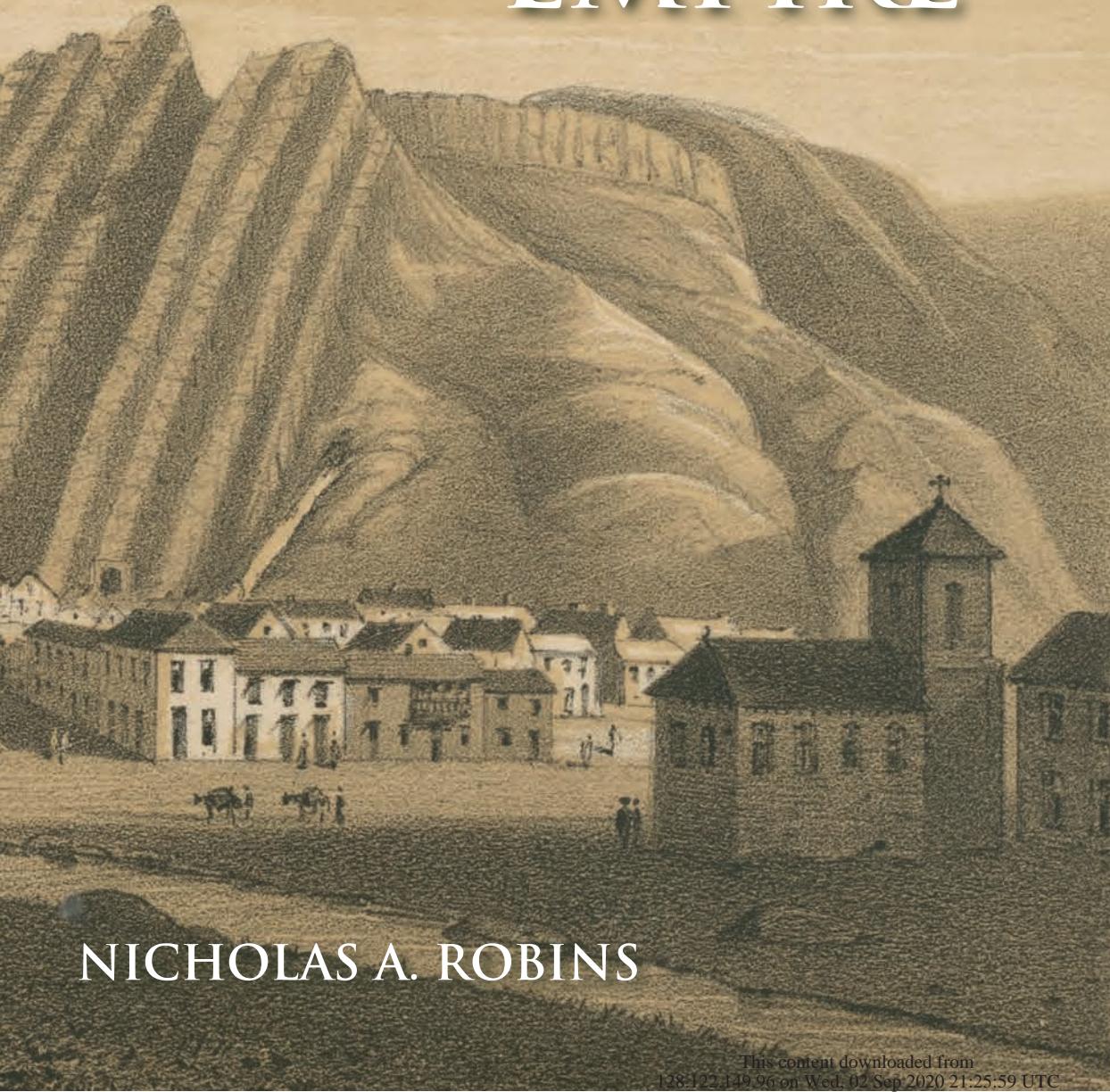


MERCURY, THE HUMAN AND ECOLOGICAL COST OF MINING, AND COLONIAL SILVER MINING IN THE ANDES EMPIRE



NICHOLAS A. ROBINS

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When the new Spanish viceroy arrived in Peru in 1569, among his highest priorities was reviving silver production, and with it, crown revenues. The viceroy set to work employing a novel method of refining silver which involved the use of mercury. Mercury and silver have a natural affinity, and when quicksilver is combined with crushed silver-bearing ore and other ingredients, a silver-mercury amalgam forms in the mass. This amalgam is separated and then purified through burning. The result is high-grade silver. What the viceroy did not know—although there was soon evidence that something was amiss—was that mercury is highly toxic.

On the basis of an examination of the colonial mercury and silver production processes and related labor systems, *Mercury, Mining, and Empire* explores the effects of mercury pollution in colonial Huancavelica, Peru, and Potosí, in present-day Bolivia. The book presents a multifaceted and interwoven tale of what colonial exploitation of indigenous peoples and resources left in its wake. It is a socio-ecological history that explores the toxic interrelationships between mercury and silver production, urban environments, and the people who lived and worked in them. Nicholas A. Robins tells the story of how native peoples in the region were conscripted into the noxious ranks of foot soldiers of proto-globalism, and how their fate, and that of their communities, was—and still is—chained to it.

MERCURY, MINING, AND EMPIRE



MERCURY,
MINING,
and
EMPIRE

*the Human and Ecological Cost
of Colonial Silver Mining
in the Andes*



Nicholas A. Robins

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*the book is dedicated to
the residents of
Huancavelica and Potosí,
past, present, and future.*

*And to
Marjorie McGann Robins*

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preface



In many ways, this book is as much about colonial mining as it is about contemporary Huancavelica, Peru, and Potosí, Bolivia, where mercury and silver respectively were produced throughout the colonial era, and where the effects of the colonial amalgamation economy continue to reverberate. Today, the residents of both cities shoulder these tragic and toxic legacies, which were central to the rise of the modern global economy. While more mercury was released into the environment in colonial Potosí than Huancavelica (approximately 45,000 metric tons versus 17,000 tons), sampling results suggest that the soils of Huancavelica are more contaminated. This may partially be a result of the steeper valley formation in Huancavelica, its smaller size, and the more concentrated placement of the smelters. The situation today is compounded by the prevalence of mud brick homes in Huancavelica that are constructed with contaminated materials, and underscores the fact that Huancavelica is the capital of Peru's poorest department. Indeed, such is the contamination that there is off-gassing of elemental mercury vapors from the interior walls of many homes there. While Potosí is more prosperous, better integrated into Bolivia, and has a greater percentage of homes built from brick, the mining of a variety of metals and its accompanying contamination continue there to this day. Despite these differences, many of the residents of both cities continue to breathe toxic air, ingest mercury-laced dust, and are otherwise exposed to the myriad risks of mercury intoxication.

