owing to anticipated global climate change impacts. The tropical Andes are intensely affected by increased global temperatures for a number of reasons: 1) The tropical Andes are located in the lateral stipe across the planet currently experiencing the greatest increase in warming, as increased temperatures are not arriving evenly everywhere; 2) The complex topology and geospatial framework of the Andes are prime spaces for the collapse of delicately entangled water-systems. The strong climactic gradients and delicate interconnections between biodiverse ecosystems are anticipated to create a domino effect of collapsed watershed systems across the country; 3) Peru generally lacks the necessary infrastructure to provide water and resources to people who are likely to be most affected in more rural regions; and 4) The country is already experiencing unprecedented urban migration from people whose land resources have dwindled, making them early wave climate refugees (though they have been politically denied the designation). Cities such as Lima, Arequipa, and Huaraz have all grown unsustainably in the form

[15] Just to name some of the people presently personally making millions off of this crisis: 1. Chevron Corp Chief Executive Officer Michael Wirth, and fellow board of directors Debra Reed-Klages, Inge Thulin, Alice P Gast, Charles Moorman, John B. Frant, Ronal Sugar, Wanda Austin, Dambisa Moyo and Jim Umpleby, 2. Exxon Mobil Corp (XOM. N) Chairman and Chief Executive Darren Woods, and collaborators Michael Dolan, Andrew P Swiger, and Mark Albers. 3. Former ExxonMobil CEO Rex Tillerson, Halliburton owner Dick Cheney, industry lobbyist Scott Prewitt, and oil magnate Ryan Zinke. These are not the people who have profited the most necessarily, but they have done considerable damage.

of suburban shanti-towns made of mud and old plastic tarps — many of which are situated on dangerous and collapsible hillsides, or in the way of river flood paths, setting them up to doubly experience climate disasters to come. Further, per capita water availability is diminishing owing to sublimation from increased heat of water resources at higher altitudes, the source of much of the countries potable water. Studies have demonstrated that demographic change of the country is already outpacing water availability, as supply systems, dependent on natural ecosystem services, are impacted by losses in biodiversity (Buytaert 2012).

Peru is one of the most vulnerable countries in the world to the effects of climate change, currently with 7 of the 9 characteristics of vulnerability established by the UNCCC's Framework Convention. Peru will have a tremendously difficult time adapting to climate change impacts as cascading systems fail into one another. Using the framework of global climate change, biodiversity is impacted not just by warming temperatures, but changes in weather patterns, increased nitrogen in certain pockets of the atmosphere, and the collapse of previously stable watershed and ecological systems. With the second largest share of the Amazon rainforest, some of the tallest peaks on earth, and oceanic ecosystems along its coast, Peru is one of the world's top 10 *megadiverse* countries (Myers 2000). Of the possible 32 climates that exist on the planet, Peru's vast diversity contains 28. This immense biodiversity provides ecological space for many protected endangered species, it works as a carbon sink capturing much of the worlds atmospheric carbon production, and it also provides necessary resources for people: including global staple foods, such as quinoa, potatoes, and coffee. These interconnected ecosystems, however, are disappearing. Some further vulnerabilities identified are that the majority of the population of the country lives in an arid zone that is rapidly desiccating (migration), most of the agriculture in the country is

highly if not completely dependent on reliable rain systems, and electrical energy for the country is generated by hydro-electrified water streams.

Though only contributing an estimated .4% to the total atmospheric greenhouse gasses (MINAM 2014), Peru has already begun to experience warming, and is projected to increase 2°–3°C by 2065, in addition to grappling with sea level rise, drought, fires, and increased incidences of extreme weather. Changes in the atmosphere will (and have already begun to) desertify and degrade soil, impact rainforest density (which is one of the largest carbon sinks on the planet), diminish fish and wildlife populations, lose crops, have reduced access to water and feed resources, aggravate respiratory illnesses, spread lower-altitude water-borne illnesses to regions across the country, and melt glaciers which act as natural water storage facilities and provide hydroelectricity, and whose melt endangers hundreds of thousands of people in disaster events. All regions of the country will experience losses, but the Highlands and mountainous Andean regions will be the hardest hit.

Andes:

The continental mountain rage of the Andes extends through multiple countries, including Chile, Argentina, Bolivia and Ecuador, and is the second highest mountain range in the world, behind the Himalayas. Altitudes in the Andes extend up to unlivable heights at nearly 7000m or 23,000'. The Peruvian Andes are home to the largest concentration of tropical glaciers in the world, hundreds of them all condensed into one subrange known as the Cordillera Blanca (named for its white peaks). The region is also sometimes categorized as el Callejon de Huaylas, which includes the valley, Cordillera Negra and Huayhuash regions. The Cordillera Blanca is one large segment of this area that is demarcated by being on the west side of the Santa River, and still having glaciers.

It is also a region economically famous for conservation (the establishment of the Huascaran National Park), mineral extraction, and forestry, and politically known for left insurgent activism, communal landholdings, and deeply "abandoned" infrastructural development (Borg Rasmussen 2017).

Geographically, the region contains numerous glacier meltwater lakes, some of the highest peaks in the world, hot springs, a dry climate, and flora and fauna species that are uniquely endemic to the region. This includes endangered qenwa polylepis trees with tissue paper bark, viscachas which are somehow rounder and fluffier chinchillas, condor large enough to hunt cows, and the ukuku speckled bear rumored to roam and guard the glaciers at night. The Cordillera Blanca is also on a fault zone, creating spectacular quebrada canyons, and extreme altitude gradients for all of the mountains. The fault zone also makes ice and overfull lakes more unstable.

In terms of climate change effects, increasing temperatures are causing droughts, fires, megastorms, floods, and melt – all of which I witnessed during my fieldwork. In the lower altitudes of the highlands, heat and desiccation have created unlivable conditions, where water is now scarcer and land is hard and arid. The water captured in soils evaporates too quickly, leading to the abandonment of land for hundreds of thousands of people. So far, the region closest to the Cordillera Blanca has only begun to feel these effects. The special high-altitude climactic zone is still cooler than lower regions, and the tall mountains capture marine layer water vapor from the coastal region to the west, but the region still faces great dangers. Cirque or mountain glaciers form on the steep slopes of mountaintops and nestle within the crests and ridges. Even though the tropics are known for being typically warmer than the polar regions, the tropical glaciers in Peru formed because of the high-altitude alpine conditions, where temperatures stay relatively low no matter the season.

While the place has yet to become unlivable (as it is anticipated), annual droughts are currently impacting viability. Each year the rainy season, which for centuries fell from August until May, has been delayed by months. During my fieldwork, this crucial agricultural time was delayed by as much as four months, with soils hardening and drying to unusable conditions. Agriculturalists reported losing hundreds of dollars' worth of seeds, irreplaceable strains from the years before, by trying to plant according to schedule, but the rain would not come. People who lost crops by planting on schedule were lucky to be supported by their communities who shared emergency resources, but this put tremendous strain on community relations (see Chapter 5) and is not a viable long term solution.

Figure 4 I took this photo on a training climb. The fires appeared so quickly, we didn't know what was happening, the smoke just poured over the mountaintops and seemed to spread with the wind.

Figure 5 Most of atmospheric particulate matter ended up polluting glacial faces, trapping heat, and causing rapid melt.

Drought conditions and anxieties worsened until November of 2016, when dry plants combusted into wildfires that spread across the entire country. The national government declared a state of emergency as fires spread through agricultural zones, killing crops and livestock, and even a young child who was unable to escape. The wildfires heightened drought anxieties, and ultimately led to intense (and expensive) conflicts between campesino community members and foreign scientists whose work it was to study and mitigate climate change.

The droughts rapidly ceased when the seasonal rains arrived as floods, mudslides, and over-spilling rivers. Owing to a dangerously heightened El Nino effect, in just 12 days' time, over 200,000 people were left homeless. Dams burst, sewage systems were swept up into debris, major infrastructure (bridges, trains, roads) were all destroyed. One hundred and seven people drowned, trying to flee meters of flood waters and landslides. Some regions saw an increase in illnesses typically contained to wetter regions, such as zika and anthrax[16]. The cities and communities near the Cordillera Blanca were rendered immobile, since every major road leading to the region collapsed in landslides[17]. ATM machines quickly ran out of cash, there were food shortages in major grocery stores, while the price of staple goods increased at least tenfold. Phone and power lines were down throughout most of the city, and schools closed since children were unable to move throughout the city to attend their classes. It was like this for weeks, with the military arriving by helicopter to try to rebuild the damaged infrastructure and restore water, power, and sewage to those who were hardest hit.

In addition to the changing climate and weather patterns, living near melting glaciers provides additional hazards. Nearby residents are threatened by glacial sliding (when a large piece

[16] For instance, the price of chicken rose from 3 soles per unit to 35

[17] Fun twist that I'll explore in another chapter: it was actually the mines who paid to rebuild the infrastructure since they were losing money on not being able to export the materials they were harvesting.

of glacier moves suddenly and violently), surging (when the entire glacier advances rapidly, and detachment (with a portion of the ice separates abruptly from the larger mass). Meltwater below and around the glacier can also result in lahars (mud or debris flows from below or around the glacier, often associated with volcanic activity and materials, that are fluid while moving then freeze solid like concrete as soon as they stop) and glacial lake outburst floods/GLOFs (which occur when the dams surrounding meltwater lakes collapse, drowning anything in its path under water and debris). The presence of any one of these effects also typically trigger another, compounding the issues.

The location of glaciers in the Peruvian Andes only heightens these risks. The tall, mountainous peaks of the Andes appeared as a result of tectonic lifting along the Pacific Ocean faults, occurring over tens of millions of years (Evenstar 2015). The active faults that continue to lift the region, also generate hundreds of earthquakes each year. During my fieldwork, 7 earthquakes larger than a 4.0 on the Richter scale shook the region, any of which could have been the end of Huaraz. The growth of old lakes coupled with the formation of new meltwater compound these issues. The weight and pressure of full lakes results in floods, or *alluviones*, which collect debris, rocks, and mud in moving, flooding waters.

Multiple times since the 1940s, major glacier related disasters have killed thousands at a time, drowning entire cities in water, mud, ice, and urban debris. In 1941, the regional capital of Huaraz was buried under the tons of water from a burst natural dam at Lake Pallkaqocha, killing 5,000 inhabitants (Carey 2010). In 1945, 500 more people were killed below the Huantsan glacier in the same manner. In 1950, the Jankarurish lake similarly burst, devastating hydroelectric infrastructure for the region. In 1970, the same dam burst again after an earthquake triggered an avalanche. That lake is now 34 times the size it was that year, and is located above one of the

fastest growing towns in the country with over 120,000 residents, still expanding to accommodate people leaving the countryside for all the reasons mentioned above.

In 1970, just up the road from the capital, another glacier related incident killed over 20,000 people in just minutes. An earthquake shook ice loose from the foot of Huascaran that tumbled into the meltwater lake below. The forcefully displaced water broke the natural dam that contained it, generating a land and mudslide so massive it was wider than a kilometer as it headed downhill and buried the entire town of Yungay. The damage was so catastrophic that the national government decided to just declare the entire town a national cemetery, and the dead would be left where they lay[18].

Figure 6 Taken at the cemetery where the few hundred survivors fled during the Yungay disaster. Over 20,000 people were killed, but this small elevated space provided a safe place for some.

[18] Just months before this event, nearby villages remember eccentric climbers who were in town for a few months climbing on their summer vacation from teaching back in the United States (Carey 2010). After spending weeks in the mountains, climbing peaks in the same valley as Huascaran, the men returned to town eccentrically trying to warn anyone who would listen that the hanging piece of ice was a genuine threat. The government assured people that these white strangers were just trying to cause trouble, there hadn't been an incident in decades, and everyone was safe, but they were unfortunately very wrong. This incident changed how public perceptions of environmental knowledge functioned in the region. Immediately after the warning the Peruvian Ministry of the Environment denied any threats, as did multiple authorities in the region. So local residents also ignored them. After the disaster, however, there was a shift from valuing knowledge produced through modeling to knowledge produced through fieldwork, especially knowledge produced by foreigners.

Today, Lake Palqaqocha threatens the lives of all of the people living below: dozens of communities with thousands of inhabitants, and the regional capital, Huaraz, where over 120,000 live in the flood modeled disaster zone. Every week, engineers from INAIGEM ride in trucks up the mountain to check on the integrity of the dam, examine the glacier from a distance to ensure that there are no pieces that look threatening to break off, and to check on the drainage system of pipes, that keeps meltwater flowing out of the lake at all times. Still the lake is 34x it's 1970 capacity.

Palqaqocha is not the only lake threat in the region. There are hundreds of new high alpine lakes that have filled up natural dams where glaciers once lay. Much of the water has mixed with high alpine rock and debris while melting, so the water is acidic (some with the same pH as lemon juice), creating new water problems. The problem of water is becoming one of too much, not the right kind, and with unsurvivable intensity in the form of storms and floods. In talking to a specialist from the United States who works in climate change related meteorology, I was told that the region had ten maybe 15 years of predicted time left before glaciers will fully melt, water will become dangerously scarce (or what is left will be stagnant and dangerous to consume), and life in the Andes will be radically different. At the time of this study, this unlivable future is not here yet, and it may never be. The moment I am studying is one in which any number of climate futures can be produced, though disaster and liberalism are both constraining though in different ways.

A Brief Environmental History

Climate change is entangled with, and exacerbates the effects of longstanding international relationships with the Global North. While goods and services moved across the continent for centuries before colonization, exploitive international extraction began in the 1500s, during the

Spanish conquest. The 95 year old empire, Tahuantinsuyo, or the Incan Empire, was militarily conquered with the help of infectious diseases to extract gold for Europe. Throughout colonization, these industries expanded to include sugar, silver, zinc, uranium, tin, guano, nitrates, nature, and the value produced by indentured labor. After independence from Spain, many of these relational patterns remained the same: community lands were taken over by large land holders interested in getting rich on the international market, and who had access to the expert tools of the state that determined property ownership. While people in the Andes had lived communally for as long as they could remember, in the high Andes, few people had officially registered their lands with the national government, making them available to the first land baron that claimed them. People who had lived on communally managed lands for generations (including all of the ups and downs of that particular environmental formation) were then expected to manage and produce on lands that they didn't own for survival, while the wealthy descendants of the Spanish and people from the capital grew richer and more powerful through systems of exports. These patterns of this hacienda system extended across the country, ultimately resulting in a sweeping agrarian reform movement.

The agrarian reform of the period between 1960-1980, dismantled the exploitive hacienda system and fought to redistribute land to their traditional owners, communities. Led by the vanguardist Marxist-Leninist-Maoists, the reforms aimed to transfer land holdings back to communities not just as a project of economic and environmental justice, but in the hopes that they would produce goods more efficiently by combining communal practices with new technologies. The new left government promised education, innovation and new technologies to help the entire country shift through Marx' predictive stages of economic evolution, getting them closer to their goals of a utopian communism. But these goals were never realized, many were killed in the civil

war[19], and the country's economy completely fell apart. Inflation was thousands of times higher than economic worth. And the Andes were subsequently institutionally abandoned by the Peruvian state (Borg-Rasmussen 2017) until the 1990s, when neoliberal economic development projects exploded nation-wide, led by science, technology, and neoliberal economic reach.

Then came *Fujishock*, or the political and economic doctrines of Alberto Fujimori, the country's President in 1990. After meeting with government officials in the United States and Japan, Fujimori was instructed to adopt a "relatively orthodox economic strategy" in order to stabilize the rampant hyperinflation, otherwise Peru would receive no support from the international financial community. The IMF and World Bank demanded deep austerity measures, the opening of international extractive markets through privatization, the tamping down on indigenous coca production (a mostly Native industry) to prevent U.S. smuggling. And to accomplish all of this, he dissolved congress, gave the Executive branch all legislative powers, rewrote land reform laws, and opened the country up to finance (Peru Decree Law 25418). He privatized everything he could, removed worker and environmental protections and began to overturn land reform through natural resource projects. Through Fujimori's new reforms, all of the natural resources within the territory of the nation belonged to the state, including water and glaciers, and they could be managed and sold however the government saw fit. While people still may own their rights to the surface land, it is impossible to survive as an agriculturalist and pastoralist on the surface above an open pit mine. Fujimori additionally disbanded communal land ownership, encouraging individualistic property relations, making mining incursions harder to fight. If just one neighbor were to concede and sell their land, all of the water, earth and air would

[19] In the Peruvian civil war of the 1980s between the government and Sendero Luminoso about three-quarters of the estimated 70,000 death toll were Quechuas, whereas the war parties were without exception whites and *mestizos* (people with mixed descent from both natives and Spaniards).

be contaminated for everyone living nearby. Communal property ownership used to prevent this, but under new forms of liberal governance, individual economic determination prevailed. Fujimori's new laws, in addition to the removal of environmental protections, changing land tenure, lowering international taxes, removing royalty fees, and liberalizing the market, all helped foster a new age of mining that boomed in the 1990s, that continues to affect people today.

In 1994, international investments in Peruvian mining increased by 2000 percent (World Bank 2005, Bebbington 2007, Li 2015). The mining boom of the 1990s was built on billions of dollars of foreign investment, showcasing the most modern, efficient, and technologically advanced projects ever seen. These projects were different from mines in the past, that relied on pick axes and human labor. They were developed by scientists, used advanced technology, and were part of more modern markets (Li 2015). They also provided fewer jobs for people in the region who lacked technical skills and training, and relied instead on visiting workers from Canada and the United States. The chemicals the mines used to process on site were more technologically advanced but they were also more toxic, and they produced more wide-reaching hazardous effects on nearby pastures, agricultural land, and waterways. All of this was marked as the cost of great economic development, led by science, technology, and liberalism. Advancements in the sciences (including social science such as economics) were foundational to the economic transformation of the country that diminished investments in infrastructure, produced more localized pollution, and generally underprepared the region for the climate change issues to come. The scientific and expert-led management of the environment has produced centuries of effects, and laid the groundwork for the emergence of climate change adaptation.

Methods

To answer the question of how climate change adaptation, driven by Science, is working in service to the reproduction of racist global vectors of power, I lived and worked in the Peruvian Andes for 18 months (3 months of pilot study in the summer of 2015, then 15 consecutive months from 2016-2017). Logistically, my project can be broken down as follows:

Phase 1: During the summer of 2015 and 2016, I camped and went on various research expeditions with scientific groups for weeks at a time. The goal for this phase was to understand how the knowledge that supports adaptation development is produced. The data collected during this time ultimately highlighted racialized divides between exposure to dangerous labor practices, a complex politics of expertise creating new challenges for sovereign and democratic land management, and revealed a realm of embodied expertise rendered invisible and undervalued by traditional practices of Science (namely, climbing). To produce this data, I spent weeks on end on various expeditions, climbing with research groups, helping to sample and collect data, observing and taking notes on camp dynamics and reported experiences, and interviewing people in camp (and then later following up with interviews in town). During this time, I met scientists, researchers, professors, students, porters, cooks, guides, and arrieros who all work to produce scientific knowledge. Their different experiences of the same events helped to make sense of the ways that data and knowledge production are cultural and political processes. I was able to do this type of research because of my background in climbing and because of the welcome generosity of research teams, who allowed me to work in exchange for my participation in their expeditions (which are typically quite pricy to produce). It was during this phase that I also made connections with a camp cook and his family, as we took turns teaching each other Quechua and English. I

would move in with his open and warm family after the summer season and live with them until January of 2017.

Phase 2: From August of 2016 through March of 2017, I was able to collect more grounded ethnographic data on the daily lives of mountain workers, and of the off-season lives of people who typically work for scientists during the summer. Throughout this time, I learned about how the Huascaran National Park is used as a porous space for pastoralists, I watched dynamics change as high alpine workers were home with greater regularity and sharing various agricultural and child caring duties, and I learned about the off season jobs many workers have. By living with a generous family whom I was able to pay rent to, I was able to better understand gendered dynamics of family households, learn about education systems for children, participate in household care, and was privileged to listen to stories and conduct interviews with older, mainly Quechua speaking family members through the help of younger translators. During this time, I still climbed, though less frequently, with hired data collectors who help produce scientific knowledge for researchers based in countries like the United States (Chapters 2 and 3 discuss the collection of this data in depth). I also attended community meetings, townhalls, public lectures by the National Institute for Research on Glaciers and Mountain Ecosystems, connected with anti-mining activists and indigenous revitalization leaders at climate change events, and interviewed people broadly with person-centered interview techniques and on more focused topics, such as environmental concerns, work in the mountains (for guides and porters), and economic development.

Phase 3: In March of 2017 the country rapidly transformed. Huaycos, or mudslide floods, began to wipe out entire towns all over the country. Climate change heightened El Nino storms raged for weeks. During this time, my attention shifted from future-oriented institutional adaptation through science to climate change disaster response. Throughout this phase, I volunteered with aid groups and conducted interviews with activists.

Phase 4: As things began to return to normal in mid-April, I returned to climbing again, but expanded the scope of my project to include more institutional actors. The goal during this time was to produce a clearer understanding of climate adaptation bureaucracy and its goals, and how they connect to the grounded science projects with whom I began my research.

Main Actors:

The bulk of my research time was spent with five groups of people: 1) Foreign Scientists: I volunteered with and studied the goals, processes and challenges faced by foreign researchers trying to be helpful through the production of data in the Peruvian Andes; 2) Peruvian Scientists: I additionally interviewed Peruvian scientists who worked on climate change adaptation plans. I attended their (sometimes contested) public lectures and townhalls; 3) High Alpine Service Workers: I followed, participated, and lived with high alpine workers who supported science crews to better understand how climate change adaptation was impacting their lives. By doing so, I was able to better understand issues facing climate impacted communities, where I attended townhalls and community meetings; 4) Activists: I also worked with local activists who were involved with producing their own variants on climate change adaptation that answered problems not even identified by experts. This involved answering questions through organizing, such as

how do people get access to clean water when the rains don't come? 5) Disaster Response Teams: finally, I volunteered with disaster response teams when climate change related floods and mudslides created the largest natural disaster emergency in the region in decades.

Methodological Reflection:

I became interested in this project for a number of personal reasons. First, my family is from a part of the country already hard hit by climate change. They live close to the first official climate refugees in the United States who lost their land from sea intrusion and storms in the Louisiana Gulf. As I was conceptualizing a research project, members of my family were rescuing flooded neighbors in boats as part of the unofficial Cajun navy and it became clear that understanding the management of climate change would be a cultural, political, and economic process, and it will look markedly different across the world. In addition to understanding climate change as an environmental justice issue that will disproportionately affect working class people, communities of color, and indigenous groups, I additionally became interested in how cultural ideologies about the environment would shape these responses. This project reflects my desire to understand how responses, especially institutional ones, might also contain culture, environmental ideologies, and political economic constraints – producing effects on the same people who are already facing the harshest of climate impacts.

I was especially interested in how Peru was adapting for a number of reasons: 1) Peru's climate change adaptation strategy is one of the most Scientifically driven responses that I have been able to find in the world and I was interested in how that might look radically different than the response in the United States. Climate activists in the United States that I know regularly postulate that if the scientists could be given more authority to direct climate action, everything

would be better. I wanted to know what that actually might look like in a place where this was actually playing out; 2) I had spent considerable time in Peru (and Latin America more broadly) during and after college, I had an undergraduate focus from the Department of History on the region, and I was a semi-decent climber with (limited) sponsorships. This truly strange blend of skills, background, and specialized knowledge made me uniquely positioned to conduct a research project like this; and 3) Because of a long personal history of activism, I am committed to understanding how the Global North continues to impact the Global South through the "help" provided by "neutral" development experts.

Outline of the Dissertation

Chapter 2: The dissertation begins ethnographically close, with a visual chapter. It connects studying the ecological effects of climate change to a longer history of political and economic development in the region by analyzing particulate matter pollution and international systems of labor. This chapter sets up the rest of the dissertation by providing context to the work of adaptation. Methodologically, the images showcase the sensorium of this type of work, while highlighting the radical interdependence between scientists and the laborers who work for them.

Chapter 3: This chapter expands on understandings of work from Chapter 2, by exploring how the sensorium of work connects to global hierarchicalized, extractive and exploitive labor systems. This chapter ethnographically expands more on the process of climate knowledge production by examining how ideologies of race and nature, both of which are from a particular cultural framework in the Global North, are foundational to the reproduction of uneven systems of labor.

Chapter 4: This chapter expands in scope to connect how scientific data, and adaptation projects more generally, futureproof culturally selected objects of value – namely the Economy. Here I examine the performative life of data for the Peruvian state, the prioritization of extractive

industries over human life, and the cultural production of boundary fields of relevance that strategically design environmental management techniques to be viewed as antipolitical. Through ethnography, I argue that the highlighted climate projects work more in service to the reproduction of neoliberal economic relations than to the survival of actually climate affected people, demonstrating not a mismanaged failure but a designed technique of capitalist reproduction.

Chapter 5: This final chapter builds ethnographically from critiques in Chapter 4, to highlight how practices and practitioners of capital-S Science are not natural allies to climate affected people, challenging the narratives in the Global North that this process of environmental transformation should be managed by specific types of experts. Here, I analyze instances of sabotage and resistance to Science (a monolithic ideal that I break down in the chapter), and highlight alternative paths forward, led by campesino and Indigenous Quechua resisters.

