“You Take Our Stars”: Harvard Astronomers in Peru, 1889-1900

By

Alex McGrath
May 2019

Submitted in partial fulfillment of the requirements for the
Master of Arts in History
Dual-Degree Program in History and Archives Management
Simmons College
Boston, Massachusetts

The author grants Simmons College permission to include this thesis in its Library and to make it available to the academic community for scholarly purposes.

Submitted by

__________________________
Alex McGrath

Approved by:

__________________________
Frances Sullivan (thesis advisor)
Professor of History

__________________________
Stephen Ortega (second reader)
Professor of History
# Table of Contents

**Introduction: Contested Epistemologies** ........................................................................................................... 1

*Harvard Astronomers in the Andes* ......................................................................................................................... 3

*Science, Modernity, and Gringos in Peru* .................................................................................................................. 6

*Labor Regimes and Knowledge Production* .............................................................................................................. 14

‘No more Peruvians’: Nation, Race, and Gender in the Labor of Remote Astronomy ............................................... 17

*Nationality, Race, and Qualifications* ....................................................................................................................... 19

*Gender and Family at Work in the Home* .................................................................................................................. 37

*Conclusion: Making Race and Gender in the Expeditionary Setting* ........................................................................ 43

**Producing Cosmic Knowledge: Empire and Extraterritorial Research** ................................................................. 45

*Imagining the Expedition* ........................................................................................................................................ 48

*Gathering and Collecting Information* .................................................................................................................... 52

*Discussing the Knowledge* .................................................................................................................................. 70

*Conclusion: Archiving the Science* .......................................................................................................................... 75

**Conclusion: Astronomy and Modernity** .................................................................................................................. 77

*Three Astronomical Expeditions to Chile* .................................................................................................................. 78

*Astronomy in History* ........................................................................................................................................... 84

**Bibliography** ......................................................................................................................................................... 86
Abstract

The Arequipa Observatory (1891-1927), established by the Harvard College Observatory to photograph the southern sky, brought North Atlantic scientific ideals into contact with Peruvian worldviews of modernity. From the journals, correspondence, publications, and photographs of the Observatory’s first decade in operation, I argue that Harvard astronomers viewed the Andean world and skies through scientific and imperial epistemologies grounded in efficient production and useful product. Labor relations in remote astronomical work created a production hierarchy built along national, racial, and gendered lines, reinforcing the imbalance of power between educated northern men, women, Peruvians, and Andean Indians. This imbalance also appears in the knowledge production of the expedition, with the scientists bringing the Andean world into the archives of North American universities, consolidating information in a process of informal empire that would serve later imperial endeavors. Departing from histories of discovery and accomplishment, this study opens the astronomical work to social dimensions of labor, empire, and political economy that explore how worldly knowledge is produced and contested. Ultimately, I question Peru’s diminished position in discussions of astronomy and the global development of scientific modernity, demonstrating the processes of extraction that made its skies, and people, a resource for Northern scientific progress.
Acknowledgements

Like all works, this was a team effort. Franny Sullivan gave fantastic advising, energy, empowerment, and guidance, without which I might have struggled to bring these thoughts back to earth. Steve Ortega, Sarah Leonard, and Jeannette Bastian, knowing or unknowing, have also guided this project. At the Wolbach Library of the Harvard & Smithsonian Center for Astrophysics – the entity formerly known as Harvard College Observatory –, where I have been employed as an archival assistant, the entire staff, notably Maria McEachern and Daina Bouquin, has not only guided me though (letting me explore and interpret) their extensive historical collections, but also given me the task of processing logbooks and notebooks from the late nineteenth century, including Peru, which had been languishing in storage for a few decades. The access to both information and moral support at Wolbach has been unmatched. There are also the nameless crews of the Harvard University Archives who, years ago, digitized many of the expeditionary collections for online access. Without the ability to lord over those documents late into the night, with coffee and snacks and conversations, interpretations, and open spaces — archives outside of the oppressive reading room allow for expanded imaginations and possibilities. Lastly, I should note that this paper was presented at the Columbia University & Stony Brook University Latin America and Caribbean Studies Graduate Student Conference at Columbia in NYC in April 2019, and has greatly benefited from the excellent perspectives and comments received there. My many thanks to everyone at every stage of the project.

On a less professional note, I extend thanks to my friends and family who have stuck with me as I try to reconcile cosmic piety with radical empathy. Their patience, enthusiasm, and will to push me runs throughout this work. The stars are for us all, in an immediate and visceral
sense that precludes alienation, but only as far as our desires and actions towards them prioritize the life around us.
Introduction: Contested Epistemologies

In preparations for their national display at the World’s Fair of 1900, a commission from the Peruvian government asked the Harvard College Observatory, who operated outside of Arequipa, if they would make an exhibition alongside their Peruvian hosts at the Paris event. The Harvard astronomers said no, preferring to include the observatory’s photographs and science in displays alongside Harvard University and other North American astronomers. These photographs were a particularly valuable commodity for the scientists and the commission: glass-plate views of the stars, from which astronomers were learning the scope and nature of the universe. The commission believed that these photographs were a perfect opportunity to showcase Peru’s industrial development and national modernity on a world stage that had once viewed their lands as plunder. Peruvians had supported and enthusiastically participated in the observatory’s project; but with gracious thanks, the astronomers rejected their bid, and took from Peru the cosmological promise that lay in its skies, withholding and coopting the nation’s key contributions to science.

This exchange highlights the contested epistemologies between the Northern expeditionaries and their Peruvian hosts – a contest between ways of knowledge through which people differently construct, perceive, and act upon the world. On the one hand, the Harvard astronomers operated under paradigms of scientific modernity that enforced systematic methods, rigor, education, and networks of peer discussion in order to create knowledge. On the other hand, the Peruvians, who welcomed and assisted the scientists, brought local knowledge, strategies, and a desire to be as modern as the rest of the world into the observatory, destabilizing the apparently benign presence of the astronomers. They were not in Peru on a simple fact-
finding mission; they actively removed the knowledge they produced – the photographs, star-charts, catalogues, weather records, and miscellaneous papers – back to Harvard. Without much consideration to any proprietary claim that Peruvian’s might make on their skies and rains, the astronomers mimicked the plunder of empire, leading one Peruvian priest to suspiciously accuse: “You take our stars and you send them to Cambridge, and they have the use of them there!”¹

The Harvard College Observatory in Peru, at times called the Arequipa Observatory, the Boyden Expedition, or HCO South, imposed North Atlantic scientific ideals over Peruvian worldviews of modernity. From the expedition’s journals, letters, publications, and photographs, I argue that Harvard astronomers viewed the Andean world and skies through scientific and imperial epistemologies grounded in efficient production and useful product. Labor relations in remote astronomical work created production hierarchies built along national, racial, and gendered lines. These hierarchies reinforced the imbalance of power between educated northern men, women, Peruvians, and Peruvian Indians. This imbalance also appears in the knowledge production of the expedition, where scientists brought the Andean world into the archives of North American universities, consolidating information in a process of informal empire that would serve later imperial projects. Departing from histories of discovery and accomplishment, this study explores dimensions of the observatory such as its labor regimes and the political economies through which they produced worldly knowledge parallel to the social production of empire. Ultimately, I question Peru’s diminished position in discussions of astronomy and the global development of scientific modernity, demonstrating the processes of extraction that made its skies, and people, a resource for Northern scientific progress.

¹ Bailey to Pickering (16 August 1893) Correspondence, 1888-1927; Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1, page 74 (seq. 76).
Harvard Astronomers in the Andes

The southern skies had special value to astronomers in the late nineteenth century. With few observers below the equator equipped with powerful telescopes, and fewer with the ability to adapt a camera to the eyepiece, the Harvard College Observatory (HCO) set out an expedition in 1889 to establish a permanent outpost that could regularly and totally photograph the southern night sky. Once established, the observatory would ship these plates back to the observatory at Harvard, where computers would analyze stellar magnitudes, variabilities, novae, and other cosmic patterns, and published this data as part of the *Harvard Photometry* project. The funding for this expedition came mostly from the bequest of Uriah Boyden, a wealthy donor who wished also to establish a permanent, high altitude observatory. A position high in the Andes appealed to HCO director Edward Pickering, and he sent his assistants to explore for a possible location.

A southern photographing station was vital for Pickering’s project to provide astronomers with full sky catalogues of both hemispheres, complete with tables of magnitudes, positions, and spectral classifications. Even more, he planned for the expedition to regularly patrol the night sky, photographing variable stars, comets, planets, and new phenomena that might appear. The ambitious project required extensive technology – telescopes, cameras, chemicals, buildings, trains, and boats – and Pickering could not accomplish it alone. Throughout the 1880s, he

---

fundraised among the New England elite for his telescopes and travel expenses, fighting for bequests and beneficences, and he administered the expedition with prudence and thrift. But without his corps of women computer assistants at Harvard, led by Williamina Fleming, he could not have analyzed all the data, nor assembled it for publication. And without the assistants and workers he sent to Peru, he could not have gathered the data in the first place.

Solon Bailey set out for Lima from San Francisco in February 1889, after assisting other astronomers in scouting for a northern high-altitude site in various California mountains. He brought with him his wife and son – they would meet his brother in Panama via New York –, two telescopes, and ten boxes of freight, including prefabricated buildings with paper walls, stockpiles of gelatin dry plates and developing chemicals, astronomy textbooks, star-charts, and a copy of S.S. Hill’s *Travels in Peru and Mexico.* With the help of the local government and railroad owners, Bailey established a provisional observatory in the mountains outside of Chosica (near Lima), at a location they dubbed ‘Mt. Harvard.’ They passed a decent but short dry season for observation and photography during the summer of 1889, but they decided to scout for a better site during the following rainy months. While keeping the Mt. Harvard station in operation under their Peruvian assistants, Bailey and his brother traveled through Chile and the Atacama before settling on a new site outside of Arequipa, in the south of Peru, early in 1891.

---

3 For a thorough narrative of Pickering’s fundraising efforts, see Nisbett, “Business Practice,” 1.
4 The data was published in the *Annals of the Harvard College Observatory,* alongside northern stellar measurements, between 1884 and 1949. Photometric and classificatory catalogues that include southern measures are found in volumes 14, 23, 24, 26, 27, 28, 34, 44, 45, 46, 47, 50, 54, 56, 59, 64, as well as the entirety of the *Harvard Photometric Catalogue* and *Henry Draper Catalogue and Extensions.*
Solon Bailey ended his first term as director of the Boyden expedition later that summer, turning the management of the expedition over to William Pickering, Edward’s brother. William served as director for two years, and built a solid stone residence for the observatory. However, his tendency to prefer visual observations at the telescope delayed the photographic project, and Pickering returned Bailey to the field in 1893.

Meteorology was a secondary mission for the astronomers. When the expedition first arrived in Peru, they asked locals for weather trends and historical reports to inform their site scouting. When Bailey found “no-one knew definitely” the amount of cloudiness around Lima, or at least that they had never taken “systematic records,” he began gathering data to inform his decision. He first carried around thermometers, aneroid barometers, sunshine-meters, and other atmospheric devices to determine where he could find the best lofty site with steady air and a clear horizon. Once they established the observatory, the astronomers continued this meteorological project, supplying both South and North Americans with a systematic record of Peruvian meteorology. They set up automated recording stations throughout the Andes to gather constant data, and hired nearby Peruvians to regularly record the instruments, rewind their parts, and send data to the observatory.

Throughout the life of the observatory, the astronomers heavily relied on Peruvian labor, concessions, graces, and assistance to complete their mission. But in their narratives of the expedition, this help is hardly apparent. William Pickering used the passive voice characteristic of science that obscures agency in the creation of the observatory: the Mt. Harvard station "was occupied for over a year, and very satisfactory results were obtained at it;" "All vegetation is

---

maintained by constant irrigation;” "tri-daily [meteorological] observations are maintained;” “over thirteen hundred 8x10 photographs have been secured with this instrument during the past year.” At the same time, Pickering and the astronomers emphatically achieved moments of scientific discovery in the active: “we have found” new variables, new cosmic structures, and new types of knowledge. When using photographic plates, the process of discovery included many people along a chain of production, observation, analysis, calculation, and publishing – more work than one scientist could handle alone. Yet Pickering’s “we” elides the manual, material, and auxiliary work involved in discovery, prioritizing northern knowledge production over local prestige. Bailey, in his 1931 history of observatory was a little more gracious, noting that meteorological observations from self-recording instruments “were made, in general, by resident natives, in some cases gratuitously.” In fact, far more than just taking readings for pay, these “resident natives” of Peru energized, sustained, and contributed to the scientific success of the Harvard project.

Science, Modernity, and Gringos in Peru

This thesis contributes to discussions on modernity in Peru and its intersection with North Atlantic scientific expeditions to the Andes. Between 1890 and 1930, scientific and academic expeditions to South and Central America gathered knowledge for their North American and European colleagues, audiences, and patrons, a process which historian Ricardo Salvatore has


called “informal empire.” This era was not all one sided; these foreign intellectuals found resistance among lettered society in Peru, who contributed to the growth of a nationalist discourse around Peruvian knowledge, people, and culture. Both imperial and emancipatory, knowledge production of the Andes overlapped and became entangled with production in the Andes as well.

The quest for knowledge paralleled the industrial and natural-resource exploitation of the region’s “export years.” In the 1970s and 1980s, economic historians analyzed the Peruvian state in terms of its development along a paradigm of capitalist modernity, viewing export as integral to Peru’s ascension onto the global stage. Dependency theorists argued that mineral extraction, first guano, then nitrates, wool, sugar, and other hacienda crops, subjugated Peru to the whims of foreign capital, and failed to break the country away from the differential power structures of the colonial era. Around the 1990s, shifts in thinking about the role of politics in society, due to the unstable fallout from the Sendero Luminoso movement in Peru as well as the cultural turn in the discipline of history, lead to discussions of the “political culture” of Peru. These historians, anthropologists, political and social scientists foreground struggles over democracy and citizen rights, and social questions regarding race, ethnicity, gender, and class, in an effort to find what

historiographer Paul Gootenberg calls a “different (kinder? gentler?) Leviathan.” Historians of the Arequipa region specifically have asked questions about the formation of regional political identity opposed to the centralism of Lima, and of subaltern political participation, revealing competing claims on the *polis* as expressed through language of international socialism. The transnational reach of knowledge, and it’s renegotiation for Peruvian interests, has always attended these debates over Peruvian politics and development.

The making of modernity is inseparable from parallel conversations about industrial and scientific interventions in the region. The question of modernity’s origins haunt discussions of Peru, at times an external application, a transference to Peruvian society, at others an endogenous reaction to a changing world. Late nineteenth century Peru experienced a surge of technological innovation, change in the material structure of life, and new imaginings of social participation that amounted to a form of the modern. Deborah Poole, historian of visual culture, noted that this modernity was an imposition of European regimes of vision and status, but also was a self-expression through established means that created Peruness (*Peruanidad*), distinct, if not resistant, to Western models.

Since the 1920s the debates on the origins of modernity have synthesized around the core problematic of Peruvian nationhood and its relationship, positive and negative, with other national identities, internal regionalisms, and global currents of modernity. In his *Seven Interpretive Essays on Peruvian Reality* (1928), leftist public intellectual Jose Carlos Mariátegui

17 Poole, *Vision, Race, and Modernity*. 
discussed the “colonial character” of Peruvian education and society, built around imposed hierarchies and superficial curricula that did not assist the needs of Peru. Mariátegui’s social ideology and diagnosis of feudalism in Peru has long “haunted” Peruvian intellectuals, and recent scholars are returning to education, knowledge structures, and their position in the nation’s long colonial history to show the ways in which the country reacted to foreign impositions. Historian Jorge Cañizarres-Esguerra discusses the idea of “patriotic epistemologies” wherein the nascent nationals invert the received knowledge of colonialism and imperialism to define and exalt their nation. Other scholars have colored in “legacies of colonialism” that persist to the present day, elements that inflect modes of Westernization with Andean ways of being, creating a new reality midway between modernity and tradition. The “Peruness” of this reality has suffered a long debate in itself, torn between national and regional characters, but its orientation has always been towards the future, towards the ”promise” of a unique past at the junction between two worlds.