Both cities must contend with their poisonous pasts and the health risks that they present, most notably to women and children. Solutions

will be complex and, given the scale of the problem, will need to be developed and funded at local, national, and international levels. For those interested in learning more, or helping, please visit the website of the Environmental Health Council (www.ehcouncil.org), which is a non-profit organization dedicated to addressing these issues in Huancavelica and Potosí.

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acknowledgments



This volume is the result of a series of journeys: historical, scientific, theoretical, and physical. Research in documentary archives opened the door and introduced me to the archive of the land and the lethal legacy of colonial mining, much of which today is literally bound with the soil. Many have been the parallels with mining itself, such as the prospecting for data sources, the descent into the darkness of the unknown, the selection and excavation of documents, the extraction of fragments of valuable information, and the process of amalgamating, refining, and making sense of it all. Many, too, are the differences, for unlike countless colonial miners, my work has been free of the coercion, abuse, toxicity, and despair which framed their lives.

Instead, I have been immensely fortunate to have had the assistance of many people who have, in diverse ways, contributed to this book. I would especially like to thank Professors David Cahill, Tristan Platt, and Kendall Brown for their strong support of this project when it was in its conceptual stage, and for their critiques, suggestions, and insights as it progressed. They played a vital role in getting it off the ground and keeping it on course. In Bolivia, I would like to offer special thanks to Marcela Inch Calvimonte, director of the National Archive and Library of Bolivia, who has supported this project from its inception and has always been most generous with her time and assistance. Likewise, I would like to express my gratitude to Joaquín Loayza Valda, subdirector of the National Archive and Library of Bolivia, and the staff of this institution, including María del Carmen Martínez López, Judith Teran Ríos, Alvaro López Donoso, Leonor Ferrufi o Fernández, Oscar Hurtado Borja, Cecilia Mardoñez Barrero, Ana María Nava, María

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In Potosí, I would like to offer my thanks to Rubén Julio Ruíz Ortiz, director of the Casa Nacional de Moneda; José Antonio Fuertes López, director of the Casa Nacional’s Historical Archive; and his assistants Silvia Flores and Luis Tórrez Ameller. Special thanks also go to Sheila Beltrán Lopéz, director of the Casa Nacional’s museum. All provided crucial—and very much appreciated—support for this research.

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One of the most interesting facets of this project has been applying what we know now to what happened in the past through computer modeling and toxicology. This book would not be what it is without the immense contributions of scientists at the U.S. Environmental Protection Agency and the support of a fellowship with the Oak Ridge Institute for Science and Education. I would like to offer my profound gratitude to Dr. John Vandenberg, director of the Research Triangle Park Division of the National Center for Environmental Assessment. He has been the fulcrum for this scientific research, helping to navigate it from nebulous concept to reality, consistently and generously offering his time, insights, and suggestions, and introducing me to many other people who have played similar roles in this work. A mentor by nature, he leads by deeds punctuated by subtlety and patience.

Dr. Mark Morris took the lead on the air dispersion modeling which is so crucial to this study. His expertise is only matched by his perseverance, and in many ways this book is the product of both. He explored different

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scenarios, incorporated new information, and continually refined the analysis to achieve and present the most accurate results possible. He has been tremendously generous with his time as he educated me during the entire process, and his support is immensely appreciated.

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Together, these scientific collaborators' suggestions, insights, and contributions have played a paramount role in making this work what it is. At the same time, they embody a world of professional and personal commitment which revolves around the relevancy and application of scientific research to achieve social benefit. Through the eyes of one who has spent many silent hours in archives, their collaborative and collegial spirit is inspiring.

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I am immensely grateful to all of those, and many others, who have brought this work to fruition. Any errors or omissions, however, remain my responsibility.

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Introduction



In late January 1757, an elderly cleric named Juan Antonio de los Santos appeared on the outskirts of the quiet village of Laguna, in present-day Bolivia. As he rode his mule into town, Father de los Santos was gripped first by surprise, and then increasingly by rage, as he discovered that the customary celebrations had not been organized to commemorate his arrival at his new parish. Spurring on his mule toward the main plaza, he encountered the lieutenant governor, Mateo Padilla, whom he questioned, insulted, threatened, and then began to chase through the village. The lieutenant governor, having briefly taken refuge near a well, was continuing his flight toward his home when “it came to the priest’s mind the very extreme of what one is able to imagine, which was that of setting foot to land . . . and throwing stones at the official.”¹

Such commotion soon caught the attention of many residents who “stood watching [the priest who was] . . . screaming out loud as if mad to all.” According to Governor Francisco de Guemes Hestres’ wry report of the incident, Father de los Santos had announced his impending arrival “neither to any resident of the town, nor . . . to his own assistant, wanting without doubt that they foresee by extraordinary means the day and hour of his entrance.”²

Following his confrontation with the lieutenant governor, Father de los Santos then went to his church and “rang the bells . . . all that afternoon, filling . . . the town with fear.” Overcoming their trepidation, several women gathered to pay their respects to the priest and “to see if . . . they could calm his mood . . . [but] he would not see them, [calling them] bitches.” Undeterred, another group of parishioners soon came to his house, but he “was

taken with such an extreme indisposition that he even slapped himself, cursed against his parents, against God and the Virgin . . . [and] against [the] Viceroy." Throughout the day, and the coming weeks, Governor Guemes and the town's residents would be subject to an unrelenting barrage of insults by Father de los Santos, such that it "embarrasses one to utter them" and "the pen cannot find expressions" to communicate their gravity.³

About a month later, despite repeated threats to abandon the parish, Father de los Santos attended pre-Lenten festivities at the home of the governor. The merriment was cut short, however, when the cleric exclaimed that his host and his hundred or so guests were "rogue dogs" who deserved nothing less than excommunication. According to Governor Guemes, this latest outburst had no "other source than his insanity" and caused the revelers to "fly with great violence through the doors of my house."⁴