CHAPTER 2: Visualizing Adaptation

Chapter Summary

What does it look like, or feel like, to produce knowledge that climate change is happening? Popular stories of climate change adaptation research feature state of the art technologies, drone photography, global land and oceanic heat mapping, and various other models built on data that requires very little "being there," as it were. These methods for knowing the world have their own embodied components that would be fascinating to follow. This chapter, however, focuses on the embodied experience of a different type of climate knowledge production: the creation of data through fieldwork. Drawing on visual methods, this chapter follows this work through the lens of a data collector, hired to help produce scientific knowledge for a U.S. based scientist as part of a complex global labor nexus (which will be explored more in Chapter 3). Arguably, all expert knowledge is corporeally enmeshed, but contrary to the epistemic form of a decorporealizing intellectual expert identified by Dominic Boyer (Boyer 2005), this visual essay traces how movements, sensations, and the environment are actually ontologically constitutive of climate change knowledge. By ethnographically exploring sensorial expertise, this chapter reveals and challenges hierarchicalized global (and racialized) labor chains. Further, this chapter highlights how political, economic, and historical relationships of development, extraction, and industry (including industries of science), are identified in the granular, atmospheric particles collected by high alpine workers. The experience of this work extends beyond the interaction of sampling, into landscape histories of uneven international relations.

This photo essay is additionally available on my website for larger images.

Courtneycecale.com/chapter Password: dissertation

Sensorium

Figure 7

This visual chapter explores the embodied knowledge[20] that makes scientific data production in the Andes possible. This series of photographs highlight how embodied knowledge that is highly skilled, technical, and sensorial are an essential part of the practice of science. Glacial literacy is more than Theoretical knowledge, it is textural, sonic, and sensational. Pictured here is Wilmer Sanchez Rodriguez, setting out on a research expedition to collect snow and ice samples on three different parts of the Yanapaccha glacier. We are tied to one another by the rope that extends out of frame at the bottom of the image. This picture, like all of the pictures in this essay, were all collected and produced by me (except the one of me on the next page, taken by Wilmer with my camera). The pictures were taken from 2015-2017 on research expeditions with Wilmer, and additional high alpine workers, to help me communicate the horizons that surround climate change adaptation.

[20] See also Goodwin on multimodality (Goodwin 2010)

Figure 8

These pictures were taken as part of my long term fieldwork project in the Peruvian Andes, more specifically in the Cordillera Blanca region. While I cringe at the idea of sharing a picture of myself, I do it just to show how the pictures were taken: alongside the work. As a cis white woman from a working class family in the United States, my positionality in this project is one of privilege and I made my absolute greatest efforts to never do anything to harm or endanger any of the people I worked with. I only ever followed already planned expeditions, and carried all of my own equipment (except on two instances where I let burros carry a bag for a couple of hours). To do this work, I trained for two years, doing my best not to ever cause an expedition to drag slower because of my altitude adjustment or lack of fitness. As a woman, I was told repeatedly how shocking it was that I did anything in the mountains, I was expected to slow teams or be a burden in some sense or another. I was committed to going a different direction with my research if I was ever too slow for the team, or if I ever affected the work, safety, or ability to go home for

any of the people I worked with. This meant that I was frequently challenged to do work I would have thought physically impossible. It was a learning expedition in so many ways.

Figure 9

The embodied knowledge of glacial literacy that I follow in this chapter centers Wilmer Sanchez Rodriguez as he works collecting data as part of a science project he has been a part of since 2014. It is through sharing his work that I learned the most about how embodied expertise

contributes to knowledge production. I also worked with and interviewed dozens of other mountain workers throughout this project, that additionally contributed to this understanding. This chapter provides an ethnographic glimpse into the world of high alpine service work. Wilmer is a science assistant working for a professional climate change researcher in the United States, who is trying to understand the impacts of black carbon on glacier melt. The goal of their work together is to produce knowledge that helps to predict the future: how much time is left until the glaciers are gone? Because the scientist that Wilmer works for lives in the United States it is impossible for him to take samples with the same frequency as Wilmer, or to climb with him. Because of this, Wilmer works alone, collecting data, and building a longitudinal framework for understanding pollution and melt.

Figure 10

Wilmer is in his 30s and was born and raised by his parents who were furniture makers just outside of Huaraz, the biggest city below the Cordillera Blanca. A number of years ago, he rode motorcycles and collected tattoos, until he moved back home again and started college. Now he

rock climbs, mountain bikes, mountaineers, and still likes rock music. He has a dry wit, never forgets your birthday, and is he more easygoing than anyone else I have ever met.

Wilmer started working in the mountains when he was an undergraduate. A scientist from the United States who leads a student and citizen science research project in the Andes every year invited him for a climb and they have been great friends and collaborators ever since. The scientists taught Wilmer how to climb, collect data, and even invented new forms of machinery that measure black carbon pollution so that Wilmer could continue to do research after he left. He frequently sends Wilmer supplies through the mail, or in the suitcases of friends expected to visit the region as climbing tourists. He also used to pay Wilmer out of pocket, he paid for much of his research out of pocket – it's why he had to invent his own equipment (which would otherwise cost tens of thousands of dollars). Now, having partnered with the National Center for Research on Glaciers and Mountain Ecosystems (INAIGEM), Wilmer works for them producing data for the same study. They pay him little, and often late for his expeditions, but Wilmer is hopeful it will connect him to a long career in scientific research.

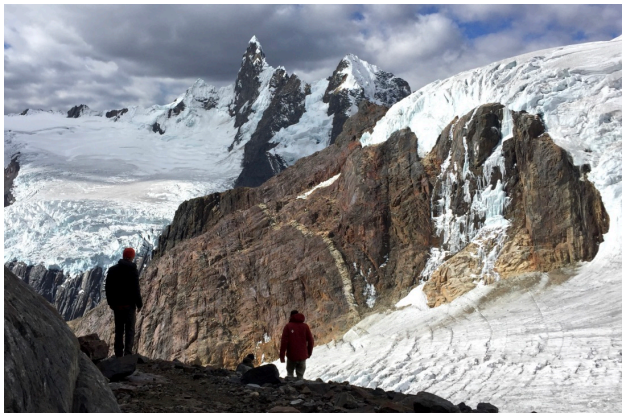

Figure 11

Wilmer was never officially trained for this work. But he learned how to be safe through repeated visits to the mountains, through practice grew expertise. The image above was taken on expedition with the scientist who hired Wilmer, an expert climber in his own right.

Figure 12

Wilmer produces data through fieldwork on two glaciers: Yanapaccha and Shallap. His studies measure the presence and effects of black carbon on these glaciers, which increases their rate of melt. Black carbon exploded as an atmospheric presence in the 1990s, when the nearby mines and subsequent development projects brought an influx in fossil fuel burning. New roads, card, trucks, and industrial equipment all burn(ed) dirty. By collecting comparative samples on two different glaciers, one near industrial life, another near more rural areas, Wilmer's work also tells a story of the relationship between climate and economic development, which historically includes fossil-fuel intensive mining. Pictured in figure 12 is the foot Yanapaccha glacier, which ascends from the bottom of the image, up, and to the right, taken on my first expedition with Wilmer.

Figure 13

Figure 14

Glacier melt is a matter of survival for hundreds of thousands of people dependent on the easy flowing downhill streams, that grow more intense every year. Glacial lakes grow unstable, bursting with meltwater. Large, threatening lakes, such as Lake Palqaqocha, sit so full above Huaraz that industrial drainage systems (figures 13 and 14) have been installed to try to mitigate the pressure on the engineering fortified damn. All of the climate workers I met in Peru were driven largely by fear of this instability, everyone wanted to help prevent an outburst flood by producing as much data as possible to model scenarios and prevent disasters. Data can be used to tell if there is more melt than usual, if dams are weakened, and if the drains are working properly.

Figure 15

Figure 16

Figure 17 Alpamayo

On expeditions with Wilmer to collect data, we would hike sometimes washed out, imperceptible paths back, deeper into the valley towards the glacier. We might start before sunup, but we don't arrive until afternoon. When Wilmer was in a hurry, we ran the route: dropped off by the early bus at 9, sprinted uphill the normally 3+ hour long hike, climbed onto the glacier, then ran back down to catch the last cars of the evening and/or hitchhike down. It's easier without carrying the sleeping bags, tents, and food for two days, and it allowed him to have more time to do things like go on mountain biking trips with his friends, or take his school exams.

On one occasion, early into our friendship, we were hiking the route when an avalanche fell not far behind us. He joked that the *apus* (mountain gods, that in this part of the Andes were interwoven with glaciers) were just jealous of any women who enter their space. Yanapaccha, a *tirakuna,* or earth being, was a female spirit who hated when anyone approached the mountain without appreciating her beauty. She would drop avalanches on them or shake below foot. He told me to look up more often, appreciate her, and make sure she knows and could feel it. Wilmer's

sense of humor was dry and I could never tell if he was fully serious. When we first met, I asked him about *apus*, and he told me it was something his grandmother believed in, but he wasn't sure what he believed personally. He assured me that he never felt like my presence endangered him, and after a while, he stopped hiking with 20' of distance between us. It's possible I just got faster.

Figure 18

Figure 19

I personally preferred the fast and light days of running for samples to the multiple nights spent camping. It is cold next to glaciers. But the cold seeps into the rocks and earth, catching wind through natural tunnels channeling it to be stronger. In California, when the sun sets, the earth still radiates heat from below foot for hours. In the Andes, it feels like it's gone in minutes. By 4pm, when the sun sets behind nearby tall peaks, the temperatures drop dramatically. The only thing there is to do is hide in the tent, in sleeping bags, and hope to fall asleep early. Sometimes, if we couldn't sleep, we'd play card games, eat snacks, or watch movies on my iPad. Wilmer tried not

to camp by himself, and would run the entire thing if he could help it. Being alone near avalanches, falling rocks, on unstable trails, below bursting lakes, is dangerous. Climbing alone is dangerous. But he prefers it this way if he can't get a friend to go along with him.

These photos show the campsite at Yanapaccha. Camp is at over 15,000', and just below the moraine (loose glacial debris zones) to the side of the glacier. We often shared a tent out of practicality: while it seems like a highly personal space, this practice was fairly common in my experience alpine climbing. People who climb meet easily in town and share a sleeping space for a week at a time. Gear is heavy, it's exhausting to carry for hours. Sharing a tent is also a fast way to make friends, which is how we initially bonded.

To get to the ice (looking at the picture on the right), you would leave the tents, and climb over the rocks on the left side of the image, climb back down on the other side of the moraine rock pile, and up a near vertical wall tens of meters high. It is still around 20 minutes to the glacier, but this is the most protected spot to camp, and near a water source, which helps with the processing of data and cooking of food. When the weather is bad, spending as little time outside the tent is ideal.

Figure 20

Figure 21

Just a note that many of these photos have been color corrected to show more light. To collect samples on ice, it is safest to climb in the early morning before the sun has risen and starts to heat and destabilize parts of the glacier. On some expeditions, this meant 2am start times, climbing by headlamp. It's also far colder at this time, so when the sun rises, it's common to shed layers to avoid sweating (which later refreezes and is dangerous – it's better not to get warm layers

wet). This wasn't typically how Wilmer worked though. He was not required to summit the peak, and owing to his speed and skill, he could collect all of the samples he needed within an hour or two, in the early morning. We also played and trained later in the day on the harder, sturdier parts of the glacier, making trips fun, experimenting with new techniques, using it as a time to learn.

Figure 22

Figure 23

To get onto the Yanapaccha glacier requires an embodied glacial expertise. It is a technical climb of about 60' up a layered ice wall. The top two images show different ways of approaching: 1. On the left, Wilmer set up ropes, built and anchor, and ran our climbing rope through it so if there is even a single misstep, it won't be fatal. To do this, a climber must understand rope gear systems, as well as ice. Building an anchor into soft or imperceivably hollow ice could mean death to a climber. Translating climbing knowledge into scientific terms, building anchors requires a knowledge of physics (ice screw and post angles), engineering (pulley systems), and glaciology.

It also means that the person who climbs first is less protected than the second climber – someone has to build the anchor point from the ground up. This could be dealt with by hand drilling large screws into the ice to act as rope catch points on the way up. 2. On the right, Wilmer soloed without any protection up the ice, which is how he did it when he went by himself. To do this, he must know with his life where it is safe to kick his crampons, and how to position his body weight over his limbs to not lose his balance. While I was conducting fieldwork, I climbed with Wilmer as often as I could (barring sickness or storms), but when I was unavailable, he would try convince a friend to climb with him, or he would solo.

Figure 24

Figure 25

Figure 26

The textures of this work are rhythmic and tedious. Once passing up the vertical ice wall to get onto the glacier, most of the climb is on its flat or ramped foot, that on a healthy day is covered in fresh snow, like in the image above. Moving across its surface mostly feels like a messy, snowy hike on a steep incline at high altitude, though parts of the terrain could be more technical. There were vertical ice walls to climb, crevasses to cross, ice bridges to test, and landscapes to read for hazards. You can see below that under fresh snow, hazards can be occluded. A novice might not know what they are stepping on. But all of the high alpine mountain workers I met claimed to know how to read the terrain.

Figure 27

Figure 28

Figure 29

Figure 30

In these images you can see more clearly how crevasses are covered, and how sometimes glacier melt from below might weaken the surface tension of the ice. On glaciers, climbers can typically hear the wind and weather. They can feel the surface tension below foot when crampons are kicked into the ice for stability, and know whether to put their weight on their front foot or not. Because of the varying temperatures from high altitude strong sun to below freezing nights, the mountains are almost never quiet. They creak, grown, break, snap, fall, rumble, slide, trickle, shake, and howl. Experts like Wilmer learn how to identify the sound, starting first with where it's coming from, followed immediately by how to respond. Distant avalanches are rarely worrisome (sometimes they are even cheered for), but the wrong soft creak below foot could mean someone will fall. It could mean someone will die

Sounds, tension, and shadows tell experts where to walk, how to walk there, and what will collapse in the presence of others. Experts learn to read and communicate with these nonhuman others, and respectfully listen to their commands.

Figure 31

Figure 32

Moving in crampons is not intuitive. The pictures above show Wilmer trying to teach a newly hired INAIGEM fieldworker how to climb (Wilmer and Harri were crying with laughter). So climbers don't slip on the ice, they wear crampons attached to their boots that break into the ice and hold their feet in place. To walk on a flat surface, climbers pick their feet up and place them down horizontally flat (instead of in a rounded, heel-toe manner), sometimes stomping down to make sure there is traction. To climb up more vertical sections, they use the spike on the front of their crampons to kick into the ice wall enough to balance their weight, and they use ice axes in their hands to keep their upper body balanced towards the wall and over their feet. A popular misconception is to think that people are pulling themselves up by their arms, but climbers mostly use their legs to kick, balance, and push themselves up the ice, and their arms just to balance their body's center of gravity over their feet. The picture below is of a pair of pants I was trying to salvage. Even after years of climbing, I still would still sometimes snag my crampons with my legs, or take the wrong kind of fall and pay for it with shredded pants, but gear like waterproof pants are too expensive to replace. The climbers I worked with, like Wilmer, were highly skilled, coordinated, and had very few holes in their clothes. They're also skilled at moving as a team, perceiving rope tensions, slowing down and speeding up with their partners, all while building new routes of switchbacks up the glacier.

Figure 33

Figure 34

The air feels different at altitude. It is lighter, less dense, and colder. It feels fresh. But there is never enough oxygen. It causes headaches, nausea, loss of appetite, and it acts as a diuretic. It can also be fatal. But for people who are exposed more frequently, these symptoms tend to be less severe. The cultivation of the body to expertly dwell in spaces that could kill other people just existing is undervalued. Like being underwater (see also Humphrey 2015), skilled divers sense and move through currents and can tell depth from temperature by repeated exposure to the embodied transformations of underwater seascapes. At altitude, acclimated bodies react seamlessly to the change in atmospheric pressure at that altitude, while others struggle with limbs that feel weighted, lungs that cannot catch their breath, pounding headaches, and upset stomachs with nowhere to go.

Figure 35

Experts also know how to use avalanches. In camps at night, waiting for hot water to sleep, I heard dozens of different but similar stories about how historically this region was too challenging to colonize. It was too high, too steep, to cold. I was also told indigenous resisters buried entire Spanish fleets under avalanche traps. Snow and ice were tools of resistance, intimate relations through life giving water, and reflective of the wellbeing of *apus*. As Julie Cruikshank has written at length, Athapaskan and Tlingit people additionally personified glaciers, giving them agency along with movement, contrary to the environmental epistemologies of the colonizers themselves (Cruikshank 2005). Additionally, her work explores historical meetings of environmental knowledges in colonial encounters. The encounter I highlight here is also one embedded in this past. People know and tell stories of these encounters, giving greater context and meaning to the losses from melt.

Figure 36

Figure 37

Climbing with a partner is usually safer, but demands a different set of skills than climbing alone. With a partner, there are sensorial ways of matching rhythms. If the rope is too taught, it means one person might be pulling the other uphill. If there is too much slack, it catches on ice blocks, drags, and weakens the integrity of the rope. The rope is used to catch the person at the other end if they were to fall into a crevasse, or if something were to break below foot. It is also sometimes used to pull dead bodies out of crevasses, and has resulted in the dragging of entire climbing teams off mountains. This happened at least annually, if not more, every year since I started collected data in the Andes. Finding matching rhythms means matching speed, paying attention to the other person who may be inaudible because of weather or distance, and adjusting climbing speed in response to the tension of the rope pulling on the harness. Rhythms included steps, breathing, turning up switchbacks, taking turns climbing, and breaks (see also Cecale 2020

on ultrarunning and attentional states). Sometimes we kept rhythm through music played loudly through cell phone speakers. These textures contextualize high alpine work, they are skilled, and they make science possible.

Figure 38

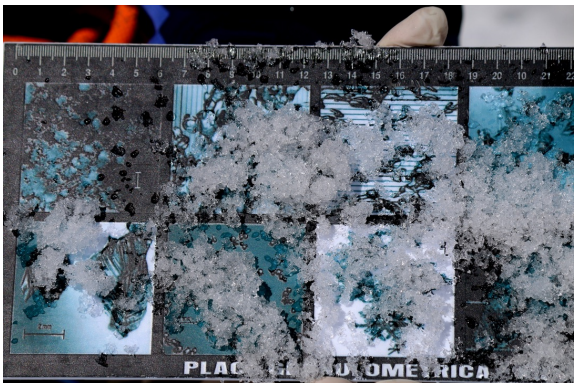

Figure 39

Wilmer's job expanded from collecting samples in 2014, to collecting more extensive data on the health of the snow and ice he was encountering. In the first three pictures on this page, he is measuring the snow and ice density and determining the types of snow and ice crystals that sat atop the glaciers surface. And in the last two pictures, he collected snow in plastic bags that he would later melt in camp to calculate the particle presence of black carbon pollution. Even glaciers that look pristine can be full of contaminants. The sample at the bottom is from Yanapaccha, the same glacier he is on in the rest of the images (though at a different time of year).

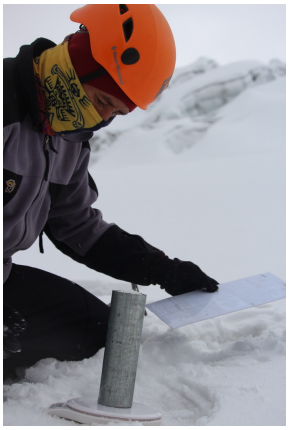

Figure 40

Figure 41

Figure 42

Figure 43

Figure 44

Figure 45 (below)

Black carbon, also sometimes known as soot, is produced through the combustion of fuels that contain carbon (such as fossil fuels and biomass). It can travel widely in the atmosphere, contributing to overall planetary warming, but it does direct damage to glaciers if produced nearby. The particulate matter lands on nearby glaciers from a variety of sources: from industrial fires to cooking with wood, and tends to exist more prevalently near urban centers. I have interviewed scientists who have lamented not being able to stop the region from producing fires (see also Wolf 1997): from not investing in cleaner cars (since automobiles were an absolute inevitability), to not being able to convince rural people in the countryside to not buy cheap eucalyptus and instead to switch to petrol burning stoves. But people were not always burning eucalyptus: “Eucalyptus was

widely promoted first as a source of mine supports when imported supplies were threatened during WWII, through USAID-funded forestry programs in early and subsequently under the agrarian reforms of President Velasco's center-left military regime of the late 1960s and early 1970s. During this time, the state took a strong interest in the affairs of campesinos, redistributing hacienda property to landless peasants in one of the most ambitious land reform programs ever attempted (Bourque & Palmer 1975). Hand-in-hand with land redistribution went a strong program promoting the cultivation of eucalyptus throughout the Sierra." (Lazar 2007). It grew quickly, prevented land recession, and would build a natural lumber market for the country. The effects of replacing dying, endemic species with a poisonous, invasive tree species continues to have lingering effects. Below you can see the melt pattern of black carbon, creating cryoconite in the surface of the ice -- and the surface coverage. And above, you can see closer textures and colors of black carbon as it mixes with snow and ice.

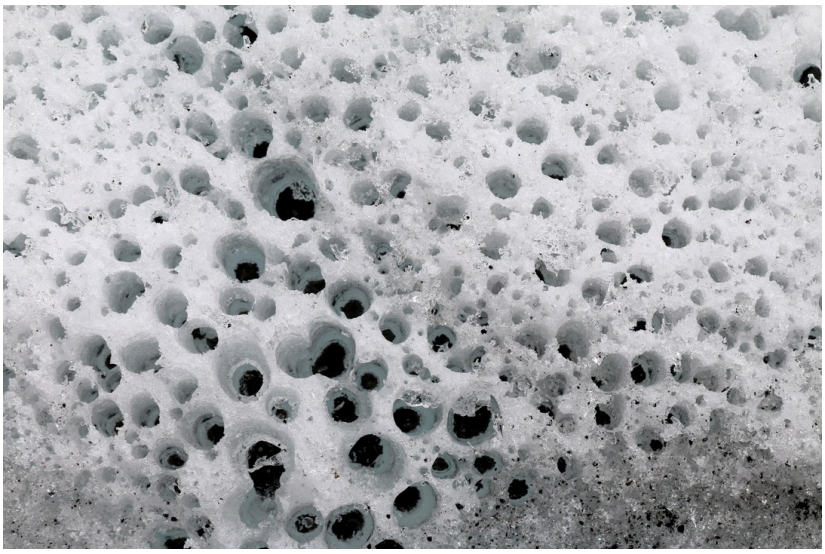

Figure 46

Figure 47

Figure 48

Figure 49

After collecting samples, we make the tent a lab. The snow is forcefully melted and put through a multitude of tests. Wilmer measures the pH of the melt, to see if it has grown in acidity since his last expedition. Then he passes the water through filters in syringe to produce tiny trays of black carbon samples. When he gets home, he will use the equipment that his scientist collaborator built for him to measure how light moves through these specific filters. The less light movement, the more pollution. The more pollution, the more heat trapped on the ice. The more heat, the faster the glacier will melt. His work produces a chronopolitical narrative (will explore more in Chapter 3, see also Bahktin 1981), that translates into a narrative that guides climate policy experts on how best to manage the anticipated future world. More specifically, it narrates, how much time is left, where, and for whom. It provides a temporal framework to strategize the fortification of and (re)building of objects of value that people hope will survive these environmental changes. My data of Wilmer's data reflects a friendship built on mutual care, concern for the same still yet to be fortified ways of life, and the privileging of people in this equation.

Figure 50

Figure 51

Figure 52 (above)

Figure 53 (below)

The rest of time in camp is spent leisurely playing games of stacking rocks or watching a movie with subtitles on my ipad, but it's cold and it's hard to eat. Even over the single burner stove, food feels dry and tough from the cold weather in my mouth. Wilmer's mom often cooked for us if I bought the ingredients. We drank a lot of hot water, and heated extra to put in a water bottle that we threw into the foot of our sleeping bags.

Figure 54

Figure 55

Surrounding glaciers and mountains were always present in the surrounding horizon, temporally and geospatially expansive. While we waited for a car to drive by for over an hour on one of our last expeditions together, Wilmer told me, “I can already see it. There will be nothing left here in 50 years.” He explained that there would be a world that his children, were he to have them, would never see, that this system would be over by then. The system he referred to was a way of life, entangled with a particular configuration of space; one that included water in many forms, slow reliable melt that feeds life and runs clean, industries around glacier tourism, science studies of ice, agricultural production for hundreds of thousands of families, clean water sources for hydration on walks, soundscapes of apus. The expanse is future oriented (Ingersoll 2016), a horizon of foreclosing possibility, made sense through a historical, cultural and ecological lens. There are so many possible futures to worry about.

On the way down, off some of the more popular mountains, plaques are placed to mark the peaks where people have died. Climbing is inherently dangerous. Many people, some I met working for scientists, died in this profession. Some of the plaques below read just by name and year, but others, like the one on the right, offer more poetic accountings. The grave marker reads, "[unintelligible] Michael Craig who died descending Artesonraju having discovered for himself some of its meaning." This chapter critically highlights some of that meaning: it reveals the skillfulness of sensorium, highlights the contributions of undervalued forms of expertise, and reveals the uneven stakes of this work for already climate affected people.