Exchanged between these worlds, scientific knowledge flowed predominantly in one direction, in a “centripetal circulation” towards the metropole. The historiography of science expeditions, beginning with European colonialism, has consistently identified the power differential that moves knowledge northwards. Both historical and sociological studies of science

---

22 Thurner, *History’s Peru.*
23 Salvatore, *Disciplinary Conquest*, 55.
and technology in South America construct the world of science between the center and periphery. Whether it was Spanish Jesuits recording constellations or global research consortiums building trillion dollar telescopes, information left its point of origin to become knowledge and science in a far off land – the Atlantic world of universities and libraries. Recent media theorists, including Poole, have observed that in these institutions photography provided the visual vocabulary through which readers began to understand markers of racial type, which alongside books of travel narratives and scientific observations set the Andean people in an immutable poverty in the shadow of western modernity. The postcolonial scientific expedition took on a different character, less focused on conforming the locals than on informing the intellectuals back home – gathering, collecting, or as Ricardo Salvatore calls, “harvesting” useful knowledge for use in the metropole. Salvatore’s understanding of the dynamics of “informal empire” that accompanied these archeological, ethnographical, and naturalist expeditions reveals the codependency of specialized knowledge and state power. Where the former required the latter’s networks and (often) muscle to form, the latter used the former to reach through new territories, confirm their superiority, and consolidate valuable information close at hand in their libraries and archives.

At the same time, historians have sought to locate where fragments of this knowledge remain behind and flourish on a national stage. Cañzarres-Esguerra shows how “patriotic

26 Poole, Vision, Race, and Modernity; Hall, Framing a Lost City.
27 Salvatore, Disciplinary Conquest, 16.
astrology” integrated with emergent racial typologies, such as creole, mestizo, or Indian, to formulate the coming of a most golden age, but hardly resolved any individual human voice in national dialogues.\(^{28}\) This is typical of empirical, positivist science, overlooking social problems and inequalities whose solutions would slow progress or destabilize the narrative. Still, scholars have taken science and its attendant modernity as powerful forces of nation-making, bringing foreign technologies into contact with national agents to create patriotic narratives around histories, peoples, and their scientific abilities.\(^{29}\)

Scholars often discuss the imperially and contested knowledge surrounding these scientific interventions through the Yale Peruvian Expeditions of Hiram Bingham, sent between 1911-15 which established Machu Picchu as a site of interest. Salvatore shows how the same historical information and material extracted for analysis, display, and storage at Yale also provoked a surge of patriotic Peruvian thought and the formation of a national patrimony.\(^{30}\) These competing epistemologies – one setting the historical significance of knowledge into the universal domain of humanity, the other claiming it for the celebration of a specific national, Peruvian past – capture the imperially and imbalance of North American knowledge participation in the Andes. Recently, historical anthropologists have viewed these epistemologies in terms of imagination and formation of identity, whether regional, national, pastoral, or scientific.\(^{31}\) Letter-writing and photography in particular have emerged as a powerful tools through which scientists and nationalists realized and contested their imaginaries, discussing the

\(^{29}\) Hall, \textit{Framing a Lost City}, 6.
\(^{31}\) Love, \textit{The Independent Republic of Arequipa}; Hall, \textit{Framing a Lost City}.  

__
details of reality and disseminating their perspectives. The Machu Picchu example, with its spectacle and sensational impact on the public sphere, demonstrates how the export of knowledge galvanized articulations of knowledge-ways and worldviews from the target location that could contest foreign epistemes.

No less impactful than Machu Picchu’s grand archaeology, the science of astronomy has long participated in this collection and export of knowledge. In the colonial and early post-colonial times, Spanish and other European missionaries and expeditionaries gathered observations, counting stars and recording constellations; at times astrologers even brought their cosmic analysis into their patriotism. Following the 1850s, different astronomical expeditions, private and government led, brought sophisticated telescopes and observing equipment to Chile, Argentina, Brazil and Peru to observe unique events such as eclipses or transits. Historians of science have focused their narratives on the discoveries and products of these expeditions, but a few recent voices have viewed them in light of national astronomical programs. About Chile, some historians have argued that the choice of North American astronomers to educate local assistants and sell their equipment discount to the Chilean government lead to a flourishing field of national science that persists today. At the same time social scientist Javiera Barandiarán argues that expeditions, specifically the space-age ‘Big Science’ telescopes placed in these periphery counties, reproduce hierarchies of dependency attendant to development capitalism.

---

32 Hall, *Framing a Lost City*.
36 Barandiaran, “Reaching for the Stars?”
The short history of modern astronomy in Peru serves as a foil to the Chilean story – when the Harvard station moved out of Arequipa, the astronomers took their state of the art equipment, effectively stymieing the development of a national astronomical community in Peru.

In a process similar to the way in which Barandiarán sees a political economy behind twenty-first century science imposing its hierarchies and priorities on the Chilean community, the Harvard expedition brought along its late-nineteenth century institutional hierarchies, methods, and social relationships to interface with the Andean world. Students and historians of the HCO have highlighted the unique gender dynamics in the workplace that allowed many of the women computers to earn scientific prestige, as well as the photographic and industrial models established to efficiently maximize stellar observation and cosmic knowledge production.\(^{37}\) The southern observatory expedition emerged from these dynamics, but its existing histories focus either on an exciting travel narrative, or its scientific and photographic accomplishments.\(^{38}\) This essay seeks to explore the social, racial, and gendered dynamics as they existed in the operations of the Arequipa observatory, and their impact on the construction of a scientific epistemology based around the universal at the expense of the local.

In many ways beyond the history of astronomy, the historiography of Peru strives towards the promise of a future based on a glorious past.\(^ {39}\) Noted Peruvian historian Jorge Basadre discussed how the postcolonial republic had always felt a cold shadow from the grand histories of the Inca and prior civilizations, and sought to transform that potential into material


\(^{39}\) Thurner, *History’s Peru*, chap. 7.
reality and wealth, through the export of guano, nitrates, wool, and scientific opportunities. The Arequipa Observatory sent regular batches of photographic plates out of the port of Mollendo, exporting the clear, crisp summer sky to Cambridge. But the actions of observing, the imaginings of other worlds, and the transfers of information between foreigners and locals in a scientific setting inspired pride and promise in the Peruvian worldview. This work will show how, just as the wealth of export commodities were a “false promise,” so too were the scientific interventions.40

Labor Regimes and Knowledge Production

This thesis argues that the scientific epistemologies of the astronomer-expeditionaries overwrote the participation and support of Peru, forging and reinforcing overlapping systems of power that extracted knowledge, prestige, and modernity for the North. The argument’s leading thread follows currents of imperialism in the expedition’s early years. Chapter 1 explores the labor regimes at work in the observatory, regimes which followed and reinforced forms of power based around race, gender, nationality, and wealth. A hierarchy of North American scientists and explorers, upper and middle-class urban Peruvians, rural and lower-class mestizo and Andean Indian Peruvians defined the degree of compensation, recognition, and respect due to each. Most employees of the observatory, assistants and servants, lived on site with the astronomers, assisting their observations and housekeeping needs. At times, the astronomers hired groups of laborers out of a feudal system of Indian peonage and poverty. By partaking in these oppressive regimes, the astronomers accepted and reproduced the racial paradigms at play in Peru.

40 Jorge Basadre, quoted in Gootenberg, “Fishing for Leviathans?,” 139.
In addition to the scientific labor, life at the observatory was a close affair, with Bailey often referring to the whole station as a “family.” North American women participated in science at the station, but remained bound to their housekeeping duties as wives and mothers. The astronomers began to conceive of an employee position of manager of the house, whom they cast as a respectable Peruvian woman, and who would alleviate their wives of dictating household affairs. While they never found such a matron, the astronomers firmly adhered to the labor practices that they brought from the north. Their efficient use of labor norms in Peru, which bifurcated society along old colonial lines, reaffirmed and encouraged continuation of these categories.

Chapter 2 looks at the process of knowledge production at the observatory, and its contributions to power discrepancies in empire. Following the notions of informal empire, I explore the way the astronomers imagined the expedition as project to broadly assist the cosmic curiosities of all humans, but more specifically assisted other North American enterprises in South America. To make the observatory function, the astronomers coordinated with Peruvian and Chilean governments for concessions, local industry leaders for space and support, and other regional power-brokers to gather data efficiently and bountifully. From this data, assembled into tables but accompanied by travel narratives and photographs of the expedition, the scientists presented a form of modernity that claimed knowledge of deep and distant spaces, Andean weather patterns, and cosmic density. They collected this modern knowledge at Harvard, but opened it to any who could come in and read the data. While the astronomers shared mentorships with promising Peruvians, and briefly participated in the academic life of Arequipa, they hardly encouraged anything north except the raw information – no students or ideas to accompany the stars. Their observatory was an institution of North American science. They shared it
accordingly, hosting anthropologists, historians, and other northern explorers and aiding their projects. These assists, integrations, and presentations perpetuated the imbalance in empire, extracting knowledge northwards and stifling the scientific promise of Peru.

The conclusion introduces the case of astronomy in Chile, which welcomed more beneficent expeditions in the late nineteenth century and experienced bloom of astronomical potential in turn. With a National Observatory equipped with respectable telescopes, Chile was able to participate in the international astronomy community, and establish a name for itself that would eventually encourage investment and development in the age of neoliberalism and Big Science. The influx of multinational telescopes and capital in the high Atacama desert, secluded from the social and political problems that affect Chile, has prompted questions not just about knowledge, power, and money, but also about the value of astronomy itself. What is cosmic truth next to human suffering? What is at stake in the distribution of resources between and within scientific, knowledge-making, and world-saving projects? How can we see our universe in a brighter light? What is the emotional fulcrum around which we leverage knowledge production?

These questions relate back to the case of Harvard astronomers in Peru, and the answers do not place Peru in a position of promise. They sat in an ancillary, peripheral position to knowledge production in distant lands. This distance compounded forces of hegemony and empire, and imbalanced relations such that Peru could never reach a cosmic modernity as immersive as the Atlantic.
‘No more Peruvians’: Nation, Race, and Gender in the Labor of Remote Astronomy

Nearing the end of his second term as director of the Arequipa Observatory, Solon Bailey confessed that he “did not want any more Peruvians” to train in astronomy. The station had been in operation for five years at this point, between Chosica and Arequipa, with many Peruvian assistants who had helped with photography, equipment maintenance and repair, site construction, scouting, guidance, and providing food and water; all of whom were “pleasant enough to meet occasionally.” But Bailey preferred that Pickering would “send down one good man” from the US, educated, “single, faithful, and reliable,” financially able to deal with a modest salary and potentially excited to take permanent charge of the institution. In Bailey’s experience, the Peruvians had not been methodical in their science, they had been distracted and flirtatious, and, most difficult of all, they expected large salaries for little labor: “For real work, give me someone else.”

Throughout most its life, sojourning North Americans staffed the observatory. They had specialized education in astronomy. Their direct connection to Cambridge consolidated and clarified the scientific mission. And their personal acquaintance with the HCO director comforted the administrators in knowing that they had reliable and trustworthy men on the ground to handle their expensive equipment and manage finances. But the observatory was never the sole outpost of the astronomer: their families traveled with them to Peru, not to mention that they could never be free of the Peruvians, whose duties, whether assisting with the science or

---

1 Bailey to Pickering (10 August 1894) Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1, page 242 (seq. 245).
cooking dinner, required on-site residence. In this chapter, I argue that scientific production followed labor regimes built along racial, national, and gendered lines, with the white gentleman scientist at the head of a shifting chain of foreign professionals, middle-class Peruvians, indigenous laborers, and family women whose work maintained the observatory’s production. Attribution lines on the HCO publications only offered international credit for work of a certain caliber; but without it all, the observatory would have produced nothing.

In its engagement with racial and gendered hierarchies to produce its knowledge, the Harvard expedition reproduced and extended these categories and roles. This chapter follows these hierarchies through their operative realms in science and the home. In the labor of science, North American men performed the intellectual work while some middle-class Peruvians assisted in routine or maintenance, receiving necessary training but hardly a substantive education. Additionally, lower-class Peruvians, racialized as mestizos and Indians, participated in this work, but the astronomers viewed them suspiciously. They were mostly employed for maintenance and construction through local, temporary connections. In the home, gendered labor demanded women’s presence. With the men hard at work in science – astronomers and visitors –, they needed their wives for homemaking. Cooking, cleaning, laundry, and childcare all fell to the women, with the North American women administering duties to various Peruvian servants. The astronomers, however, thought this unbecoming of their wives, and considered hiring a Peruvian matron to head the house-staff. Adhering to these gendered and racialized labor paradigms both reinforced them and created them anew. With an apparent distrust of Peruvian science, the astronomers kept mastery of their subject and did not extend it to any potentially promising Peruvian scientists. Bailey’s Peruvian assistants may not have been model
astronomers, but their field training left them with little foothold in the international science community, and little ability to lift themselves further.

Nationality, Race, and Qualifications

The hierarchy of astronomical labor began with the men, specifically the white North American college-educated astronomer. Bailey, a man with two Masters degrees from Harvard and Boston University, led the expedition alongside his brother Marshal, and had added help from his other brother Hinman in the early years of establishing the observatory. While the family was helpful for daily support and management, Pickering felt that someone with more “scientific knowledge” would be better to place in second-command of the observatory. The Bailey brothers continued their employment in Peru, especially valued for their excellent “business management,” but for the scientific project to meet a satisfactory output, Pickering wanted more scientists.²

Bailey’s replacement, Edward’ brother William Pickering, brought along two professional assistants from Cambridge, George Vickers and A.E. Douglas. While both were interested in astronomy, neither had much practical experience before the expedition, and their work proved lackluster – they were not offered a second term. The next two assistant that Pickering sent down, to an exasperated Bailey frustrated by his Peruvian assistants, were William Clymer and Delisle Stewart, both young graduates from New England universities who had shown their promise in both routine work and specialized theory in employment at Harvard.

² Pickering to Bailey (25 November 1896) Cambridge to Arequipa correspondence, 1892-1898. UAV 630.100, Box 5, page 490 (seq. 521).
When searching for the right professional assistant, education trumped experience. Clymer had only just graduated from Harvard when his name came up for Arequipa. For this assistant position, Pickering considered two other men as well: one (Edward Black) had had expedition experience in building an observing station for Harvard in southern California; and the other (A.E. Douglass) had already served a year in Arequipa with William Pickering. These men had served the observatory well, and would have been prepared to lead the observatory, but in retrospect the director thought their work lacked “system” and scientific rigor; the work each produced was “far from satisfactory.” Clymer, however, had been working the cameras after midnight for a few years in Cambridge, and done so well that the leaders of the observatory personnel corps, Williamina Fleming and Willard Gerrish, judged him to be the most suitable candidate.³ The exigencies of expeditionary work could be learned in the field, but scientific promise remained the gift of institutions.

It was also important that the assistant be married, or at least primarily disposed to work before play. Bailey appreciated the energy and work-ethic of a single man, nicely seen in Clymer, but for leading the observatory, both Bailey and Pickering wanted someone with demonstrated stability in their social relationships. Bailey reported that due to some “peculiarities” Clymer had been slow to make friends in Arequipa, and as a result was not on gracious terms with the townsfolk. Bailey had spent months cultivating a relationship of goodwill with local elite and everyday visitors to make the observatory’s work and life as easy as possible. On the other hand, a married man was not always better suited for such leadership. Bailey thought that Stewart, who had spent his first few weeks in Peru on honeymoon with his

³ Pickering to Bailey (28 September 1894), Cambridge to Arequipa correspondence, 1892-1898. UAV 630.100, Box 5, page 248 (seq. 279).
new wife, did not give the local community the necessary attention. Still, he considered it a “liability” that Clymer was not married. Stable and healthy relationships were vital for the observatory, and a star-crossed love with someone in town could end with bad feelings, rumors, and hostility. Best to keep matters at home.

Once in Peru, these men had to be paid, and the administration found it favorable (and cheaper) to transfer funds to US accounts than deal in Peruvian soles. The expedition money went south through the W.R. Grace and Co. banking firm, but North American employees often requested their salaries withheld until they returned, or disbursed at home to a relative or to pay off debts. The assistants started on for a year at the salary of $500, with an additional $100 for every year after. Additionally, they received board, warm meals, and sturdy housing. When building costs stressed the budget, the director considered offering a higher salary and adding a charge for room and board, but he realized later that this was excessive for such necessary accommodations of foreign service.