Father de los Santos' treatment of the *corregidor*, or governor, coupled with threatening his parishioners "with rigorous exams of doctrine and confession," explained the "terror and . . . panic with which his parishioners see him" as well as why no one "dared to appear at his church."⁵ For his part, the governor also chose to attend services officiated by another cleric. One Sunday, while crossing the crowded plaza on his way home from mass in the company of another priest, the governor encountered and greeted Father de los Santos. In response, the cleric,

furious and . . . filled with ire, asked why I had not attended mass, to which I answered with the utmost courtesy . . . that . . . I had already heard mass. To this civility and politeness of mine he lost all control (if a madman has any control to lose). Telling me with greater ire and louder shouting and . . . coming near . . . to attack me and wetting my face with his spittle, [exclaiming] "don't you know that you have an obligation to attend mass in your parish and . . . that I have more jurisdiction than you, that I will excommunicate you and banish you from town, that the *corregidores* are servants of the priests" . . . to which I said to him, with calmness . . . that I would hear mass where I chose.⁶

Father de los Santos then moved to assault the *corregidor*, and would have done so "if the pleas of two clerics that were there did not restrain him."⁷

Governor Guemes had learned of Father de los Santos some six years earlier, in the fabled silver mining city of Potosí. There, according to Guemes, the cleric was "known by everybody [to be] . . . crazy . . . and I assure Your Highness . . . by the observations I have made . . . that he is crazy . . . [and] his insanity comprises several emotions such as those of joy,

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obscurity, hypochondria and ire, which is the one which most frequently reigns over him.”⁸ Although Corregidor Guemes sought guidance from his superiors concerning what action to take, he had his own suggestion. He noted that “I have seen madmen in the hospitals . . . whose company would make for the true parishioners that this gentleman should have” and urged that Father de los Santos be “tied up and sent to his Provisor.”⁹

The corregidor’s letter is laden with rich details which strongly suggest that the clergyman was mentally unbalanced. What makes it especially intriguing, however, is the fact that de los Santos had lived in Potosí. As we shall see, this may have been a cause of his insanity.

Potosí, Pesos, and the Rise of the Pacific im

Located in a barren region at almost 12,000 feet, Potosí owes its existence to the chance discovery in 1545 of rich silver deposits in the reddish, cone-shaped Cerro Rico, or Rich Hill, which gracefully looms over the city. Initially, the surface ore was so laden with silver that Indians could simply smelt it, paying a share to their masters while keeping a bountiful load for themselves. Starting as a ramshackle collection of hastily constructed shacks, Potosí would become renowned for its splendor, profligacy, violence, native exploitation, and jealous defense of its privileges.

Like many mining centers, Potosí’s initial boom was soon eclipsed by a bust as the rich surface ores were depleted. As the silver deposits in the hill are largely contained in a V-shaped mass, miners had to burrow increasingly deeper to extract ore which was of increasingly lower quality and ill-suited for smelting. By the early 1570s, Potosí was on its economic knees, with little hope of resurgence. As one chronicler put it, “the costs were many, the ore poor, the mines very deep [and] it did not look like it was sustainable.” Such had been the decline, he averred somewhat hyperbolically, that “if in this time a man arrived with 200,000 pesos, he could have bought all of the mines of the hill.”¹⁰

A new and forceful viceroy, Francisco de Toledo, had arrived in Peru in 1569, and among his highest priorities was reviving silver production, and with it, crown revenues. Toledo was aware that miners in New Spain, present-day Mexico, were employing a novel method of refining silver that involved the use of mercury. Mercury and silver (as well as gold) have a natural affinity, and when quicksilver is combined with crushed silver-bearing ore and other ingredients, a silver–mercury amalgam forms in the mass. This amalgam is then separated from the mixture by placing it in water, where the heavy amalgam sinks to the bottom before it is purified.

through burning. Once the mercury is volatilized, the result is high-grade silver.

The application of this technique led to the resurgence of Potosí, which soon regained its footing as an economic whirlpool, drawing myriad goods from thousands of miles away to its vibrant markets on the desolate and barren altiplano. The silver that fled from Potosí and other mining centers in Latin America would not only help Spain consolidate its position as a global power but would also play a key role in the emergence of the industrial revolution and ultimately, modern, global capitalism.¹¹

Just as the explosion of silver production would have far-reaching consequences on the global economy, it also had a profound and enduring effect on the people and communities that were linked to mercury and silver production. This book explores those effects in the Andes and tells a multifaceted and interwoven tale of what the early stages of the development of modern capitalism left in its wake. Fundamentally, it is a socio-ecological history which explores the noxious interrelationships between mercury and silver production, urban environments, and the people who lived and worked in them. It tells the story of how native peoples in the region were conscripted into the toxic ranks of foot soldiers of proto-globalism and how their fate and that of their communities were chained to it. Within this context is an account of the oppressive, caste-based colonial system in which they labored and a description of how it affected people's minds and bodies, as well as their relationships at both the individual and community levels. The distinction between these three components is more apparent than real, because they all continually interacted and conditioned one another. They are all strands of the same cord; and by following it back in time, we can trace the emergence of the modern, global economy in which we live today.

New World silver, primarily from Peru and New Spain, would prove in many ways to be as much a curse as a blessing for Spain. Between 1550 and 1800, at least 136,000 metric tons of silver were produced in Latin America, accounting for 80 percent of global production during that period. This unprecedented and massive influx of silver would spark considerable inflation both in Spain and Europe through the sixteenth and seventeenth centuries. As in modern times, those on fixed incomes were especially affected as they saw the value of their incomes decrease, and wages generally lagged behind the increased cost of living. In addition, within Spain, the expectation that more New World silver was on the way discouraged economic diversification, reinforced traditional agricultural and pastoral orientations, and precipitated increasing trade deficits.¹²

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The belief in an unending flow of silver from the Americas also encouraged profligate spending by the crown, underwrote Spain's military and political ambitions, and reinforced its commitment to Catholic orthodoxy. As early as the mid-1570s, one quarter of the royal budget was dedicated to sustaining 63,000 troops fighting Protestants in Flanders, and the silver peso of eight would serve as the currency of both armies and merchants for many years to come. As a result of the combination of political and military ambition, religious orthodoxy, extravagance, and the expectation of future riches, the Spanish crown became chronically indebted to German, Portuguese, and Italian lenders, reinforcing the capital outflow. Seeking to get at the source of Spain's new wealth, British, French, and other European countries developed a vigorous contraband trade throughout Latin America while also exporting their products to the Americas through intermediaries in Seville and Cadiz. As a result, when silver shipped from Peru and New Spain, it would often have only a brief sojourn in Spain, if any, before landing in British, French, Dutch, or Italian hands. As the Venetian ambassador to Spain expressed it at the close of the sixteenth century, "these treasures, which arrive in Spain from the Indies . . . have the same effect as rain on the roofs of houses, that while it falls upon them, it descends to the ground without first providing them with the least benefit."¹³