Figure 56

Figure 57

CHAPTER 3: The Work of Expertise, Laboring for the Future

Chapter Summary

This chapter expands on Chapter 2, by ethnographically connecting the sensorial expertise of high alpine service workers to broader, global relationships of power and exploitation with the Global North. Here, I analyze how one facet of adaptation, the production of predictive climate knowledge through fieldwork, is produced through – and reproduces – (a deep history of) uneven global relations. More specifically, this chapter argues that while well-intentioned scientists from the Global North aim to help imagined climate-impacted people of the future by producing predictive (and hopefully preventative) knowledge, the labor relations that make prediction possible presently affect and harm people today. To understand the aforementioned labor formations, in this chapter I analyze a taxonomy of work: first to highlight the various contributions of different expert skills that are rendered invisible through scientists and institutional Science narratives, and second to critically examine the disproportionate risks and hazards that face workers in the Global South in this industry. The point of this chapter is not to suggest that scientists themselves are individually cruel, thoughtless or ill-intentioned, but rather I aim to highlight that their work is reliant on long, historical relationships of inequality (from colonialism to economic development). The type of fieldwork that I analyze in this chapter exists in the formation that it does because of the enduring inertia of institutions, and the cultural rendering of science, no matter how it is produced, as an antipolitical act. This chapter speaks to all "field" (Gupta and Ferguson 1997) working researchers, including anthropologists, who rely on the work, expertise, and knowledge of people in already precarious positions to help produce knowledge about the world. While thoughtful scholars have written at length about the harmful effects of field

research practices, this chapter expands the conversation to domains of climate change adaptation, and highlights how cultural values of nature and race shape this process.

As this chapter unfolds, I begin with a brief ethnographic vignette that helps to contextualize some of the labor that supports climate change adaptation. I move into an analytic discussion of how knowing the future is a present act of labor. I briefly touch on a history of high alpine service labor, culminating in a contemporary ethnographic typology of labor forms. And I do all of this to show how expeditions, like those of the past, are racially and economically divided. These endangerments are made invisible owing to cultural ideas of nature and race. This is part of a long history of naturalized endangerment and exploited work that emerged as a global labor system under colonialism, but is coated today in logics of The Economy and a liberal belief in the free exchange of labor.

Yanapaccha, Quechua for Black Waterfall (17,913')

It is quiet at 17,000'. Surrounding heavy clouds dampen sound from even 10 meters ahead. Climbing on my team, I hear only my own exasperated breathing, the rhythm of my crampons breaking fresh tracks on ice. I feel the thin, fresh, and cold wind burn my eyes and thunder across my waterproof clothing, and the damp air coats my skin, hair and clothes. My face feels cold to the touch but my heavily bundled body is rapidly overheating under the warm layers; they felt essential just an hour earlier when I emerged from the warmth of my sleeping bag. Inconsistent currents of clouds temporary veil the sublime Andean peaks I know loom above my head, and I see nothing but an atmospheric sea of wet grey.

Figure 58 still from a GoPro camera video while climbing, 2017

If it was a clearer day, I could see miles across the valley, to multiple glaciated peaks: Chopiqalqi, Huascaran, and the Huandoys. More people have died on Huascaran than any other peak in the region. It is the tallest, it's highly technical, and the terrain is constantly shifting – made worse now because of climate change. To a passionate climber, this rare sight harkens some of the most famous mountaineering accomplishments in the sport. But the people I work with climb these mountains dozens of times per year. It's a site of work, friendship, potential economic mobility, deadly hazards, and a place to predict climate futures.

Following my sightline down, I'd watch glaciers melt into streams imperceptibly filling turquoise lakes, thousands of feet below where we were. I could trace the over-spilling lake downward into pastures where hundreds of cows graze, pasture workers might be changing shifts or sharing snacks, and what's left of the adventure tourism industry hosts altitude-wrecked visitors as they take pictures in front of teal lakes. On a clearer day, I'd hear the sounds of avalanches and rockfall echo for kilometers, as other parties on the mountain anxiously laugh, cheer, and

sometimes frantically reread their mountain lines. I would also hear Wilmer scraping the surface of a glacier with his climbing axe to collect ice samples just meters away, probably also listening to the Red Hot Chili Peppers from the small distorted speaker on his cell phone, tucked away in his chest pocket. I would hear the textures of science, the production of knowledge, an attempt to forecast and control climate futures, and a friend making a living.

Foreign researchers have been conducting fieldwork in the Peruvian Andes for over a century, coupling adventure tourism with the declaratively neutral goals of understanding glaciers and studying ecosystems (and writing anthropologist dissertations[21]!). With the emergence of climate change and the increasing likelihood of natural disasters, more researchers than ever are working in the region to help predict and offset the worst effects (and to study the cultural politics of these processes). To conduct research fieldwork, scientists (who are mostly STEM trained) work with a local support crew, people who better know the terrain and what paths to take, who are better adapted to the altitude, who are stronger and can carry more things on their backs or with their animals, who have access to camp tents and chairs that are difficult to travel with, and who are willing to work for cheap on the constricted budget of a research grant. Building on Chapter 2, this chapter traces multiple different forms of labor that support the generation of predictive climate knowledge, and analyzes the risks laborers face in the process of preparing for dangerous futures. These risks disproportionately fall to people of color, in already marginalized positions in the Global South (namely, campesinos and Quechua indigenous people[22]) who make up the bulk

[21] Not neutral

[22] As we have long known, race is a powerful cultural, political and economic construct that has shaped inequalities for centuries. In Latin America, and especially in the Andes, this takes particular formations, where Indigenous people are treated as a categorically racially distinct group of people. In the mid 20th century, there was a movement to eradicate the use of even the term *indigenismo,* where calling someone Indigenous became synonymous with a racial slur for someone who was uneducated, rural, and backwards. As a result the term campesino became more predominately used. This took other formations in different countries in Latin America, where being Indigenous became a source of tremendous political power in places like Bolivia and Ecuador. In steep contrast, in Peru, the

of workers in the industry of high alpine service work. These workers are exposed to grueling physical challenges and frequent extreme hazards that risk their lives in service to the production of knowledge. By following this work, this chapter reveals how global labor systems are reproduced by climate scientists, whose rely on existing historically produced grooves of global inequality to produce more affordable data, troublesome especially for folks affected by the tightening of the neoliberal strap around academic institutions. In other words, scientists are plugging into already existing uneven labor schemas in service to the imagined future, reproducing inequality in the process (and also ensuring an unequal labor future, at least in the near-term).

To demonstrate these interconnections, I ethnographically trace the experiences of laborers who assist on scientific expeditions with mainly foreign scientists (who are mostly white from the Global North). The data collected from these expeditions later informs environmental risk management policies that protect national and natural resources (such as the recently enclosed Huascaran National Park and hydroelectric waterways). The paradox here is that the labor performed to protect targeted futures risks the health and lives of already climate endangered people, exposing them to Altitude Sickness (headaches, vomiting, dizziness, fatigue, shortness of breath and disorientation), Acute Mountain Sickness, High Altitude Pulmonary/Cerebral Edema, and environmental threats (avalanches, glacier collapse) – all of which could be fatal. This chapter analyzes these relationships by ethnographically expanding upon the roles and risks that of each of the team members face, and situating it in an international history of high alpine service work.

term campesino came to stand for anyone who lived in the countryside, even if they spoke Indigenous languages and practiced cultural customs of Indigenous peoples. From the capital, Lima, this term represents mestizaje, or the blending of white settlers with Indigenous communities, but in practice, at least in the communities with which I was involved in the Andes, people speak Quechua, they often dress in a more traditional style, eat foods that are more traditionally inspired, and organize social life in a way that reflects the primary Quechua ontological values.

To better understand the cultural politics of the production of this knowledge, I mountaineered with research expedition teams on high-alpine glaciers, documenting scientific processes, as well as the relationships between foreign researchers and the local laborers who make this knowledge possible. As scientists were studying ecosystems on expeditions, I was studying how social formations of labor make this specific strategy of climate change adaptation possible, and the work involved with making emerging processes of adaptation possible. While it is undoubtedly important to develop climate mitigation and adaptation strategies, expeditions are dangerous, and threaten to harm, injure and even kill. This scope of this chapter is not a critique on why these datasets are incomplete, or wrong for the task of building resilient climate futures, but rather, in trying to know the future, local campesinos (who are largely of indigenous Quechua backgrounds) are being negatively impacted in the present by working for mostly white foreign scientists from the Global North.

Anticipatory Work

Technologies of anticipation are all the tools, information systems, methods, and techniques that are used to generally produce forecasting information about the future.[23] Technologies of anticipation are used to make informed decisions: in economic modeling, day-to-day weather preparations, logistics and transportation, environmental risk and hazard management, future resource availability, medical decision making, and in climate change mitigation and adaptation strategies. Technologies are built of and within complex sign systems, systems of power, ways of knowing and being in the world, and technologies of the self (Foucault

[23] Some of these frameworks emerge from a conference panel on which I presented organized by Sara De Wit and Sophie Haines titled *Untaming Futures? Plural Knowledges, Unknown Environments and Technologies of Anticipation*

1988, Butler 2011, Broadwin 2017). In many ways, foreknowledge makes the future appear more controllable. Predictive foreknowledge can reduce uncertainty about what might be to come. It can be the basis of plans and orientations toward the anticipated future (for instance, if it is raining tomorrow, I might pack an umbrella). Foreknowledge additionally makes possible and/or precludes the likelihood of dangerous futures (for instance, disasters can be averted, or people can strategize to win an election). Forecasts can produce self-fulfilling prophecies (Ringel 2016, Nielsen 2014), for instance predictions of limited toilet paper under COVID-19 led to panic buying of toilet paper and the subsequent production of scarcity in a time a crisis. People can use forecasting knowledge to *time-trick* or "modify, mangle, bend, distort, speed up or slow down the structure of the times they're living in" (Morosanu and Ringel 2016). And powerful forecasting knowledge, available in scarcity to select few (such as those with technologies, or people connected to those in power), may (re)produce social, political and economic inequalities through all of the aforementioned strategies. As we see in this dissertation, the production of forecasting knowledge is also a product of labor. From the mining for minerals that make scientific equipment possible, to the actual hired laborers who collect data for scientists: knowledge production about the future, when viewed ethnographically, is additionally an historical, economic, and political relation.

With climate change quickly rising as one of the greatest existential threats of our time, forecasting knowledge will impact who is the most prepared and what systems will be fortified to durably survive the expected future[24]. By being able to predict certain environmental futures, those with privileged access to data and institutional resources for support are able to utilize the strategy of thinking backwards in design from the anticipated future, what Hirokazu Miyazaki calls

[24] Chapter 5

reimagining "the present from the perspective of the end" (Miyazaki 2006, 157). Data about the future not only produces systems of power through strategic forecasting (i.e. which systems, resources, and places are prioritized), but data about the future is additionally produced by and within them (Foucault 1978, Ferguson 1994, Scott 1998, Mitchell 2002, Li 2007, Escobar 2011) – as this chapter will show, through global multinational labor systems. In this chapter, I grapple with the political framings of skilled versus unskilled labor, the disproportionate risks and dangers of low wage work, and the production of *dead* labor (Tyner 2019).

Further, ideological frameworks that surround the production of *data,* such as scientific neutrality and the universality of scientific universal truths, often render invisible prognostic politics to even people who believe they are helping (De Wit and Haines 2019). This chapter grows from literatures on development, future studies, and the STS politics of expertise, to ethnographically highlight how forecasting Peru's impending climate future is done through risky labor, rendered invisible by values and ideologies of scientific neutrality, rugged individualism, and cultural values of nature. I do this by grounding data locally (Loukissas 2019) in labor – where, how, and by whom was anticipatory knowledge made? This chapter highlights how technical studies of the climate, couched in rationalist liberal ideologies, and purportedly intended to help, can be harmful – even resulting in death.

Fieldwork Basics

There are numerous ways that the future is forecast through data production in the Peruvian Andes.[25] As scientific researchers are thinking about their career futures, they produce studies

[25] I want to stress that researchers are not the only people who are thinking about the future, making predictions, or trying to understand changing environmental effects. People throughout the region are trying to understand how and why their lives are changing (looking up at a disappearing glacier, planning water storage solutions, comparing personal and communal environmental experiences over time to predict future happenings, etc.).

predicting environmental futures from anywhere in the world (assuming they have the right technological connections). They can tap into satellites in order to map large scale changing environmental conditions, such as glacier retreat over time. They use existing censors placed across the world to produce records of global heat indices rising on land and in oceans. And they can build models from existing histories of data to produce new and updated future predictions. However, for the more fine-grained understandings of how ecosystems are adapting or collapsing from global climate change, knowledge must be produced that is a little closer in nature. The type of forecasting knowledge that I focus on in this chapter, is produced through fieldwork, by the being-there with place, space, and people.

Although fieldwork had been a practice for naturalists for decades, in the mid to later part of the 19th century, fieldwork transformed the sciences. Disciplines changed from more "armchair" approaches to more fieldwork oriented approaches when the reliability of produced data became entangled with the virtue of the researcher, cultivated by character-molding expeditions that test the endurance of researchers (Kuklick 2011). Academic fields that expanded the fieldwork practice were largely naturalism, glaciology, and anthropology, whose work was made possible by the global geopolitics of the time, including colonialism. Historian and Sociologist of Science, Henrika Kuklick writes, "European visitors anticipated little difficulty in satisfying their needs for local assistants of various types, ranging from local informants and translators to servants, since they could rely on the authority of the colonial regime—threatened or actual—to secure the personnel they required....Pacified colonies became important workplaces for all sorts of naturalists" (ibid, 3). The author continues, "Scientists were, in fact, just one among the many social types who enjoyed more opportunities for self-promotion and self-aggrandizement in colonies than were available at home" (ibid, 5). Many of these studies were part of a liberal

project of mapping and transforming the natural world into national resources. These international relationships continue into the present day, revealing that scientific fieldworkers, producing knowledge about the future, are plugging into these same uneven and historical relationships (see also colonial encounters in Cruikshank 2005).

This chapter ultimately argues that scientific field researchers – even well intentioned ones, who want to prevent climate crises – are so preoccupied with potential future disasters, and mapping a *future history* (Ballestero 2019) of climate change, that they are presently endangering the lives of already climate impacted people in the present. The people being doubly endangered here are the mainly poor, campesino and indigenous Quecha workers who make their expeditions possible. These endangerments are made invisible owing to cultural ideas of nature and race. This is part of a long history of naturalized endangerment and exploited work that emerged as a global labor system under colonialism, but is coated today in logics of The Economy and a liberal belief in the free exchange of labor. In the next section, I highlight typologies of labor to show the different types of work that support scientists, I also analyze the disproportionate risks they face for little pay, and the chapter concludes with a discussion that connects these issues to history and cultural ideologies from the Global North.

Figure 59

Fieldworkers

Scientific Researchers

Nearly all of the scientific fieldworkers that I met were in the country on tourist visas during the summer coming from the Global North. While I am certain that scholars in the Global South also scientifically study the Andes, none of the people I interviewed worked with scientists from anywhere but the U.S. and Europe (some folks specifically learning English, French and Portuguese to accommodate frequent visitors). It wasn't because I was not looking for more people to talk to, but in campsites and town, and in talking to the high alpine service workers that I knew, I learned that scientists from the Global South were almost never present (or if they were, their research was self-contained and they somehow evaded detection by folks who frequent the mountains). Additionally, though, I met researchers from INAIGEM, who did one research expedition during the entire time I did fieldwork (which I talk about in Chapter 4, where I discuss state science). They have since done more, but state supported science reflected different goals than the individualistic coupling of adventure mountaineering with the production of knowledge.

Mountaineering fieldwork is a pretty self-selecting industry for foreign researchers, myself included. When I began this project, I was also a moderately strong climber and mountaineer (I even had a semi-professional sponsorship), and I hoped that during my off days I would get to enjoy being in one of my favorite places on earth. That isn't how my project turned out. What I thought would be a break from work, ended up being the primary focus of my research. However that played out (see Introduction), my knowledge of and connections through climbing are largely why I was granted access to so many different communities (of foreigners and locals). I am undoubtedly part of a lineage of people, who extract data in foreign countries in the Global South to build careers in the Global North – which is something I have struggled with, and why it has taken me years to figure out how to write my dissertation. My hope with this project has become not one that speaks for people in the Global South, but speaks to people in the Global North who think they are helping. They are not. I am trying to produce a reflective critical analysis that shows this, that maps the harmful effects as an accountability mechanism.

The job draws people with extensive backgrounds in outdoor industries. Some of the scientists I met were previously professional climbers, Olympic athletes, and had scaled some of the tallest peaks on earth, including Everest. They would pretty neatly fit into the category of a nature-loving adventure tourist, were they not also producing scientific climate data while scaling mountains. They were strong, able-bodied, university-trained, experts of their STEM fields who had deep knowledge of the environment.

Sherry Ortner writes in her work on Sherpa people (and mountain workers) in the Himalayas, "High-altitude mountaineering is one of the most dangerous sports on earth. The most frequent kind of death is sudden and shocking, a slip or a drop off a sheer face, a fall into a crevasse, or – the biggest killer in terms of numbers – burial in an avalanche" (Ortner 1999, 6). Conditions

in the Andes are similar. The dozen or so people who died annually in the mountains were mainly killed by avalanches. One memorable death was a falling ice block that decapitated someone who had been climbing tough peaks for years. Another group of three I remember personally passed me up on a mountain, and later fell into a crevasse because of a collapsed ice bridge. But the body breaks down in other ways on the mountain. Even experienced climbers sometimes succumb to the effects of altitude, whose symptoms range from lightheadedness to stroke. A high alpine service worker I knew died from heart failure on a climb.

Unlike the Himalayas, however, the Peruvian Andes lack a lot of the infrastructure that comes with climbing Everest. Everest base camp is famous now for parties, raves, wifi, full service libraries, TVs that run on solar power, and it can be a luxury experience. There are helicopter services for transportation and emergencies. And, in terms of worker protections, Sherpa people who work in the service industry have become organized and unionized. After a disaster in 2015 that killed over a dozen Sherpa men, they successfully bargained for fairer pay, more reasonable work restrictions, better emergency services, and the cost of funerary arrangements should the worst happen. It is still the deadliest industry in the world (Ogles 2016), but Peru has none of this infrastructure. There are no helicopters. Accidents more likely lead to death than injury.

Based on my experience volunteering with scientific research teams, most expeditions last 5-14 days – all of which took place in the Huascaran National Park. This is time where people are camping, have no access to electricity or showers, and all of their resources must be carried in (and carried out), including food, soap, scientific equipment, notebooks, sleeping bags, tents, chairs, cook stoves, personal items such as warm clothes, entertainment, and medical supplies. Bathing is done by baby wipes or by braving the near freezing temperatures of meltwater rivers. Cell phones and electronic devices must be charged by agonizingly slow solar devices. Bathrooms are tents

with a dug out hole (or behind a large rock). And returning to the regional capital, where most expeditions are homebased, would take 2-4 days of hiking, climbing, crossing dangerous mountain passes, and trekking through dozens of villages to a town large enough to have a combi or minibus terminal. There are no roads that lead to a sample site, everything is done on foot, with a tremendous amount of help – and there are no easy evacuation strategies. Unlike the Himalayas, which are also magnetic to mountaineering scientists, Peru lacks the infrastructure necessary for evacuations, and quick medical response. It can take days to coordinate a response (all done over the regional WhatsApp group of alpine guides), making the job for both scientists and their support team even more dangerous.

Also unlike the Himalayas during the 1990s when Ortner was writing, mountaineering has changed culturally. Most of the international scientist fieldworkers that I met all knew people who had died climbing in the mountains. This self-selecting bunch knew the risks intimately. Injuries and death were not a far off possibility that no one thought about – on the contrary, nearly everyone had a near death experience in their past, or had lost a close personal friend in this game. And the risks were made more likely by choosing dangerous routes, soloing up hard sections of rock[26], and specifically climbing notoriously crumbling glaciers.[27] One scientist even survived an 80 foot fall down a crevasse on Everest just the year before! This produces another kind of anticipatory future, one where the researchers themselves can also envision a future in which they die doing this type of work.

[26] According to climbing grades, these routes would be rated anywhere between 5.10 to 5.11. This puts them at an intermediate to hard level. But grades (that are based around the difficult of move) do not always take into consideration additional dangers: the quality of rock that could easily break, the location of where someone might fall and if that would be certainly deadly.

[27] I may consider myself a climber but I did not accompany these especially dangerous expeditions. I, on occasion, even tried to talk people out of them.

In order to do forecasting fieldwork, foreign researchers coordinate months, if not years ahead of time to design their research experience. They book flights, lodging, local transit, interpreters and hire all of the people necessary that will make scientific research at 19,000' a possibility. Before even beginning sampling, most foreign crews travel long distances, fly into the Lima airport, take an overnight bus 8 hours up into the mountains north of the capital, and spend days in town acclimating on shorter hikes. Peruvian scientists from lower altitude cities, such as Lima, are also greatly affected by the topographical landscape. Huaraz, the main town where researchers stay, and where INAIGEM is based, is around 12,000' in altitude, which is higher than most US towns. At 12,000' most people who haven't been exposed to altitude experience some signs of altitude sickness: mild headaches, shortness of breath, loss of appetite, and fatigue. But the more time spent at altitude, these symptoms typically wane until reaching higher elevations[28].

Foreign scientists regularly come with expensive resources and research equipment that is inaccessible to the majority of Peruvians (Carey 2017), including machines designed by the scientists themselves to measure highly specific data.[29] They analyze datasets specifically important to the scientific field -- since data are objects made meaningful through the lens of social systems. These scientists produce information about the changing height of mountains, solar radiation and wind patterns, the particular presence of heat-trapping black carbon particles, and the pH balance of mineralizing meltwater streams. From this, they construct forecasting stories about the world and build future predictions: climate change is already here and acting in

[28] I have seen instances of people unable to adapt to this altitude. Extreme reactions include intense migraines, an inability to keep food down, and they risk high altitude cerebral and pulmonary edemas, which I will explore later in the paper. The people that I have seen unable to handle the altitude of town had no choice but to leave, and descend to lower altitudes by bus or hired car as soon as possible, typically with the help of a friend, family member, or partner.

[29] Such as the machinery mentioned in Chapter 1, designed to study how light passes through snow samples to measure the presence of particulate matter pollution (black carbon)

predictable patterns, glaciers are melting and the effects will be vast and felt soon. If all of the right conditions can be studied, modeled, and predicted, theoretically lives can be saved with responsive action build on forecasted data.

Many of the researchers I talked to expressed a deep personal concern for the worsening climate conditions in the Andes as one of their primary drivers for doing the type of research they do. They wanted the data they produce to help predict and prevent disasters, they wanted to understand ecosystem collapse so policy makers know how to bolster it, and they fundamentally wanted their work to help people who are expected to be hard hit by looming climate futures. They used the alternative skills they had, such as outdoors skills, to complement their research agenda. They could make careers modeling data, or working off satellite imaging, but their fieldwork research methods produced real time data that was hard for others to collect who lacked their skills. Few people on earth could produce knowledge in this way, and they wanted to do their part in service. They (at least partially) understood their privilege as people who would likely not face climate change issues in the United States, and were willing and able to endure temporary risks, for the chance as helping imagined people in the future.

In addition to future concerns, researchers I talked to additionally felt tremendous personal guilt over the climate conditions in the Andes. One scientist, working at a university in the U.S. south shared that they felt morally responsible to participate in climate change adaptation and mitigation in hard hit parts of the world, in large part because he came from a country that was one of the worst carbon emitters in history. He had the skills to tackle at least part of this problem, and it was his moral obligation to do something about it. Other researchers reported that by participating in climate change adaptation, they were "doing something meaningful with their lives," and committing themselves to hard, dangerous work, in the service of others. By hiring

local employees in the now struggling adventure tourism industry (fewer glaciers means fewer visitors), scientists have additionally remarked on how their projects produce jobs, keep industries alive, and support families. I was personally surprised when even moderately leftist researchers used the neoliberal language of "job creation" to describe an industry that is exploitive and dangerous, possible to result in death, for people expected to be hit additionally by climate change. This revealed my own biases in the values that I hitch to climate change (stemming from an analysis of the root problems), but it also marked a moment during fieldwork where I began to understand the various ways that Science, or rather scientists, bring additional ideologies about how to best organize a society with them as they build anticipatory knowledge (see also Chapter 5).

All of the researchers I met were so deeply committed to their fieldwork cause that they found ways to fund their own research projects. They applied for grants and fellowships in their home countries, and some people even paid for research out of pocket. Advanced scholars built their own equipment (in place of buying $10,000 tools), solicited donations through the establishment of scientific nonprofits, and they worked as mountain guides for people who just wanted to climb and were happy that science was an added bonus[30]. A few clever researchers organized field schools and study abroad opportunities on all STEM research teams, offsetting many of the logistical costs while also providing students with the opportunity to learn how to do science on the ground. What they taught students, climbers, and patrons, however, was how to do research in a particular way. Like the foreign mountaineers in the Himalayas (Ortner 1999), many of the researchers I met didn't speak Spanish, they did not socialize with support staff, they did

[30] This created a new form of adventure tourism: science tourism. Folks who wanted to climb, but wanted it to be "for a cause" could plug into organizations created by researchers to "climb for science," and by extension, climb for climate change.

not credit the work of arrieros and porters and cooks as people who were essential to the research projects success (see below), and they often chose dangerous routes and approaches for fun (which endanger the lives of the guides hired to make the expedition possible). I am not suggesting that people were intentionally or interpersonally cruel to support workers, but the structure of expedition research is one that constructs invisibility, relies on the fact that saying "no" to dangerous work is an economic impossibility, and underpays people simply because they live in the Global South.