At the observatory, these men split their work between nighttime hours of observations and photography, and daytime hours of maintenance, development, construction, and record-keeping. These duties were split between “first” and “second” rate assistants, categories determined primarily by education, but also dictated by nationality and race. In annual writeups for the director in Cambridge, Bailey highlighted the “division of work and labor” at the observatory, which he listed through instrumentation and the ‘first-rate’ assistants who used

---

4 Bailey to Pickering (5 January 1897), Arequipa to Cambridge correspondence, 1897 January 5-1899 December 18. UAV 630.100, box 9, volume 3, page 495 (seq. 8).
5 Bailey to Pickering (10 March 1896), Arequipa to Cambridge correspondence, 1895 January 14-1896 December 22. UAV 630.100, box 9, volume 2, page 417 (seq. 134).
6 Pickering to Bailey (26 April 1894), Cambridge to Arequipa correspondence, 1892-1898. UAV 630.100, Box 5, page 169 (seq. 200).
7 Bailey to Pickering (10 August 1894) Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1, page 244 (seq. 247).
them for the observatory’s projects. His listing also fell along national lines, crediting US assistants with astronomical observations from the plates and telescopes, while the Peruvian assistants “do a large part of the meteorological work.”8 Assisting the assistants, the ‘second-rate’ category attended to the more menial and manual labor that Bailey did not usually report. Bailey sought someone “second-rate” when trying to replace a young assistant he had hired from the Lick Observatory, George Waterbury. Waterbury had not had much education in astronomy, but he had the stamina to complete late night routine work, difficult backcountry treks to weather stations (including biweekly ascent of the Misti volcano to its summit station), and also assist in record-keeping, calculation, and the “easier, i.e., simper” work like keeping the lab in order, packing, unpacking, and developing plates.9 For all this, he was paid $100 for the first year, increasing $75 each year after. When Waterbury left, exhausted but on good terms, Bailey sought replacement labor from his other Peruvian assistants of the same, ‘second’ rate: Juan Muñiz would assume his meteorological duties, he would train “Manuel” to climb the volcano, and his son could start shadowing lab-work while tiding-up.10 Muñiz, an Arequipeño discussed further below, performed admirably, meriting credit for his maintenance and improvement of many of the remote weather stations throughout the Andes, and even routine work at the photographic telescope on the late night shifts.11

9 Bailey to Pickering (21 March 1894) Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1, page 187 (seq. 189).
11 Bailey to Pickering (20 September 1896) Arequipa to Cambridge correspondence, 1895 January 14-1896 December 22. UAV 630.100, box 9, volume 2, page 471-4 (seq. 188-91); Other annual reports found at: Bailey to Pickering (30 September 1897) Arequipa to Cambridge correspondence, 1897 January 5-1899 December 18. UAV 630.100, box 9, volume 3, page 548 (seq. 61); Bailey to Pickering (30 September 1898), ibid, page 599 (seq. 113); Bailey to Pickering (30 September 1899), ibid, page 685 (seq. 195)
The astronomers’ discussion and construction of this ‘second-rate’ labor reproduced the national, racial, and economic paradigms that haunted Peru in an efficient scientific laboratory. But without the rigorous education of their northern colleagues, the Peruvian assistants were not afforded the same tasks and responsibilities in the expedition’s primary mission. Unlike Waterbury, their status as second-rate assistants sat deeper than a lack of education. They performed integral support functions, and, with some field training, also contributed to photography and astronomy. Rather, the Harvard astronomers perceived elements of Peruvian nationality that blocked the way of their advancement. They viewed Peruvians as characters too passionate, proud, or youthful, and they did little to encourage their careers further in astronomy. Before Juan Muñiz proved to be a satisfactory Peruvian assistant, Bailey had experienced difficulty with two others, Elias Vieyra in Chosica and Luis Dunker in Arequipa, both of whom had seemed promising at first but ultimately left after offending Bailey and impeding functions at the observatory. But however much Bailey resented the unprofessionalism of the Peruvians, he recognized that they were easier and cheaper to hire than Northerners, and also put the observatory in good standing with the community. It was only a matter of trial and error until he found the right assistant, who could serve the observatory as a reliable, stable, family man. All the same, these second rate assistants came from privileged local positions of wealth and education, appearing (and sounding) more European to the North American visitors. The struggle to find the right man reveals the national, racial, and gendered preconceptions that attended the astronomers, obstructing their work, and also preventing any technological or prestigious transfer to Peru in development of their-own national sciences.

Elias Vieyra was young, energetic, and social. Once the telescopes were ready for their first observations on Mt. Harvard, Bailey hired Elias Vieyra as an assistant for late night
telescope and camera work. It is unclear how Elias came into contact with Bailey, whether through recommendation or recruitment, but “as a young man who speaks English very well,” he was eager to offer his service to the observatory. Also, he brought a “lively Spanish disposition” to the grounds that energized the atmosphere, sharing his grandmother’s folktales and playing with Bailey’s son. Bailey recognized that Vieyra’s personality was stifled in such a remote station, and allowed him monthly vacations to Lima for a few days, to rejuvenate his spirit with friends and parties. As for his work, Vieyra received 20 soles per month to watch and photograph the sky after 11:30 pm, although by late summer, he began to rely on servants to watch and call for him when the clouds broke. When, at the end of the dry season, Bailey decided to continue the scouting expedition for a more sustainable site in the south, he left Vieyra in charge of the scientific work, maintenance, and administration of the station. In many respects, Bailey later considered, the poor weather of the wet season mitigated the ensuing disaster. Photographic plates, half-developed, packed and shipped to Cambridge arrived broken, while lazy repairs had exacerbated problems with the telescopes. Bailey defended Vieyra to Pickering in light of these setbacks, recognizing the difficulty of Vieyra’s residence on-site in flimsy houses during the stormy season, and commending his repair work on the structure. For all the difficulty, Bailey increased his monthly salary to 40 soles.

12 Bailey to Pickering (5 June 1889) Arequipa to Cambridge correspondence, 1888 November 16-1889 July 16. UAV 630.100, box 6, folder 1. (seq. 45).
13 Bailey to Pickering (12 October 1889) Arequipa to Cambridge correspondence, 1889 August 4-1889 December 25. UAV 630.100, box 6, folder 2 (seq. 25-30); Also for stories see Solon Bailey, “Tales of Peru” in Journal. 1889. [phaedra0699], in “Project PHAEDRA. Harvard College Observatory observations, logs, instrument readings, and calculations.” John G. Wolbach Library, Harvard College Observatory. Cambridge, MA.
14 Pickering to Bailey (31 December 1889) Cambridge to Arequipa correspondence, 1889-1891. UAV 630.100, Box 1 Volume 1, (seq. 88-90); Bailey to Pickering (13 February 1890) Arequipa to Cambridge correspondence, 1890 January 14-1890 July 7. UAV 630.100, box 6, folder 3 (seq. 11-14).
When the time came to move the observatory south to Arequipa, the astronomers discussed whether to keep Vieyra or let him go. On the one hand, Vieyra had demonstrated skill in learning the basics of photography and spectroscopy, and appeared to be a faithful assistant. On the other, Bailey was suspicious that Vieyra was “putting up appearances” and “not wholly truthful.” He did not intend to slight Vieyra’s character, but rather to comment on the characteristics of “this country: they believe in lying for the mere pleasure of avoiding truth.” Moreover, Vieyra was “intensely egotistical, more so than his countrymen” and would launch into long lectures on all phases of life and any topic about which he just learned. To Bailey’s concern, this “conceit” manifested itself in Vieyra’s work, leading to underdeveloped photographs and small damage to telescopes. None of this was malicious, Bailey believed, just born of “egotistical” pride and an eagerness to accomplish the work. Ultimately they decided to leave him in Lima, with the possibility of hiring his services for miscellaneous astronomical or meteorological observations at a small price. As the first assistant, Vieyra had served the observatory well and was exemplary in his versatility. However, to the Harvard astronomers, a certain Peruness obstructed his science.

The astronomers faced a similar problem in Arequipa, where they hired young Luis Dunker to fill the gap left by Vieyra. At 20 years old, “Don Luis” shared in Vieyra’s Peruvian confidence, becoming the stations “authority on local weather trends,” seasonal volcanic activity,

15 Bailey to William Pickering (16 July 1890) Arequipa to Cambridge correspondence, 1890 August 2-1891 May 14. UAV 630.100, box 6, folder 4, (seq. 3-4).
16 Bailey to Pickering (13 March 1890) Arequipa to Cambridge correspondence, 1890 January 14-1890 July 7. UAV 630.100, box 6, folder 3 (seq. 17-18).
17 Pickering to Bailey (18 January 1896) Cambridge to Arequipa correspondence, 1892-1898. UAV 630.100, Box 5, page 451-454 (seq. 404-07).
and nearby ruins. Like Vieyra, he was hired on a salary of 20 soles per month, with an increase of 5 soles every six months; and during his three years at the observatory, he worked the early shift at the telescope, recorded the metadata of plates (from which he once discovered a comet), and prepared their shipment back to Cambridge. Additionally, Dunker helped establish, read, and maintain the chain of meteorological stations from Mollendo to La Joya. In all, Bailey was pleased with Dunker’s performance, and even believed that, if he developed some “systematic persistency,” he could do well studying astronomy in Cambridge. As it was, however, Dunker’s “artistic, erratic disposition” amounted to irresponsibility. The astronomers reported that he was slow to start a project of photographing specific stars to measure their variability, and that his plate records were often incomplete, missing key information such as date, time, and zone in the sky. When left alone, he had a tendency to break plates; and his calculations needed thorough checking, an error occasionally slipping by. Most problematically, however, he played fast and loose with the observatory’s credit in town, already a high and delicate subject.

When Dunker resigned, it was with encouragement from Bailey. His irresponsibility had begun to cause problems with the scientific work, and his profligacy around town had driven the observatory into an awkward position. Either Bailey could repay Dunker’s debts to Arequipeño shops, at great and unnecessary expense; he could dispute the charges, which would be rude and insulting to the locals; or he could pursue legal redress with Dunker, a path Bailey saw as

18 Bailey to Pickering (8 September 1893) Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1, page 97-99 (seq. 96-98); Bailey to Pickering (26 January 1894) Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1, page 172 (seq. 174)
19 Bailey to Pickering (4 January 1894) Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1, page 183 (seq. 185).
20 Pickering to Bailey (29 June 1894) Cambridge to Arequipa correspondence, 1892-1898. UAV 630.100, Box 5, page 284 (seq. 225).
“useless.”21 He made an agreement with Dunker – a revision from a previous agreement to withhold some portion of his monthly salary until the accumulation covers his debt– wherein Dunker continued living and eating at the observatory in exchange for early morning observations. Dunker had originally resigned to join a German musician on tour, but to climb out of this debt, he reapplied the skills learned at the observatory and took a job at a local photography studio, alongside indigenismo portrait photographers who celebrated Peruvianess alongside and against these foreign technical marvels.22 In addition to the reckless spending, with the growing political tensions of 1894, Bailey noticed that Dunker was growing more passionate about his home, and cultivating a character of the “most radical Peruvian type,” not unlike many of his countrymen.23 “At any price,” Bailey was comforted to be rid of such a volatile agent at the observatory. But at the same time, Bailey was happy to keep a friend, and as long as Dunker stayed in Arequipa, the two continued their recreational mountaineering trips in the cordillera. Dunker’s passionate and modern character was intriguing for a friendship, but they were not qualities that bolstered his science; they detracted from expectations of rigor and trust, calling into question the whole work of expedition.

Where Dunker’ and Vieyra’s youth may have worked against their favor, Dunker’s successor, Juan Muñiz, arrived with a long experience of tinkering with machines. Moreover, nearing his middle years, Muñiz married early in his tenure – an excitingly stable prospect for

21 Bailey to Pickering (22 August 1894) Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1. page 253-4 (seq. 256-7).
22 Bailey to Pickering (30 October 1894) Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1. page 263-267 (seq. 264-8). For more on the genre of indigenismo photography, see Poole, Vision, Race, and Modernity, chap. 7: The New Indians; and 8: Renegotiating Modernity.
Bailey, but something he soon realized made Muñiz “uncertain, unreliable, and ruined.” In time, after the heat of the marriage simmered down, Muñiz came to devote his life to the observatory, not only maintaining the myriad of astronomical and meteorological instrumentation around the observatory, but even drafting and producing new, more efficient, “ingenious” designs. He was placed in charge of all meteorological stations, traveling on month long trips inland to gather data, maintain and repair the instruments, and enlist local recorders for the next season; additionally he made regular trips to the station on the summit of El Misti, and, despite his regular sickness from this, refused to rest, relent, or even eat on the journey. Muñiz’s health also suffered from lack of sleep, to which Bailey responded by removing him from all night work. His reliability and handiwork with the instruments made him invaluable to the observatory’s operation.

Bailey accommodated Muñiz more than his other assistants because he was a family man, exhibiting the same ideal masculine traits of stable household, dedicated work-ethic, and passion for knowledge. With the value of his scientific work firmly established, keeping Muñiz meant supporting his family. After experiencing housing troubles in town, Bailey decided to build a residence for Muñiz and his family – a wife, “two or three children,” and a handful of servants – on site at the observatory. The cost of construction was covered by the observatory, and by late 1897, the Muñiz family lived on site, with a monthly salary of 90 soles plus the use of the cottage. Bailey thought “he really cannot live on less.”

24 Bailey to Pickering (3 December 1893), Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1, page 153 (seq. 153).
25 Bailey to Pickering (3 April 1899), Arequipa to Cambridge correspondence, 1897 January 5-1899 December 18. UAV 630.100, box 9, volume 3, page 628 (seq. 138).
26 Bailey to Pickering (12 October 1897) Arequipa to Cambridge correspondence, 1897 January 5-1899 December 18. UAV 630.100, box 9, volume 3, page 548 (seq. 63)
and his wife tended to their home duties and supported their children. When his son came of age, he also began working as his father’s assistant, and eventually his successor. The observatory quenched their thirst for knowledge with tutoring lessons in astronomy, and by sending textbooks on meteorology. Over the years, these efforts cultivated a series of “wise and faithful assistants” from the Muñiz family, whose scientific work the astronomers could trust. Partly due to his personal dedication, and partly to his family-brand masculinity, Muñiz was able to thrive in the scientific space of the expedition.

Besides assistants for the scientific work, the astronomers also sought help with accounting and finances. Bailey’s brothers initially helped him with this matter, but after their terms in Peru were over, it was necessary to find a more permanent and locally knowledgeable accountant. In Arequipa, an old Mr. Mechelhof, émigré from Germany, performed these functions “admirably” for the price of 20 soles per month. Aside from his reliability with numbers, Mechelhof’s age and race gave him an authority over other assistants, such that only he could handle money and authorize purchases (effectively curbing Dunker’s wild spending). His age, however, made him a precarious employee of the observatory, and Bailey often planned how they would modify his position for his replacement. They might want a “matron” to manage

27 Bailey to Pickering (10 August 1894) Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1, page 240-244 (seq. 243-7).
28 Mechelhof was not the only German immigrant in the area. Bailey lists many German names in is listing of meteorological readers, and notes a German meteorologist who is also sued by Calisaya (more below). For more information on the activities of German intellectuals in the Andes, which followed similar paradigms of informal empire, see Uta Raina, “Intellectual Imperialism in the Andes: German Anthropologists and Archaeologists in Peru, 1870–1930” (Ph.D., Temple University, 2007), accessed November 9, 2018, http://search.proquest.com/docview/304827968/abstract/A0F2953F3D7740D9PQ/1.
29 Honor, masculinity, and respect along lines of Spanish, European, or Limeño ideals played a large role in the civic life of Arequipa. For more see Chambers, From Subjects to Citizens.
all household affairs (this gendered labor will be discussed below), but whomever they might hire “must equal Mr. Mechelhof in their knowledge, dignity, and respect.”

These assistants, all of whom dealt in the knowledge production and sustainability of the observatory, were all hired from the upper echelons of Peruvian society – the “gentlemen” of the Peru. Bailey’s problem with this “better class” of people was that they expected a high salary, and disliked manual labor so far as feeling insulted if asked. Bailey could fix the problem of pay (and expertise) by hiring US students at modest salaries, but, in his view, excessive manual labor was just as unbecoming to the educated astronomer. Bailey was more than happy to get his hands dirty when needed, but he found that there was so much “routine and photographic work” that they needed help from a man “in good health who will be faithful, regular, and systematic; if he is a genius afterwards, it is very well.” The man Bailey had in mind would be a “‘cholo’, but of the better class, who can read and write,” and who could provide inexpensive help in all quarters of observatory life. Muñiz and his family eventually filled this role, but, in conceiving of this routine and nonscientific work as appropriate for a certain race, the apparent neutrality of the expedition fell away, replaced by colonial categories, constructions, and limits of race.