While some of this influx of silver to Britain, France, Holland, and Italy was invested in these countries, much of it was again exported through trade. For example, tens of thousands of pesos of eight made their way from England to Holland as interest payments, where it was then traded for Russian, Polish, and Swedish products. As early as the 1540s, pesos of eight were exchanged throughout Europe, and by the 1570s they had found their way to Constantinople. New World silver was also critical in developing British and Dutch trade with the Levant, the East Indies, and China, ultimately leading to the decline of Venice's role as a crossroads for Asian goods by the early 1600s. On any given day in the seventeenth century in the markets of Europe and the Middle East, one could hear the heavy, dull clang of silver as it was exchanged for myriad products. It was literally the sound of the leading edge of modern capitalism and global integration. Like a restless traveler on a global journey, silver was itinerant, making its way ever more eastward through Persia, India, and China, exchanged along the way for tea, spices, porcelain, silks, satin, dyes, incense, gemstones, and other high-value, low-volume goods. The eastward flow was like a rising tide, increasing from approximately 14 metric tons in 1600 to 220 metric tons in 1700, before reaching 382 metric tons by 1780.¹⁴

Despite problems with the quality of pesos of eight and the often debased silver of which they were made, by 1600 the peso of eight had achieved the status of a global currency by virtue of its durability and sheer abundance. Weighing just shy of a modern ounce, at twenty-six grams, the peso was called “of eight” because it could be divided, like a pie, into eight *reales*. Such was the ubiquity and availability of the peso that during the U.S. War of Independence it served as the basis of the reserves warranting paper money. In 1792, the U.S. Congress established parity between the American silver dollar and the Spanish peso, and such was the overlap of the currencies that the peso remained legal currency in the United States through much of the first half of the nineteenth century.¹⁵

It was in China, however, that the worn and often fractured peso arrived at its final destination and met its demise. The abandonment of the paper money system there in the 1450s and the imposition, in the 1570s, of a silver-based tax stimulated demand for the metal among China’s 100,000,000 inhabitants. This demand was easily met by the growing global craving for Chinese exports, and as a result, by the 1600s up to 136 metric tons of silver was entering China annually. As trade within China was generally conducted on the basis of weighed silver bullion, the pesos were generally melted and recast.¹⁶

While most of the New World silver that entered China in the seventeenth century came the “long way” via Europe, hundreds of tons of it also came directly from Acapulco to Manila, where it was then traded for Chinese goods. The flow through this “back door” was huge, accounting for over one-third of all silver entering China in the seventeenth and eighteenth centuries. While most of this was Mexican silver, Peruvian merchants also took advantage of the opportunities such trade offered, sending silver from Potosí and other Peruvian mining centers directly to the Orient or up the coast from Callao to Acapulco, where it was loaded onto the Manila galleons and carried across the Pacific Ocean.¹⁷

This unprecedented flow of New World silver was not only the catalyst for the development of a global economy; it also sustained the world’s economy for centuries. Beyond leading to the emergence of Spain as a global power and spurring inflation in the regions through which it passed, it also created the milieu and networks from which the industrial revolution, and modern global capitalism, would ultimately emerge. Arguably, these events were the result of the first extended and widespread example of racial exploitation of an industrial nature tied to a worldwide market. The global impact of Latin America’s silver production was not lost on the miners or residents of Potosí, one of whom noted that his city “keeps the world supplied with silver.”¹⁸

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“If There Was Not Mercury, nor Would There Be Silver”¹⁹

So wrote Viceroy Luis de Velasco in the early 1600s, recognizing that mercury, not silver, was the fulcrum upon which Spain’s wealth and power rested. While smelting silver was considerably less expensive, complicated, and harmful than amalgamation, it was suitable only for the richest, scarcest, and most quickly depleted ores. It was mercury that allowed the tens of thousands of tons of silver which circled the world and transformed its economy to be produced from lesser-quality ores on a sustained and industrial basis.

In the Andes, the vast majority of the mercury used in silver production was mined near the town of Huancavelica, in present-day Peru. Despite its remote location and its modest size compared to Potosí, the vital importance of this town to the Spanish empire was clear to miners and royal officials alike. Contemporaries described Huancavelica as “the universal cure of this kingdom,” having enabled “the resurrection of Potosí and all of the realm.”²⁰ Together with Potosí, it served as the “poles which sustain” Spain and “the axles upon which ride the wheels of all of this kingdom, and the wealth” which it contained.²¹ One colonial writer noted that “Th s hill of mercury has been the life of . . . Peru, because had it not been discovered, it would be the poorest and most costly [realm] in the world.”²² Others averred that not only could “the wealth of all of the kingdom” be traced to Huancavelica but that the silver refined from the mercury produced in the town had made “all of the world rich.”²³

What these writers fail to mention, however, is that this “source that fertilizes all” of the mines of Peru also poisoned or killed hundreds of thousands of people. Mercury is known, and was known during the colonial era in Latin America, to be toxic, although medical research has only recently revealed the full scope of its effects. Unlike many other elements, mercury has no known biological use in the body. While its use in felt production has long been recognized as the cause of “Mad Hatter’s disease,” it has many modern uses in such common things as paper, paint, electrical components, thermometers, and dental fillings. It has also served as a component of makeup, skin-whitening agents, calomel lotion, purgatives, and anti-fungal seed dressings. Fish, especially tuna, swordfish, and other long-living animals at the top of the food chain, contain high levels of mercury. Just as they accumulate it from their prey, so do humans when they eat significant quantities of these fish. Mercury is also released during combustion in coal-fired power plants, accounting for over 80 percent of modern mercury emissions. These pollutants are carried by air currents,

to be inhaled by those downwind and to settle in the land and waterways, where they enter the food chain.²⁴