In terms of transparency and visibilities, the value of producing specific stories of research is one that still perplexes me. While some researchers are required to produce knowledge as part of their career track (i.e. tenure track individuals), data produced through team research is not harmed or diminished by the truthful inclusion of hired expert labor as part of a methodological practice. Yet inclusion is routinely missing from articles, press releases, public facing interviews, and even social media posts. Some scientists have even interviewed for and been featured in National Geographic[31] stories, given charismatic talks about changing the world through predictive sciences at climbing events, and inspired a new generation of young nerds to combine their passion for the outdoors with purportedly helpful research -- all of which are based on stories of rugged individuals conquering nature. As mentioned above, the jobs that scientists created for local workers would not be possible without the long lineage of colonialism (and the neo-colonialisms that followed in the form of economic development), but conversely to a relationship founded on

[31] Just as a moment of reflection: I tease researchers here for their collaborations with National Geographic, but I admittedly have partnered with them on an interview before. My work, photographs and interview content, however, strategically decentered me as a researcher and instead focused on the labor of citizen scientists and high alpine service workers who make climate knowledge possible – not on myself as a charismatic figure of science and adventure.

economic beneficence, most of the expeditions I witnessed would just not have been possible without skillful local support, which I will outline as a taxonomy of work next.

Arrieros

For centuries, arrieros, or burro drivers and their animal companions, have acted as transporters for goods, services, messages, and news throughout the Andes. Before the roads, everything was moved through arrieros. Today, the mostly indigenous and campesino arrieros raise burros, feed them, care for them, breed them, and use them for various types of labor: from plowing agricultural plots, to helping scientists achieve their goals. On expeditions, researchers require food, personal tents, sleeping bags, climbing equipment (crampons, boots, axes, crampons, waterproof shells, gaiters), heavy scientific equipment, computers, solar panels, dining hall tents, dozens of chairs, propane gas stoves, plates, cups, silverware, etc. Nearly all of this is carried, on at least some leg of the journey, by burros led by arrieros.

On large expeditions, burros are strapped with hundreds of pounds of equipment on their backs (which can take hours to get right) and are led in a transport train by expert arrieros, who mostly run for miles besides them. They communicate through clicks, yelling, pushing, and sometimes thrown rocks, as the burros read the signals of the arrieros who guide them along near invisible mountain paths. In wool sweaters, woven pants, and large hats, arrieros evaluate their animals, pack them with equipment, get them moving, run after them, unpack them, and very often leave for home with them until their services are needed for the return trip and they run out again. When not working on expeditions, arrieros deworm their animals, test them for anemia, give them vaccinations, tame them when they're young, train them to follow a trail, and keep them healthy for as long as possible. They are further used in various forms of yard work, pulling ploughs,

hauling equipment, and moving goods to market. The pair are entangled in a number of industries, plugging into the one that is most sensible when opportunities arise.

Figure 60 arriero herds grazing animals after hauling gear, returning home

Figure 61 (above)

Figure 62

Figure 63

Figure 64 (below)

Nearly all of the arrieros I met were older, some well into their 70s and 80s, leaving the higher altitude jobs of guiding and portering to their younger family members, mostly young men. Though arrieros are significantly older than the rest of the high alpine service workers[32],

[32] Unclear if this is self-selecting based on difficulty of work, if older generations are just less interested in more extreme work that takes them away from their additional agricultural and animal duties, etc.

Maxamilliano (83) told me that he was chosen because he knows the mountains, and he already has the animals necessary to do the job. He has done some version of this job for decades, but the work is harder with scientific equipment: there is so much more to carry. Maxamilliano shared stories about his accidents, bags falling off animals onto him, tearing ligaments and breaking bones. Animals buck, landslides happen, and arrieros who are injured face being left for days in cell service dead spots before someone might find them.

While arrieros have worked in the Andes for hundreds of years, since the 1500s, the job has only gotten harder as people bring more heavy research equipment into the mountains. Sometimes arrieros can secure enough work for themselves that they travel through high altitude canyons multiple expeditions per week, stacking trips out into remote areas with people also looking to return on that very same day. During high season, while walking in and out of any canyon, there are dozens of burros with drivers moving equipment, earning anywhere from $15-50 a day for their services (the lower end of which translates to below national minimum wage).

During the off season, arrieros tend to come from poor, mostly agricultural families. They raise other animals that graze, such as cows and the rare alpaca, and bring all of their animals through the Huascaran National Park to keep them fed. Families rotate duties: arrieros might spend a couple of days in the mountains working for foreigners, but typically they'd spend one or two days per week grazing the community animals, and the rest of the week managing their own agricultural plots. On expeditions, I'd see young porters and cooks offering up their uncle's burros as a service, just to make some extra cash for the family, bargaining with foreigners for fairer wages, promising a more enjoyable nature experience.

Porteros & Cocineros

When the arrieros can no longer ascend, when the rocks are too large or too loose, when the icy foot of the glacier arrives, porters and cooks take over. In addition to carrying heavy loads for foreigners, porters and cooks (often the same people shifting labor between them) are responsible for building and managing camp: they set up all of the additional common tents, including the dining tent, cooking tent, medical tent, and bathroom latrine tents (which they also dig holes for, keep clean, and stock). They set up the camp solar lights, lay tablecloths down, set the table for snacks, tea, coca, coffee, and meals (which they also cook over a hot propane stove). They serve food, wash dishes in the nearby river, and prepare hot water for bottles to go in the foot of cold campers sleeping bags. I've seen them make as little as $13 per day, dependent on tips from generous campers, as their work is both undervalued and considered unskilled.

Porters and cooks often shift through duties depending on their mood, and relationship with their clients. Sometimes they stay in camp while the highest parts of the expedition are under way, but I've witnessed them summit on multiple expeditions, acting as on-the-fly guides since they've been up the mountains so many times. They are also responsible for climbing highly technical peaks, such as Huascaran. They're highly skilled, can cook at finnicky high altitudes[33] for as many as 30 people at a time, they coordinate and manage camp schedules, know how to pack and carry heavy gear, emotionally manage fears, doubts, worries and moods, all while breathing less oxygen.

Owing to a drop in air pressure that starts at just 6,000', altitude makes it difficult for the body to take in enough oxygen, especially difficult when strenuously working and carrying heavy

[33] Cooking at high altitude can be frustratingly difficult. Food takes much longer to cook owing to low air pressure. The air is drier and so is the food. Water boils at a lower temperature, so it is difficult to gauge when water is safe to consume and cook times are typically longer post boiling point. Successful recipes require more water, hotter temperatures, and more cook time, but tend still to result in hard, dry food that is ever so slightly cold for the novice chef.

equipment. Some people adjust to this drop in altitude, but most people experience at least some symptoms. It begins with basic altitude sickness: a headache and a light cough. The headache is caused by brain swelling, and the cough from your lungs capillaries struggling to function as normal. Next comes the loss of appetite, extreme fatigue, a lack of mental clarity, the loss of the ability to speak, an inability to sleep. The real threats are blood clots and fluid in the lungs. The higher the altitude the greater the risk. On well-supported expeditions, doctors travel with dexamethasone (commonly known as *dex*) to treat conditions on site. But Peru generally goes without it, and people at extremely high altitudes face the fatal threats -- in addition to permanent brain damage.

Figure 65 A group of scientists and support workers crossing ice bridges on the peak of Huascaran (photo shared with me by Wilmer Sanchez Rodriguez)

Porters are protected by law from carrying more than 44 lbs of gear, with 11 of those pounds reserved for personal items for them (things to keep them warm, food to eat). In some parts of the country, such as the trek up to Machu Picchu, there are unions such as the Federation of Porters 'Camino Inca Daniel Estrada Perez' (RFP) that help protect workers from being exploited

and prevent undercutting. In those highly visible places, porters make around $70 per day for their work, and are so impressively strong, they run home at the end of each day to spend with their families (running back up the mountain early the next morning to meet up with expeditions). In the Cordillera Blanca, however, these protections are almost never enforced. Elias, a guide who has worked in the region since the 1990s, shared that the adventure tourism industry workers tried multiple times to form regional unions, to find ways of protecting workers from low pay and impossible, dangerous work standards, but they were always undercut: "there was always someone desperate enough to take less." Today, in place of worker protections, there are expensive schools and certifications for guides and high alpine workers, where foreigners can pay extra money to climb with technically classroom trained workers, but locals know that money cannot buy experience. In interviews, guides who had worked in the Andes for decades complained about losing work to people who were able to buy their way out of classes, pay off their instructors, and who endangered the lives of people with the recklessness. While most of the guides I met at the school seemed like smart and thoughtful people, these accusations were worrying. Additionally, knowledge of how to be in mountains and glaciers rests on sensorial and embodied expertise (see also Chapter 2). Scientists plug into these chains, often hiring through these exclusive organizations, sometimes through word-of-mouth recommendations from their locally connected ex-patriot friends, and other times hiring people they've met on expeditions before.

In camp, porters and cooks spend most of their time together, and typically separate from the science crew. They eat separately, sleep separately (typically in one large tent also used for cooking), and their duties in camp keep them preoccupied during meal preparation, service, and cleanup times, when scientists would be socializing the most. Their entire sector of camp is typically distanced from the expedition teams, looking for silence and views of solitude, just within

sight of the dining tent and bathrooms. They also speak primarily Spanish and Quechua[34], languages many foreign researchers do not speak. But at night, in the cook tent, it can be fun. Alcohol and stories are shared, including legends about sun bears on 22,000' peaks told from memory.

Having seen the industry change significantly since the 1990s, nearly all the porters and cooks I met knew that the industry was going to end one day, possibly soon. The forecasting of scientists is additionally mirrored by the forecasting done by workers in entangled fields. People can see that the glaciers have been melting for decades. They compete more for tourism work, which grows more scarce to the region each year. Alfie told me one night, "we know that we don't have a future, that this industry doesn't have a future, it's why we keep farming." He explains that many people are just trying to make money while they can. It's a temporary job, but it offsets losses from agricultural desiccation. At home, wives, elderly parents, and children help manage the farm plots while husbands, fathers, uncles, and sons work in the mountains. These seasonal, unreliable labor fields that emerge for porters and cooks during the summer require a gendered and generational shift in labor during those months, as members of the family at home take on more work to keep households afloat. I asked Alfie how he was preparing for no future, "We're not." He laughed, "What future?"

[34] "Language barriers," or foreign scientists working in countries where they don't speak the language, were the primary reason that the porters and cooks I worked with cited having to work for expatriates who coordinate experiences for English-speaking people. While I was in Peru, a family of mountain workers tried to create their own organization, asking me to translate their new website for them into English, so they could work directly with foreigners and cut out the middle-man; the plan was that they would get paid more and tourists would still pay less in fees. It was a sensible business model. But managing relationships with foreigners was impossible without help in camp as well, and successful marketing was difficult to accomplish, so the business was unsuccessful. The father and son team both still work for the same American.

Guias

Arrieros, porters, and cooks help on many expeditions in the Andes, but guides are essential on all of them. Guides route find up technical mountains. Like I highlight in Chapter 2, they read glacier conditions to determine if ice is stable, or hollow, melting, fragile. Using their bodies, they assess the tensions below their feet, they read terrain under snow patterns, have learned to walk softly and with ease using crampons across narrow ice bridges, and kick-step the knife-point of the front of their boots up vertical walls. They build gear systems, anchors, and make sure everyone is safe at all times. Guides move people forward and upward, keep people alive, keep people from falling to their deaths off the top of peaks, and then they turn around and do the whole thing in reverse, but more exhausted. During research expeditions on crumbling glacier peaks, guides are expected to know how to cross shattered blocks of ice, to read conditions no one has seen in years, and to write a new, safe route for a peak's last ascent.

Guides are sometimes the only people on their climbing team who know how to climb safely. On a team of expert equals, all parties know what to do if someone were to fall into a crevasse: the entire team that is tied together falls to the ground, slams their ice axe into the ground to stop the movement of everyone, then together they build a pulley system to pull their party member up and out, since it's unlikely they'd be able to climb out. But teams were rarely perfectly balanced[35]; for many people, a 20,000' mountain in the Andes was their first and last time mountaineering to such extremes. This meant, that if, for whatever reason, the ice below the guides feet were to break, no one on the team would know how to stop the fall of the entire party. If the guide were rendered unconscious, or if something happened to their health, no one would know

[35] I trained for years in climbing techniques, climbing gear systems, wilderness first response, search and rescue, and safer mountaineering techniques to ensure my lack of knowledge would not harm someone.

how to build the gear systems necessary to lower the whole party safely. They would be trapped, and likely freeze to death.

Tourists and scientists alike would often joke, with each other and with the guides, that Peruvian guides are just biologically better at this type of work, that Peruvian lungs were larger, and that they had evolved to be suited for this type of work. It's easy for them – or at least far easier for them than for a white person. The narratives indexed that when white people accomplished something big in the mountains, it was because they could overcome their body and the environment, not because their bodies were just naturally better adapted, better at hard work. Racist cartoons were shared in camp and over social media, intending to celebrate the sometimes unbelievable strength of guides, that showed porters and guides easily carrying 100lb packs and passing up a weak white tourist on the mountain with a smile on his face. I also heard in camp, people talking about how it's easy to know the mountains when you grow up in them, as if the everyday lives of people are consumed by learning the intricacies of cliff faces and ice sheets. I once even heard a researcher on a scientific expedition say that they too would be that fast if they had the advantage of growing up in Peru. The hard earned skills of Peruvians were erased as a product of their naturalness, the embeddedness in "the environment."

In addition to mountain skills, guides also communicate with the science team: they tend to speak multiple languages: English, Italian and French, in addition to languages spoken at home (primarily Spanish and Quechua). Unofficially, guides also sometimes carry personal packs for people who simply cannot make it to the top with the 5-10 pounds of extra weight. They provide emotional support, encouragement, and build morale for the entire team. Really good guides make their team feel accomplished. They tell stories of wild adventure, and are generally liaisons between the cooks, porters, and arrieros while in the mountains. Their expertise expands beyond

knowledge of mountains and ice, to expertly managing people, their hopes, expectations, and emotional lives in a variety of cultural contexts.

Today, most young guides come from climbing families: one or more of their uncles, fathers, brothers, or even grandfathers works in the industry. [36] Young guides in Peru are trained at the Association of Mountain Guides Peru (AGMP)[37] school connected to the Casa de Guias, which connects guides to tourists and scientists looking for expedition support. Older guides[38], between late 30s and mid-40s, learned on the job, before the school ever opened.

Fredi, who I met on a science expedition in August of 2016, learned to climb when he was just a teenager. On a day when he and some friends had blown off school, Fredi saw a white man with a large bag walking towards a rock wall in his community. Fredi followed. He approached the man and asked him what he was doing. The man told him he was going to climb the wall, which surprised Fredi. He asked Fredi if he had ever climbed it before. And Fredi lied, "of course." The man asked him if he'd be willing to hold the rope, Fredi again, "absolutely" – but he had no idea what he was doing, and it was obvious to the climber. They befriended each other, the man taught him how to use safe climbing best practices, and Fredi caught the man on several climbs that day. Fredi was excited by the possibilities, and built a life around catching climbs. Amongst the dozens of guides I interviewed for this project, several of them had similar starting points: someone saw a white person doing a weird thing, asked him about it, then was somehow roped

[36] Even though women are now starting to attend guiding school, very few actually graduate with certifications, and those that do, tend to leave the region to work elsewhere like in Patagonia. Women in the industry are treated terribly, often denied jobs under the premise that they're not strong enough for their duties, not strong enough to carry a body off a mountain if they needed to, or to carry the backpacks of struggling clients. In my 18 months of fieldwork, I only ever met women guides who did hiking at lower elevations (not technical climbing) or climbing guides from Argentina and Chile trying to expand the field to women through the Mujeres de las Montanas program.

[37] AGMP is partnered with organizations like INAIGEM the Huascaran National Park, and the Ministry of Tourism

[38] Not that they themselves are older, but that in the age range of working guides, 37-45 was the oldest age category

into the industry. Alfie, now in his mid 30's followed a white person up the mountains behind his home when he was a kid to watch what they did. Enrique and his brother tried to sell gum to tourists out in the campo as kids, when he watched someone climb for the first time. Now with the school, rich wilderness enthusiasts from Lima who were interested in becoming professional climbers and expanding their climbing portfolio across the world are arriving in Huaraz to train for certifications. The labor field is changing, but as wealthier guides leave for pristine areas of Torres del Paines in Patagonia, older and poor guides from campesino communities are left on crumbling, climate ravaged terrain. The work becomes more dangerous and less frequent for those who stay.

In addition to the hired expeditions, to maintain fitness and keep climbing senses sharp, guides must conduct training climbs and perform supplemental work throughout the year. Christian, a guide who was then in his mid-20s and from a campesino family, was training for a big summer climb with a research team from Europe when he had a near death experience that changed his life. On an otherwise sunny afternoon in the early 2000s, Christian and his team were surprised by an avalanche. The shake threw him more than 20' to the bottom of a dark crevasse, severing his rope, and separating him from the rest of his team. He was panicked and injured, but aware enough that he had no choice but to follow the wind of the crevasse downhill if he hoped to find a way out. He was lucky. It did. But by the time he emerged, one of his friends had been buried in snow above him, and he was assumed dead. They searched for hours but they never found his body. They almost never do in these cases.

In an interview at our campsite many years later, Christian, now 44, told me about how this affected his life. He quit his job, was deeply depressed, gained 50 pounds, moved back in with his mother, and was overwhelmed by anxiety and fear. He explained that he developed susto as a

response to the fight he experienced on the mountain. Susto, or fright, causes long term, chronic suffering and is conceptualized as a spirit attack (Castillo 1997). He stopped working for years, recovering from his experiences, and watching bootleg boxset DVDs with his mom that he got from his cousin. He eventually returned to work, the money was too good and he missed his friends and the life he built. He explained that his soul had eventually returned to his body, but he still refuses to climb hard peaks. Occasionally, he has troubling experiences with clients that challenge his rehabilitation. On an expedition in 2014, a woman dropped her camera into a crevasse they had just passed and berated him for not finding a way down to get it. He remembers her berating him, "I thought you were a professional," and yelling at him until he caved to figure it out for her. At the time, he felt worried she would spread harmful rumors about him as a guide which would threaten his business, and he felt challenged in his masculinity. As a man, he was obligated to help women, even if he hated them. After events like this, he takes long breaks. He feels he is more susceptible to susto, to losing his soul, now that he's already experienced it once, and he can't risk it returning. He says he wouldn't survive it.

Technically, everyone on an expedition is in danger for as long as they are on ice. But guides are more greatly endangered by the frequency at which they climb. Scientists do 1 — maybe 3 — expeditions per year. But high alpine workers around the world are exposed to threats like this on every single expedition they go on — sometimes dozens a year. On Everest, high alpine service workers climb sometimes 12-15 times per season. Wilmer climbs more than 30 times per year. The increased exposure to risk is in part what makes the work for guides so dangerous – they climb more than anyone else. Increased risk leads to more frequent injuries, and more opportunities for deadly accidents. Climbing that hard, that frequently is hard on the body. High alpine workers

who guide routes on ice have one of the deadliest jobs on the planet, with higher rates of mortality than miners, commercial fishermen, and even soldiers in Iraq between 2004-2014 (Ogles 2014).

With science expanding as an industry as environmental and adventure tourism dwindles, this work is picked up in new networks for people trying to map the future. Guides are expected to have knowledge of glaciers that no one has climbed in years, owing largely to dangerous conditions that emerged with melt. Their jobs are more dangerous than they have been in their lifetimes.

Data Collectors

In addition to the expedition research described above, some high alpine workers are hired to do all of the data collection for scientists all by themselves. Wilmer is one of these people. Twice monthly he is paid out of pocket by an atmospheric researcher working in Colorado to collect black carbon samples on two glaciers in different canyons. The meteorologist was dedicated to doing everything in his power to better prepare the world for climate change futures, and spent nearly all of his discretionary income to do so. He designed studies in mountain regions around the world that locals could help collect data on, he designed his own research equipment to the presence of carbon through light, and he did his best to equip the people who worked for him safely while providing opportunities to grow in the field of science. He met Wilmer as an undergraduate student in Peru, and asked him if he wanted to climb with him. Wilmer had never done anything like it before, but it looked like upward mobility and it looked like fun. For the meteorologist, he hoped that his work would paint a better picture of melt, while providing a young Peruvian student from a low-income family the opportunity to earn research skills and build an impressive scholarly portfolio.

When I first met Wilmer he had been on this research project for two years already. Every month, he summited these highly technical glacier faces alone to collect samples for this study. He was paid $50 per trip, which also had to cover all of his travel, food, and expenses getting out there (more than half of the money went just into the cost of expenses). In my decade of climbing experience, I've never heard of anyone, even professionals, being cavalier enough to climb glaciers on their own. He was climbing on 20 year old equipment, that had been damaged and donated. For each summit, he had to find a friend to borrow a tent, a sleeping bag, a stove -- whatever he couldn't find he made do. He had aspirations of becoming a scientist himself, but he was rarely paid enough or on time to maintain enrollment in his college classes. He hoped he was working on a project that could help stop climate change. Part of the project of data collection for him was about producing a record of harm -- maybe people don't know what they're doing by producing carbon? Or how bad it is. I'm not sure where he stands today. We don't talk about it.

Figure 66

Wilmer's job is to collect samples of snow and ice on three different points of the glacier to measure the presence of black carbon. Black carbon is the sooty black material typically produced through the burning of fossil fuels or coal fired plants that transform into an atmospheric pollutant and greenhouse gas. The meteorologist explained to me, "[black carbon] is like wrapping the glacier in a black plastic garbage bag -- if we could stop the pollution, we could buy more time, up to twenty years! That would provide more time for adaptation." Wilmer's work is intended to help predict the future lifespan of the glacier, and to buy as much time as possible for the region to adequately prepare. The model he's hired Wilmer to build is designed to predict how human behavior, namely the nearby production of atmospheric black carbon, will impact the health and vitality of glaciers, an essential resource for the country.

In response to the database that Wilmer's work produced, the directors of INAIGEM worked directly with US scientists to come up with a plan: reduce black carbon pollution. Educational materials were produced, public talks were scheduled and held by experts all focused on getting poor people to stop using natural wood and shift to petroleum gas burning stoves that "burned cleaner." These initiatives, designed by the civil engineers at INAIGEM, ignored the largest producers of black carbon in the region: automobiles that arrived with the expansion of roads and the mining industry. There remains speculation that the mines themselves additionally contribute to GHGs in the region, but the tests needed to prove it are too locally expensive and neither INAIGEM nor the Ministry of the Environment is investing in finding out. The GHGs produced by cars and possibly mines are ignored as inevitabilities of economic development. Instead, INAIGEM expected hundreds of thousands of poor campesinos to somehow switch to newer technologies and petroleum products to save the glaciers and buy time.

In addition to threatening high alpine worker lives, the data produced through their labor is predicated on values of expertise and scientific neutrality, yet clearly they produce deeply political policies. Prognostic politics of forecasting the future are entangled in, rely on, and reproduce global labor systems, yet ideologies of science, adventure, and nature (explored more in Chapter 4 and 5) systematically erase these contributions.

Analysis

The above sections highlight the invisible, underpaid, and dangerous work of the support staff that makes possible scientific research on climate change. I ethnographically trace the experiences of workers in the park to highlight their contributions, and additionally to reveal how expeditions are racially and economically divided. The problem of unevenness is not that scientists are cruel or evil, but that climate change adaptation plugs into existing political, cultural and economic systems in order to futureproof identified objects at risk. These objects include analytic constructs such as the ecosystem, the environment, and nature – but as we see through workers, it does not seem to include already climate affected people in the present. What's more, the ease of plugging into this work relies on racialized ideas of people in the Global South's skills and abilities. In his article, "'Oaxacans like to work bent over': the naturalization of social suffering among berry farm workers" anthropologist Seth Holmes argues that migrants, positioned in racialized labor schemes, are treated by employers as if their suffering at the hands of grueling labor were not only nonexistent, but a preferential way of being for people whose bodies naturally live and move through the world in certain ways (Holmes 2007). International labor relations, reliant on racialized ideas of how bodies prefer to be or what skills just come naturally to people of color, extend beyond the borders of the United States to labor relations people in the Global North have with people in

the Global South. By providing a taxonomy of work, I elucidate the layered system of support labor that makes expeditions possible.

Following historical trajectories of colonialism, these relationships reproduce what Quesada, et al. call "structural vulnerability" based on race (Quesada, et al. 2011). Structural vulnerability is defined as the positionality that imposes suffering on specific population groups in structurally patterned ways. Made clear through health disparities, and in studies of migrant labor, this chapter contributes ways that climate change adaptation is participating in this process.

In the case of workers in Peru, multiple industries boomed and collapsed in the last 30 years, all of which reproduce the same patterns of harm, danger, and death for those disproportionately stuck in uneven relational networks of work. Judith Butler frames this as precarity, or the "politically induced condition in which certain populations suffer from failing social and economic networks of support and become differentially exposed to injury, violence, and death" (Butler 2009) But precarity is not owed to a failure of social and economic networks, it is constitutive of them (Appel 2019). Critical Development scholars have for half a century argued that the global south's position is not one of underdevelopment, but of extraction and the production of relationships of dependence, through cycles of expert frameworks. The same relations of precarity justified by experts were at work in finance and debt restructuring to international monetary groups, in the development of extractive industries that were supposed to make everyone rich, and are even part of the rise of conservation and environmental tourism industries that displaced people for parks.