The different ways that the astronomers treated the “gentlemanly,” Spanish, urban, wealthy, and white sectors of Peruvian society, on the one hand, and, on the other, the Indians and mestizos they encountered in the countryside, played into the perennial “Indian problem” that haunted Peruvian efforts towards a modern, integrated society. As a “complex political and representational problematic” that seeks to find the Indian and creole mestizaje position in the modern state, this problem has received repeated diagnoses as a holdover from colonial, feudal

---

30 For more on the matron and gendered labor at the observatory, see below.
31 Bailey to Pickering (4 January 1894) Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1, page 187 (seq. 189).
land-tenure systems that forced Indigenous and mestizo Peruvians into positions of servitude and rural poverty. Indeed, as Bailey traveled through the area, he noted the general conditions of “wretched poverty,” mud huts, bland meals, and bare feet, working as livestock grazers, sugar plantation hands, tenant farmers, and day laborers. Looking for cheap workers for construction and routine labor, the astronomers drew from this racial class to complete their scientific work. They relied on the familiar, European elements of Peruvian society, and followed suit in their categorization and treatment of mestizo and Indian Peruvians.

From the astronomer’s letters, journals, and published accounts, it is difficult to comment on their attitudes on this racial dynamic. They use words such as “cholo,” “mixed race,” “half-breed,” “half-blood,” “indian,” and even “Inca,” but primarily consider the people only in the sense of their utility – of what they might offer (or how they might hinder) the operations of the observatory. With this perspective, Bailey integrated the production needs of the observatory into an already established political economy and national labor regime: negotiating with small power brokers, such as muleteers and transport workers, to hire groups of people for regular service (in the case of food and water) or large one-time building projects. Muledrivers in particular were uniquely connected to large rural labor pools, traversing social spaces and productions zones of the altiplano. Bailey could hire “their indians” at a cheap price; and, on occasion, some surprised the astronomers with their technical competence.

To assist with the first site scouting around Lima and Chosica, Bailey hired the muleteer Antonio Viera through the railroad superintendent of the Oroya line, Mr. R.B. Hubbell. Viera not

34 Jacobsen, Mirages of Transition, 4, 38.
only helped oversee the labor hired to build the observatory, he also found a man, Francisco, whom he believed could serve as a helping hand around the station. Moreover, Francisco’s new wife, Vincenta, (in addition to demonstrating his constancy) could also help with the domestic work. Viewed as a stereotype, as “childlike and affectionate” Indians, growing gardens, cooking grains, living among the animals, with “curious and interesting ideas of science,” they still assisted in the scientific work, from tasks as small as calling out a break in the midnight clouds, to washing the glass plates and developing the photographs. However, Bailey became troubled when Francisco “arted so well that he soon got a big head,” treating plates so carelessly that Bailey “took it from him.” At the end of the time on Mt. Harvard, they had served so well that the astronomers gifted the land and shelters to their family, and continued to hold Francisco in mind as the exemplar “half-Indian” who could learn to wind the clocks, rotate the domes, change the plates, and “especially do the heavy work.” And at a steady rate of 15 soles per month, their labor was also more economical – and encouraged to be more precarious – than that of the privileged, first and second rate classes of assistants.

In Arequipa, where the observatory commanded more space and hosted more visitors, the servants became more anonymous, and their duties less scientific and increasingly domestic. Clymer informed Pickering that the accommodations he expected as an assistant amounted to “table board, room, furnished, cared for, and lighted and laundry work” – all of which would be done by the staff on hand. The Arequipa observatory budgeted for five servants, 60 soles

______________________________________

36 Bailey to Pickering (12 November 1895), *Arequipa to Cambridge correspondence, 1895 January 14-1896 December 22*. UAV 630.100, box 9, volume 2, (seq. 129)
37 Pickering to Bailey (18 January 1896), *Cambridge to Arequipa correspondence, 1892-1898*. UAV 630.100, Box 5, (seq. 407).
monthly total, or twelve for each, but they often found they could work with one fewer and some part time hours.\textsuperscript{38} These servants, men and women, also lived on site and their duties were divided between kitchen work and housekeeping. The male servants served as an interface with Arequipa, where they would make frequent trips to the shops for food, photo chemical supplies, or to deliver post to the railway.\textsuperscript{39} None of these servants, however, appeared to satisfy the astronomers as much as Francisco and his eager assistance, and Bailey was left wanting this hybrid ideal, “both cheap and useful,…who won’t think he is an astronomer as soon as he learns how to open the door and wind the clocks.” Peruvians still appeared to be too volatile and haughty for the astronomers to maintain the efficient purity of their science, even when the most economical options confronted them with interest and energy.

In addition to the science, the astronomers needed hands to help build paths, buildings, and walls, in addition supplies of food, water, and shipments of goods to and from the port. The astronomers often complained that they received inadequate work, laziness, drunkenness, or outright deception from their work crews. In Chosica, Bailey found himself bombarded by “\textit{cholos}” who knew of fantastic watering holes, hidden groves, and lodestones no gringo could resist; but Viera warned that these men were scammers looking for a way into the expedition’s coin purse.\textsuperscript{40} At any rate, Bailey and Viera found it useful to hire them to build a mule path to the station site, eight miles from town. It was difficult work, made no easier by the unreliable access to water, with which Bailey was unable to supply the slow and grumbling workers for two

\begin{footnotes}
\item[38] William Clymer to Pickering (18 October 1898), \textit{Arequipa to Cambridge correspondence, 1897 January 5-1899 December 18}. UAV 630.100, box 9, volume 3, page 597-8 (seq. 111-2).
\item[39] Bailey to Pickering (27 January 1895), (seq. 15).
\end{footnotes}
days!\textsuperscript{41} Throughout the early days of the expedition, Bailey had difficulties with hiring “drunk and lazy” men who failed to supply the remote station with water, food, and supplies. He hardly trusted these crews enough to transport the glass plate photographs along the mule trail. At length, they found a reliable transporter, Ascenio, whom they paid a \textit{sol} for each daily delivery.\textsuperscript{42}

In Arequipa, astronomers continued to rely on local muleteers and their networks of day-laborers to complete short-term, large-scale projects. The landowners from whom the observatory bought the land organized construction crews from the nearby village to construct the white stone residence, but the astronomers preferred to do the important construction of the telescope foundations and instrument set-up themselves. For other projects, such as scouting for meteorological station sites or building a mule trail to the station at the summit of El Misti, the observatory relied on Francisco or Calisaya, Arequipeño mule-drivers whom they had met through a helpful gentlemen in town, Sr. Romaña. On these projects, these men worked as overseers and received double the pay of the laborers – ten \textit{soles} per day. As for the workers with the spades and hammers who built this path through shifting sands, their anonymous but

\textsuperscript{41} Solon Bailey (26 May 1899) \textit{Journal of South American Expedition, 1889 February 2-1890 March 31}. UAV 630.100, box 13, folder 3, (seq. 112).

\textsuperscript{42} Solon Bailey. \textit{Annals}. v. 34, 22.
collective labor was reflected in Bailey’s documentation of the project (Fig. 1). Bailey paid the group of “indians” five soles per day to compete the path, and on the third day, with the summit in sight, Bailey offered an additional five soles if they complete it by evening. This, plus two more, was incentive to speed up work, but when food and water failed to come through, Bailey had to tap into his wine reserves to rally the men to the end. On the one hand this was the action of a generous supervisor; on the other hand, the benevolence of the overseer did not extend the discoveries of science and technology to these people living in poverty.

In connecting with Peruvians neither European or Europeanized, the astronomers invited worldviews alien to their-own into the observatory, sometimes with great hassle. On the occasion of property damage, such as when one of Calisaya’s mules died falling into the volcano, the muleteer attempted to sue the observatory for redress. At the time of the incident, the observatory had “shared the loss” with Calisaya, offering a small sum of money, but no amount sufficient to replace the shortfall to his livelihood. He now sought 160 soles to purchase and rear a new mule. Unfortunately, Bailey took advantage of the shoddy professionalism of Calisaya’s lawyer, and had the suit dismissed upon appeal to his friends in Lima. This legal incident demonstrates the contest of worldviews between the astronomers, viewing their presence as incidental and benign, and the local workers, whose lives were structured around concepts that the scientific epistemology could not compute. Condolences and a small bonus, however unobtrusive to the

43 Bailey to Pickering (10 October 1893) Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1 (seq. 128).
44 Bailey to Pickering (10 October 1893) Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1 (seq. 128); Bailey to Pickering (22 August 1894) Ibid. (seq. 257).
45 In discussing altiplano economies, Nils Jacobsen uses the concept of “defensive change” to identify the new forms of social relationships that emerge when older, indigenous behaviors resurface to contest the power of western capitalism. Calisaya’s rebuke is such a moment where methods of legalism and living-systems come together as a tool for dignity. For more see Jacobsen, Mirages of Transition, 8.
data gathering they might have been, were hardly sufficient replacements for the vehicle of one’s life and economy.

Through all of this labor, neither Bailey nor the mule-drivers were detached overseers, although they did hold the power to withhold wages; rather, they shared in the manual labor, the frustrations when water-boys were unwilling to deliver up the mountain, and even from the small lunches they had brought, nourishing their workers to accomplish the task as efficiently as possible. Yet the temporary employment fed into a lifestyle of precarity. It perpetuated poverty in the region, failing to provide a means to break away from the labor regime that limited opportunity in accordance with race and wealth. A field education in astronomy might have benefitted, or at least entertained, these workers, but a few soles for their manual labor left them back in the dust.

However insufficiently recognized, their quotidian contribution does stand in the scientific record. Published narratives of construction, such as in the *Annals* of the HCO, exposed the difficulties and labors of the project, applying collective credit to a racial class of people. Bailey reported that carrying meteorological equipment up the *Misti* volcano on mule-back was “constant struggle” and “exceedingly hard for the drivers and Indians.” However, in his narrative, the success of ascension is not theirs – Bailey goaded them to the top with food, wages, and obstinacy, preventing any workers from taking an undue break. Beyond construction work, many of the instrument readers and weather observers that the observatory hired were interested locals willing to work for cheap – if they refused payment (of 10 soles per month), it

was because they had enough money and participated out of personal interest.\textsuperscript{47} The meteorological data, also published in the \textit{Annals}, included a credit to these observers, each formally named, but given different titles of respect (e.g. “F. Chavez” or “Sr. Ayulo”).\textsuperscript{48} The astronomers, with their labor and production methods bound in ideas of nationality and race, permitted the layman this terrestrial science; but their celestial projects remained under the purview of the imported expert. If any of these Peruvians wanted to contribute to the grand astronomical project, they would have to find an education in the United States or Europe.

Gender and Family at Work in the Home

At the same time that the astronomers were dividing their labors between employees of different nationalities and races, their wives and families, and those of their assistants and servants, were also at work at the observatory. Solon Bailey traveled with his wife and son, Ruth and Irving; and William Pickering traveled with his wife, mother-in-law, two daughters, and their maid.\textsuperscript{49} These women attended to a range of domestic duties – such as housekeeping, house finances, childcare, food preparation, nursing the sick, and entertaining guests – and these similarly fell into strata of race and class. Much like historians have seen in the imperial settings of British India and French Indochina, a “broad range of approaches to homemaking” attended women in these extraterritorial projects, often creating both imperial and national connotations of home life and policy.\textsuperscript{50} In the case of the scientific expedition, the astronomer’s wife was

\begin{thebibliography}{10}
\bibitem{Bailey1894} Bailey to Pickering (14 July 1894) \textit{Arequipa to Cambridge correspondence, 1893 March 3-1894 December}. UAV 630.100, box 9, volume 1, page 217, (seq. 219).
\bibitem{Pickering1890} William Pickering to Bailey (18 September 1890), \textit{Cambridge to Arequipa correspondence, 1889-1891}. UAV 630.100, Box 1 Volume 1, (seq. 131-134).
\end{thebibliography}
expected to bring New England life to the Peruvian observatory, sustaining their husbands, and even assisting their work at times. The local women, however, made this task possible, especially as the observatory grew, sharing local knowledge such as gardening practices, nursing techniques, and plenty of thick alpaca wool to keep warm. These contributions made the observatory Peruvian, at least in its home life, no matter how much the North Americans tried to recreate their familiar world.

The astronomers designed the presence of women at the observatory to benefit its production. At times mirroring the strategic policy of imperial projects to control the colonial space through a rigid enforcement of gender categories and domestic expressions of desire, this expedition sought wives, mothers, daughters, and other stabilizing forces to properly direct the men’s energy.  

Bailey explained, 

“I think it would be highly imprudent, since human nature is what it is, for several young men, even the best disposed, to run the observatory alone...as single young men get lonely and seek perhaps more consolation in the society of señoritas in town than is always best for work.”

This applied equally to their US employees as their Peruvian assistants and servants, most of whom lived with their families on site or close nearby. While Clymer’s unwed status caused concern, Stewart’s new marriage gave him promise; likewise, Francisco, on Mt. Harvard, brought his wife Vincenta; in Arequipa, Muñiz brought his family, along with their two servants, and their two children. As seen with Stewart and Muñiz, a fresh marriage meant greater distraction, but the long term return on stability and focus could improve any man’s productivity.

__________________________


52 Bailey to Pickering (30 October 1894), Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1, page 214, (seq. 226).
Accompanying the women was the construction of a domestic space that could support employees and visitors, fostering a fruitful work environment. The deployment of this domestic environment allayed the anxiety of the expedition’s administrators back at Harvard. And its economic efficiency and easy implementation made it even more appealing.

In the field, the astronomer’s wives recreated a familiar, comfortable, and healthy domestic space for their family and children (Fig. 2). This included managing the duties of domestic servants, in addition to arranging the matters and styles of home. They received

Fig. 2: "SI Bailley [sic: Solon Bailey] with son on his lap and Mrs Bailey painting, in sitting room]" on Mt. Harvard Station. Harvard University Archives, UAV 630.271, Series 3, "South America 1889-1927"
frequent shipments of domestic goods from Cambridge, such as “fancy articles,” “fancy crackers,” cornstarch, toilet paper, scarves, and twenty-two boxes of Christmas toys and ornaments (organized by Williamina Fleming) – all of which made the expedition site warmer, more familiar and hospitable. Ruth Bailey also assisted the observatory staff in illness, a frequent occurrence at the high altitudes. The astronomers were just discovering the effects of altitude sickness on a maladjusted body, an illness they termed the *soroche* and observed with care. Bailey was always concerned about his wife, despite her demonstrating great resilience, because of the sudden death of the wife of one Bailey’s friends from the railroad while scouting for a site along the Cuzco line: they took a nice seaside breakfast at Mollendo, and she was dead by twelve-thousand feet.\(^5^3\) In less severe cases, the sickness amounted to a headache and dizziness which they treated with rest and refreshments. Ruth Bailey also attended to her son and husband when they fell ill with the inevitable travel bug immediately after arriving in Lima, and also found that she was needed in “doctoring” the assistants on Mt. Harvard during the rainy season, “to keep the help and all from sickness.”\(^5^4\) In many respects the care, both preventative and prescriptive, that Bailey provided to these employees diverted an emergency for the expedition: Elias Vieyra manned the station while Solon explored for alternative sites in the south, and Bailey ostensibly was left to relax with her son in Lima. If Vieyra had fallen ill, the photography would have stopped, the science stalled, and the expedition wasted.

These women also assisted in this scientific work. In early days of the expedition, when the observatory only had a few extra hands, Bailey felt compelled to ask his wife, Ruth, to help

---

53 Bailey to Pickering (4 January 1894), *Arequipa to Cambridge correspondence, 1893 March 3-1894 December*. UAV 630.100, box 9, volume 1, page 115 (seq. 180).
54 Bailey to Pickering (16 March 1890), *Arequipa to Cambridge correspondence, 1890 January 14-1890 July 7*. UAV 630.100, box 6, folder 3. (seq. 39).
copy records and correspondence to send to Harvard, a task for which he paid her twenty-five cents per hour. He made sure to check that this price was consistent with the wage paid to the women computers at the Cambridge observatory, so as to leave no work undervalued. Less formally, Ruth Bailey assisted her husband with photographic analysis, serving as the second counter in his quantification of globular star-clusters, and also as a regular weather observer. For each of these endeavors, she received a small credit line as “Mrs. S.I. Bailey” in the final publications.