Because of mercury's high toxicity, much modern research on its effects has been based on animal studies as well as accidental and occupational human exposure. Some poisoning by mercury compounds went unrecognized for generations, such as the use of mercurous chloride, or calomel lotion, on infants. This appears to have been a principal cause of pink disease, characterized by insomnia, perspiration, loss of sensation in the extremities, irritability, and various mental disorders. Hypertoxic methyl mercury has also received considerable scientific attention, especially after the mass poisonings in Minimata, Japan, in the 1950s which resulted from pollution by a plastics plant. Other mass poisonings include those in Iraq and Guatemala in the 1970s, when thousands were sickened as a result of eating bread made from wheat and barley that had been intended to be used as seed and had been treated with a methyl mercury fungicide.²⁵

Harmful when absorbed through the skin, mercury's effects can be quick and even lethal if its vapor is inhaled, such as when it is refined or when it is burned off of amalgam to yield silver. During the colonial era in Latin America, contemporaries recognized that uncontrollable tremors, teeth falling out, drooling, weight loss, gum discoloration, and anemia were symptoms of mercury intoxication. What contemporaries did not know, however, is that mercury poisoning has a plethora of other physical and psychological symptoms which have profound impacts on both health and human relations. Psychological symptoms of mercury intoxication include irritability, anxiety, depression, manic disorders, insanity, paranoia, and hallucinations. Depending on individual sensitivity, mercury poisoning can also produce a tendency to violence or to timidity and withdrawal. Physical symptoms include female infertility, birth deformities, problems with gait, immune disorders, asthma, chronic fatigue, and arthritis. It can also produce chills, a lack of appetite, insomnia, visual disturbances, vertigo, and hearing impairment. Within the body, mercury tends to accumulate in the brain, kidneys, and liver, producing disease in these organs.²⁶

During the colonial period, Huancavelica produced approximately 68,200 metric tons of mercury, and a total of approximately 45,000 metric tons, from all sources, were consumed in the city of Potosí. Of this, approximately 39,000 were volatilized, and the rest became uncaptured runoff. All of it was ultimately absorbed by the atmosphere, watershed, people, animals, and plants, resulting in one of history's most massive and sustained cases of mercury intoxication.²⁷ In the case of Potosí, a large urban area whose population at one time exceeded 160,000 and where silver refining took place day and night throughout the year, its inhabitants were

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constantly exposed to mercury vapors and particles that literally permeated their environment, their homes, their clothes, their food, their skin, their lungs, and their brains. The effects of this poison were also spread throughout the land, as laborers and others who were exposed to mercury returned to their homes or migrated to other regions. Just as we cannot understand the rise of Spain and the emergence of the modern global economy without examining the key role of mercury in the production of silver, we cannot fully understand colonial Latin American society without accounting for the impact that quicksilver had on the environment, people, and their relationships. Insidious, subtle, and multifaceted in its noxious effects, mercury was an exacerbating element in what was already a violent, ruthless, and brutally exploitative society.

It is impossible to release tens of thousands of tons of mercury into an ecosystem and not have a monumental impact upon people and their environment for generations to come. Even today, quicksilver which had been mined at Huancavelica forms part of the global background levels of mercury in the atmosphere and, in minuscule quantities, is part of the air which we breathe. Much more relevant to present-day residents of Huancavelica and Potosí, however, is the mercury that remains in the soils of these cities. Soil samples taken from both cities and analyzed by atomic absorption spectrometry reveal high concentrations of mercury throughout both urban areas. These tend to be highest in Huancavelica in locations where mercury was refined, while in Potosí they peak along the canal which ran through the city and provided water to the refining mills. Not only do people breathe dust which is bound with mercury, but toddlers and children are especially exposed due to their high levels of hand-to-mouth activity and the ongoing development of their brains and nervous systems. Perhaps worst of all, in parts of Huancavelica where smelters were located, many families have built their homes out of mud bricks which contain cinnabar tailings and other byproducts, exposing them daily to high levels of mercury vapor. Far from being relegated to the past, the human and environmental toll of historic mercury and silver mining continues to this day.²⁸

The Spanish crown maintained a monopoly, and detailed records, on mercury production and to whom it was dispensed. Apart from the revenue this generated, it was also intended to serve as a check against contraband by acting as a rough indicator of how much silver should be produced and hence brought to the treasury office for payment of the royal fifth. In a further effort to discourage contraband, the Spanish crown prohibited all mercury production in Latin America except for that in Huancavelica, which was generally destined for Andean silver mills. In contrast, those in New Spain were mostly supplied from the mercury mine in Almadén, Spain.²⁹

As there are reasonably reliable production figures of both mercury and silver in Huancavelica and Potosí respectively, the manner and amount of mercury released into the environment can be estimated with a degree of accuracy. By examining the mercury and silver production processes and combining production and consumption levels with meteorological and topographical data, computer-based air dispersion models can approximate the mercury vapor concentrations that people were breathing at different production levels in both Huancavelica and Potosí. On this basis we can begin to understand the public health and wider impact of one of the largest and longest-recorded man-made environmental catastrophes.

Making a Mint: Metals Production, Capitalist Conscription, and the Decline of Native Communities

A brief look at the refining processes of mercury and silver illustrates their range of ecological effects. Mercury is extracted from cinnabar, or mercuric sulfide, and the Santa Barbara Hill just outside of Huancavelica contained the largest known colonial deposit in the Americas. There, both forced and free laborers extracted and broke up the ore before transporting it to nearby smelters. Refiners then placed the ore in a retort, where the heat would vaporize the quicksilver. As it cooled it would condense and be collected, stored, and sent to mining centers. The human toll of this rather simple and primitive process was enormous. Several years after mercury mining began in Huancavelica, the provinces surrounding it that were subject to forced labor levies were largely depopulated. Those who did not die or become incapacitated from mercury poisoning as a result of working in the mines and smelters fled to other provinces that were not subject to forced labor or to regions that were not under Spanish control.³⁰

Until the late 1770s, the primary destination of the mercury produced at Huancavelica was Potosí, although it supplied other important mining centers such as Oruro, Castrovirreina, and, occasionally, New Spain. Once at its destination, the quicksilver was used to produce silver. First, however, the silver-bearing ore was mined, carried to the surface by forced laborers, sorted on the basis of quality, and brought to a refining mill. There, other forced laborers broke it into smaller pieces, ground it with stamp mills, and sifted it. The clouds of dust generated by this process caused endemic silicosis among these workers.³¹

After mixing water, salt, mercury, and other ingredients with the ore, the dark, pasty substance was spread out in a stone patio, where it would sit for weeks. There, other forced laborers, usually barefoot and up to at least their

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knees in the muck, would tread on it throughout the day for up to a month to ensure that the substance was properly mixed so that the silver would bond with the mercury. While all refiners recognized the importance of treading in enabling the amalgamation process, some called for the process to be done more intensively so that the heat from the Indians themselves would expedite the reaction.³²

Once samples indicated that the amalgamation was complete, the mass was put in a trough with gently flowing water. The silver–mercury amalgam would sink to the bottom, and the rest was washed away, usually to containment ponds. The slippery, shiny paste which resulted was then placed in a conical mold and squeezed as dry as possible. The resulting *piña*, so called due to its resemblance to a pineapple, had five parts mercury and one part silver and was then smelted to vaporize any remaining quicksilver. It was at this point in the production process that tons of mercury were released in the city of Potosí and breathed by its inhabitants each year. While the wealthy were immune to the hardships of working in the mines and mills, no one was above the often subtle but always noxious effects of mercury vapor.