As I have shown, high alpine service workers experience uneven risks and hazards at far greater frequency, including sickness, injury and death. I revealed one way that technologies of anticipation (and field sciences more broadly) are constituted by uneven and inherited global labor

systems, reproducing them into the designed future. It does not have to work this way, but it does because of a long history of colonialism, expansive economic development built on extraction from the Global South, and racist ideas of expertise and skills. This chapter is ultimately about the social reproduction of global divisions of labor through climate change adaptation strategies, rendered invisible by a cultural ideology of science and nature – all in the name of producing a safe, climate-adapted future.

CHAPTER 4: Investing in the Future, Futureproofing the Economy

Chapter Summary

This chapter expands in scope from focusing on the work of knowledge production, to how those processes connect to wider institutional goals. In this chapter I examine how it is that adaptation projects futureproof culturally selected objects of value, reflective of the cultural beliefs and ideologies of neoliberalism. In this chapter, I argue that the highlighted climate projects work more in service to the reproduction of neoliberal economic relations than to the survival of actually climate affected people, demonstrating not a mismanaged failure but a designed technique of capitalist reproduction.

A Meeting on Glaciers

An office building is tucked away in the corner of a courtyard where over 70 businesses that cater to international ecotourism flourish. It's 8:30, so they're not yet open. But signs are pasted and tacked up all over the walls and windows in English, promising sensational "while you still can!" experiences of melting glaciers. In just an hour or two the outdoor adventure gear rental places, souvenir shops, pricy tourist restaurants, and the Casa de Guias (the local tourism center) will all be open and full of foreigners. And the inconspicuous office building will be full of conflict.

In a room on the top floor of the building, with tall ceilings and fluorescent overhead lights, over 100 green plastic chairs sat all facing the front of the room, decorated with national emblems and flags. At the front is a podium, a projector screen, and small 1' tall stage, with two tables pushed together and a microphone for invited guests to share. As I enter, the room is packed. People crowd into rows, and overflow along the walls and into the hallway.

The purpose of the event that day, I thought, was to educate "the public" on how climate change is impacting the region. The slated list of guests were nearly all scientists (and all men),

which also additionally included the Director of the Huascaran National Park and the President of the National Institute for Research on Glaciers and Mountain Ecosystems (INAIGEM)[39], who was selected for his position after a long career as a private consultant for foreign mining companies expanding in the Andes. He was an expert on Peruvian geology and glaciology, as evidenced by his ability to use them to turn a "sustainable" profit[40]. As the room bustled, women in fancier dress than anyone else[41] served complimentary instant coffee to the attendees, and offered snacks made from choclo (large seeded corn) from carried trays. With the other 100 people in the room, I wait for the meeting to start — it's already 20 minutes late at 9:20. The room was full of conversation as people introduced themselves to their neighbors, caught up with old friends, crowded into friendly groups, and tried to catch the attention of the refreshments.

Once the event began, men took turns in front of the room to present their latest research findings that would be published in the forthcoming scientific journal launching through INAIGEM. One person explained that more glacial lakes have been found this year, confirming fears that there were now hundreds that took the place of former glaciers. Another person spoke about the role of endangered micro-life in the ecosystem of the region. An economist did a cost projection analysis on how much a major disaster might cost the region (including the financial cost of human lives lost from no longer producing for the economy, see also Eyal Weizman 2007). The director of the Huascaran National Park, Jesus Gomez, spoke about state of the park's ecosystem, and their modest ecological conservation goals in light of their tight budget constraints. Nearly every speaker went over their time limit, and it was over 2 hours before we reached a

[39] Just for quick reference, this is the organization tasked with managing climate change adaptation research and policy development for the nation.

[40] Some forms of mining were considered part of sustainable development in the 1990s. For a future project, I am interested in parsing out more what sustainability means in that context.

[41] I later learned that some of these women were employees at INAIGEM as assistants.

breaking point. Their presentations painted a grim picture of how climate change was already affecting the Andes, it had already arrived, establishing permanent conditions of endangerment for people living nearby. During the break, women again served snacks on napkins and hundreds of styrofoam cups half-full with purple chicha were distributed to the crowd and honored guests.

At some point during the break, however, the entire room shifted. At first it was imperceptible, it just looked like people moving around, stretching, searching for restrooms, because of the recess. But the architecture of the chairs were no longer in neat lines, people had moved them to sit in groups with friends, spilling into the aisles and hallways. There was now a stand with a microphone that had been placed in the space of the audience, and people that had been seated were now filing in line behind it. Friends found one another, held hands, hugged, and gossiped for the time being, waiting for the event to resume and (I would find out later) strategizing. Empty chairs, guarded by jackets and scarves, were in disarray in the shape of isles for the people waiting to speak. Everyone in the room seemed to know their role in what was to happen next, as if this happened regularly (I would find out later that it did). Loud voices from the crowd dictated the order in which people stood, and people quietly coached one another on what they were going to say into the microphone. At the end of the break, the bustle settled and the host announced it was time for public questions and comments.

The room buzzed with hushed speaking, as people began to address the experts at the front of the room. They started out as expressions of concern and questions about the environmental issues people were facing. But one after another, the crowds attention began to reflect anger, heartbreak, and loss, not necessarily at climate change as it was defined by the panel, but climate change as an extension of the neoliberal policies that have impacted the region for decades – as an extension of Antamina, the wildly lucrative nearby mine responsible for devastating, irrevocable

environmental damage in the region. The loss of water systems from climate related drought compounded the historical water losses from mining runoff contamination, while the atmospheric pollutants from sustainable development around the mine contributed to increased melt. Mining and melt fed one another, made possible by the neoliberal frameworks of the state and their toothless regulatory agencies.

Local activists also ignited the crowd. Carmen Shuan, an anti-mining activist whose family members were incarcerated for peacefully protesting mining contamination made an impassioned speech about accountability. As did Percy Angeles, a notoriously sensational leftist, who additionally critiqued systems of capital, which the scientists were accused of being a part. Democratically elected heads of over a dozen communities spoke, representing the interests of their residents. They complained about the fact that they had still not been compensated for the extensive damage done by the mine (even though Antamina and the state had long reached an agreement on a fair price for the destruction of life), and that people from their communities were still being held in prison for protesting legally. Some of the activists kidnapped mineworkers as part of their protest, so they are incarcerated for that act, but that was a small fraction of the dozens of incarcerated people. The public participants made their complaints and asked their questions in Spanish and Quechua, and some of the scientists asked for translation help from their peers on the panel, while others nodded along solemnly at the crowd approved cues.

But towards the end of public commentary, a man who was sitting mostly by himself, tall in Caterpilar workwear, stood up from his seat in the middle of the room and spoke without invitation or a microphone:

> “I’m listening to you all complain about the mines, but you don’t understand. I started working there to provide for my family. The mines brought money to my family. But we

lost everything. I didn't know what it would cost. I'm dying. I have cancer. From working in the mine. I listened to them say it was safe... Now I have months to live.

<gestures towards the panel with his hands>

You need to take responsibility for what you've done here, like me. Like I am doing now.

<gestures back to the audience with his line of sight and direction of voice>

You can't trust them just because they said you should. You cant trust them."

He sat down, stunning the room into silence[42]. I knew townhalls could be fraught, but I felt tremendous intellectual and empathetic whiplash as this all unfolded at a meeting on climate change. A long history of destruction, deception, and dispossession were leaking into the otherwise neatly defined meeting of antipolitical scientific information dissemination. Somehow this event had been transformed, from a space for the public sharing of deeply boring, technical, scientific information, to a political accountability mechanism for neoliberal environmental management strategies by the state – and for INIAGIM President Benjamin Morales (Arnao) specifically. Morales, now the country's primary climate change adaptation research and strategy development manager, had previously worked for decades as a glaciologist and geologist for mining companies to help them understand risks and expand multinational industries to Peru. His work helped to politically produce mining as a management object of the Economy rather than a lived, environmental issue. In a region with a fraught mining history, however, this was not something anyone was actively trying to hide. On the contrary, Morales, who came to power and wealth under the neoliberal shock doctrine of the 1990s President Alberto Fujimori (see also Introduction), was given the job as the President of INAIGEM specifically because of his long history of expertise in

[42] Later in the meeting he turned to me, sitting in the same row as him, and he asked me if I worked for the mine, and if his speech offended me. I clarified that I did not, and apologized if that caused him worry. We later became friends, and after seeing my camera, he wanted me to take pictures of the effects of the mine for him and his family.

managing environmental projects in the Andes. He designed and participated in programs that expanded industry, raised the GDP, neoliberalized the economy, and built enduring international economic relationships -- all through his technical environmental expertise. And he was selected for his role, overseeing the development of climate change adaptation and mitigation because his background reflected the expertise the Ministry of the Environment wanted for this new state project.

The blending of neoliberal economics with climate change adaptation had actually become constitutive of INAIGEM. The organization's explicit goal is: "[to] generate and promote scientific and technological research on glaciers and mountain ecosystems for the benefit of citizens....[in order to make] a modern country that makes sustainable use of its natural resources and is concerned with conserving the environment by reconciling economic development with environmental sustainability" (INIAGEM 2014). Through INAIGEM, the official goals of climate change adaptation were entangled with the always incomplete project of economic development and modern state building.

As the event unfolded, a climate scientist sitting on stage looked bewildered, while the service working women with refreshments smiled and tried to keep the event moving by ushering on the next speakers. Three men on the panel were trained scientists, one a park director[43], what could they possibly do about mining (or the complicated histories of their bosses)? The young glaciologist made confused eye contact with the park director sitting beside him, who assured him with a small pat on the back. One of the scientists reacted with apologies for his situation, then patiently tried to swerve the conversation back to the intended focus, the climate. He reminded the

[43] As it would happen, the Director of the National Park shuffled into a position at INAIGEM, and left it shortly after for a position at Antamina. These positions of authority between the park, the mine, and climate change management rotate important men between them.

audience that this meeting was intended to be specifically about climate change (as it was discursively produced by the experts in the room). It was my impression that he did not intend to be dismissive, as much as desire for the crowd to transition back to a space where he could be relevant, where his expertise was helpful. He was trained in a specific field, and this public confrontation was well out of his wheelhouse. It was at this time in the meeting that Morales left the conversation, and the room.

The young glaciologist was in the unfortunate position of having to personally answer for a lingering history of some of his work superiors, and for the organization of the research institute that employed him; he was only a glaciologist. Later revealed in a brief interview we had, he simply wanted to solve a *technical* problem of risk: ice melt. Now in his 30s, he studied glaciology in college and graduate school in order to produce helpful knowledge about the world. He wanted to help prepare the region for certain kinds of risks; he understood why people were upset (he had his own critiques), but this was not supposed to be a space for political debates about mining, which was politically filed under the managerial realm of the economy. Yet, as this chapter will show, lived experience collapses these categories: neoliberalism (this case, in the form of mining) has heightened the effects of climate change, and climate change has heightened the effects of neoliberal austerity, lack of infrastructural investment, and the state abandonment (Rasmussen 2016) of actual people the Andes. They are inseparable. People experience them together, heightening one another: a process driven by a small group of rotating bureaucrats. But in this state-run forum on climate change, these interconnections were designed to be strategically absent. Climate change adaptation was a space for science and sustainable development. What's more, in addition to drawing political boundaries of relevance (Gieryn 1980), neoliberalism was being

written into the institutional climate strategy, made invisible through cultural ideologies of science as neutral, antipolitical, rational, and explicitly non-metaphysical.

This chapter is inspired largely by Jeremy Schmidt's environmental philosophy research on water, where he traces the embrace of water as an agentic force in the early 1900s United States in order to generate "normal water," or the cultural understanding of water as a natural resource to be managed by the ethnocentric, decidedly "rational" and technocratic actors of the state as a project of national development. He argues that the historical transformation of water into a resource and force for liberal state projects of the early 20th century is why "some water challenges are recognized and prioritized and why others are not" (Schmidt 2017, 223). The liberal state precluded many ways of being with water, producing instead white settler cultural logics of water management by technocratic experts, ethnocentrically viewed as inherently rational. These cultural practices were forcibly exported around the world, through places like Latin America, through policies of economic development, sustainable development, and tourism-focused conservation – and I will show that it also is happening today through neoliberal climate change adaptation strategies. By neoliberal, I use David Harvey's definition which explains, "Neoliberalism is a theory of political economic practices proposing that human well-being can best be advanced by the maximization of entreprenureal freedoms within an institutional framework characterized by private property rights, individual liberty, unencumbered markets, and free trade" (Harvey 2007, 22). He continues, "The role of the state [in neoliberalism] is to create and preserve an institutional framework appropriate to such practices" (ibid). Like Schmidt's normal water, I show how climate change has become a depoliticized environmental process to be technocratically managed by experts of the state to ensure the reproduction of a certain kind of institutional framework. This

chapter examines the state management of climate change as a project that reflects and protects the reproduction of neoliberalism.

While activists across the world hitch issues of social justice to climate change mitigation and adaptation projects as a tool for survival, state actors are also working to futureproof (Rich 2014, Ghertner, et al. 2020) institutions, resources, and logistical chains that are targeted as the most strategically important to them. By futureproof, I mean the ways in which processes of ensuring that an object, structure, idea, or value will continue into the future by anticipating and minimizing the effects of forecasted events (Rich 2014, Ghertner, et al. 2020).[44] As explained above, one way this developed in the Andes is by putting a former mining consultant in charge of climate change development, ensuring the representation of specific economic, political and cultural interests are represented in the climate change adaptation process.

In this chapter, I will highlight the lived consequences of using climate change adaptation to futureproof the neoliberal state. First, I will analyze how the production of environmental data as a risk management strategy is used in service to produce green finance more than tangible aid strategies (as the adaptation project). Second, I will analyze the state handling of a climate disaster made worse by the spread of contamination from the mining company Antamina. I will demonstrate that precedence was given to reproducing neoliberal life, over the protection of people impacted by climate effects. And finally, I will return to the narrative at the beginning of this chapter, to demonstrate that these are not analytics that I came up with, but that were revealed through ethnography. People resented the neoliberal state formations of trickle down aid they were

[44] To be fair, climate change will likely cost trillions of dollars in adaptation infrastructure to build the kind of resilient, sustainable, capitalist state envisioned by the mission statements of the adaptation organizations. That kind of money can only be produced by participating in certain kinds of markets. However, this chapter reveals that what is happening is not just an additional state investment that gives the country access to green finance, but a salvaging of certain ways of living, and a prioritizing of the Economy over everyday forms of economic life (and in some cases, basic survival).

offered, and refused to accept the depoliticization of their environmental experiences. This final section highlights that this is an ongoing, always unfinished project of state making. Ultimately, this chapter highlights how scientific "futureproofing" (Ghertner, et al. 2020) serves the reproduction of a resilient liberal nation state, and not necessarily the greatly (already marginalized) people in the region. In the next section, I will contextualize this argument in relevant literatures, highlighting how the production of risk is entangled with the project of state-making through environmental management strategies.

The Political Management of Risk

Production of Risk

As seen in the introduction, the risks of climate change in the Andes are extensive. From melt to drought, fires to floods, the region is increasingly endangered with every passing year. But the targeted objects of what is *at risk* are determined through lived experience. For people who are campesinos or agriculturalists, one risk might be unstable water sources. Another could be the lack of infrastructure like roads to move goods and resources to nearby communities. In the city below high altitude villages, one risk might be property damage from floods, or the loss of industry jobs, leaving the region do to the increased lack of environmental security. Asa Boholm writes, "risk emerges from situated cognition that establishes a relationship of risk between a risk object and an object at risk" — in other words, risk is inherently relational (Boholm 2011, p 175). It would not be risk if there was no potential threat to something. She continues, "risk is a product of situated cognition that establishes a causal and contingent relationship of risk between a risk object and an object at risk so that the risk object is considered, in some way and under certain circumstances, to threaten the value attached to the object at risk." To unpack this a bit, risk is a theoretically and

symbolically understood outcome of the process of one object threatening another object in a way that threatens it's value. That value can be something like land which creates food and thus survival. It could be a loss of identity, which feels like an invaluable thing to risk sometimes. Boholm also explains that risks are socially embedded and "culturally biased," meaning that a risk object for some can be an object at risk for others. The object has to have some sort of socially recognized significance, value, or meaning in order for there to be any risk in losing it — it can be a mood about a process, an object feared endangered, or a culturally selected amalgam of potentially lost value (Elam 1973). To dig more into the thick of *risk*, Marshall Sahlins explains risk: "a relation between a certain happening and a given symbolic system," it is foundational to culture's very production. In the cases that I am exploring in this chapter, what is produced as objects at risk, and therefore protected as endangered, are made sense of through logics of the neoliberal state. Institutionally selected strategies and mechanisms for managing risk through climate change adaptation rely on neoliberal cultural logics of what is of value, what is worth protecting, and by design, what is worth trying to save into the future.

Anthony Oliver-Smith has written extensively about disasters and environmental hazards whose emergence has created what some call a natural laboratory (Oliver-Smith 2009) or spaces where people must adapt creatively to emerging circumstances, deciding if they will try to live as if they had before, or through new, adapted ways of being -- similar to Mattingly's moral laboratories (Mattingly 2014), where the dilemma focuses on the types of moral choices people make to produce the future. Climate change, the looming yet ongoing risk-event horizon, is demanding this type of accounting.

With the risks of climate change immerging right now, experiential, social, and political worlds are being challenged to creatively find solutions to the end of worlds. In his book on queer

futurity, Jose Esteban Munoz writes about the way that queerness is "not yet here," it is an anticipation, a horizon of being (Husserl 1991) "that can be glimpsed in utopian bonds, affiliations, designs and gestures that exist within the present" (Munoz 2009, p 23). It creates uncertainty in the present about the types of futures that will be reproduced, and this tension between the present and queer futures provide an uncertainty of hope - challenging everything from aesthetics to space, and even conceptualizations of time. A key question I would like to interrogate here is how anticipated risk influences horizons of possible futures as part of the project of capitalism. Many different types of people, with varying levels of political, economic and social power, are trying to ensure their right in this future. This can either look like a reproduction of capital into climate change adaptation, or we can all just decide to do something else collectively. Of course, I know it's not that simple and it is made even more complicated by the strategic deployment of climate change adaptation as a project of the neoliberal state. This chapter contributes to literatures on anticipated risks, by analyzing how the production of future risk management fortifies uneven institutions and relations in an already highly socially, economically, and politically stratified place. I argue that what the state means by anticipatory climate adaptation is different than what climate justice activists might mean, backed by the weight of history and power of international economic relations.

Environment, Governance, and Power

In addition to understanding how the production of risk is tied to climate change adaptation strategies, this chapter additionally engages with literatures on the environment, governance and power, to highlight how long, historical, enduring relationships are rebuilt, fortified, and secured through climate change adaptation policies. Climate change adaptation is taking place at the front

end of a long history of colonialism, imperialism, and destructive economic development – all of which I file under the category of technologies of global capitalism. These technologies utilize tools such as structured debts and aid, that erase the fact that "underdevelopment" in Latin America was created through historically exploitive material relations with Europe, and have replaced violent extortion with softer economic forms of exploitation (Frank 1967) — rendering both the techniques of capitalism as well as the historical knowledge behind their evolution invisible. What's more, they were also, like climate change adaptation, rendered inherently helpful, antipolitical, and expert driven by people who also argued that their intention was to help, to lift people out of poverty through silly means, like expanding the country's GDP.

In the last hundred years, the shape of colonial, militant, and violent power from the Global North has transformed into neoliberally rationalized economic relations of soft power (Gramsci 1971), with sometimes unlivable material outcomes (Frank 1967, Galleano 1970, Cardoso 1972, Freire 1996, Frank 1967, Das and Poole 2004, Wallerstein 2011, just to name a few). The technologies of global capitalism were transformed through dialogic processes, and leave traces of historical exploitation embedded in institutional, epistemological and cultural forms. These governing amalgams rely on the cultural belief in liberal, rationalist, and expert driven ways of operating, obscuring the cultural politics of these institutions.

Michael Taussig in his earlier work takes a stance against the spread of culturally constructed expert knowledge forms validating through soft power the exploitation of people through extractive industries (though it remains arguable, to me at least, that this is inherently the way out of rationalist neoliberal thought frameworks). He argues that through the lens of the other, accessed through ethnographic accounts, we can gain greater insights into the ways that these knowledge forms function, travel and subsume the worlds they encounter -- and as a

surprising materialist (surprising because of his later works), he argues that by critically examining the economic, cultural and material conditions outside of capitalism we could be better anthropologists at understanding the human condition. He locates the seams between capitalist histories and noncapitalist histories in the stories of mine workers who make deals with the devil that make a person rich. Like the work of June Nash (1979), Taussig points to the ways that successful capitalists, who profit well beyond their neighbors, and often at their expense, are moralized as having deals with the devil, and are expected to meet intense forms of cosmological retribution. These effects can be felt in their families, in their land, and in the very social and environmental economies upon which they depend. Here, the cosmological is part of the symbols of power that govern ecological relationships, providing contrast to and ethnographically destabilizing the capitalist technologies of power.

Stuart Kirsch writes, the effects of capitalism are "exacerbated by neoliberal economic policies that view the market as the most efficient means of solving these problems and assert that effective management of these issues by the corporation can substitute for regulation" (Kirsch 2014, p 1). According to Kirsch, the logics and technologies of capitalism naturalized the harmful effects of these industries as "inevitable consequences of modernity" rather than historically contingent destructive forces and relied upon legal frameworks to reconceptualize protections in order to increase maximum profits. It is not simply that there is not enough knowledge of the effects on groups of people, but institutions structure forms of governance around *relevant* knowledge, which selectively reproduces structural hierarchies that threaten the very lives of people deemed not worth the consideration of the state. These processes happened with extraction (Taussig 1982, Kirsch 2014, Li 2016), they happened again in processes of environmental

conservation (Argawal 2005, West 2006), and are happening now through the process of climate change adaptation.

The work of James Scott, *Seeing Like a State*, asks most clearly: How did the state gradually get a handle on its subjects and their environments? How did the state become an extension of the neoliberal project of governance, and what ways can we ethnographically trace this (Scott 1998)? Scott's text goes through the various systems through which the state came to be a project of what he calls high modernism that are inherently embedded in enlightenment values of making legible the developing world in order to establish firmer control. This took place through the creation of permanent last names (that destabilized kinship regimes), through the standardization of weights and measures, through the mapping of territories that would later be contested, and through the standardization of forms of language through which access to resources became necessary. The beauty of Scott's work is the way that the bureaucratizing of life failed to cover all of the aspects of society, and people remain ungovernable through these principles because they exceed them.

Andrew Matthews also discusses the relationship between state forms of knowing and environments by exploring the new green practices that national and global "truth regimes on nature" are using. He argues that "When a whole range of actors, from World Bank lawyers to international conservation scientists, are commissioned to rewrite national property rights laws, redesign state agencies, and localized production practices based on new global norms, they transform conventional forms of state power, agency, and sovereignty" (Matthews 2011). While people may still exceed their forms of governance, Andrews writes that the material reality of their lives is still that the art of governance used to manage emerging ecological forms are creating what he calls eco-governmentality. He explains, "Coterminous with the rapid expansion of green

scientific practices are powerful effects that get dispersed over a wide range of social spaces, influencing the formation of governing agencies that oversee scientifically constructed objects of study such as watersheds, wetlands, and indigenous peoples' extractive reserves" (Matthews 2011, p 503). These regimes lead to dams, tourist centers, the establishment of national parks, the ability to access and use lands necessary for resources, and through scientizing, and de-politicizing the environment, eco-governmentality becomes a new form of green neoliberalism.

Finally, in Akhil Gupta's Red Tape, he asks: "Why do regimes whose legitimacy depends upon bettering the lives of the poor continue to allow 250 million to 427 million to live below the poverty line?" (Gupta 2012, p 3). This text and much of his previous with in collaboration with James Ferguson, seeks to understand not just how to think through deliberate acts of violence (such as police brutality), but also what he calls "administrative and judicial action or inaction that prevents poor people form making a living, obtaining medical aid, and security such as necessities of life" (Gupta 2012, p 5). Here is certainly where a Nietzsche-Foucault genealogy of state institutions would come in handy. What Gupta provides, however, is far richer ethnographically. By looking at the everyday experiences of bureaucratic workers in India, Gupta traces the ways that the divisions of labor, the limits of bureaucratic jobs, and the inability to work outside of systems of paper and already existing frameworks, are in large part why people are relegated to forms of bare life (Agamben 2005). Gupta explains that "bureaucratic action repeatedly and systematically produces arbitrary outcomes in its provisions of care" — and he asks how violence comes to be intertwined with institutional forms of care. Although predicated on neoliberal, calculating rationalism, the state is highly ineffectual owing in large part to its historical formation, but also because the state is "far from being a unitary organization acting with a singular intention,

the state is characterized by various levels that pull in different directions" (Gupta 2012, p 46). Gupta additionally provides a silver lining: although the state came into being through practices and discourses, the fact that the state is not singular and is laden with institutional problems demonstrates its historical contingency, and reveals the very ways that the power of elites is tenuous and not a naturally occurring phenomenon.

These literatures contribute significant understanding of how the management of environments by experts (who, in turn, produce the very idea of risk) can have harmful effects on people they are purported to help. Next I will analyze 1) how climate change adaptation is part of this long lineage, and 2) how it is that the neoliberalism is reproduced through a project, purportedly devoid of politics – highlighting how it is that neoliberalism is reproduced through climate change management strategies.