The wives of the astronomers also delegated domestic duties to the Peruvian servants, in kitchen work, cooking, cleaning, laundry, childcare, shopping and supplying the observatory from town, and occasionally gardening. Ruth Bailey also handled the interface between servants and scientists, making sure everyone received the proper meals and maid service due to their board arrangements. On Mt. Harvard, where the Baileys lived in close quarters with Vieyra, Francisco, and Vincenta, the station took on a “family” home quality. They shared stories, trekked along the mountain ridges, and played tennis on a make-shift court. In Bailey’s journals and letters to Cambridge from Arequipa, the servants did not receive names for their work. Rather, they only register outside of routine, such as when a sudden and dramatic earthquake compelled Josefina and Pelionela to vigorously pray at their household altar, or when Vincenta

55 Bailey to Pickering (5 June 1889) Arequipa to Cambridge correspondence, 1888 November 16-1889 July 16. UAV 630.100, box 6, folder 1. (seq. 50)
56 Bailey to Pickering (10 June 1889) Arequipa to Cambridge correspondence, 1888 November 16-1889 July 16. UAV 630.100, box 6, folder 1. (seq. 54).
57 Bailey reports that she chose this attribution. Bailey to Pickering (21 June 1893), Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1, page 60 (seq. 60).
58 Solon Bailey (4-11 April 1893) Journal of the Peruvian Expedition, 1893, 1894, 1899. UAV 630.100, box 13, folder 5, page 25 (seq. 29).
59 Bailey to Pickering (10 August 1894) Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1, page 243 (seq. 245).
shared her stories about cursed pregnancies, sour milk, and saintly nuns. 60 By recording only their novel cosmologies, Bailey overlooked their real contributions to the expedition. This gathering of knowledge, to which I will return in the next chapter, eclipsed the labor of the “servant” class at the observatory. In astronomer’s eyes, these Peruvians could offer only ancillary or supplementary help towards the observatory’s primary mission. Their knowledge was not scientific. And their labor was not credited in any of the observatory’s scientific or narrative publications.

The work must have been intense – even Mrs. Bailey grew tired of delegating so many tasks. After the observatory moved to Arequipa, the scope and presence of the observatory slowly expanded beyond the simple “family” dynamic of Mt. Harvard, and into a more hotel atmosphere, hosting visiting scholars, friends, and other Peruvians. Moreover, the growing number of assistants coming to live on the grounds, along with their growing families, made the prospect of such labor going unpaid unthinkable. Bailey believed that his wife might be able to “superintend” the domestic work for three more single men, but if they brought their children, it would become a cumbersome duty. As a solution, Bailey suggested hiring a “matron or manager of the household,” to live on site, serving as the “responsible head” of the observatory. Bailey saw two major benefits to this “lady’s” service: she could keep a close eye on the servants (“nearly all petty thieves”) and, regarding the observatory as a “hotel,” she would represent the “social standpoint” for the observatory. That this “manager” was foremost a “matron,” and gendered feminine in all other references, reveals Bailey’s dependence on the familiar and easy

routine of gendered labor. Where his wife had managed the small affairs of the expedition family, a professional matron could handle the work scaled up. It was not certain that she would be “faithful” in the management of the house, but if she could be trusted, such an arrangement would benefit the productivity of the observatory, as well as its social standing in Peru and abroad. As it was, the astronomers never hired such a matron – the logistics of room and board and the conception of a midway house for science proved too unwieldy for the astronomers to manage alone. Their wives continued to help them.  

Conclusion: Making Race and Gender in the Expeditionary Setting

Labor at the observatory divided work into categories of scientific worth, operating within local Peruvian regimes to create the Northern scientific world. Interactions between Northern scientists and Peruvian laborers sustained and reproduced categories of race and gender that descended from colonialism, and would remain active components in the extension of US empire. Historians of empire identify domestic spaces as hotspots where imperialists inscribe race and gender as a modern imaginaries and limits in social possibility. While the astronomical expedition was hardly a civilizing project, it did deploy tools of empire to facilitate its scientific mission. Functioning as a home and a hotel, as a studio and a station, and site of construction, extraction, and a base for outside research projects, the observatory combined many worlds – Peruvian, Indian, scientific, professional, domestic, worlds of money, power, knowledge, and projects.

61 Bailey to Pickering (20 April 1896) Arequipa to Cambridge correspondence, 1895 January 14-1896 December 22. UAV 630.100, box 9, volume 2, page 426 (seq. 143).
62 Stoler, Carnal Knowledge and Imperial Power; Poole, Vision, Race, and Modernity.
While the astronomers relied on an imbalance of power in these worlds favoring the global north, the effects of their actions reinforced formulations of identity at the local level. In much the same way that historical anthropologists have found Indian, mestizaje, or middle-class rearticulations and cooptations of colonial racial categories to produce new identities with honor and history, the employees of the observatory turned this given hierarchy into a privilege in the community, a status and exception. Luis Dunker is the most apparent example, with his dependence on the observatory’s reputation to rack up substantial debt in Arequipa. However, in his recordkeeping of the expedition, Bailey was more concerned with productivity and science than Peruvian folkways and formulations of nation. He did not record how Francisco and Vincenta told their friends about their work, how Calisaya made his life away from the observatory, or the lives of their house staff and delivery crews. He did record a general pride felt in the observatory, a high regard that emerged from both his diplomacy with power brokers and also the general curiosity about the expedition – his lectures packed halls, and Arequipeños regularly made the five mile trek to Carmen Alto to see the photography in action. Since Bailey was happy about the apparent social success of his expeditionary project, it is difficult to comment on the reality of these local opinions without local voices. Some questioned the scientific collecting, some facilitated it. But knowing how, or if, the astronomy inspired the Peruvians to follow scientific pursuits and define their own space in the world will require a different set of sources. All that is apparent in the observatory’s records is a labor structure, imposed to sustain productivity, adapting and deploying racial and gender categories to divide the work into scientific and supportive roles.

Producing Cosmic Knowledge: Empire and Extraterritorial Research

While the Boyden expeditions lacked the pride and militancy that typically accompany imperial projects, the ways in which the astronomers imagined, enacted, and archived their scientific mission mirrored dynamics of empire. Beyond the truism that all knowledge is imperial (in that it ‘conquers’ ignorance), Ricardo Salvatore has argued that the disciplinary knowledge created by early twentieth century North American scientific explorers in South America reinforced the cultural, industrial, and financial hegemony of the North over the South in a process of soft or “informal” empire.¹ Not only did scientists gather information to facilitate business and political expansions over the continent, but the pull of the knowledge back to the metropole imbalanced relationships in the impossibility of reciprocity. Salvatore identifies four main features of this knowledge that contribute to the imbalance: (1) their status as extraterritorial expeditions based in Northern universities; (2) the simplification of their data collection so as to render the knowledge “visible” to the science community; (3) the framing of that knowledge in utilitarian terms, especially regarding extending empire and refining knowledge production; and (4) their interdisciplinary nature, combining a variety of natural, physical, historical, and social sciences. The first and last features gesture at the wide transnational scope and breadth of the expeditions, which often combined resources to gather as much knowledge as efficiently as possible. The second and third features reveal the mechanisms through which the scientists designed and performed their program. Through these actions,

¹ Salvatore, Disciplinary Conquest, chap. 3.
knowledge emerged as imperial, connecting the ordered imagination of the ivory tower with a world dense, lush, and beyond.

I do not intend to argue that the Harvard astronomers were secret imperial agents out to surveil the world, sending dossiers to state patrons eagerly waiting at their gunboats. Rather, I suggest that the scientific mission to photograph the southern sky prefigured Salvatore’s “disciplinary conquest” in ways that both facilitated later expeditions to the Andes and negotiated the northern ownership of Andean knowledge. As a transnational expedition, working between the US, Peru, Chile, and Bolivia, the mission marked out a region peripheral to the scientific centers of production in Cambridge. From this external vantage, the Harvard astronomers published observations and readings from star-photographs and meteorological stations, simplified into narrative or tabular form, for use by general astronomers, or special voyagers to the Andes. Among these special voyagers, anthropologists, such as Harvard’s own F.W. Putnam and George Dorsey, or celebrity expeditionaries, such as Yale’s Hiram Bingham, used the HCO’s Arequipa Observatory as a base and contact for their projects in the region. Extraterritorial, simple, and used by more than just astronomers, the knowledge gathered at the Arequipa observatory was North American knowledge – Peruvian only insofar as its source.

Through imagining the cosmic enlightenment of all humanity, the northern scientific epistemologies that accompanied the expedition controlled the production of knowledge from southern resources. Ostensibly contributing to new ways of understanding the universe, the expedition aligned its knowledge needs, and the attending expense of resources, towards northern science, often at the expense of educational, economic, technological, and scientific development in Peru. Under this positivist imagination, the enactment of the mission – which sought definite, objective cosmic truths –, its collecting of data, discussion of information, and
the archiving of its knowledge followed paths of empire. Circulating around the imperial center, the knowledge became removed from its origins, and Peru was distanced from its stars for the sake of general humanity and universal benefit. Overshadowed by the colossus of North Atlantic astronomy, Peru and Peruvians received little of this gain.

This chapter follows this process of knowledge production in informal empire. First, the imagining of the expedition – in its calls for funding, initial travel planning, and conception of data usefulness, results and imagery – placed the astronomers in a position of ostensibly universalist contributions to all thinking minds; and, in light of Harvard’s participation in the 1893 Chicago World’s Fair, brought a more industrial, modern, and patriotic pride to the scientists. The Peruvians did not figure in this imagination, nor did the dirty and unpredictable reality of moving through foreign spaces. Next, in full swing of the expedition, astronomers collected data with the help of government, business, and industry connections made between the North American world and the Andean nations, receiving concessions and land-use rights, building walls, and welcoming scientific guests with hospitality. When the astronomers shared their knowledge it was in a range of genres, such as expeditionary travel narratives, numerical tables of stellar or weather data, or photographs of stars, spectra, and landscapes – all of which tended to suppress the Peruvian contribution to science. The Peruvians, however, often contested this view, offering alternative narratives of their participation in the expedition in local settings. In the end, whatever the Peruvians contributed to the production on the ground, the knowledge was archived at Harvard and put to use in the extension of US imperial projects over Andean space. This process, with the ostensibly neutral object of cosmic knowledge, effectively sanitized the science of its Peruvian effects, leaving a silence in the historical record, and limiting the possibility of Peru to follow the scientific promise of its own skies.
Imagining the Expedition

When the observatory moved to Arequipa in 1891, after the disastrous rainy seasons at Mt. Harvard, the astronomers felt comfortable, and even excited, about the crystal clear skies. Ready to get some real work done, HCO director Edward Pickering issued a call for donors who might fund a new large telescope. In an article published in *Astronomy and Astrophysics*, an early precursor to *Popular Astronomy*, Pickering lamented the current placement of all the world’s most powerful telescopes, north of the 35th parallel, where they were only able to view one-fifth of the sky. The HCO’s new station in Arequipa, however, provided the opportunity for a regular view of the southern skies, and with it views of nebulae, variable stars, and planets neglected by the current discipline. Pickering concedes that such novel views from the south will not be able to confirm alien life on Mars, but they will open up a “field of work comparatively new.” The newness of this field, partly bound up in photography and developments in spectroscopy, emerged also from its vantage point in an undiscovered space. Ultimately, with the ability to study southern sky phenomena, the new telescope would further “our knowledge” of the heavens with “unequalled advantages.” Pickering found the funds necessary to build this telescope and begin this mission from Catherine Wolf Bruce, a wealthy New York widower, who shared in his vision of astronomical progress. By Pickering’ estimates, the cost would have been over $200,000, had Harvard not already established a suitable location in Peru.

Pickering imagined that this photographic telescope would passively capture the starlight on glass plates for analysis at his astronomical library. With the proposal to create a full-sky

---

3 Ibid., 785.
4 For more on the Bruce bequest, see Nisbett, “Business Practice,” 1: "Thanks for the Check".
catalogue, and well as establishing a regular sky-patrol program for future time-domain observations, he knew he would soon have an astronomical amount of glass to work with. To obtain the funds for storage space and “readers,” as he called the computers hired to analyze the images, he wrote to the Carnegie Institution of Washington:

“We have this great library of glass photographs, each unique, easily destroyed, and containing a vast number of facts relating to the entire sky, for some portions of which there have hitherto been no readers. This grant furnishes readers, who will extract from this storehouse of the history of worlds, facts heretofore unknown, and which, except for this collection, could never have been learned, since it contains the only record of them upon the Earth.”

While Pickering was surely amplifying the grandeur and appeal of his project, his proposal still highlighted the myopia of the new astronomical discipline, unable to see past their routine science into their interactions with other cosmologies. Had there been no Peruvians, or Amerindians before that, who “read” the stars for information on historical worlds? Evidently not for “facts.” Pickering did not exaggerate on the uniqueness and precarity of the collection – Harvard remains the institution with the largest collection of astronomical glass plate photographs, totaling (after a few unfortunate purges and disasters) over half a million images. This collection, allegedly the only record of special celestial phenomena, would naturally have a home in Cambridge.

Another metaphor that Pickering favored for the expedition was one of mining and ore refinement. He explained to the Visiting Committee of 1906, sent by the Harvard Corporation to assess the observatory’s funding needs, that

“Like a mining company which has put out of the ground a cast quantity of precious ore, but lacks the means for reducing the ore and preparing the metal for market, the

__________________________

Observatory possesses a great store of knowledge in the rough, but wants the means for working this knowledge into useful shape for the benefit of the world.”

The universal beneficiary of this knowledge production could not understand the benefits without refinement, without a reader, without the preliminary knowledge to understand the language and signs of science. Since the material was located at Cambridge – by 1906 the southern observatory had been regularly “mining” plates from the sky for over fifteen years – the surge of astronomical learning would happen there. Photography was a technical novelty for the study of the stars over time, but it came at the expense of developing sciences in Peru.

The placement of astronomical knowledge into libraries and archives has imperial implications to which I will return below, but the need for the information to be located at Harvard revels the centrality of imperial knowledge to the expedition as a whole. Ostensibly, the information would stand at the service of anyone and everyone (provided they could get to the data and read it). But the collection was physically aggregated at the center of intellectual activity, in New England, far from its point of origin, and behind a front of institutional clout that might deter the curious visitor. In a later letter to the Carnegie Institute, thanking them for the grant and demonstrating its success, Pickering referred to the collection as “like the Sibylline books” – an appropriate analogy for information so arcane, erudite, and sequestered in the halls of power.⁷

Imagining the fruits of the expedition included more than a dream of scientific progress. At the simplest level, without any literacy skills, everyone can marvel at the splendor of an astrophotograph – not only at the celestial image, but also at the basic technological capacity to

represent such strange sights. For George Hale, an astronomer in charge of planning the astronomic exhibit at the 1893 World’s Columbia Exposition in Chicago, Harvard’s photographs demonstrated the potential of science and industry in the United States. Thousands of expected visitors, Hale suggested, will view the astronomical exhibit with an eye towards the “progress” and “development” of the science, industry, and art. Since the event planners grouped exhibits by nationality instead of subject, Hale also thought such an exhibit could “stimulate national pride,” and show the US “laurels” to the global scientific community.  

Peru was not part of this community. In fact, its representation at the Fair reveals it as the subject of this community, most notably through the anthropological exhibits and gravesite reconstructions by Putnam and Dorsey. It is not surprising that Peru, a land with ancient histories that tease an American antiquity, was read as a text, and, in the colonial tradition, mined for information. But historical anthropology and astronomy diverge in their subject and source material, such that far fewer ethical and human considerations attend the astronomer. It might be that this distance inspired a certain ambivalence, or perhaps a passion that was genuinely (but broadly) humanistic; at any rate, in the display, Harvard’s photographs hailed from the Harvard Photometry and Henry Draper Memorial Catalogue of Stars rather than the Arequipa Observatory. They did not reference or credit the Peruvians who took the image.

Administering the expedition from Cambridge, the director did not register this discrepancy as a concern. He needed trained professionals to do the best work possible, and there

---


was nowhere in Peru to train professional astronomers. Moreover, he only trusted Harvard men to responsibly handle Harvard money, a rare quality in which even his brother failed when establishing and building the observatory in Arequipa (more below). Dependent as the expedition was on such precarities as funding sources, weather conditions, and the political climate, Pickering firmly adhered to his research designs to ensure success. On the expedition, astronomers changed priorities, established new contingencies, and addressed exigencies at length through letters and telegrams, but the universalist vision for the project remained constant. Harvard was in Peru to take photographs of the sky, no more. Any astronomy teaching, or sharing of cultures and ideas was ancillary to the mission, considered only as far as it could produce useful information.

Gathering and Collecting Information

Once the expedition had set out from Cambridge, progress updates and project renegotiations took place over letters. Before this, the director had made agreements with glass-plate manufacturers, chemical suppliers, and building companies to ship materials through the

Fig. 3: Verrugas Viaduct, near Chosica, photographed in Spring 1889 (left) and Summer 1889 (right), showing destruction of bridge due to flash flooding. Harvard University Archives, UAV 630.271, Series 3, "South America 1889-1927"
W.R. Grace and Company, a shipping, trading, and banking firm operated between New York and Lima. In Peru, this company was able to connect the astronomers with ‘gentlemen’ across the country, including railroad superintendents who could provide tickets, and large landowners on whose land the astronomers could test views or establish a weather station. The astronomers received the invitation to travel through Peru in the comfort of modern wealth, with whole cars reserved on newly built railroad tracks. Unfortunately, the railroad engineers were having difficulty keeping their infrastructure in place on the shifting Andean soil, and flashfloods and landslides swept away their bridges and tracks, preventing the astronomers from exploring beyond Chosica except on mule-back (Fig. 3). The construction problems were not insurmountable, but a conflict over funding had arisen between the Peruvian Corporation (the British company who owned the railroads) and the Peruvian government, with talks of expropriation preventing any improvement. Regardless of this expensive damage and controversy, both parties invited the astronomers, and their equipment, to ride free of charge – all for the implicit return of scientific knowledge and prestige to Peru.