Although the advent of the amalgamation process would revolutionize the global economy, it was at the direct cost of the Indians and their communities who were forced to work in the mines and mills. To ensure that the most basic and least desirable tasks were completed, the crown established the *mita* system, which was a forced labor draft of men between eighteen and fifty years old. While the mita was in theory only to call up about one-seventh of the population from designated provinces, it was in practice a numerical assessment on the community that varied somewhat over place and time.³³ As disease decimated the native population in the generations after the conquest, in some areas reaching 95 percent, adjustments to labor levies generally lagged well behind the population decline. The result was that when people would return to their villages after a year in Potosí or several months in Huancavelica, they would again be dispatched for the mita within a year or two, as opposed to the theoretical seven.³⁴

Many would return home, broken in body, mind, and spirit, only to find their homes shorn of their meager belongings and their lands reassigned to others. Furthermore, they would be liable for tribute payments for their time away in addition to numerous civic and religious exactions. No sooner would they arrive home than they would be forced into generally unpaid labor for their local chief, or *curaca*, priest, or governor. Although this provided ample reason not to return home, there were other advantages to moving to a different town. By taking up residence away from

their birthplace, they became *forasteros*, or “foreigners,” and were not only exempt from the mita but also paid less tribute. As a result, the mita system destroyed native communities on two levels: by relocating men at the height of their productive years and subjecting them to the most dreaded form of colonial labor, and by encouraging their flight from their communities before, during, or after their mita service. The result of this process was the progressive destruction of Andean native communities, which became some of the earliest victims of globalization.

Overview of This Volume

The opening chapter of this book details the emergence of Potosí and its initial boom years, as well as its subsequent decline.³⁵ The work then shifts focus to examine the discovery and application of the amalgamation process, the establishment of Huancavelica, and the transformative effect this had in Potosí. The book then explores the labor systems and working conditions in the mines and mills of Huancavelica and Potosí, the controversy surrounding them, the differing manifestations of the human toll of mercury and silver refining, and native responses to their servitude.

This creates the background for an approximation and analysis of the myriad and interconnected human, social, health, and environmental tolls levied by the mercury amalgamation process, based on state-of-the-art air pollution models. The work then focuses on indigenous communities to detail how they were degraded by the mercury and silver mining economy, the alternatives native peoples had in colonial society, how the mita system affected power relations among the elite, and how, toward the end of the colonial era, the collapse of Indian communities spurred the collapse of the mita system.

Back in the village of Laguna in 1757, Father de los Santos’ behavior elicited not only fear but also bewilderment. We will probably never know the cause of his insanity; just as some people are genetically sensitive to mercury intoxication, others are predisposed to mental illness, and some to both. It is quite possible, however, that his residence in Potosí resulted in mercury poisoning. His manic behavior and tendencies toward violence and irascibility, as well as his excessive salivation, all of which Corregidor Guemes referred to in his letter, are highly suggestive of mercury intoxication. Just as the effects of the priest’s illness were not limited to himself but characterized all of his social interactions, so too were the effects of the amalgamation economy experienced on individual, societal, and ultimately, global levels.

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Amalgamating an Empire



When Francisco Pizarro and his band of conquerors landed on the coast of Peru in 1532 they, like many of their compatriots, were inspired in no small measure by the legendary success of Hernán Cortés in New Spain. In 1521, following an epic and bloody saga, Cortés and his followers finally conquered the Aztec empire. Their victory rendered to Spain, and themselves, one of the New World's most powerful empires and its seemingly infinite riches. Like Cortés and thousands of conquistadores throughout the Americas, Pizarro and his followers were generally men of modest means and little formal education, whose independent spirits were matched by their ruthless ambition.

Unlike most of their contemporaries, however, Pizarro and his men would encounter a highly developed civilization whose achievements in constructing roads, bridges, and buildings astonished them. Taking a page from Cortés' playbook, Pizarro would exploit internal divisions within native society and hold a native king, Atahualpa, hostage in order to wrest control of his empire. After Pizarro promised to spare the Inca king's life in exchange for filling three rooms with tons of gold and silver, the conqueror then ordered him killed, fearing he was plotting an uprising. The sheer amount of gold and silver that Atahualpa was able to gather before being garroted demonstrated beyond any doubt to the Spaniards that the empire they had seized was endowed with almost unimaginable wealth.

Having seized and pillaged a kingdom, the conquistadores set about the more time-consuming tasks of bringing the native peoples under their control, nominally converting them, and putting them to work. The primary instrument for this during the post-conquest period was the *encomienda*,

a system under which colonial authorities would place Indians in a given geographic area under Spanish control. While the Spanish *encomenderos* were obligated to Christianize their charges, they were also entitled to receive tribute and labor from them. Mass baptisms in a language few Indians understood became a prelude for service for a new, foreign, and seemingly insatiable master.¹

As in New Spain after the conquest, the crown sought to assert its control over Peru and its wayward and conflict-prone conquistadores. Reflecting the immense wealth of the region, the region was elevated in 1541 to viceroyalty status, with jurisdiction reaching from what is today Colombia south to Chile and Argentina, and eastward from the Pacific Ocean to contemporary Paraguay. Fearing the rise of a New World nobility that would escape their control, and in an effort to limit rampant abuses against the Indians, the next year the crown decreed the New Laws, which called for the phasing out of the encomienda system. When Peru's first viceroy, Blasco Núñez Vela, arrived in Lima in May 1544 and refused to suspend the New Laws, the conquerors organized a rebellion.