The Performative Life of Data

In August of 2017, a man hired to cook meals and manage camp for a team of expedition researchers dragged a scientist for over an hour to the top of the tallest glaciated mountain in Peru, Huascaran (22,205'). The team of over a dozen people had climbed for days to reach this point: from the nearest village where a van dropped them off, they hiked up rocky terrain, trekked with crampons across the tongue of the glacier, climbed further up by technical ice walls (some over 100' high), and moved quickly through moving block tons of ice that melt and shift below foot in sunlight. On the day of the summit, everyone was exhausted, and it seemed unlikely that one member of the team was not going to make it on his own without help. In an interview I recorded with him later that week, Ricardo Villanueva, a friendly and warm project director in his late 40s who had never climbed before the conceptualization of this project, laughingly recounted, "I laid down on the ice and I told him to just leave me behind! 'Leave me! Go on without me!'" Most of

the team had, some had been waiting at the top for two hours. the cook stayed behind with him, encouraged him, coached him, guided him. Ricardo remembers the cook strategizing ways to keep him moving, "He'd say, 'Look, we'll go until you can't anymore. Let's just make it to that one spot on the horizon, then we'll see how you feel. Let's just walk until there and we'll see.'" And when Ricardo couldn't take another step, the cook carried him the rest of the way. By the rope that connected the two he pulled Ricardo for the entire last hour all of the way to the top of the peak. Ricardo recounts this story with humor, but as a climber, I found this story deeply worrying as many people I know have died from the effects of altitude.

Ricardo was the only person who knew how to turn on and activate the scientific machinery that was hauled up ahead of him on the back of a hired guide, and everyone was waiting for his arrival to finish collecting their climate data. While it was neither the job nor the expertise of the cook, his labor and knowledge, based on years of accompanying other climbing groups (many of which were scientists), saved the expedition. The entire team celebrated at the top, posting stories on social media from their phones that they charged by solar panel, sharing videos, checking in with their boss, texting friends, and calling their moms. And Ricardo, on his second climb ever[45], scaled one of the most challenging peaks in the world — a peak which took the lives of dozens of highly skilled climbers during my fieldwork from 2015-2017.[46] Ricardo, however, wasn't well. He felt sick, light headed, extremely fatigued, he kept wanting to fall asleep on the mountain, and had trouble forming coherent words and sentences – all dangerous symptoms of high altitude

[45] The first was his one and only training expedition required and paid for by his job at INAIGEM a few weeks earlier. Ricardo did virtually no training for this event.

[46] During my first year of research, 11 people died on Huascaran, the next year 10 people died on Huascaran. These were expert climbers, who traveled from all over the world (Spain, Patagonia, Ecuador) and some even worked as professional mountain guides in their home countries. In my years of climbing in the Andes, I have never attempted Huascaran because of its dangerous legacy, and I did not pursue following any research expeditions up it, even though friends and interlocutors regularly had to climb it. I am simply not skilled enough to not endanger people's lives with my limitations.

exposure. He remembered thoughts feeling impossibly incommunicable, which worried him at the time but he was joking in a self-deprecating manner about it now. He knew what he was trying to say, but couldn't make the right words happen, or happen in the speed or order which he planned. So the team sent him back down ahead of them, again with the expedition cook, where he slept early to descend again as early as possible the next day[47].

Figure 67 This is the type of terrain that the team would have to cross. For scalar reference, the ice wall towards the bottom of the frame is roughly 20 meters tall. This is before reaching the solid, vertical wall that is around 250m.

Upon their arrival back in the village where they departed, the group of scientists were met with celebration by the director of the Institute for Research on Glaciers and Mountain Ecosystems (INAIGEM -- the center directing the nations climate policy for the entire country of Peru), media

[47] Most mistakes mountaineering are made on the way down. People are tired, and the effects of altitude cause a type of brain fog that makes movements done 1,000 times previously impossibly difficult. With the exception of avalanches or ice bridge collapses, this is the way the majority of people I know have died: by making mistakes at this stage. It is crucially important that he was accompanied, it very likely saved his life.

outlets, friends, coworkers, and family. They ate plates of fresh food, shared stories of the expedition, and took photos that would later appear in local, national, and international newspapers. The photographed scientists were dirty and clearly exhausted, but smiled victoriously next to the 80 year old Executive President of the Institute for Research on Glacier and Mountain Ecosystems (INAIGEM), Benjamin Morales[48]. The media celebrated the achievements of the scientists, the research organization, and by extension the nation, for their investments into modern solutions to emerging climate issues. Yet explicitly missing from the reported stories, press releases, and mentions in published work were all of the service workers whose labor made the expedition possible. They were not part of the story of scientific achievement, nor the valorization of the nation – they were excessive to the national and political story being constructed (de la Cadena 2016, Postero 2017. They did not fit the discourse of state science, which was about advanced technologies, not labor treated as unskilled. The story was instead about the advancement of science, the use of highly advanced technological equipment, and the investment by the state into sustainable development (see also Chapter 3).

INAIGEM President Morales explained the expedition in interviews made available the public. Regarding climate change, he grounded the solution in advanced technologies and scientific knowledge production, and he stressed Peru's central role in global climate change adaptation. An interesting facet of this grandiose display, however, is that this data could easily have been produced with a satellite system, and had actually been produced before. The data was not essential to any plan that helped people understand the threats or dangers upon them below, it

[48] As I will get to later in this chapter, Benjamin is a relatively famous figure in Peru for directing the mining development initiatives that arrived in the regions around Huaraz in the late 1980s and early 1990s. He was a Fujimorista, which means he was part of the shock doctrine of rapidly neoliberalizing every sector of the economy in the 1990s. In his role as acting director of this climate change organization, has said on more than on occasion that Peru is a mining country. It is what he is known for.

endangered the lives of all of the underprepared workers, and erased the contributions of anyone not seen by the state as a science expert, but it did showcase Peru's advanced technological prowess and willingness to contribute large sums of money for sustainable development.

In an interview for the newspaper, El Comercio, Ricardo explained their mission: "For the first time, Peruvian teams will use advanced technology to conduct research at the highest tropical glacier in the world" (El Comercio 2017). Sifting through the dozens of articles about the expedition, journalists posited that missions like this prove Peru, too, was a scientific leader in climate change research, leading with technology, and showcasing Peru's modern answers to issues of climate change. The event, and subsequent interviews and press releases all produced a broader narrative of a nation invested in climate change adaptation as an extension of *modernity*. Just like in the ethnographic example from the opening of this dissertation, they were not investing in small-scale fractured projects like Mr. Gold's, as they had been accused by the IMF and green finance groups, they were scientific leaders. It was a sensational and charismatic story of Science solutions accomplished by the nation. Other stories of its kind also circulated widely: pictures taken with drones that cost thousands of dollars (that could have been produced through existing satellite connections), events to educate the public on climate change that appear in the media but invites to the public were almost never made available anywhere, and there was even an INAIGEM trip to Antarctica that highlighted Peru's commitment to ice in general[49]. For an organization with an operating budget of over $11million annually, INAIGEM produces projects for the state that are highly technical, driven solely by STEM research, and that to the protection of *biodiversity* as a national natural resource. These activities paint climate change adaptation in the light of the non-metaphysical, "rational" and scientifically neutral light that Schmidt discussed in his history

[49] It is still unclear to me what this expedition was supposed to accomplish, as almost nothing had been written about it publicly.

of the transformation of water. Here the strategic (de)politicalization of climate change, and the dramatic performativity of the state, was instead embedded in frameworks of modernity and resource investment. More importantly, it would lay the groundwork for investment by green finance (which I develop in just a moment), who demand a scientific accounting as part of their relationship building.

When I asked people in the community where I was living what they thought of these types of science projects, people found them outrageous. Alfie, a mountain guide from a high mountain community in his late 30s, expressed his anger that they would invest so much money in that, but not in a flood alarm system that could save his life. To prevent the deaths of the 120,000 residents living below Lake Palqaqocha, people have been requesting a flood alarm system for years. This would provide people who live below the lake time to evacuate if the lake were ever to burst.

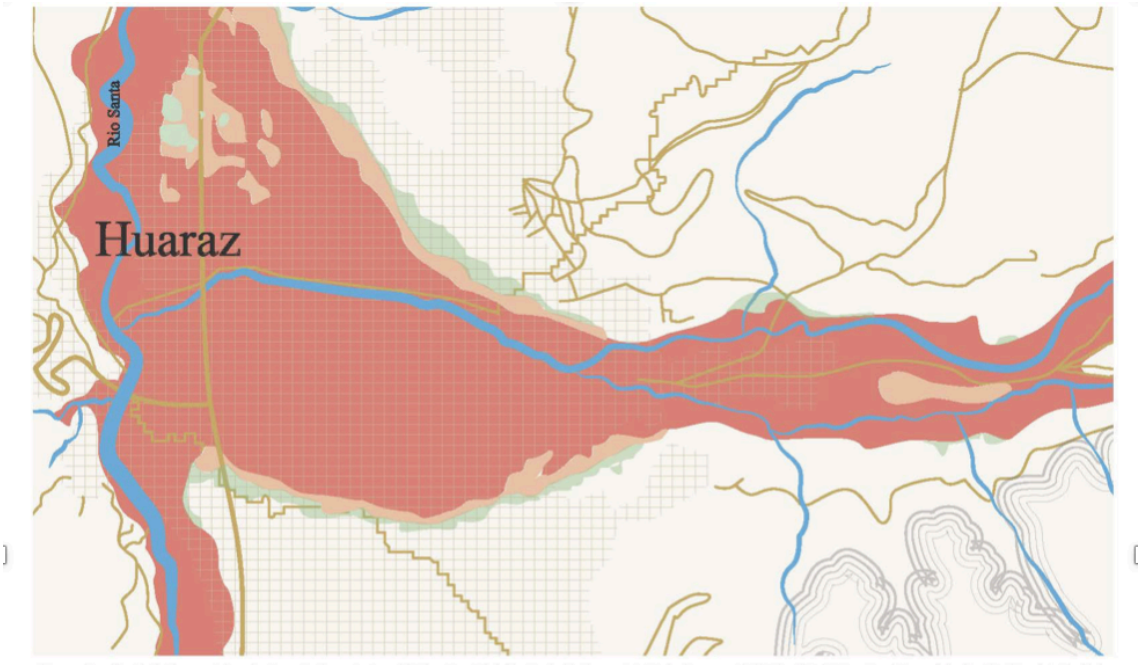

Figure 68 Map shows the modeled flood projection (compiled with data from the University of Texas)

Right now there was only a man who lived at the lake for weeks at a time (unless he left, which no one would know) whose job it was to alert someone via walkie talkie at the office in

Huaraz if the big flood were to come. He would probably die in the process. It was not popular job, and people cycled through the position multiple times during fieldwork. Alfie, and later multiple other people agreed, that it wasn't part of the state's plan to invest in this type of system because it "wouldn't make the news," or "if it made the news, it would only be because it failed." He joked that for wasting $17K on a single research expedition, the least they could do was hire him personally to take the scientists up – he could "at least make some money before dying in a flood". While it may seem like a mismanagement of money to people frustrated with a lack of support for their particular climate change issues, investments into projects like this are actually strategic.

In 2014 at the United Nations Climate Change Conference (COP) held in Lima from December 1-12th, participating nations met to negotiate climate futures together. While delegates from the Global South (Annex II) were unsuccessful in holding the Global North (Annex 1) nations accountable for the "loss and damages" caused by climate change (a cause championed by the Tuvalu Islands), they were suddenly made available to $100 billion per year as part of the newly established Green Climate Funds[50]. Peru would have been a country that would benefit from this, but they are also OECD aspirants[51], so other countries mostly took point in these arguments. This money could theoretically be used to help the country prepare for the worst anticipated impacts of climate change, while also developing markets for carbon sinks, and sustainable industries. Peru was one of the countries who first requested these funds, and was heavily criticized. Annex I

[50] This was the anticipated financial figure as of 2014

[51] The Organization for Economic Cooperation and Development is an international economic development group that was established after World War II to facilitate the Marshall Plan for global reconstruction. The group now functions as primarily an international finance group, driving economic development policies that match the goals and values of the organization. Full member countries include mostly European nations, the United States, Japan, Israel, Chile, Colombia, Mexico, Turkey and Korea. To become a full member entitles a nation to specific benefits that nonmembers are prevented from accessing.

countries accused Peru of not investing their own money to solve their problems, by focusing on small scale solutions that were fractured[52] around the country, instead of centralized for the nation. Somewhat ironically, they were also criticized additionally for not turning sustainable development measures over to the private sector, since money from the state was considered less sustainable than private partnerships. They were both too invested in the wrong ways, and not invested enough. The International Monetary Fund (IMF) explains that to have access to green bonds and green finance (to be able to use debt capital markets to fund climate solutions), requestors of funding "gain authority by assembling teams of top scientists and leaders to develop and promote rigorous standards and by winning the endorsement of a critical mass of issuers and investors" (IMF). In other words, projects needed to be scientifically driven, demonstrate advanced capabilities, and be charismatic enough to win over whoever happened to be on the board making decisions that day in order to access these global chains of credit. Science provides transparency in investor asset assessment, proving it to be "credible, science-based, and widely-supported" while also being eye catching enough to excited potential investor groups (Climate Bonds Initiative 2020).

So the day after COP ended, December 13th of 2014, INAIGEM was founded. The explicit goals were to research, understand, and write policies that protect Peru's natural resources of biodiversity. The production of *sustainable* climate change adaptation, as determined by international monetary and finance organizations, shaped the form that Peru's own adaptation would take because without it, they would be denied access to the now $31 trillion dollar industry[53] of investment. The restrictions on what counts as responsible sustainable development (not the

[52] By fractured, they mean disjointed, and in places all over the country, not centralized or interconnected in some way.

[53] This is the estimated financial figure as of 2020. It has grown larger than ever imagined.

small scale, and fractured projects Peru was previously accused of[54]) dictate the possibilities for Peruvian development, ensuring the reproduction of neoliberal state formations through even the worst climate catastrophes. Large scale, large budget performances of Science, such as the Huascaran expedition, fit into the acceptable rubrics for national climate change interventions, and sensational stories could mean millions (if not billions) for the country.

Additionally, in order to access big green money, countries are required to demonstrate that they understand how climate change will be affecting the nation. In the performative life of data, the production of knowledge is additionally used to demonstrate due diligence of research, the more technological, the better. The pursued partnerships between the state and neoliberal finance institutions (who have the resources to survive climate change) determine climate change adaptation constraints in Peru, and actively reproduce the state as a neoliberal operation. The productions of national commitment, technology, and of knowledge enable access to a green Economy. Of course, the catch is that this money comes from multilateral development banks and Annex 1 countries and does not arrive as a check to cash; it comes in the form of concessional or traditional loans, bilateral or multilateral subsidies, debt swaps, guarantees, risk transfer instruments, green bonds, and/or blended finance. It takes a creative mind to build and install a flood alarm system that could save 150,000 lives with blended finance (and it has yet to be accomplished), but the form of the neoliberal state will be resilient in the face of climate change. It explains, at least in part, why the manager of the climate change research and policy organization for the country would be a former mining big-wig. The state might even make money. Green finance structures projects such as the flood alarm system to be an impossibility, left to foreign

[54] According to the Green Economic Consortium of the EU

scientists to spend their NSF budgets on. It is futureproofing the Economy, but not economic life (or even bare life).

Huaycos

There was a line around the Banco de Credito del Peru in Huaraz but no money left in at any of their ATMs. Nor was their money in the Interbank or the BBVA ATMs across the street or around the corner. People were lined up for blocks to access their money through a banker, but people were being turned away. There was a nationwide disaster underway, hitting Huaraz especially hard, and people were panicking.

Owing to a dangerously heightened El Nino effect, Peru's 2017 rainy season was devastating. The increase in surface temperatures over the ocean contributed to larger, wetter storms that flooded the country for weeks. So much rain fell that the foundational earth liquified under massive infrastructures, mud rivers flooded into homes and shops, roads along waterways and mountainsides collapsed in metric ton chunks. From the end of January to March, there were over 200 huaycos, or mudslide floods, that were registered across the country in nearly every region – though some had it worse than others, having been buried completely by debris (Relief 2017). Dams burst, sewage systems were swept up into debris, billions of dollars of major infrastructure (bridges[55], trains, highways) were all destroyed. One hundred and seven people drowned trying to flee meters of flood waters and landslides, and over 200,000 people were reportedly left homeless, though the nonreported data is likely worse (El Comercio 2017). Almost immediately, some regions saw an increase in infectious illnesses typically contained to wetter

[55] There was an additional political drama that played out over the collapse of a bridge in Lima that was built in 2010, while bridges from as far back as 1610 were still standing. This led to numerous accusations of negligence, corruption and mismanagement of public affairs, the upseating of major politicians, and the incarceration of the indicted.

regions, such as zika and anthrax, and the higher altitudes who never had to face such problems were dangerously unprepared.

In Huaraz, the regional capital of the glaciated Cordillera Blanca region, foreign tourists, scholars, and expatriates were evacuated by plane to the safer, wealthier regions of Lima, while everyone else in the area was rendered immobile and silent. In addition to the lack of power and running water in much of the region, every major road leading to and from the region had collapsed. Internet lines, and cell phone towers were destroyed. Access to clean water was a primary concern. The huaycos damaged or contaminated water supply lines for thousands of people with mud, rocks, and debris. This made clean, potable water scarce, even though people were otherwise surrounded by water. Workers from INAIGEM tried to conceptualize a plan to move overfull glacier water by the truckload to affected communities, but it proved too dangerous, expensive, and bureaucratically slow of a solution – another problem of too much water, but not the right kind, and highly technical solutions bounded political red tape.

Banks ran out of printed money from panicked people trying to take out the maximum allowable daily cash allotment. And resources upon which the region relied were prevented from arriving, including food and fuel. Stores downtown began to lose stock of nonperishable foods such as dried ramen noodles, canned food, rice, and other regional imports, and shelves started to empty[56]. Store owners began to charge more for staple foods like chicken, which was more than ten times more expensive than usual, pricing people out.

As anyone familiar with environmental justice histories might rightly assume, the huaycos produced disproportionately harmful effects on poor, campesino, and Quechua indigenous people

[56] The Covid-19 panic buying and social shut down are the only other time in my life I've seen goods completely fly off shelves, though the items were markedly different. No one in Huaraz was mass buying toilet paper and hand sanitizer, and instead bought bottles of water.

throughout the Cordillera Blanca region. Agriculturalists who lived near water resources experienced massive flooding. People who bought cheap land tended to live at dangerous river junctures, or on unstable foundations that were washed away. Pastoralists who lived entangled lives with animals lost hundreds of companions. People higher up into the hills were additionally cut off from the cities below since the shoddy roads and cheaply built infrastructure crumbled[57]

Figure 69 Water wends through the rural areas for agriculturalists and pastoralists, heightening the dangers of intense flooding

Aid tents were set up in the central Plaza de Armas, by local organizations where people brought purchased, donated and shared, clothes, water, and medicine for those affected. Volunteers organized the materials into categorical stacks, as hundreds of bags of material rolled in each day.

[57] Out of 140 countries, Peru is ranked 89th in terms of national infrastructure capacity, made worse in rural areas. With over ¾ of the country's population living in urban spaces, people in rural areas hardly experience any investment in infrastructure that would keep them safe and improve their quality of life. For instance, before the huaycos only 2% of the rural areas of Peru had safe drinking water, regardless of the government publicly declaring water as a human right, with a week's worth of celebrations.

People who owned hearty trucks and all-terrain vehicles volunteered to circulate internally for the weeks that we were all cut off, as local volunteers tried to reach people in the more remote regions, while waiting for the roads to reopen to the more hard hit parts of the country. Much of the immediate aid and relief to people was provided by volunteers, through individual or family donations, and by the acts of neighbors taking care of one another. Unfortunately, many people still died.

Because of the huaycos, all of the roads leading in and out of the Andean region were completely destroyed. There was no way in or out. Geospatially interconnected economies were hurting, such as food production, fishing, and the largest industry in the region: mining. On a good year, Antamina's operations generate annual export earnings exceeding $950 million USD. So for every day the transportation of materials was closed, the company lost millions of dollars (Shalizi 2003). Deciding this loss was too unacceptably expensive, Antamina donated their geoengineers[58] and their technical equipment (bulldozers) to build exactly one new road, opening up their mineral transportation route to the ocean to move their exports. Because of the road's instability[59], it was open only to employees of the mine and pre-approved, absolutely essential government and aid personnel (it essentially functioned like a private space for business, making an exception for extreme government need). It was over a week before that road was open to pre-approved busses that would move regular people wherever they need to go. All of the other major roads leading in and out of the region (including the one connecting to the region to Lima) were all still destroyed,

[58] People in communities affected by mining complained that the jobs of rebuilding roads should have gone to local people long affected by mining contamination, downstream from the mine. Napoleon Perez Saavedra, the President of the community of San Pedro, released a public statement on behalf of his community, stating that they requested temporary jobs to alleviate their destroyed economy, but they never received a response.

[59] They publicly feared the road might collapse again (which it did at least once).

and they remained the problem of the government. Weeks passed before full mobility to the region was restored for everyone else.

Figure 70

Figure 71

Figure 72 The entire road washed away from the force of the rain, building a new river through the campo

After reopening the one road they needed to reopen the Economy, Antamina released several press releases about their commitment to helping Peru through this environmental disaster. Along their mineral transit route, they made sure that people had access to water through the donation of water bottles, and by rebuilding destroyed city water pumps. They volunteered the use of their generators, motor pumps, back hoes, tippers, front loaders, and other equipment. In a press release Antamina reported, "The most notable thing yesterday was that a 50-meter long riparian defense rock wall could be built with which to control a possible new overflow of the Huarmey River. This work has been carried out with the companies OHL and Atlantic, strategic partners of the company." Not only was Antamina invested in reopening their supply lines, but they were futureproofing them. With the right investments and built infrastructure, business would not again be threatened by the future possible threats of climate change. Antamina additionally posted press releases on their website about the affected towns rebuilding, "Huarmey Hospital will be a reality," about projects they had nothing to do with.

Statements were made from various national and regional government offices, thanking Antamina for their contributions, and the media celebrated the new private-public partnership as a mark of a modern response to climate change. Newspaper El Montonero reported, "Huarmey can be an example of a true alliance between the public and the private… There is no doubt that the company deserves applause." Of course, they earned more than applause: they also earned tax credits. In their 2017 sustainability report, Antamina noted, "Our work with municipalities, regional government and ministries under the scheme of Public Works for Taxes, has permitted [these] communities [to] accelerate in their path to development" (Antamina 2017). Their widely celebrated contributions were framed as a mark of a developed state who had excellent relations with their private partners that helped them reopen the Economy in the midst of a disaster, but it

cost the nation money it would have earned through taxes, and during a year when resources were already unacceptably tight. David Harvey argues that under neoliberalism, "The state has to be concerned, for example with the quality and integrity of money. It must also set up military, defense, policy, and juridical functions required to secure private property rights and to support freely functioning markets" (Harvey 2007, 22). And in the case of Peru, the state must fortify private markets affected by climate change.

Unfortunately, Antamina also produced incalculable harms during the Huaycos (which goes against one of their Sustainable Development Goals listed on their website (reconciling harm done to indigenous communities). Somehow during the huaycos, the company failed to safely secure their large depositories of toxic waste that had become inundated with water, mud and debris, and washed away into the disaster flows. People who lived downstream from the mines reported copper concentrate and cyanide waste spreading into their communities through mudslide floods, affecting people all the way to the Pacific Ocean. Reports of mining waste in huayco water circulated over Facebook networks[60] as people reported on the mining contamination in their own communities. There were pictures of desperate parents carrying sick children into overfull hospitals, pictures of elderly people in face masks being treated by medical professionals, and pictures of the purported mining valves and contamination monitoring stations destroyed beyond any legibility. In addition to mining heightening the effects of climate change in the region[61], climate change was likewise heightening the historical effects of mining. People in these same

[60] Some people still had access to the internet through their phones, especially if they used the Bitel service that connected through satellite connections and not cell towers. This was one of the cheaper services in town, and it happened to be the one I used, and regularly cursed – except during this time.

[61] The mines were indirectly responsible for the rapid arrival of black carbon producing, fossil fuel dependent industry in the region (and all of the accompanied "development" infrastructure, including roads, cars, and various other regional technologies that produced GHGs, producing somewhat irrelevant global atmospheric carbon levels, but locally significant black carbon that coated nearby glaciers, melting them faster.

communities complained for decades about toxic pollution, even winning court cases against them, without ever seeing the payouts they agreed to. Like many mining complaints in the region, however, the evidence of contamination in this case was visual and visceral, but not scientifically substantive enough to warrant a governmental response[62], and Antamina began by accusing the affected people of lying, then later pivoted,

> "We have received inquiries and known testimonies regarding copper concentrate and its alleged effects on people's health, following the breakdown of the Antamina pipeline caused by a Provías contractor...we want to be clear in reporting the following:
> 1. No mineral mined and produced in Antamina contains mercury. Consequently, it is not possible to speak of contamination due to this element, or of its presence in the mineral that has escaped.
> 2. The so-called "orange book" of the United Nations does not consider copper concentrate in the list of dangerous substances for land transport.
> 3. It is known that several people came to the Barranca Hospital to receive a preventive medical evaluation. At the close of this communication, all had been discharged.
> 4. We reiterate that the copper concentrate that escaped from the pipeline did not reach any body of water. Likewise, we would like to inform that the cleaning works have begun in the area.
> 5. Antamina will continue to be vigilant and willing to take the necessary actions to minimize the impact of this event, caused by a third party.