Pickering, with the help of Harvard president Charles Eliot and his connections with the US State Department, had arranged for smooth, duty-free import and export of employees, telescopes, building materials, and photographs. The Peruvian government was actively interested in scientific expeditions to their nation, in the hopes that it would bring educational opportunities, foreign investment, and modern technology. In 1888, President Cáceras of Peru had asked a leading member of the School of Mines in Lima, E.J. Habrich, about promoting the

10 The Grace company, as a firm of international capital, had a “profiteering” reputation among the subaltern population of Arequipa at this time. For more see Onken, “Subaltern Political Culture in Arequipa,” 253.
11 Solon Bailey, Journal, [February] 2 to May 1, [1889]. HUG 1191, Box 1, Folder 3; Bailey to Pickering (8 March 1889) Arequipa to Cambridge correspondence, 1888 November 16-1889 July 16. UAV 630.100, box 6, folder 1.
scientific potential of the Peruvian Andes, which offered ancient histories, diverse biomes, and new vistas for astronomy. The letter of this request eventually made it to Pickering, who forwarded it back to the Peruvian government with his plan. Through the American resident minister in Lima, he wrote requesting these concessions in light of the “scientific character” and “praiseworthy object” of the expedition.12 The government enthusiastically agreed, “duly appreciating the importance of the expedition” and its goal to make high altitude observations, offering “all the aid and faculties possible” to assist the mission.13 With this promise in writing, it traveled in Solon Bailey’s pocket to Peru, where Cáceras himself added a standing order for all provincial governors to assist the expedition. But after visiting the presidential palace, with its shadowy halls, locked doors, and soldiers behind every corner, Bailey felt uneasy about the strength of Cáceras’s words beyond Lima, the supposed center of Peru. Indeed, many of Bailey’s friends at Grace cautioned him not to use the letter unless absolutely necessary “as it would cause ill feeling for the Government compels the peons to do the work without any pay [sic].”14 Tuned into these political delicacies on the ground, Bailey never invoked the central government’s order.

The political situations in Peru in the 1890s caused the astronomers many difficulties. Between Lima and the rest of Peru, tensions between centralism and different regionalisms led to frequent disagreement about the domain of the nation, the power of provincial governments over foreign involvement in their economies, and growing senses of indigenismo and “expressions of

the sierra conscience and Andean sentiment.” At times, these disagreements burst into violence, paralyzing all activities in the regions affected by the fighting. Such was the case during the Revolution of 1894-5, which saw large swaths of Peruvians of all classes and races mobilize for republican ideals and a “regeneration of nation.” While the astronomers had little interest in these political struggles, they needed the national infrastructure to operate in order to send the stars back to Harvard. They adapted as they could, eventually coming to expect the “annual revolution” in some Peruvian province, keeping an ear to its winds lest it pose danger to their project.

Meanwhile back in Cambridge, Pickering and Eliot expected robust support and assistance from the Peruvian government, and more so from the American Foreign Ministry in Lima. They were disappointed. With the threat of civil disturbance in 1894, Pickering took immediate concern with the safety of his astronomers and observatory. Through the prior year, Bailey had informed Pickering of escalating tensions, and discussed plans to shutter the observatory and bury the telescope lenses lest a crowd accost the observatory. He more feared an “attack of drunken or disorderly stragglers rather than from regular troops,” however, because he felt any warring governments would respect an American flag. While Bailey’s attitude had been cavalier (he suggested turning the empty telescope tubes into cannons), Pickering was more concerned with his safety. After a delay in communications in the winter of 1894/5 (when fighting came to Arequipa), Pickering sent an urgent telegram to the American minister in Lima,

15 Mariátegui, Seven Essays, 171. For a take on Arequipeño regionalism, see Love, The Independent Republic of Arequipa.
17 Bailey to Pickering (1 May 1899) Arequipa to Cambridge correspondence, 1897 January 5-1899 December 18. UAV 630.100, box 9, volume 3, page 654 (seq. 165).
18 Pickering to Bailey (29 September 1896), Cambridge to Arequipa correspondence, 1892-1898. UAV 630.100, Box 5, page 252 (seq. 328).
again through Eliot, directing him to “spare no efforts” in the observatory’s protection from war.\footnote{Gresham to McKenzie (4 December 1894) Cambridge to Arequipa correspondence, 1892-1898. UAV 630.100, Box 5, page 280 (seq. 311).} Slightly confused, since he had heard nothing of danger from Bailey, the minister agreed and sent letters of support to the prefect of Arequipa. There also the urgency seemed unwarranted; the minister reported that many of the gentlemen believed that there is no one in Peru “disposed to injure the observatory” and that, in fact, many of them took great interest in its project.\footnote{McKenzie to Gresham (4 December 1894), \textit{Ibid}, page 281 (seq. 112).} Bailey himself, finally able to send letters back to Cambridge in early March, agreed with this conclusion. In the current political drama, “people of all parties” showed interest in the observatory and they found “real friends” on both sides; in the long run, if any danger beset them, Bailey was confident that “the better class of people” would stand by the observatory.\footnote{Bailey to Pickering (14 January 1895) Arequipa to Cambridge correspondence, 1895 January 14-1896 December 22. UAV 630.100, box 9, volume 2, page 283 (seq. 9).} At any rate, Bailey had actually reached out to the US minister in Lima, who started his fresh term early in 1894, but never received a response. The previous minister had shown great interest in the work, but his replacement seemed aloof – “I care nothing about it personally but am anxious that he should take an interest in the observatory as we are somewhat dependent upon him.”\footnote{Bailey to Pickering (4 January 1894) Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1, page 167 (seq. 169).} This dependency stood more for peace of mind than immediate protection; an American flag flying above the observatory residence was enough to deter trouble.

The reliance on the Peruvian and American governments, however superficial or unworkable the relationships turned out, reveals the political nature of the expedition. The astronomers received favors and free rides, while the national transport infrastructure crumbled, feudal systems of peonage exploited Indian and mestizo citizens, and many Peruvians felt
misrepresented by their government. Cáceres may have been enthusiastic about attaching the name of his Peru to the scientific mission, just as Piérola (the victor of the 1894/5 revolution) eagerly accepted an invitation to tour the observatory as President, but neither leader situated the observatory in terms of its Peruvian science, harnessing the expedition’s potential to improve infrastructure, education, or enact social change. Rather, they seem to have subscribed to Pickering’s universalist imagination, seeing the abstract contributions of knowledge to the scientific mind as more beneficial (or expedient) than addressing key political questions.

With less social responsibility, businessmen, *haciendados*, and industry leaders throughout the Andes also went out of their way to accommodate the scientists and their projects. These relationships emerged early in the expedition from Harvard networks, Grace connections, and recommendations from other gentlemen. Scouting for a site in 1889, Bailey spent much time interviewing local gentlemen about regional weather trends (about which they somehow knew nothing) and receiving recommendations for a site. He received an invitation to the oil wells near Payta from a prospector whose son had recently graduated from Harvard, a site which was unfortunately too far north to command a view of the southern circumpolar region.²³ Sugar plantations, breweries, and silver mines also opened their doors to the expedition, offering permanent support for a modest fee, but none satisfied the requirements for a horizon line. Even after establishing the provisional station on ‘Mt. Harvard,’ Bailey continued to build networks with these gentlemen, believing it expedient to combine resources with other enterprises already established.

²³ Bailey to Pickering (25 February 1890), *Arequipa to Cambridge correspondence, 1890 January 14-1890 July 7.* UAV 630.100, box 6, folder 3, (seq. 15-6).
Bailey found a promising location in the high, dry Atacama Desert, at Pampa Central and the nitrate works of the Compania de Salitres de Antofagasta. As guests of the owners (introduced through the local railway superintendent), Bailey and his brother observed local conditions at a distance: over 1000 residents, a shabby commissary, hourly trains to deliver water and transport the raw nitrate to the coast for refinement. While the stars shone the brightest Bailey had ever seen, the logistics of placing the observatory in the middle of the desert seemed insurmountable; “nearly everywhere there is a complete lack of everything.”²⁴ As an attachment

Fig. 4: Children Playing, Street Scene, Pampa Central. Harvard University Archives, UAV 630.271, Series 3, "South America 1889-1927"

²⁴ Bailey to Pickering (13 February 1890), Arequipa to Cambridge correspondence, 1890 January 14-1890 July 7. UAV 630.100, box 6, folder 3, (seq. 11-3).
to the “Nitrate Town,” however, Bailey believed it could work, but only with thrift and caution. It would be expensive to live in the desert, even with a discounted rent from the company. Moreover, the telescope would need a guard, or at least a strong door and padlock to protect it from the allegedly ubiquitous thief. But perhaps most obstructively, Pampa Central was not at all a “decent” place for a lady, let alone a family (Fig. 4). Nevertheless, the fact that infrastructure was already in place to transport equipment in and send out regular shipments of photographic plates, buildings already built to shelter astronomers from the sun, and plenty of food and water coming regularly, made the site a leading contender for a permanent outpost. The declining quality and price of nitrate, however, cast a shadow on the future of the nitrate works, and if the company went under, there would be no reason for the railroad to continue operation, effectively stranding the astronomers in the desert unless they funded the rails. They settled at a more sustainable location, a short distance outside of Arequipa “nearer civilization and where more of the comforts of life would be found.” Industries were precarious, self-serving, and dependent on the whims of global markets; there was no way to ensure the security, success, or enjoyment of expedition while relying on such conditions.

While the astronomers deemed the industries inappropriate for hosting their work, they still enlisted them as suppliers of meteorological observations, and once they established meteorological stations, as readers for the data. This remained a precarious arrangement, with observers often ceasing communications without any notice. Upon leaving Pampa Central,

25 Bailey to Pickering (14 January 1890), Arequipa to Cambridge correspondence, 1890 January 14-1890 July 7. UAV 630.100, box 6, folder 3, (seq. 1-4).
26 Bailey to William Pickering (13 February 1890), Arequipa to Cambridge correspondence, 1890 January 14-1890 July 7. UAV 630.100, box 6, folder 3, (seq. 11-13).
27 Bailey to William Pickering (31 March 1890) Arequipa to Cambridge correspondence, 1890 January 14-1890 July 7. UAV 630.100, box 6, folder 3,(seq. 23-28)
Bailey enlisted a clerk, Hugo Enrique von Dassauer, to keep a weather record for four months, offering him 10 Chilean pesos per month, all up front. Two months later, the records stopped coming. Similarly across the Andes, Bailey hired landowners, land workers, or interested townsfolk for a small monthly wage of 10 soles, to send instrument readings to the observatory. At times, his luck brought him into contact with men of education, who could both make sense of the meteorological readings and repair any broken instruments, and who were so enthused about the project that they worked for free (Bailey would repay this man’s kindness with photographs and copies of the published weather records). At other times, his luck backfired, and the remote stations went ignored or were even looted. The meteorological project, not imagined as part of the initial expedition, had a wider actionable relevance than stellar photometry, such that future Andean travelers could consult the data and dress for the proper weather. For Bailey to have established “professional” observers at each of these stations would have been far too expensive. These instruments were self-reading and automated; all Bailey needed was someone to wind the clocks and write down the numbers; anybody interested would do. It was these connections with local industries and gentlemanly networks that facilitated the production of this knowledge – knowledge which would assist future expeditionaries in extending the informal economic, cultural, and political hegemony of the north over the south.

Demonstrating the “interpenetration of business and science,” Ricardo Salvatore notes that Hiram Bingham, in his 1911-15 Yale Machu Picchu expeditions, also relied on established

30 Bailey to Pickering (14 July 1894) *Arequipa to Cambridge correspondence, 1893 March 3-1894 December*. UAV 630.100, box 9, volume 1, page 217 (seq. 219).
31 After ten years in operation, in 1900, the observatory terminated its regular weather reporting and closed the Andean stations, citing the unreliability of observers and the constancy of weather patterns. R. Dec. Ward, “Current Notes on Meteorology,” *Science* 13, no. 319 (February 8, 1901): 233–234.
enterprises in the Andes to facilitate his archaeological collecting.\textsuperscript{32} Two corporations provided important assistance: W.R. Grace and Company, the large trading firm that proved its worth to the New England science community when it provided intelligence and social connections to the Harvard astronomers, and the HCO, whose outpost in Arequipa supplied over ten years of regional weather records.\textsuperscript{33} Bingham’s expedition exploited the landscape and people in a much more clear, real, and controversial way than Bailey’s, but the information that the astronomers had gathered, through forging connections with regional power brokers in business and industry, compounded and extended the Bingham’s abilities to plunder the artifacts of the Andes.

The sciences were complementary, and the established remote scholarly outpost could bring different disciplines into collaboration out in the field. As an established institution, the Arequipa Observatory could host foreign scientists and friends to the scientific community, as well as carry out remote researches for scholars who could not make the trip. Visiting astronomers, from Lick Observatory or the Smithsonian Astrophysical Observatory, found like minds to discuss their eclipse and solar observations, and chemists, botanists, archaeologists, and anthropologists were also welcome. William Pickering’s assistant, A.E. Douglas, often performed anthropological observations around Arequipa, excavating skulls, stones, and other specimen from Mejia, all of which he returned to Pickering, as “the archaeological relics are the property of the observatory.”\textsuperscript{34} The observatory formed a special relationship with F.W. Putnam,

\begin{footnotesize}
\begin{enumerate}
\item[32] Salvatore, \textit{Disciplinary Conquest}, 79.
\item[33] Salvatore, \textit{Disciplinary Conquest}, ch. 4 note 7 cites correspondence Bingham to Pickering (14 January 1914), Yale University Library, ypep, series 2, box 10.
\item[34] Pickering to Bailey (9 April 1894) \textit{Cambridge to Arequipa correspondence, 1892-1898}. UAV 630.100, Box 5, page 163 (seq. 194). After leaving the Arequipa Observatory, Douglas went on in a career in astronomy to discover the field of dendrology (observing solar cycles through tree rings) and, more relevant to his historical interests, contributed to the early field of archeoastronomy, which attempts to both do ancient astronomy from the archaeological record, and ancient history with our knowledge of time-domain astronomy. For more on Douglas’ transdisciplinarity, and his Arizona expeditions funded by National Geographic to date the \textit{pueblos} structures and
\end{enumerate}
\end{footnotesize}
a Harvard professor of anthropology, who would either send assistants to exhume and collect gravesites, or instructions and best practices for when the astronomers found time for fieldwork. Just across the river Chili from the observatory, Bailey unearthed a grave still complete with bones and pots, which he photographed and collected according to Putnam’s instructions. Bailey, unimpressed, still followed the instructions to the letter, “understanding Professor Putnam that any careful work in this vicinity would be valuable.” For the more remote sites, such as the

![Fig. 5: View of Arequipa Station of Harvard College Observatory with mountains in background](https://example.com/arequipa_station.jpg)

Fig. 5: [View of Arequipa Station of Harvard College Observatory with mountains in background], Harvard University Archives, UAV 630.271, Series 3, "South America 1889-1927"; A similar view appeared in most published accounts of the observatory and its work, although with the village huts in the foreground airbrushed out.

also establish sites for telescopes, see A. E. Douglas, “The Secret of the Southwest Solved by Talkative Tree Rings,” *National Geographic*, June 1929.

Bailey to Pickering (8 September 1893), *Arequipa to Cambridge correspondence, 1893 March 3-1894 December*, UAV 630.100, box 9, volume 1, page 97-8 (seq. 96-7).
summit of Mt. Chachani, Putnam sent his own assistants to collect “Indian relics.” Pickering thought the archaeological ascent would be especially interesting, but he was more excited at the prospect of the archaeologist taking some meteorological readings from the summit.36

The Arequipa Observatory was hardly a mere field post. While the Mt. Harvard station had been a scattering of paper houses and tents, in Arequipa, the astronomers built what has been called a “commodious hacienda.”37 On a hill, overlooking an acre and a half, the astronomers built multiple small instrument sheds and large telescope domes that surrounded a stately mansion made of white sillar stone from the nearby volcanoes (Fig. 5). They had bought the land for $750 from a local large landowner, Sr. Polar, who had previously let the land to village farmers and livestock grazers. This was no small fee, and the luxurious construction costs inflated the expenses well over $12,000, over twice the original annual budget of the expedition.