In the coming months, Viceroy Núñez would be forced from office, jailed, and released en route to Panama. He lost no time returning to Peru, where Gonzalo Pizarro had been sworn in as governor, and who went in pursuit of the deposed viceroy. In January 1546 Pizarro defeated Núñez' forces outside of Quito, crowning their victory by decapitating the viceroy. The following year, a new governor sent from Spain, the cleric Pedro de Gasca, arrived in Peru. The New Laws had been modified somewhat to assuage encomendero opposition, and Gasca combined an offer of a general pardon with the threat of force to divide Gonzalo Pizarro's followers and bring many of them to his side. His emphasis on politics and diplomacy worked, and by December 1547, Gonzalo Pizarro had surrendered and been executed. Power was back in royal hands, and by 1550 Gasca had returned to Spain, having ceded his powers to the Lima *audiencia*, or court with legislative and executive functions.²

Disease and Demographics

As the Spanish were engaged in their internecine struggles, the indigenous population of the Andes was experiencing a demographic free fall of unprecedented proportions. The conquest and ensuing civil war among the Spaniards, along with overwork, drought, and famine, cost thousands of native lives. This, however, paled in comparison to the mortality wrought by disease on a population which had no immunity to a plethora

of new pathogens. Pestilence both preceded and facilitated the conquest of the Inca. Between 1524 and 1531 smallpox and influenza spread southward from Panama, carried by merchants, messengers, and other travelers, who unwittingly laced their path with death and despair. Among the casualties was the Inca king Huayna Capac and members of his family, who perished from smallpox in 1524. Huayna Capac's death set off a succession battle between the half-brothers Atahualpa and Huascar, which the conquistadores stepped into in 1532 and successfully exploited.³

The ensuing collapse of the population almost defies the imagination and was, according to one scholar, "in terms of the number of people who died, the greatest human catastrophe in history."⁴ In the region of present-day Peru, the total population fell from approximately 9,000,000 people in 1520 to about 1,000,000 in 1580, reaching a nadir of only 600,000 in 1620. This demographic implosion of 93 percent was caused primarily by measles, smallpox, influenza, typhus, and plague, with nine epidemics ravaging the region between 1572 and 1635. There were regional variations, however, as some communities in the hot coastal lowlands literally disappeared, while highland inhabitants often fared somewhat better as a result of cooler temperatures, less contact with Spaniards, and more dispersed populations. Reflecting this, in the highlands of present-day Bolivia, the population fell by approximately 60 percent between 1532 and 1550, and 75 percent overall between 1532 and 1720.⁵

Witnessing death became a way of life in the early colony, and a Dominican friar wrote in 1550 that "of the people, livestock, towns, buildings . . . and everything else that was in this land when entered ten years ago . . . there is not at present half, and of many of these things, not even a quarter . . . such that if . . . things are not remedied, shortly . . . there will be no one left to remedy them."⁶ It was not only disease that depopulated towns but also flight to unconquered regions and emigration to cities, where diseases spread with even more facility. In the 1680s Viceroy Navarra y Rocaful alluded to the desolation of the countryside when he wrote that "for many years it has been recognized the great depopulation that has come to the towns of these . . . provinces of Peru . . . it is not possible to maintain the kingdom with only the main cities."⁷ While many contemporaries recognized the roles that disease and flight from Spanish domination and abuse played in the depopulation of the region, others had different, self-serving theories. The Dominican Reginaldo de Lizárraga was, for example, convinced that the widespread drinking of *chicha*, a fermented corn drink, had "consumed the Indians in the valleys, in the plains, and will consume the few that remain."⁸

The Rise of Potosí

It was in this context of upheaval, civil war, and demographic implosion that Potosí emerged. The Incas had long mined silver in the nearby region of Porco, and Hernando Pizarro, among others, had moved quickly to exploit these deposits, often by dispatching encomienda Indians to extract and refine the ore. In 1544 or early 1545, an Indian from the region of Cuzco, named Gualpa, was leading his llama train back to Porco from the town of La Plata with a cargo of foodstuffs when he stopped in what would soon be Potosí. Accounts differ, but Gualpa ascended the Cerro Rico in pursuit of either prey or an errant llama. Climbing the steep hill, he is said to have grabbed a shrub to steady himself, uprooting it in the process. With the keen eye of a miner, he recognized that the soil in which it had grown was laden with silver. What he could not see, however, were the myriad changes that this chance event would have both in Peru and the world.⁹

In the coming months, Gualpa furtively returned many times to the hill, gathering and refining its rich ore. Although he tried to keep the source of his new and increasingly apparent wealth secret, Gualpa yielded to the pleas of his friend Guanca and brought him to the site. Disagreements soon arose, however, as Guanca complained about the hardness of the rock that he had agreed to mine. Unable to overcome their differences, Guanca told his master, Juan de Villarroel, of the discovery and the two formally registered a claim on one of the richest veins in the Cerro Rico in April 1545.¹⁰

Just as Gualpa was pushed aside by the one with whom he shared his secret, so too was Guanca soon sidelined by Villarroel. In September 1545, Villarroel and seventy-five other Spaniards gathered to formally found the city of Potosí.¹¹ This got off to a rough start as control of the town shifted between royalists and rebels during the civil war, although it began to develop on a more stable footing in 1548 following the death of Gonzalo Pizarro. A plentiful spring water supply was vital to the subsequent growth of the town. Not only were there excellent springs just outside of town but also, as a Dominican friar observed, "One hardly finds a block that does not have many springs, nor houses without wells, and in the streets many [springs] spew forth water."¹² A dirty, ramshackle boomtown sprang up as people fled from Porco and La Plata to prospect and stake their claims on the hill. By 1548 its population had already reached 14,000 people living in about 2,500 hastily constructed, straw-roofed houses. One writer at the time noted the contrast between the town's tremendous wealth and ostentatiously dressed Spaniards and their houses which were "the worst in this region . . . simple, low . . . disorderly . . . and small."¹³