The condescending and defensive tone of the response, never addressed the complaints people had of copper concentrate making people sick enough to go to a hospital (safe for land transport is not the same as safe to ingest or be exposed to, and being released does not mean was not treated), and the entire statement relies on technicalities to produce a narrative that says they are both not responsible for this problem because it is not a problem, but also they are looking into it because they are a vigilant company. The issues with the contaminated communities lasted barely a news cycle, people were never compensated.

After these events, Antamina began to work closer with the state on various environmental projects, mainly focused on climate and conservation. They donated funds to various projects, including the Huascaran National Park, environmental education, and to INAIGEM (the National Institute for Research on Glaciers and Mountain Ecosystems – the country's climate change

[62] In other words, there were no scientists on the scene collecting verifiable data that could be used in court.

adaptation and policy organization under the Ministry of the Environment), building environmental care into their investment profile for charitable causes. Their investments supported the same types of decidedly antipolitical, STEM research mentioned in the opening section of this chapter, at the glacier meeting, additionally laying the groundwork for broader green finance engagement.

This section highlights how, in the midst of disasters, industries that already produce harm in the region have heightened effects owing to climate change, without recourse from the neoliberal government. It highlights how public-private partnerships actually end up costing the state money, and how even in a nation-wide disaster, the Economy still takes precedence. The prioritizing of the mining closure crisis over the mining contamination crisis -- and throughout the broader huayco crisis – reflects and discursively reproduces the neoliberal Economy as the object at risk, the most important thing for the state to protect and futureproof.[63] Through the handling of climate change disasters, the state solidified relations with extractive industries, provided financial incentive to remain in the region, and even failed to prosecute environmental crimes. The neoliberal state is not only present, but finding ways, even in disaster, to solidify commitments to private enterprise.

Analysis

I will return to the meeting at the beginning of this paper, to demonstrate that these are not analytics I came up with, but they were revealed through ethnography. As the meeting between the scientific researchers, the Director of the Huascaran National Park, and the public continued, people pushed back on the idea that there was some sort of separation that made sense between

[63] See also the U.S. handling of Covid-19

caring for the environment under the realm of science (for climate conservation) and caring for the environment as a lived space (as a space greatly impacted by the economic domains of mining).

To begin with, melt, the geomorphological problem entangled with all life, is one of many symptoms which result from the contamination of the globally common atmosphere through the reckless industrialism of the Global North (Chakrabarty 2012, Latour 2014, Ritchie & Knight 2015, Haraway 2015, David & Todd 2017). Conversely, melt, the technical scientific problem, is a result of the historically strategic de-politicization of Scientific environmental management, as we see contested above (Schmidt 2017), made possible in Peru after a long history of uneven world relations (Rodney 1978, Escobar 1990, Galleano). These two avenues through which climate change politics are obscured additionally pivot away from the reality that climate change adaptation is being used to reproduce the neoliberal state.

Even though the meetings provided public discourse marking the boundaries for what state responses to climate change would look like (antipolitical, scientific, technocratic), lived experience collapses these boundaries. People resented the trickle-down, Economic aid they were offered, and refused to accept that a culturally situated, neoliberal scientific management was an answer to the problems that they were facing. Neoliberalism is a project: incomplete, processual, requiring continued investment, labor, and discursive work. What I have discussed here is emblematic of how climate change adaptation is operating in partnership with neoliberal systems worldwide (including extractive industries, like mining), futureproofing industry and reinforcing neoliberal relationality. As seen through the ethnographic components of this dissertation, the production of scientific knowledge and the management of disaster are both entangled with these forces, and are becoming distinctions in the mark of liberal governance, driven by values of rational, liberal and scientifically technical achievement while also ensuring the upper

redistribution of wealth. These processes and performances reveal the incomplete and ongoing project of neoliberalism, now reproducing through climate adaptation strategies – and highlight ways that the state is deepening its commitments to mining and science simultaneously, bolstering one another through economic futureproofing.

CHAPTER 5: Rejecting the Beneficence of Scientific Governance

Chapter Summary

This chapter returns back to the work of science as a tool for climate change adaptation, and examines why it is people are both rightfully skeptical, and in open conflict with some of the projects taking place in the Andes. I argue that contrary to popular responses from scientists, the media, and the government, people are not scared of science because they are superstitious, are climate deniers, and do not understand what is being brought to them. They are not trapped by uneducated, local understandings. Rather, they have a deep historical knowledge of how the patterns of purportedly helpful science have affected the region. This chapter examines ethnographically elucidated moments of resistance to better understand how it is that science is not always the natural ally to climate change adaptation.

Sabotage!

The summer of 2016 stretched into November. Typically, the dry season lasts just three to four months every year during the summer, from May until August, but there was still not a cloud in sight, and no sign this drought would end. Land was growing arid. Waterways were thinner. And seeds planted in anticipation of the rains in August hardened and lay ruined in hard worked fields. Some people had waited, well past the seasonal time to plant, afraid something like this would happen – while others lost a season's worth of food. Hot winds rattling dry land led to wildfires raging across the entire country. Government officials in Lima declared a national state of emergency: agricultural plots burned from wildfires, killing plants, animals, and even a child.

Rumors circled through dinner-side gossip shares that people were growing desperate. There was a body found in the river, which I was told is believed to bring the rain. While farmers actively

burned refuse to seed new clouds; they would become so full they would have to burst with rain. Smoke filled the valleys of the region for weeks as people desperately burned whatever trash and organic matter they could find, but there were no clouds to swell, just haze[64]. Multiple people in the campesino and indigenous Quechua community I lived told me that in countries like Bolivia, where they are more respectful of Mother Earth, they're not having the same problems in their mountains. Where people successfully defended from mining, they are not being punished the same way.

Figure 73

Figure 74

In the early morning on November 24th, people from the small Cordillera Blanca villages of Hualcán, Shilla, Pariacaca acted in response to worsening environmental conditions. Just before sunrise, dozens of people marched up dirt roads, continuing onto hiking and cattle trails, through agricultural fields and wide grazing pastures, all the way to the lake that sits above their communities. I learned through interviews, Facebook accounts, newspaper stories, and *chisme*[65] that the group of mostly men gathered in a circle to address their concerns about the rain with community leaders and the *alcalde*, or mayor of the province, Jesus Caballero. They sat on large boulders, discussed, debated, argued, and shouted over the fate of an enclosed small metal box, a

[64] And terrible allergies

[65] Gossip chains

solar panel, and an antenna that arrived Swiss researchers put it there in 2012. They dismantled the pieces, and did a pretty thorough job making sure that it was impossible to put back together by smashing key components. The group ultimately decided to completely destroy it, though accounts differ on who did what, and in what order. The alcalde claims to have been there only to lead by listening, but people I interviewed insisted that he helped to galvanize the crowd, and one person swears that he helped in the dismantling[66].

Some people who participated were certain that the equipment they destroyed was the cause for the drought. Building on that belief, some people additionally thought the anti-rain equipment was probably the property of the mining company across the valley. Speculations flew: maybe it could increase their productivity and profit margins in the open air pit mine if the rains never came back, maybe they were expanding again without warning, maybe they already started operations and no one noticed. Others, unsure of the mining connection, didn't know why it was there to begin with: they were never consulted, they never asked for it, and it was on communally shared land. Sure enough, after the destruction, the rains arrived the very next day, swelling into the disastrous huaycos from Chapter 4, and didn't stop until May. This chapter puzzles over this event, and additional scientific sabotages, and interrogates why people would destroy scientific instruments – especially those intended to help with climate change effects.

The equipment that was destroyed was the only flood alarm system[67] in place in the Andes, which could warn people below if an overfull meltwater lake were to burst. It was developed in partnership with the Swiss Development Cooperation, the University of Zurich, and the

[66] The Alcalde eventually went silent on social media, making all of his accounts private, because of all of the harassment from people calling him a dangerously ignorant campesino and insisting he resign (these were not his constituents)

[67] Communities across the Cordillera Blanca had been requesting some sort of flood warning system for over a decade, but almost no one had access to one, save for Carhuaz. Larger, more populated cities with over 100,000 people still did not have a reliable system.

international NGO, CARE Peru, in response to the increased risk of disasters near melting glaciers. It was designed by scientists to better prepare people who live below swelling lakes from outburst floods that threaten to drown thousands. In 2010, a rock-ice avalanche lodged a piece of debris into the glacier lake, so powerful that it generated a 24 meter high wave, overtopping the dam, and creating a small mudslide flood. Thankfully, the damage was minimal; mud slid downhill and mostly covered the grassy pampa below. No one was injured or killed, and it could have been a lot worse. But because of events like this at Laguna 513, Swiss scientists who had long studied glacial lake floods and who had previously conducted research in the region, identified the community as being in need for this type of equipment. To the scientists, local government and partner organization, CARE, preparing for incidences like this is essential to the adaptation process, whether or not we accept the inevitabilities of worsening climate change.

The equipment that was destroyed could have potentially save the lives of the 6,000 inhabitants of the city at the bottom of the mountain, Carhuaz, who lived within an earshot of the alarm at the bottom of the mountain. If an outburst flood were to happen at Laguna 513, sensors would detect it, sending a signal to the data center in town. Operatives would then sound the alarm, or begin the mass texting program designed to warn people to flee their homes to get out of the way of oncoming debris. But the alarm did not reach far, and if people did not have a cell phone or know how to join the mass texting list, there were no safety measures for them. The mostly Quechua-speaking, agricultural and pastoral communities between the city and the lake would never be warned. The equipment was on their communally shared land, but it did not serve them.

In addition to simply acting as an alarm, the overall project helped scientists more broadly to develop flood scenario models, which they shared with targeted local decision makers[68].

[68] a term used by scientists in reports and in during interviews referring to the government officials who work out of the municipal office in Carhuaz

Together they trained more than 90 public officials, university professors, and agency staff on the harms of climate change, adaptation, and risk management measures as a best effort to help the region prepare for any potential disasters (Hill 2006). They also helped to develop educational curricula so younger generations would also have access to this knowledge (Frey, et el. 2014), and could potential share it with their families at home. University of Zurich glaciologist and project contributor Christian Huggel says of the $65,000 project, "[it's] the first of its kind in Latin America, especially in its social aspect of training leaders and strong local inclusion" (ibid). The goal for the project was to share as much knowledge as possible with affected people, to model disaster scenarios, and to potentially save thousands of lives. Unfortunately, it is impossible to reach everyone with every initiative, and while tremendous effort was made to reach as many people as possible, communities between the lake and the city below were ostensibly ignored in this process. It was the communal land of these specific communities where the equipment resided.

A further goal of the project aimed to explore opportunities for public-private partnerships, including industries of hydropower production "for the community". Huggel argued, "This aspect of the project is founded on the belief that the private sector should be more involved in local communities' climate change adaptation, especially with concerns of funding," he hoped it would help sustainable development and remove the local dependence on international aid (Hill 2016). Scientific aid was arriving with cultural beliefs about economic models that should be enacted to support the expansion of further scientific environmental management.

After the sabotage of the very expensive equipment by Laguna 513, Facebook was alight with complaint stories from scientists I knew from working in the region of having to "deal with" locals while "just trying to do research." They were frustrated by "local ignorance" when they were "just trying to help." People shared stories of various forms of sabotage and threats they had

experienced or heard about while working in the region, while others piled on in frustration. Local Ancashino[69], Huaracino[70], and national news outlets framed the events as a problem of governance: the issue was that indigenous people were dangerously uneducated, and the answer they proposed was stronger governance and a militaristic, guarded presence in the region of crucial climate infrastructure.

Because of the international interconnections of this specific event, articles appeared in the New York Times and the Guardian, also lamenting the loss of the alarm system. The New York Times piece called the saboteurs "climate change deniers, similar to what we have in the U.S." indexing that they were anti-science for attacking a scientific project. Apart from being wholly incorrect in their analysis (I did not meet a single person in Peru who does not believe climate change is happening), these responses were worrying. Before diving into the argument, I want to explicitly state that none of the hundreds of people I talked to in the Andes during my 18 months of fieldwork doubts that climate change is happening, nor do they personally know anyone that doubts it. People are grappling every day with drier plots, while watching people at lower altitudes abandon farms to become unofficial, unrecognized climate refugees in already overfull major cities. Just by looking, people can see that glaciers have melted. They know that many of their grazing animals are starving from the disappearance of feed grasses and endemic species of flora. People remember glacier lakes bursting just decades ago, and see that they've grown dangerously overfull since – some 34x as full as they were in 1970. People do not doubt the importance of understanding this phenomena, even if mutual understanding is not happening.

[69] The province

[70] The province capital city

If people disagree with the choices of scientists, they are publicly labeled ignorant, anti-scientific, climate deniers, and judged as being unworthy of further aid (see also Mauna Kea, Karse 2012, Matthews 2017). Quick accusations of locals as "backward" and ignorantly attacking the purportedly-neutral scientific aid offered to them, illuminate social, political, and economic issues that arise in climate adaptation projects, especially those designed by countries in the Global North and implemented in the Global South. As I argued in the previous chapter, people have been critical of projects enacted by the state that work in service to the protection, reproduction, and security of neoliberal state organizing, institutionally defining climate change adaptation as an economic puzzle. But as I will highlight in this chapter, climate change adaptation, led by scientists have also fallen under critical scrutiny. This chapter traces that scrutiny, and reveals how, contrary to popular opinion, science as it is practiced is not always the natural ally of people experiencing climate change.

Historically, science projects have contributed to the environmental conditions that are now being exacerbated and made dangerous through climate change (namely, the loss of water, land, and the increasingly rapid melt of glaciers). And presently, projects are also creating problems (which I will outline below). This chapter attempts to make sense of these relationships, first by historically contextualizing the relationship between science and the exacerbation of climate effects, second by ethnographically examining more contemporary conflicts between scientists and affected communities, and third by concluding with the complex desires of communities, climate activists, and anti-mining groups that are both local and grounded in a global, political and economic understanding of the mechanisms of climate change. This chapter highlights that specific forms of scientific projects (predicated on expertise and liberalism) are not always an ally of

climate change adapters, and showcases methods for adaptation that rely on ways of adapting otherwise.

This is not a chapter on how culturally and politically produced scientific *universals* are picked up in global frictions (Tsing 1993), but rather how they are rejected. Comparable to the foot dragging and peripheral acts of resistance done by peasants to state actors in Malaysia (Scott 1998), this chapter examines sabotage as a form of refusal by the mostly indigenous Quechua and campesino inhabitants of the Cordillera Blanca region. The acts of resistance I follow highlight a rejection of the folding of life and land into liberal formations in exchange for safety from climate chaos (especially since that chaos is understood to be created by the same people trying to help). By liberal formations, I point to a way of organizing life that ideologically conceptualizes and manages lived spaces as empty sites of *nature* (Cronon 1990), that culturally manages land, water and glaciers as natural resources, and that values Science, rationalism, and experts above more egalitarian forms of social organizing. Additionally, this chapter will contribute a deeper, historical understanding of how science and forms of liberal governance have long been part of projects of dispossession and institutional gaslighting that have affected peoples lives for centuries, making clear the stakes of the political negotiations at hand.

STS scholars have long conceptualized the co-constitutive relationships between science and social, political, and economic institutions. As Sheila Jassanoff writes in her book about the entangled science-law nexus, Science emerges "not as an independent, self-regulating producer of truths about the natural world, but a dynamic social institution, fully engaged with other mechanisms for creating social and epistemological order" (Jassanoff 2005, xv). Science not only contributes to politics, economics and cultural worlds, but is constituted by them. This is made especially clear through the production of natural laboratories (Quiroga 2009), or the

transformation of lived spaces into sites of study for experts, many of whom don't even live in the region. Diego Quiroga writes about how the production of the natural laboratory produced troubling effects for the residents of the Galapagos Islands, diminishing subsistence industries and transforming the island into a tourist destination rather than a place where people live and have lived for as long as anyone can remember (ibid). This chapter highlights that not only does the production of a natural lab produce effects[71], but it is deeply constituted by uneven cultural, economic, and international political relations and driven by a politics of liberalism, modernity, and capitalist logics.

"The Geologists Came First"

I cannot remember how we met, but I have been friends with Gary now for over five years. I remember feeling suspicious of him at first, since he worked for the mining company, Antamina, but he loved to gossip, seemed to know everyone, and he had great stories. Gary was in his 60s, he had worked in Los Angeles in the entertainment industry for most of his life, and he now had a young son in elementary school with a Peruvian woman he met on vacation. He stayed in Peru to be close to them, it's why he reluctantly took the job of document translator for the Canadian mine, Antamina[72]. The mine provided free housing for all of their foreign employees in their Huaraz compound, El Pinar, which was an 8 hour bus ride away from his son in Lima, who lived with his mother. His son was somewhat of a surprise, but his birth was an opportunity he didn't expect, and a chance to build new foundations for himself later in life. Together they traveled throughout the Cordillera Blanca on school breaks, with Gary teaching him how to fish, climb, and value the more

[71] Such as emerging labor fields, the closing of porous borders to traditionally accessible places by the state for scientific studies, and the enclosure of grazing pastures for pastoralists, just to name a few

[72] Antamina is one of the ten largest mines in the world (Antamina 2020), producing copper and zinc on the south east side of the Cordillera Blanca.

rural parts of the country. Gary is conversationally playful, dry, and absolutely aware of how harmful mining has been to this part of Peru, but he needed a job and needed to be close to his son.

Over a cup of coffee in the yard of his three-bedroom, gated apartment in the El Pinar compound, we discussed the history of the Antamina mine that owned this property: "The geologists actually came first!" He explained that before the mines were established, a wave of scientists arrived from Canada and the United States, hired to conduct land surveys. They studied and modeled the topology of the region to understand the risks and hazards of earthquakes, floods, and to find veins of valuable minerals that could be extracted. The scientists generated maps that were shared with the Peruvian national and local governments. The maps revealed which parts of the region were at greatest risk from glacial lake outburst floods, they highlighted which mountain tops would be the most seismically sound in the instance of an earthquake, and they traced the veins of natural resources below the surface of the earth. The mines bought all of this safe, valuable land, enclosing it behind gates while setting up open pit mines near peoples communities, agricultural plots, water sources, and homes. The anti-mining activists I interviewed, who supported the sabotage at Laguna 513, also remember the scientists first. Scientific endeavors have been intimately connected in this region with dispossession and the expansion of the extractive neoliberal state for generations. Part of the incompatibility in the region stems from failing to recover these relationships. Below I will outline the harm that was done by first ushering in scientists, and then later using the tools of scientists to institutionally gaslight people, preventing them demanding recourse for mining contamination. I speak of science here as a monolith, largely because of how it is experienced. I cannot remember the amount of times that, when asked why equipment was present, something was enclosed, or people were policed in the park, that I was

told “it’s something for science” – and it was left at that. People most typically encounter science through objects, policies, and projects, but they rarely encounter them as people in the campo.

Figure 75 Views from El Pinar

Mining History, Before and After the Geologists

While goods and services moved across the continent for centuries before colonization, exploitive international extraction began in the 1500s, during the Spanish conquest. The 95 year old empire, Tahuantinsuyo, or the Incan Empire, was militarily conquered with the help of infectious diseases to extract gold for Europe. Throughout colonization, these industries expanded to include sugar, silver, zinc, uranium, tin, guano, nitrates, nature, and the value produced by indentured labor. After independence from Spain, many of these relational patterns remained the same: community lands were taken over by large land holders interested in getting rich on the international market, and who had access to the expert tools of the state that determined property

ownership. While people in the Andes had lived communally for as long as they could remember, in the high Andes, few people had officially registered their lands with the national government, making them available to the first land baron that claimed them. People who had lived communally for generations were then expected to manage and produce on lands that they didn't own for survival, while the wealthy descendants of the Spanish and people from the capital grew richer and more powerful through systems of exports. These patterns of this hacienda system extended across the country, ultimately resulting in a sweeping agrarian reform movement.

The agrarian reform of the period between 1960-1980, dismantled the exploitive hacienda system and fought to redistribute land to their traditional owners, communities. Led by the vanguardist Marxist-Leninist-Maoists, the reforms aimed to transfer land holdings back to communities not just as a project of economic and environmental justice, but in the hopes that they would produce goods more efficiently by combining communal practices with new technologies. The new left government promised education, innovation and new technologies to help the entire country shift through Marx' predictive stages of economic evolution, getting them closer to their goals of a utopian communism. But these goals were never realized, many were killed in the civil war (most of whom were indigenous people and campesinos), and the country's economy completely fell apart. Inflation was thousands of times higher than economic worth. And the Andes were subsequently institutionally abandoned (Borg-Rasmussen 2017) until the 1990s, when neoliberal economic development projects exploded nation-wide, led by science, technology, and neoliberal economic reach.

Then came *Fujishock*, or the political and economic doctrines of Alberto Fujimori, the country's President in 1990. After meeting with government officials in the United States and Japan, Fujimori was instructed to adopt a "relatively orthodox economic strategy" in order to

stabilize the rampant hyperinflation, otherwise Peru would receive no support from the international financial community. The IMF and World Bank demanded deep austerity measures, the opening of international extractive markets through privatization, the tamping down on indigenous coca production (a mostly Native industry) to prevent U.S. smuggling. And to accomplish all of this, he dissolved congress, gave the Executive branch all legislative powers, rewrote land reform laws, and opened the country up to finance (Peru Decree Law 25418). He privatized everything he could, removed worker and environmental protections and began to overturn land reform through natural resource projects. Through Fujimori's new reforms, all of the natural resources within the territory of the nation belonged to the state, including water and glaciers, and they could be managed and sold however the government saw fit. While people still may own their rights to the surface land, it is impossible to survive as an agriculturalist and pastoralist on the surface above an open pit mine. Fujimori additionally disbanded communal land ownership, encouraging individualistic property relations, making mining incursions harder to fight. If just one neighbor were to concede and sell their land, all of the water, earth and air would be contaminated for everyone living nearby. Communal property ownership used to prevent this, but under new forms of liberal governance, individual economic determination prevailed. Fujimori's new laws, in addition to the removal of environmental protections, changing land tenure, lowering international taxes, removing royalty fees, and liberalizing the market, all helped foster a new age of mining that boomed in the 1990s.

In 1994, international investments in Peruvian mining increased by 2000 percent (World Bank 2005, Bebbington 2007, Li 2015). This was when the geologists arrived. The mining boom of the 1990s was built on billions of dollars of foreign investment, showcasing the most modern, efficient, and technologically advanced projects ever seen. These projects were different from

mines in the past, that relied on pick axes and human labor. They were developed by scientists, used advanced technology, and were part of more modern markets (Li 2015). They also provided fewer jobs for people in the region who lacked technical skills and training, and relied instead on visiting workers from Canada and the United States. The chemicals the mines used to process on site were more technologically advanced but they were also more toxic, and they produced more wide-reaching hazardous effects on nearby pastures, agricultural land, and waterways. All of this was marked as the cost of great economic development, led by science, technology, and liberalism. Advancements in the sciences (including social science such as economics) were foundational to the neoliberalizing of the country that diminished investments in infrastructure, produced more localized pollution, and generally underprepared the region for the climate change issues to come.

Technocratic science was essential to the arrival and production of new mining forms in the 1990s, and it additionally played a role in preventing a just accounting of environmental destruction. People in nearby communities complained of poisoned pastures, sick and dying animals, and reported higher rates of cancers. But they had no scientific proof that it was the result of the mines. Elio, a 36 year old high alpine porter, remembers when Antamina opened up nearby. Some of his more distant family member whom he regularly visited lived just downstream, and he remembers the contaminated water. Walking along the river shore, following the path of the water where it connects to fresh junctures, you could see the difference. It had an opaque orange tint to it. He said the water felt warmer if you put your hand in it, but he wasn't sure if he was imagining it.

Figure 76 This photograph was taken by Oscar Vilca who works at INAIGEM, and it is included with permissions, originally posted on Facebook. The Rio Santa meets contaminants described as mining runoff.

In her 2009 article on the development of Environmental Impact Assessments, Fabiana Li wrote about how the development of environmental impact assessments made it impossible for people to make claims to the government of pollution. The laws required people to have scientific proof, as recognized by experts in the field, in order for claims to even be filed. Access to the content, language, and tools of science were already denied to a region that lacked elementary schools, much less complex technical equipment needed to measure contamination particles (PPI) from cyanide leaks. It took years for people living in affected communities near the Cordillera Blanca to make and win a legal case, dozens of people are still incarcerated for protesting, and people have still not been paid what they were promised in criminal and civil suits. The public-private partnerships of the state and mining were a core part of the project of liberalizing the economy, causing decades of destruction in the region. The history of the neoliberal state-science-

mining nexus, has since informed how people see, experience, and often worry about the arrival of foreigners conducting research, leaving machinery and enclosing space on communal land.

When climate scientists arrived in 2012 to place machinery on communal land above Carhuaz, people feared it was another extension of the mines – they'd already expanded without warning or local permissions in 2012, and their neighboring communities were feeling it. When the equipment was destroyed in 2016, this narrative of the equipment belonging to mining companies reemerged. People worried that the mines had an economic interest in preventing the rains, since it might correlate to greater earning for the open pit. They worried because expansions had arrived first with scientists, and science had long been a tool of neoliberalizing reforms in Peru that are inherently connected to the upward redistribution of wealth. Led by technological advancements from foreigners, science has been at the forefront of every major environmental problem that communities have had in the region for decades, by both neoliberal and vanguardist left governments alike. The projects made possible by science have resulted in contamination, dwindling clean water and land resources, and the increased melt rate of glaciers coated in locally produced atmospheric black carbon -- all of which are compounded by climate change. I do not meant to suggest that science should never happen in the Cordillera Blanca, or that there is an impossible to rectify dilemma here, but rather, the techniques employed by scientists (leaving equipment, not understanding how communal land works, not expressing respect for *tirakunas* – the more than human actors) all mirror historical patterns and express specific values and ideologies from the scientists themselves, which I will explore in the next section.