In Cambridge, Edward Pickering was confused and angry that so much scientific money should be wasted on comforts and enjoyments, especially when the astronomers did not increase production accordingly (it was, in fact, decreasing).38 William Pickering, his brother who had recently taken over directorship of HCO South after Bailey’s first term, thought differently. He believed the expedition funds had been set aside for the “establishment” of an observatory, not a temporary remote data outpost.39 William’s view prevailed, mostly because Pickering could not stop what had already been started. But by the time revolutionary troubles, state delegations,

36 Pickering to Bailey (29 September 1896), Cambridge to Arequipa correspondence, 1892-1898. UAV 630.100, Box 5, page 427 (seq. 503).
37 Sobel, The Glass Universe, 44.
39 William to Pickering (22 May 1891), Letters from Arequipa to his brother Edward, December 20,1890-July 18, 1893. Papers of William Henry Pickering, 1870-1907, HUG 1691.4.5. Emphasis original.
visiting friends and colleagues began arriving in town, Pickering realized the lasting value of a decent establishment with solid walls.

As the scope of the expedition expanded in Arequipa, adding telescopes, weather recorders, and earthquake sensors, the astronomers found they needed even more space. Moreover, they found the space they had was not entirely theirs. Villagers continued to plant into the observatory’s lands, and their animals regularly trampled these crops and made a mess of the grounds. Not even a fence of barbed wire could keep them away, first pushed aside by the pigs, then cleared away by the villagers for ease. This attitude is unsurprising, given the contested organizations and conceptions of space between indigenous traditions of communalism in ayllus and Western capitalist demarcations of private property. The trespassing, however, occasionally turned malicious, with thieves breaking into instrument sheds, and youths throwing rocks at the telescope dome. Bailey viewed this as a problem and proposed a solution: to buy more village land from Polar, and construct an adobe wall around the perimeter. He hired a few men to build the wall, but the work was incomplete by the time of the civil war. Fearing for his astronomers’ safety, Pickering suggested a refortification of the current mansion along the lines of those seen recently in Ireland, where rowdy mobs laid siege to the estates of their landlords and colonial governors. Bailey was not so concerned about the danger of communal revolt against the observatory, since he believed that locals were well disposed to the project. But the construction of walls delineated Northern space in the Andes, limiting the local imagination and

---

40 For a history of an Andean altiplano community, Azángaro and the contest between indigenous traditions and “legacies of colonialism” see Jacobsen, Mirages of Transition.; Also, for examples of peasants reasserting the communal ayllu during the Piérolista revolution of 1894/5, see Jacobsen, “Bridging the Local and the National: Political Mobilization During Peru’s Revolution of 1894-1895.”
41 Bailey to Pickering (14 July 1894) Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1, page 233-236 (seq. 235-238).
42 Pickering to Bailey (19 March 1895) Cambridge to Arequipa correspondence, 1892-1898. UAV 630.100, Box 5, page 378 (seq. 329).
use of land, and effectively creating an enclave for the collecting of stars. As objects of wealth, protection, and knowledge, the estate and its walls contrasted with the surrounding village landscape, marking the material difference in a landscape that now privileged imperial epistemologies over local prosperity.

When the wall was complete, the danger of molestation was mitigated, but by no means did Bailey close the observatory to the local community. The observatory remained a popular spot for visitors alongside the daily work-crews, deliveries and departing shipments (Fig. 6). In

Fig. 6: [View of street leading to Harvard College Observatory, Arequipa, Peru], showing the regular crowd of locals at the observatory. Harvard University Archives, UAV 630.271, Series 3, "South America 1889-1927"
1899, after eight years in town and with the help of “local subscribers,” Bailey added a paved tennis court to the observatory grounds, to provide “healthful exercise and amusement” for all the young men present. To the extent that it did not inhibit its rate of production, the observatory was open to both foreign and local visitors.

These negotiations over the organization of space reveal the dynamics of imperialism that attend the ostensibly neutral, positivist scientific expeditions. Whereas land had had a communal status in the peasant imagination, the assumptions of private property and use by the foreign scientists (in alignment with local aristocrats) physically separated the observatory from the local landscape. The wall, rising from the base of the terraced hill to its crest, made the observatory into an enclave, where exchange and society could take place, but only on the astronomers’ terms. Moreover, the exchange was highly imbalanced, such that the visitors, who might receive a cursory explanation at the scientific tasks in front of them, could reciprocate with folk knowledge and other stories. In view of their scientific epistemology, the astronomers took this folk knowledge as novelty. Bailey’s journal contains a section “Tales of Peru” which records folk tales of Jesus in Peru eating cherries with Peter on the beach, young soldiers making deals with devils, the health and curses of pregnant women, and local suspicions about the moon and “superstitions of astronomical flavor” – entertaining information for the tourist, but ancillary to the scientific mission. These stories were not reproduced in the observatory’s official publications or discussions of their data, no matter how cosmologically relevant they might have appeared at first. But for those sharing, these were not meaningless pleasantries, but ways in

43 Bailey to Pickering (14 August 1899), Arequipa to Cambridge correspondence, 1897 January 5-1899 December 18. UAV 630.100, box 9, volume 3, page 697 (seq. 189).
44 Solon Bailey, “Tales of Peru” in Journal. 1889. [phaedra0699], in “Project PHAEDRA.”; Bailey to Pickering (8 September 1893) Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1, page 97-8 (seq. 96-7).
which they could equate their knowledge with this imported concept of scientific value.

Unfortunately, Bailey had a laugh the “curious and interesting” beliefs of the Peruvians, telling Pickering, “you ought to hear our cook’s [Francisco] ideas of science.”45 Not everyone at the observatory could contribute knowledge on the caliber of scientific rigor that the astronomers expected.

Photography was an essential tool in the astronomers knowledge production kit, primarily through astrophotography, but also in tourist snapshots that illustrated the expedition for its audience back home. Bailey’s letters included numerous views of Inca ruins around Cuzco, dramatic mountain vistas in the Andes, as well as the more scientific shots of geological formations, volcanoes, construction, and equipment arrangements. In many ways, these photographs served as a mode of witnessing and verification of the truth of the expedition to the watching public back home.46 With the aid of photographs Bailey was able to communicate the detail of Inca stoneworks just as well as E.G. Squier had in his 1877 seminal archeological survey of Inca ruins.47 On the more regular level, the photographs could illustrate his interactions with the environment – Bailey might draw in the path up a mountain (Fig. 7), or mark the location of a weather station – making visible the methods of his science. But, save for his hand, this knowledge was presented sanitized of it Peruvian origins – the labeled path did not include reference to Calisaya, Francisco, or Quispe, the mule-drivers who led him to the summit.48

________________________

45 Bailey to Pickering (11 September 1889) Arequipa to Cambridge correspondence, 1888 November 16-1889 July 16. UAV 630.100, box 6, folder 1. (seq. 13-14).
46 Hall, Framing a Lost City, 71–2.
48 Bailey to Pickering (31 August 1893), Arequipa to Cambridge correspondence, 1893 March 3-1894 December. UAV 630.100, box 9, volume 1, page 81-91 (seq. 80-90). In the published narrative in the Annals, Bailey refers to the resistance of these “Indian guides,” notably Quispe, to the construction of a mule trail to the summit; he
Just as a telescope can visualize hidden views, so too can a camera. As a rigid technology with authorial gaze over unspeaking subjects, photographing could be seen as an extension of imperialism. This is the case in the classification of racial types. At times the astronomers played an explicit role in this: upon request, Bailey sent photos of “Aymara peoples” for Putnam to include in Harvard’s anthropological library. But more often the astronomer was an

“claimed familiarity with the region” and protested that the shifting sands of the volcano would immediately undo any of the construction work. Nevertheless, Bailey thought his own scientific reasoning more authoritative than local knowledge. For more see Bailey, *Annals*, v. 39 (1899), 23-4.

Poole, *Vision, Race, and Modernity*.

unwitting agent of technological imperialism who already had a clear picture of the Andes. Once, when departing for a mountain trip, Bailey saw a man herding him llamas up the hill, and thought it a nice picture. He asked for the man to stop, who evidently thought they were thieves, or that the camera was some sort of “engine of war,” because he stood frozen until they all turned around to pack up, when he took the opportunity to flee as quickly as he could herd his llamas (Fig. 8).51 Chuckling at “these simple-minded and harmless people,” Bailey had indeed illustrated his view of the Andes.

![Fig. 8: "El Misti to the SW from pampa near River Chili," showing the man accosted by the camera. Harvard University Archives, UAV 630.271, Album 1](image)

In gathering and collecting their information, the astronomers found a world of contingencies that, if harnessed properly, could enrich their mission and their contributions to science. This same world, however, was filled with promise and precarity for people who lived it. At times the astronomers welcomed the aid and interest of the public, but to reach the core of their mission, they sought the assistance of governments, industries, aristocrats and other local power brokers. Integration into these networks prefigured and propagated the wave of scholarly interest and expanding informal empire over South America that began to surge in the early twentieth century. Like those expeditions, the astronomers had a public audience at home in the Atlantic world of letters, both in the academic community and the general public. And it was in the discussion, refinement, simplification, publishing, and storage of this information – all of which occurred in the metropole – that this knowledge enterprise reinforced the asymmetry of power relationships between the north and south.

Discussing the Knowledge

In sending photographs, both tourist and scientific, along with their data and stories back to Cambridge, the expedition became a public event. Both categories of information circulated around scientific and public spheres, offering insights into worlds beyond and spaces unseen. Popular and scientific magazines, such as Harper’s Monthly, Century Illustrated, National Geographic, and Popular Astronomy cast these expeditions in heroic terms, striving for success against all odds. In their success, scientists debated the nature of the stars, while viewers awed in their splendor. Among these readers, Peruvians saw an unfair representation, of an antagonist against science. Not passive actors, the Peruvian contested this misrepresentation, placing the observatory in the awkward position of apologizing for imperial sentiments and imbalanced
worldviews. But however much the Peruvian’s goodwill helped the observatory to function, the interpretation of the data and the discussions that made it useable occurred at Harvard, where no Peruvians were engaging in astronomical work of any kind. These discussions reinforced the conception of Peru as a resource for the extension and development of global, northern knowledge.

The most general articles on the observatory and its work usually included notes on the Peruvian expedition, which tend to follow the genre of exotic travel narratives with added scientific heroism, representing locals as mysterious antagonists to the intrepid quest of the explorer. In her 1897 history of the Harvard College Observatory, published in *Century Illustrated*, Mabel Loomis Todd described how the astronomers made it possible to “apprehend the wide breathing-space of infinite distance” through their analysis of stellar plates. Many of these plates, containing cosmic sights unseen in the north, had an unlikely origin:

“Upon a mountain over 6600 feet high, a few devoted observers nightly photographed the wide-spread sky, even if the next morning’s breakfast were problematical; the accumulated valuable data of the Southern heavens, even if water and building materials were securely lodged eight miles away.”

Out of this sacrifice and hardship, these astronomers “alone” have delivered “over fifty volumes” of records for the observatory to publish; and an entire Astrophotographic Museum full of photographs “for verification and posterity.” Todd focused on Pickering, Williamina Fleming,


and glass plate analysis in Cambridge for most of the article, mentioning the Peruvian stations only insofar they could supply data and drama. The true scientific work happened in Cambridge.

To the northern journalists, the landscape was not the only volatile actor threatening science: the natives also posed a risk. Reporting on the establishment of the Misti weather station in *Harper’s Weekly*, Charles Lummis gave much more credit to Bailey and his colleagues, but at the expense of the Peruvian people. Living in a “hotbed of fanaticism” with lingering “mistrust and hatred” for Americans, Lummis wrote, these Peruvians had made the astronomical work “as difficult as was in their power to do.” Lummis had accompanied Bailey and his assistants to the weather station on the summit of the volcano shortly after its construction, and retold the story with an emphasis on overcoming the ruthless altitude sickness with “scientific enthusiasm.” He illustrated his narrative with Bailey’s photographs of the volcanic crater, as well as a shot of the observatory, the inside of a hut, and a line-up of the climbing crew, a shadowy row of men in ponchos; all images that are “substantially accurate,” and visually attest to the attainment of scientific knowledge. Lummis himself took an interest in the archaeology and anthropology, asserting that any pre-European assent of the mountain was “not for knowledge, but for purely Indian motives,” which he believed were tied to volcanic sacrifices. Lummis charges this article with discrimination that insulted the Peruvians, as if their experience with their world somehow has not qualified as knowledge. Regardless of who was there before, the mountain needed Northern scientists to be understood and fully conquered.

Lummis’ article attracted attention beyond *Harper’s* US audience, drawing criticism from Arequipeños over their unfair representation. Responding to angry newspapers and townsfolk, Bailey felt compelled to issue a “refutation,” despite the fact that he was not

responsible for Lummis’ words or Harper’s publishing, because the locals “naturally associate the whole thing together.” Privately fuming at the reference to fanatics, and confused that Lummis “could be careless enough even if he believed it to say so,” Bailey “smoothed down the lacerated feeling” and successfully repaired relations.\textsuperscript{55} After hearing about the controversy, Lummis wrote Bailey that those words were added by his editor, in response to vandalism that had been reported on the observatory’s property as the article was going to press.\textsuperscript{56} At any rate, the reactions evidence divergent views on the Peruvian role in the expedition. The North focused on the heroic struggles and stacked odds of their expedition despite the fact they had tremendous help from locals; while the South sought recognition and return for their assistance. The competing focuses of the narrative framed the potential of power in the region: either for the imperial conquest of knowledge or for a national uplift through science. Local articulations of this dilemma – an attempt to reclaim this knowledge – might have affected the whole system of production, disrupting the flow of information to distant halls for discussion and analysis. But, with adept negotiations, the astronomers preserved their production, situating themselves in a position of power that diverted resources north for knowledge, at the expense of southern prosperity.

Part of these negotiations including returning the developed knowledge to those who helped, in the form of observations, data sets, and astrophotograph reproductions. These publications, along with reprints of the stars, became a sort of currency with which the astronomers could repay the service of local Peruvians, and further promote the project to the

\textsuperscript{55} Bailey to Pickering (14, 27 January 1895) Arequipa to Cambridge correspondence, 1895 January 14-1896 December 22. UAV 630.100, box 9, volume 2, page 283-4 (seq. 9-10).
\textsuperscript{56} Bailey to Pickering (29 March 1895) Arequipa to Cambridge correspondence, 1895 January 14-1896 December 22. UAV 630.100, box 9, volume 2, page 328 (seq. 54).
local community. Bailey requested copies of the *Annals* for the Cáceras and Piérola
governments, as gifts to the local university in Arequipa, the *Universidad Nacional de San
Augustin*, and as thanks and assistance for their particularly passionate meteorological
observers.\(^5^7\) For Bailey, this knowledge transference satisfied Harvard’s part of the bargain to
engage in science in Peru; yet, it was not accompanied by any supportive infrastructure,
education, or technology by which they could continue the science, nor was it even offered with
intention that it be understood as science. He preferred gifting photographs and illustrated books,
“the brighter the colors the better, to interest the ‘natives,’ rich and otherwise.”\(^5^8\) The
visualization of these “interesting objects,” nebulae and star clusters invisible to the naked eye,
served as a way for Bailey to verify his work with the local community, offering the aesthetics of
discovery to justify his institutional presence.

In science and society, the star photographs had the effect of expanding the cosmos,
requiring the formulation of new frameworks of understanding to comprehend the lodes of new
information. The computers in Cambridge recorded variable stars and novae, devised stellar
classification systems, and formulated methods of measuring the universe.\(^5^9\) With the plates
analyzed, editors worked to tabulate and publish the results, as well as discussions and
conclusions in the *Annals* and other observatory publications, often with great difficulty due to
the sheer quantity of information.\(^6^0\) Meanwhile, astronomers continued to publish articles about
their science, connecting the detail and quantity of observations to transcendent feelings of awe

\(^5^7\) Bailey to Pickering (14 July 1894) *Arequipa to Cambridge correspondence, 1893 March 3-1894 December*. UAV 630.100, box 9, volume 1, page 240 (seq. 242); (10 August 1894) *ibid.* page 242 (seq. 245); (1 May 1899) *Arequipa to Cambridge correspondence, 1897 January 5-1899 December 18*. UAV 630.100, box 9, volume 3, page 632 (seq. 143); (24 July 1899), *ibid.* page 668 (seq. 178); (14 August 1899), *ibid.* page 673 (seq. 183).
\(^5^8\) Bailey to William Pickering (17 October 1890)
\(^6^0\) Williamina Fleming, “‘Diary of 1900.’ Chest of 1900” (Harvard University. Cambridge, MA, 1900), HUG 1396.2, Box 59, Harvard University Archives, https://iiif.lib.harvard.edu/manifests/view/drs:300738451i.
and wonder. The study of “universology – the knowledge of the structure and extent of the universe,” required expansive catalogues of stars and other cosmic phenomena, with precise positioning, measurements, and rigorous calculations to conclude anything. In offering detailed descriptions of their work, astronomers began to include in their articles and lectures images of star clusters or spectra, “most magnificent,” “beautiful,” “incomparable photographs…kindly provided by Professor Pickering.” Again, these articles rarely discussed the Peruvian creation of these photographs, often only referencing their Southern origins and Harvard connection.

Simon Newcomb, in his discussion of astronomical activity worldwide at the turn of the century, referenced the *Carte du Ciel*, a stalling astrophotography collaboration between European and southern hemisphere observatories in Argentina, Chile, Brazil, South Africa, and Australia, whose production had paled in comparison to the work done “alone” by the Harvard College Observatory. The science happened in Cambridge – its analysis, discussion, simplification, and sharing –, the periphery was only a source of collecting and gathering information.

**Conclusion: Archiving the Science**

Following the completion of this collection, or at least of one cycle, along with the dispersal of astronomical and meteorological data to interested parties, astronomers stored the pictures and manuscripts in their libraries near the Harvard campus. While data tables and plate reproductions could interest the armchair astronomer, any ground breaking research needed the full range of plates, over as wide a time-domain as possible for maximum coverage. If they could


not make the trip to Cambridge, inquiring astronomers could request certain plates, or ask to hire an assistant to locate certain interesting objects. But it was most efficient to travel to the observatory, where Pickering could host visitors in his home next-door. Access to the glass plate library depended on Pickering, who, while liberal and excited in sharing his storehouse, still held the keys.

With the information imagined in universal terms, gathered in routine expedience, and discussed with discrepant grandeur, the knowledge processes of informal empire now placed the final product in the archives and libraries of the powerful. This occurred in a remote distance, four thousand miles spatially removed from its source, centralized in the metropole, an academic hub of research and theory. Meanwhile, the science in the periphery could not match this intellectual gravity – the pull of resources towards the center of learning and ideas, where scholars produced knowledge for the sake of expanding and sustaining empire in a program of power that siphoned data off to locations where it they could interpret it *rightly*. The peripheral scientists – the Peruvians involved in collecting and providing preliminary interpretations of the data – received little credit beyond their routine accomplishments. When northern representations of the expedition mischaracterized the local community, outrage in response could threaten the stability of the project. But the ways in which the astronomers integrated into local power networks that suited their needs effectively placed the Peruvian contribution in the background. Through the production of knowledge out of a foreign and peripheral space, the astronomers extended empire, and overwrote sciences emergent from different epistemologies.
Conclusion: Astronomy and Modernity

The Harvard astronomers blocked the advancement of science in Peru. The expedition followed imperialist tendencies of Northern governments and industries, and through their science they perpetuated global imbalances. However, other examples of North American astronomical expeditions to Chile demonstrated the possibility for cooperation, education, and invitation of peripheral nations into the center of scientific discourse. Unlike Peru, the ability to act independently in science allowed Chile to ascend to an image of modernity and respect on the world stage.¹

Three expeditions arrived in Chile from the United States: the Gilliss Expedition of the U.S. Naval Observatory (1849-1852); the Mills Expedition of Lick Observatory (1903-1928); and the Montezuma station of the Smithsonian Astrophysical Observatory (1918-1956). When their projects were completed, the first two expeditions sold their equipment to Chilean universities after educating Chilean students in their continued use. These university observatories – the National Astronomical Observatory at the University of Chile, and the Foster Observatory at the Catholic University of Chile -- became renowned in the international astronomy community, and made a scientific name for Chile. With such a reputation, Chile has become the world’s most sought after site for high-altitude, large telescopes, able to contribute

¹ Ultimately, the Harvard astronomers did not settle in Chile due to its nascent national scientific programs. When Bailey and his brother Marshal arrived in Santiago to scout for sites in 1890, Marshal visited the National Observatory at Santiago. He described it in belittling terms, noting their stolen equipment from Peru after the recent War of the Pacific, and the generally shabby, “political” appearance of the observatory and its operations. Bailey noted that he “could not help feeling that they were ashamed of the condition of things which they attributed to lack of appropriation by the government and that an active station near them would not be a source of pure satisfaction to them.” Had Harvard set up operations nearby, they would have contested the opportunities and possibilities of the Chilenas’ sciences. Bailey to Pickering (13 February 1890) Arequipa to Cambridge correspondence, 1890 January 14-1890 July 7. UAV 630.100, box 6, folder 3 (seq. 11-14).
geographical advantages (access to clear southern skies) and scientific expertise. The Smithsonian expedition, however, mimicked Harvard’s Arequipa station. Secluded in the Atacama, these astronomers hardly found space in the nation’s academic universe; they packed up and returned their solar equipment north, having what one historian has called “no impact” on Chile or Chilean science.²

Three Astronomical Expeditions to Chile

The Gilliss Expedition, led by James Melville Gilliss, sought a southern observation site to complement planetary observations in Washington, allowing for a parallax calculation that would estimate the size of the solar system. Departing in 1849, this expedition did not plan to take photographs (indeed, photographs at that time were barely sensitive enough for the moon). These scientists still participated in the characteristic interdisciplinary plunder, gathering Inca relics, remains, flora, fauna, and fossils, to send back to the Smithsonian Institution.³ But without the need for photographs in their astronomical project, the naval astronomers kept their eyes on the telescope. And without the demand for constant production, the astronomers could share the eyepiece after they had made their recordings.

The Chilean government welcomed the naval astronomers as well as the Peruvian’s had Harvard, but offered more enthusiastic and direct assistance to the observatory. Arriving with letters from U.S. ministers and officials, the expedition received duty-free imports of goods and peoples, a deed to any unoccupied ground (they settled on a forested hill close to the center of town), and a promise for any further assistance. To make their dedication known, the Chilean

Minister of War insisted on supplying an armed guard for the observatory, and when the astronomers politely declined, a regiment appeared regardless, to serve and protect the expedition. The generosity exhibited by the government led Gilliss to exclaim “As a patron of science, in stability of government and steadily progressive prosperity, Chile is far in advance of every other nation of South America.”

Chile was not the source of knowledge, but rather an invaluable participant in its attainment.

The Chilean government was not only after universal contributions to science; they also sought for their citizens to profit from the astronomers presence. To this end, they contacted the expedition early on, requesting that they train a few students at the university in Santiago in practical and theoretical astronomy. The astronomers eagerly accepted, opening their books, offering any explanation tutoring, and scheduling observation times for each student on all the observatory’s instruments. The Naval Observatory paid these students, and in return, once they learned how, they assisted in magnetic, meteorological, and astronomical observations. One of the students, a professor in mathematics at the university, brought the knowledge back to the school, beginning an astronomy program. This served Chile well when the expedition concluded its observations and sold its equipment at discounted price. More than anything, Gilliss was pleased that the Chileans “cherished a desire to promote the interest of astronomy.”

There was no discussion of return on investment or maximizing efficiency.

The teaching of the naval astronomers extended beyond formal instruction to reach any casually interested visitor. Gilliss reported how they admitted all who were curious at the telescopes: “men, women, and children, rich and poor” were all given time at the eyepiece, in

---

5 Ibid., 3:xxxviii.
addition to being able ask the astronomers questions, and witness their type of work. Space was limited, and a line often formed down the hill. As egalitarian as Gilliss’ telescope nights seem, he noted how the “poor” would “deferentially wait” and give their places to “their more fortunate countrymen.” The astronomers had been warned that the lower-classes could harm the observatory (hence the guard), but they found that these public nights demonstrated the “civility” of the expedition. They showed that the astronomers were in Chile “as expounders of astronomy,” not as “foreigners who…came to accumulate.” With such a generous disposition towards their host country, the observatory was able to harness their science to not only further astronomy, but also uplift a national scientific community that could continue their good work.

With the North Americans gone, the National Astronomical Observatory could begin work in its own right. Over the next hundred years, the observatory flourished in the international community, publishing observations in major European and North American journals such as *Astronomische Nachrichten, The Monthly Notices of the Royal Astronomical Society*, and the *Astronomical Journal*. They made observations, and eventually commissioned new equipment, going so far as to build pioneering radio-telescope arrays in the 1950s, early in the life of radio astronomy. Additionally, the National Observatory sent participants to conference meetings of the Solar Union (which would later become the International Astronomical Union), and students to the University of Cambridge, to supplement their southern sky education with a glimpse at the north. The observatory would never be free from northern science and its imperial baggage. With close cooperation between the National Observatory and Universities of Chicago and Texas, in 1962, they opened the Cerro Tololo Interamerican Observatory in the Atacama with state-of-the-art telescopes and digital sensors. At the same

6 Ibid., 3:xxxiv.
time, European nations were negotiating with the government to open the European Southern Observatory (ESO) nearby. These were exorbitantly expensive projects, and most of it was funded with foreign capital. To ensure their continued and relevant presence in the life of Chilean astronomy, the Chilean astronomers wrote a clause into the contracts that secured telescope time for their observations. Otherwise, the national science would have stalled against the projects of so many foreign astronomers.⁷

Following the success of the Gilliss expedition, a group of astronomers from the Lick Observatory in Southern California traveled to Chile in 1903, hoping for the same grace and ability afforded to the naval officers. Indeed, they received concessions, assistance, and a bodyguard, setting station on a hill in the suburbs of Santiago. To build these relationships as securely as possible, William H. Wright, the leader of the expedition, referenced the travel narratives of Gilliss and Bailey, taking advice on who to contact and how much to trust the locals. Aside from labor strikes, they never experienced difficulty. The Lick Observatory had planned a photographic spectroscopy project, by which they would calculate the velocity and motion of the stars, and this required shipping the photographs north. It is unclear if the Chileans interpreted this as ‘taking’ stars, but Wright reports that “the Chilean people generally” assisted and “advanced the cause of science.”⁸ At any rate, when the astronomers concluded their project in 1928, Chilean politician Manuel Foster purchased the building and instruments, and donated them to the Catholic University of Chile. As one of the conditions of transfer, so that the work of the observatory could continue once they have gone, the astronomers agreed to spend their last

---

year in Chile training students to take observations. As the Manuel Foster Observatory, it, however, failed to reach the level of international acclaim and scientific participation as the National Observatory. Still it published observations in local publications, and took on the primary character of a teaching institution.

The Smithsonian Astrophysical expedition, sent by Charles G. Abbot between 1918 and 1956, had a different character than the two that came before it, more distant and detached from Chilean life. Their scientific mission was to measure the solar constant, a task for which they needed regular, strong, daily sunlight – the Atacama was a perfect candidate. Abbot confirmed this by asking Pickering to supply pyrheliometer readings of the region in the decade before departure. Whereas Bailey and his expedition found it unlikely that the astronomers could support themselves in the desert without help, Abbot tactfully negotiated with the Chile Exploration Company to use their abandoned buildings at a depleted nitrate mine near Calama, where they could meet the railroad west. With no local community around, the Smithsonian astronomers were hardly able to form as close a bond with Chileans as with the expeditions around Santiago. Their nearest friends worked at the copper mines of Chuquicamata, and these eventually became so numinous that the mineworks began to smog out the sun. When the astronomers packed up to relocate to site in California, they did not work with Chilean scientists to transfer their equipment or teach about solar astronomy. The director of the Smithsonian Astrophysical Observatory, Fred Whipple, wanted to transfer the station to the Chilean

government as a “friendly international gesture,” but this idea was rejected by his superiors in the Smithsonian Institution, who believed the instrumentation and photographs from the expedition could be “sold for window glass.”\textsuperscript{11} The scientific mission had fulfilled its purposes, all the administrators needed was their checkbook balanced.

This was hardly a loss for Chile, since, by the middle of the twentieth century, it had already made a name for itself as a nation of science and modernity. The growing investment of international capital into Big Astronomy projects confirmed the abilities of Chile to host, complete, and develop new science projects. With the rise of Salvador Allende’s democratic path to socialism, however, some North American scientists worried that the Chilean government would divest from their projects and expropriate the telescopes – or at least nationalize so many foreign enterprises in the country that the US would stop funding these cooperative science projects.\textsuperscript{12} Ironically, after Pinochet’s coup, it was the Soviet astronomers who were forced out, leaving behind their telescopes in the custody of the National Observatory.\textsuperscript{13}

In the era of neoliberalism and post-Pinochet politics in Chile, the national scientific scene has stalled, allowing transnational interests and funding to dictate research programs, instrument construction, and astronomical participation. The military regime closed the universities’ astronomy programs, instead encouraging private universities to offer more specialized, technical degrees. In her recent survey of astronomy in Chile, Javiera Barandiaran warns that the Big Telescopes, with multinational funding, seems “ripe for reproducing the

\textsuperscript{13} Keenan, Pinto, and Alvarez, \textit{The Chilean National Astronomical Observatory (1852-1965)}, 64.
hierarchies of dependency between the north and south.”

The government, driven by models of economic growth and development, bypasses the national astronomical community in favor of enticing foreign involvement and investment. In 1997, after a lengthy court case against the ESO on expropriated lands, the foreign astronomers renegotiated the terms of their presence, dictating 10% of all telescope time to projects proposed by astronomers at Chilean institutions. Still this has been insufficient, with the government extending tax exemptions, land rights, and few environmental and technical regulations – some have swimming pools and shoot weapons-grade lasers into the sky to calibrate their instruments. All of this has stifled the ability of Chilean astronomers to articulate their science in national terms on an international level, but it has not prevented Chileans from keeping an interest in astronomy or taking pride in the telescopes. In fact, the telescopes are able to employ many young Chileans with engineering degrees, whose duties include calibrating and maintain the instruments, as well as executing programs and observations sent from foreign astronomers, and who are beginning to take this technical experience into other sciences and modes of national development.

Astronomy in History

Science is not a neutral agent in world, but it is not necessarily evil. The case of Chilean astronomy shows how the relationships between Northern and Southern scientists can foster a national pride, uplift spirits, and extend possibilities. In the Space Age, however, this is threatened by power brokers, the movement of capital, and preservation of wealth. Similarly, a hundred years prior in Peru, the Harvard astronomers arrived with their project, technology, and

---

14 Barandiaran, “Reaching for the Stars?”
15 Ibid., 159.
efficient plan to catalogue the stars. While the people enthusiastically participated in the astronomy, no broker in Peru, government or university, sought the scientist’s equipment and training to continue their project after they left. Without such a transfer, the Peruvian *altiplano* lacked the ability to kickstart their scientific promise as in the Chile.

The history of astronomy in Peru extends far beyond this one Harvard expedition. Foreign expeditions from North America, Europe, Asia, as well as national government attempts and private citizen endeavors have left established observatories with respectable instrumentation all over Peru. On one level, the story of the Harvard expedition, with its imperial baggage, is the story of exploitation, resistance, and capitulation to science. But a closer examination of the ways that different agents harnessed knowledge and used their experiences to order their world reveals competing epistemologies with potential to resolve into new worldviews. In line with Peruvian national historian Jorge Basadre and historiographer Mark Thurner, we can read the history as one *for* the people in science rather than of the science itself, deploying the promise of history to launch from the past to a better future.\(^\text{16}\) It dismisses the narrative of progressive discovery and achievement, moving towards an operational analysis that reveals the discrepant power structures affecting knowledge production and action. As a recent publication in a Lima newspaper demonstrated, with so much promise in their high mountains and clear skies, a refocused narrative can reclaim the observatory for Peru, and revitalize the latent cosmic promise of a people.\(^\text{17}\)

\(^{16}\) Thurner, *History’s Peru.*
Bibliography

Archival Collections


Published Materials


Referenced Literature


Bailey, Solon I. *Scenes in the Aymara Country*, 1903.


Ritchey, G. W. “Photographing the Star-Clusters.” Harper’s Monthly Magazine; (Cover Title: Harper’s Magazine); New York, N.Y., September 1, 1904.

Rost, Ernest C. “Navigation above the Clouds.” Harper’s Monthly Magazine; (Cover Title: Harper’s Magazine); New York, N.Y., June 1, 1903.


Tejada, Jaime Moreno. “Lazy Labor, Modernization, and Coloniality: Mobile Cultures between the Andes and the Amazon around 1900.” *Transfers; Oxford* 6, no. 2 (June 2016): 4–22.


http://www.nature.com/articles/229294a0.