The Natural Laboratory

I was accompanying a research team on a nine-day research expedition into one of the Cordillera Blanca's valleys when a scientist from a U.S. university encountered a destroyed

exclosure she had made just a couple of years before. The wood and wire fence enclosed an area maybe 400 square feet to keep grazing animals and trampling humans out of this specific area for study. Her hopes were to better understand how climate change was impacting the flora of the region by isolating some of the variables: she wanted to know just about the region's biodiverse nature, without interferene from the people who used the space.

She was visibly upset. Her and her team had spent hundreds of dollars of their own money on this project. Rebecca was in her 40s, and her and her partner visit the region annually to study the effects of climate change, paying out of pocket every year. She is dedicated, successful, tough and absolutely brilliant. With the exclosures she built, she hoped their data could be useful to the Huascaran National Park managers whose budgets kept them from being able to do their own studies of this kind. She was also frustrated because she had done her due diligence by reaching out to officials through the proper channels. While she traveled to the region on a tourist visa, she had partnered with the Ministry of the Environment and the Institute for Research on Glaciers and Mountain Ecosystems (INAIGEM – the national center direction climate change policy) to gain official permissions for her projects. But that did not protect their research.

This wasn't the first time that she had an experience like this. Years earlier, her research team set up exclosures in other valleys that, even under the surveillance of camera equipment, was destroyed. They assumed the camera and pieces were stolen and later sold in town. Multiple scientists I have talked to in the region report similar crimes: people have destroyed their equipment, started arguments, and even threatened people with violence if they ever came back and tried to build things on their communal land. In her frustration, she called whoever cut the fence short sighted: the data being produced would be able to help experts better understand regional desiccation patterns in the future. It might help the region better adapt to climate change.

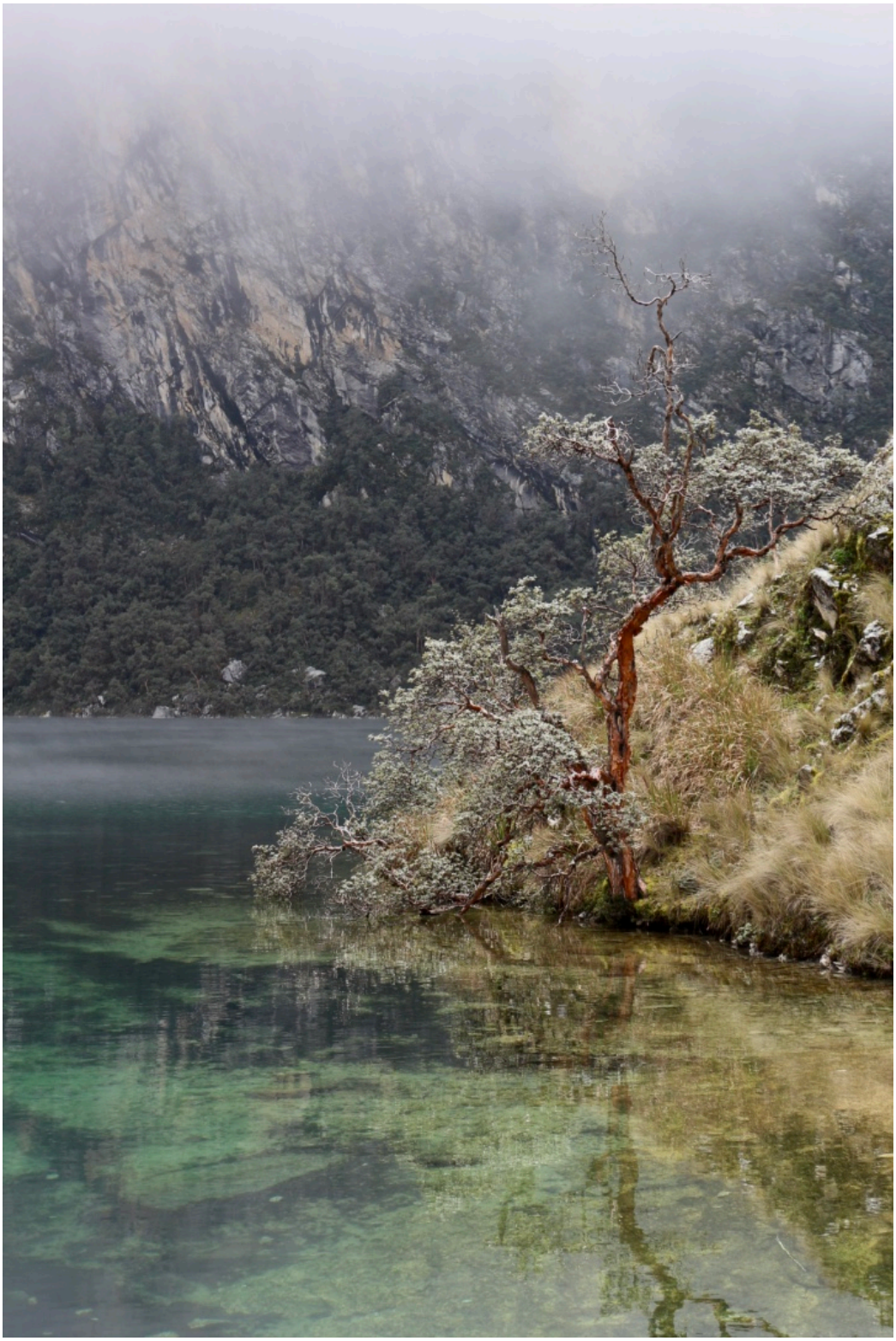

Figure 77 The Polylepis tree is one of the species endemic to the high Andes that people are worried will disappear owing to climate change. They are a winding evergreen, with shedding, paper-thin red bark that grow well above the tree-line.

Pastoralism has existed as a practice for centuries in the Andes (Dransart 2018). People have relied on the existence of wild pastures to feed herds of animals such as llama, alpaca, and (after colonization) cows, sheep, donkeys and mules. This work is traditionally done communally, splitting duties between neighbors, friends, and extended family. In part, this is because it is highly unlikely for any one person or family unit to own enough land for all of their animals, in addition to their other agricultural demands. If they grazed animals individually, someone from the small network would have to be with the animals day and night, which is neither practical nor desirable. So, people in a given network share the obligations of herding animals from pasture to pasture, protecting them from thieves and predators, and caring for herding creatures in groups. Communal grazing allowed for communities to grow richer with more animals, without personally having to be in the pasture every single day to watch them. While out in the pastures with animals, pastoreos sleep outdoors or in built shelters where food is stored for a couple of nights at a time, tagging in a neighbor, cousin, brother, or friend when their shift is over. With this strategy, people have time to concentrate on other means of subsistence that supplement grazing, such as agricultural farming, crafts, and in some cases wage labor jobs. The diversity of subsistence creates more sustainable economic prospects for people, not reliant on any one method of income or food source, while participating in important traditional economic formations that keep communities close[73].

Owing to climate change, pastoral land is diminishing in both size and quality. The earth is growing drier, making it hard for the normally sturdy alpine plants to survive in these new conditions. Rudy, a pastoralist from the community in the Rurec valley, told me that he sees it get worse every year. His animals are ostensibly starving in the same places that they used to flourish

[73] These formations also sometimes have their downsides, they can create conflict, make mobility challenging, and are subject to sometimes troubling forms of corruption.

just decades before. It worries him because he cares for his animals, and these losses threaten his economic viability.

On expeditions that wound through the pastures and into the canyon valleys, expedition scientists would also see these effects. Cows would often chase passersby, or sometimes quietly surround their tents during afternoon rests. They were waiting. Where someone might squat to use the bathroom outside they'd have to be watchful; cows would sometimes charge to be the first on site to consume the minerals in the urine and excrement they were missing in their diets. On these expeditions, and during days I accompanied pastoreos, I witnessed cows so thin you can count their ribs and make out the outline of their entire pelvic bones under stretched skin. Some were unable to produce milk for their offspring, who subsequently died. While others were so thin they were decidedly not worth killing for meat since they would taste and be texturally undesirable. By setting up exclosures of any size, scientists were preventing animals from having access to valuable and increasingly scarce food and resources that they need to survive. There were not enough plants to spare, even for hopeful adaptation planning. Science projects were directly contending with resources already made scarce by climate change.

Figure 78

Figure 79

The agrarian reform movement of the 1960-70s helped to establish the basis for the natural lab as a project of capitalist development. Not only did it help to reallocate land to communities dispossessed by the hacienda system, but the environmental programming of the new left government additionally helped to develop new regulations for the establishment, management and exploitation of conservation sites as a mechanism for economic development that blended traditional land management with new technologies. The money made from these projects was intended to be redistributed throughout the state to selected targets, as a project of communist development. The Huascaran National Park was one of these first sites. The park conserved over 340,000 hectares of land to protect the important flora, fauna, and landscape from abuse by managing the space scientifically, and to create a robust and sustainable tourism industry that would attract environmentalists and adventurers from all over the world.

The Huascaran National Park is massive, and the conservation goals expansive. The park spans 10 provinces across the region, and is 158km long, including canyons, valleys, plains, hot springs, meadows, mountaintops, glaciers, and all of the wildlife in between. There are grasslands, scrublands, tropical tundra, endemic species, charismatic mammals (sun bears, viscacha, giant cats, and vicuna), giant condors, and hundreds of plant species, some old enough to be pre-Columbian. It is the highest tropical mountain range in the world, with the highest peak in the country, and the largest concentration of tropical glaciers on earth. It's also a place of work and life.

The park posed a challenge to people who lived in and near areas intended for conservation. When the park was established in the 1960s, laws were passed to prevent activities that might harm the integrity of the protected area; felling lumber, hunting animals, and mining were nearly all banned. But people were entangled in these environments in other ways. People graze their

animals, people have spiritual relationships to apus and cochas, and people sometimes collect ice for special occasion dessert treats. These activities were protected through contracts and customary law, but they were and still are regularly challenged by folks like the park director, unless people are willing to pay tourism prices to enter. Geographer Mary Barker explains further,

> "Wherever possible, the boundaries were drawn to exclude settlements. But several communities continue to use land within the park for livestock grazing, although there are attempts to regulate the practice...compensation in the form of money, bonds, or future employment in the park was granted during the land-expropriation phase that took place before the park was established. It was proposed to use peasants as tourist guides in cases where use of grazing lands was no longer permitted." (ibid)

There is very little written about the expulsion of people from the park borderlands during its conception, but in interviews people remember, or were told from their parents and grandparents.

During an interview my first week of fieldwork, I asked the director of the national park, Jesus Gomez, about the removal of the Quechua communities that spanned park boundaries. He quickly corrected me: “They’re not indigenous, they’re just campesinos.” Confused, I asked him to elaborate. He explained that poor people and campesinos are not naturally part of these spaces. He assured me, “The government takes tremendous care of our native people,” providing examples from the Aymara people in the jungle and the protected communities around major cultural tourism sites near Cuzco. Campesinos were conceptualized, not only in planning but in continued management, not as an integral or rightful user of land, and not as someone authentically indigenous enough to work in harmony with disappearing natural resources, but as a risk to the park as a natural resource. Conservation measures were implemented to prevent their continued use of this fragile place (see also Neuman 1998, Agrawal and Bauer 2005, West 2006, Igoe and Brockington 2007, Loww 2013, Fletcher 2010, Buscher et al 2012). The creation of this park through the agrarian reform movement created a basis for legally and bureaucratically solidifying hierarchies of access, based on ideologies of indigeneity and nature – all of which is echoed in the treatment of communal lands by scientists today.

While promising economic development in exchange for removal, the park created only around a dozen jobs for local workers (Barker 1980), who became responsible for manning borders and boundaries and charging entry fees to anyone who wanted to enter. It was nowhere near enough work for the region. The managerial jobs and research went to foreign scientists and technical experts from big cities in Peru[74]. Some environmental experts were even brought in from the Canadian Rocky Mountain national parks. They had experience managing large mountain ecosystems, and shaped not only the formation of the organization, but the relationship the organization has culturally, economically and politically with people nearby. They designed top down projects that would sometimes check in through public educational meetings about projects that were already being implemented. There was no system of co-management, much less inclusion in parkland projects.

Today, the people who manage the park are largely scientists who trained in various STEM fields. Jesus explained that the national parks workers are deeply concerned with the health and vitality of ecosystems, but all of the park's tourism revenue returns to the Ministry of the Environment in Lima, and very few scientific projects are actually able to be conducted on their budget. It is this lack of funding that encourages partnerships with foreign scientists, like Rebecca, who self fund all of their own research. Jesus listed off his dream projects that he would like to do in the park -- they were all so technical I could barely understand them, but he seemed excited just talking about the possibilities. Occasionally, the park has the opportunity to conduct land-capability analyses that study the effects of continued grazing in fragile biospheres. While people have a right to graze their animals, through contracts and customary rights established when people

[74] Many of the people involved in parks projects (and climate change adaptation organizations) also at some point end up working with or for the nearby mining companies. The musical chairs of experts between these organizations is also in part why people are deeply distrusting of their aims.

were removed from the park borders, the park is still exploring ways to challenge these practices. Burros remove plants from their root, making it difficult for them to ever grow back. The animals sometimes trample plants, break trees, and scare off fauna. The puma was hunted out of existence in the range because it interfered with the ability to raise animals in the region.

During fieldwork, while trying to build a research partnership with the Huascaran National Park, I was asked to help with this type of research (which I did not do), to report back on the number of animals each individual grazed, and to see if anyone was violating the terms of their contracts to remove their ability to return to the park. I was told it would help preserve the natural biosphere, imagined as a space without people (Cronon 1990). Slowly, in an effort to preserve endangered nature through scientific justifications, the park is transforming from a porously lived space, to a closed natural laboratory, available with greater enthusiasm to foreign scientists than local people who have lived and worked and been integrated with the land for centuries.[75] Scientists' ability treat porously lived spaces as natural laboratories is the result of state policies that make science a vehicle for the destruction of some livelihood formations, while at the same time the site producing others through labor.

While out on an expedition with Wilmer who was collecting data for a scientist from the United States, I saw equipment that I couldn't identify just before stepping onto the glacier. The box, antenna, and solar panel were pieces I had seen before, but it wasn't clear what kind of data it collected, or who it belonged to. I asked Wilmer about it, and he told me, "I don't know, scientists left it here." He thinks it's to measure solar radiation, but he isn't sure. Equipment is left all over communally used spaces throughout the region. While the data produced may be helpful, there are no notes, signs, plaques, or public explanations of any of the items I encountered, left about in the

[75] I also want to stress that there was so timeless harmony here and that local conflicts and relationships have always existed

produced natural laboratory of the Cordillera Blanca. These are not empty spaces for science, but shared spaces, spaces that determine peoples livelihoods, spaces where communal land was historically contested by the interests of outsiders, where the arrival of Science has produced and defended deadly effects.

Figure 80 This is the equipment I spotted in the Shallap valley at the foot of the glacier

The objects left behind by scientists are objects made sense of in a deeper history of science and environmental justice in the Cordillera Blanca. These are not short-sighted solutions to climate futures, but long, historical memories of dispossession through scientifically guided practices of extraction and conservation. This is made especially significant when we consider that science and the production of data are not preventative actions. As paleoglaciologist Lonnie Thompson said in an interview for Nature, "I can monitor and document the rate of retreat…but unfortunately cannot stop its demise," as he compared his data collection to time spent on a "salvage mission" with a terminal loved one (Fraser 2019).

The Committee of Water Users

After a 20 minute combi ride across town, I arrived to a small community I had never visited before on the other side of the valley to meet Carmen Shuan, an activist from the meeting on glaciers in Chapter 4. Carmen is a community organizer in the region, and she had invited me to a closed community meeting on water. Before ever meeting, I had seen Carmen speak at several environmental events about the effects of mining on her community. She was impassioned, and well connected, hugging friends who were influential journalists, professors, and alcaldes (mayors).

Upon my arrival to the meeting, I saw several whom I had met from other communities across the valley standing outside. The group, chatting, laughed when they saw me and asked if Carmen invited me. The meeting was a call to expand organizing strategies to new communities. While the government and scientists focus on the production of data as an answer to the climate crises, people have no choice but to act today in order to survive lost water sources. Carmen was planning, building networks, and tapping into traditional knowledge systems for water management projects in scarce times. She helped plan for rainwater capture tanks and more efficient irrigation systems through Ayni, or a form of mutual reciprocity. For many Andean communities, Ayni is one of the five central pillars of community (in addition to life, work, knowing and loving). Through Ayni, people perform Mink'a, a type of communal work that helps entire communities. This is made especially interesting in this case because Mink'a expands beyond the community, to campesinos and Indigenous Quechua people across entire valleys: surviving climate change required an expansion of what it means to be a community, including struggling people, with few resources, alike.

Through her work, rotating systems of volunteer labor would move from community to community one day every week to build helpful infrastructure for struggling people. We talked after the meeting, and she shared a document with me that was produced by people from all over the valley, by the Committee of Water Users.

Organized like a legal document with proposals and demands, the document argues that contrary to the state's focus on Science and green markets, the ideological goal that they propose is based on Good Living. It argues, "Based on our knowledge and ancestral practices of Good Living[76] as alternatives to the climate crisis and crisis of civilization that are shaking the planet….[they propose a] rupture with predatory developmental capitalism and the adoption of a new paradigm based on dialogue and harmony with Mother Earth." They argue that it is not possible to find solutions to the climate crisis within the framework of the capitalist system and the technocratic institutions that support it, that rich countries are shirking their responsibility, "[they] refuse to change their consumption patterns, reduce their voluminous greenhouse gas emissions, and only agree to false solutions based in market mechanisms." Therefore, the Committee of Water users, and the water users of the Cordillera propose a cultural pillar of sustainable development that acknowledges and works from a place of understanding that natural diversity and cultural diversity are linked. The united villages call upon international legal precedents (like neighboring countries) such as the UN Declaration of Human Rights, the UN Declaration on the Rights of Indigenous People, the ILO Convention, the Convention on Biological Diversity, to demand consent for everything that affects indigenous peoples, including the use of communal lands for projects. This assertion reframes relations, changing the position of

[76] Buen Vivir never really took off in Peru as a movement, but the language of it is used a lot in critiques and demands made by environmental activists. Most people are not interested in taking over and making a Buen Vivir state, but are focused more on how to enact the principles through community practice, free from the effects of the state.

campesino groups as one of multiple stakeholders managed by the state (with preference given to state-sanctioned experts), to people with governing rights as guaranteed through customary law and international protections (people who were experts in different types of environmental management).

Lawyer, scholar, and indigenous revitalization (Sumak Kawsay) activist Gerson Paukar explained these demands in an interview we had at a later date that took place after an anti-mining meeting. He knew Carmen and had organized events with her in the past. People are leveling complaints against mining companies being able to buy access to places where they live, while the money goes directly "to Lima." These are lands in which peoples lives are inextricably entangled. Climate scientists, by showing up occasionally and treating communally used land as a natural resource, an empty space of *nature*, and a natural lab open to science, tracks into these historical political grooves. Gerson explained their critique further, "It is also against development of climate change initiatives that are not anti-capitalist." What might an anti-capitalist science look like?

Analysis

Marisol de la Cadena explores the ontological experiences of indigenous Quechua people in moments of clashing and disagreement with nonindigenous worlds. In an example of the limits of political recognition, de la Cadena tells the story of Peruvian President Alan Garcia both wanting to acknowledge and respect indigenous politics, while also confronting the reality that anti-mining activists were concerned not about jobs and neoliberal offers, but for the mountain gods, the apus; he ultimately decided it was a problem of 'education'. De la Cadena provokes her reader to consider that recognition is "an offer for inclusion that — not surprisingly — can transpire only in the terms of state cognition: it can be as long as it does not impose on those terms." For people invested in helping the Andes transition to a resilient climate future, similar considerations are

required, or as de la Cadena frames it, incommensurability and mutual differences need to be accepted. Otherwise, scientists should prepare for more sabotage, resistance, and conflict.

In 2019, there was another incident that was far more dangerous and more expensive than the smashing of equipment at Laguna 513, or the cutting of exclosures. A group of scientists from the United States began an expedition onto the highest mountain in the country, Huascaran (22,205') with the goal of collecting ice core samples. In interviews with various news agencies, the scientists in charge of the trip shared that, while their data cannot stop climate change, it is possible that something that they uncover will help the region adapt to looming futures. Dr. Thompson, a thoughtful man in his late 60s described the experience as sitting with a terminally ill loved one. But their expedition was cut short. In the nearby village of Musho, from where many expeditions leave into the mountains, villagers protested the suspicious men after rumors circulated that they were possibly affiliated with the nearby mine. They were worried that their water would become contaminated, that they didn't know these men, and they hadn't asked for respectful permissions. First the team was given 12 hours to descend and leave (an impossibility at that height, even if one were running), but later they were given five days to take their equipment and leave. Reports circulated that the scientists needed to be helicoptered out, with all of their equipment to avoid confrontations. In an interview for *Nature*, the scientist reflected that he's not surprised that people keep tearing things down, these are holy places and he emphasized that his team needs to work with respect for the surrounding cultures. Though Peruvian officials from INAIGEM have instead made it an issue of education, "we don't make enough effort to inform the people what is happening… Why is climate changing? What happens with the rain and precipitation? This is one part of the problem" (Fraser 2019). They transform the issue of institutional harm, into a failure to modernize through education systems, and a lack of

understanding more technical environmental systems. But local, national, and international relationships with environments are not now and never have been de-political, and mining is experientially always entangled with science. As I write this, experts who traveled to the region to work for the Barrick Gold mine just up the road have introduced Covid-19 to the region, and they're neither stopping production nor providing health care for affected communities.

DISSERTATION CONCLUSION:

Since I finished my fieldwork in 2017, there have been multiple shifts in management at INAIGEM. The director of the Huascaran National Park worked there briefly, scientists that I knew and respected did not have contracts renewed (there was speculation it was because people did not want to do more dangerous fieldwork, but that is just gossip). And a research scientist has recently taken over from Benjamin Morales Arnao, promising to lead with more research than ever before, including some social science studies (though I have yet to see or read the results of those, if they have begun). Since I left the field, friends have died in service as high alpine service workers. People were killed in accidents, avalanches, and below some of the most dangerous crumbling glaciers on earth. One guide died because his team did not bring enough oxygen so he went without, Richard Hidalgo. His heart stopped in his sleep. I think about his death the most.

My goal in writing this dissertation is not to say that all climate scientists or climbers are bad people, and that people who work for the state are somehow ethically compromised. I too work for a neoliberal academic institution, and I am aware of the limitations in power, opportunity and organization that accompany a research job. My first goal instead was just to highlight the ways that scientific research can produce (even unintended, invisible) harms: it endangers laborers, it reproduces harmful economic structures, it disempowers communities, it infringes on land – and it doesn't have to. It can look different. My second goal was to communicate that scientists, as they build careers off data collected in the Global South, additionally arrive with their own cultural ideas about how the world should look. This is reflected in the ways scientists push for specific economic funding models (such as public-private partnerships); the way lived spaces become natural laboratories based on ideologies of place that imagine the sublime as a place without people; the way there is an assumed, undervalued, and endangering ideology that brown people in

the Global South are "naturally" good at hard work. These cultural ideologies are racist, and they have deadly effects. I do not have a list of aspirational goals that all fieldworkers should subscribe to, but my hope is that my research points to ways that science always comes with culture, and that it encourages researchers to tread more carefully, listen better, build genuine partnerships and relationships, and listen when people say no.

More broadly, my dissertation ethnographically reveals that, as activists and community organizations work towards social justice as an embedded climate resilience project, resilience looks different according to the goals of the state and the economy. While people attempt to fortify and make flexible their futures, institutions are also working to reproduce themselves, with all of the harms, power imbalances, economic inequality, and politicking that they produce in the present. Paying attention to climate change – even through promises of leading with Science – does not ensure a safe future for everyone. I suspect many people will die because of this, some already have. My recommendation is a healthy skepticism of climate projects that promise charity without offering justice.

Moving forward, there are a number of additional projects that could be developed from this initial study. A longitudinal analysis on how climate change adaptation has changed from its insipient years in the Andes would provide a rich understanding of how policies and projects change over time, in relation to rapidly transforming global relations (especially now in a Covid-19 world). There could be more in depth analyses generated about how it is people who lack access to infrastructural affordances that are trying to adapt: what types of water systems are being developed, what ways of organizing socially keep communities afloat, and how are people fighting for the justice they deserve. These types of studies could be useful for activists in water scarce communities around the world, to build solidarity and to learn from one another. Additionally, a

study could be expanded from this project that follows families who have abandoned the Andes and moved as climate refugees to other parts of the country. There is almost no data on these climate migration patterns (I was told once by a state employee that they prefer not to use the term "refugee" when talking about people who abandoned their climate ravaged homes), but they are important. There is so much work to be done to figure out how to best be helpful, accountable, and provide justice to people who lost everything while contributing almost nothing to the problem of global climate change. For me, this is a lifelong project.

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