What this shoddy town on the barren altiplano lacked in aesthetics, it offered in opportunity. Just as prospectors, miners, and refiners were attracted to Potosí, so were merchants, artisans, and moneylenders. At almost 12,000 feet above sea level, no crops were grown in the immediate area, and everything from food and tools to clothes and furniture were brought upland by mule and llama train. The high prices for which the town was soon known reflected not only transportation costs but also the abundance of silver and the profligate ways of those who had it. Despite their disdain for engaging in commerce, many Spaniards could not resist the profits to be made and had Indian servants sell their goods for them. Potosí quickly became home to the largest market in the Andes, where tens of thousands of pesos were exchanged each day. As Potosí prospered and the name of the town became synonymous with wealth, its residents increasingly chafed at external control, whether from Spain, Lima, or La Plata. As a result, in November 1561, its leading residents were glad to purchase their independence from the jurisdiction of La Plata, paying 79,000 pesos to the crown for the right to form their own city council. Reflecting the rising tide of their fortune and their pride, Potosí was granted its own coat of arms in 1563.¹⁴

Although the Cerro Rico was the font from which such legendary riches flowed, the Spaniards were entirely dependent on the native peoples who mined and refined it.¹⁵ In addition to encomendero Indians sent by their masters to produce silver, thousands more came willingly. Like the Spaniards, they were drawn by the quality of the ore and the relative ease with which it was extracted. Many of these Indians were known as *yanaconas*, which in the early colonial period referred to Indians who had a Spanish master who was not an encomendero. They did not pay tribute nor were they subject to an Indian overlord, and as a result yanaconas had somewhat more freedom than the encomienda Indians.¹⁶

In the years before amalgamation was introduced, yanaconas often ran smelting operations and employed encomienda Indians as assistants, although both groups also mined the ore. They would enter into an agreement with a Spanish mine owner to work a given section of the mine, measured in *varas*, which is roughly equivalent to a yard. Known collectively as *indios varas*, these Indians provided their own tools, sacks, and supplies, except for the crowbar which was supplied by the mine owner. Only willing to work the richest veins, they would pay a premium of up to a pound of silver a week to the mine owner, and, in the case of encomienda Indians, a pound a month to their master, and otherwise keep the ore they extracted. While some Indians would refine it themselves, most would take

it to a native smelter who would refine it for a fee. Overall, in the days before the mercury amalgamation process, the Indians in Potosí made a relatively good living as miners, refiners, transporters, and merchants.¹⁷

The most skilled, and often lucrative, occupation was that of a refiner. One resident of Potosí would later recall how many Indian refiners would “become wealthy and bring to their lands a great quantity of this silver. And this was the reason why so many thousands of Indians from many parts of the realm came to this town.”¹⁸ As elsewhere in the Andes, during this time the Indians generally employed traditional smelters, called *guayras*, to refine the ore. Although in pre-Hispanic times most were constructed of stone, after the conquest they were usually portable. Made of ceramic, they measured anywhere from three to six feet high, were wider at the top than the bottom, and had ventilation slits on the sides. At the base was an opening to load fuel, which generally consisted of wood, charcoal, or llama or other dung. Inside, the refiner would stoke a fire and place ground ore of differing qualities in a vessel above the flame for about two full days, repeatedly removing impurities and collecting the silver and lead which remained.¹⁹

This lead–silver mix would then be smelted a second time over the course of another day. The third and final smelting was often done in people’s homes in a round stone furnace called a *tocochimpó*. About a yard in diameter and stoked by blowing into copper, reed, or other pipes, the refiner would heat the mixture, blow off any frothing impurities, and be left with silver.²⁰ While profitable for the refiner, this was a highly toxic process given the amount of lead in these richest of ores. Although the historical record is largely silent on the issue, the operators of *guayras* and *tocochimbos*, both in the pre-Hispanic and early colonial periods, in all likelihood suffered from high rates of lead poisoning.

The *guayra* formed the backbone of the early mining economy in the Andes and was responsible for the initial torrent of silver which flowed to Spain and Europe before the advent of the mercury amalgamation process in the 1570s. Just as the conquistadores depended on a breeze to propel them to the Americas, they also depended on the wind for the production of silver. To operate properly, the *guayra* required a steady, moderate air current, which a bellows could not offer, to generate the high heat necessary to extract the silver from the ore. The trick was the right amount of wind, for too much would burn the fuel without transferring the necessary heat to the ore, and too little would not generate sufficient heat. The portability of the colonial *guayras* allowed their operators to place them in the most advantageous location, which was often on hilltops.²¹

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Such was the dependence on a good wind that when it would cease for a few days, Potosí's clergy would lead religious processions and prayers for a steady breeze. From Potosí, the sparkling sight was spectacular, with up to 6,000 guayras operating at a time. One contemporary waxed that the "guayras are placed on the summits and bases of the hills . . . that . . . surround this town . . . some placed neatly on the . . . pinnacles . . . like lanterns, and others placed confusedly on the slopes and ravines, all together they make a joyful and pleasant sight."²² It was thanks to the guayra and its native operators that, as one miner put it, "so much silver fl wed in that town that . . . it appeared a thing of fables . . . and dreams."²³

But, as a civil official would write years later, from these "incredible riches . . . was born . . . arrogance, vices, inhumanity and misfortunes"²⁴—and, he might have added, a process of severe and rapid environmental degradation. Although this would reach unprecedented heights with the later use of mercury to refine silver, it was already well under way by the 1550s. When Gualpa first discovered silver in the Cerro Rico, what would become the city of Potosí was then a forest, and the hill was "from top to bottom a mountain thick with trees that we call kenua, twisted . . . [and] good for firewood and charcoal."²⁵ These evergreens are found only in the Andes and thrive well beyond 12,000 feet, high above the normal tree line. While its dense wood and papery bark make exceptional firewood and tinder, the tree can also be used in construction. Given the absence of almost all other vegetation in the area, except for a spiny, beige straw called *ichu*, which was used for roofing material and fuel, the population of kenua trees was rapidly depleted as buildings took form and as refiners used it to generate the heat necessary to smelt silver in the guayras.

By the dawn of the seventeenth century, not only was "there . . . no more memory of the" kenua trees on the Cerro Rico, but it had been stripped of all of the *ichu* as well.²⁶ In 1603, one writer noted that "today, as a result of the continual work . . . on the hill, there is not a trace that it was once covered in trees . . . not even weeds are found on the hill, nor even [can one] find tree roots, which is most astonishing, as everything is loose rock with little or no dirt."²⁷ By the late eighteenth century, a civil official would describe the Cerro Rico as "eroded . . . bald, sterile, cold, disagreeable and dry. Although today it produces neither fruit nor weeds . . . it was not that way at the time of its discovery . . . and as the movement of goods on the hill by mules and llamas is continuous . . . it is almost entirely composed of prospecting holes, tailings and small gullies, [and] the growth of new vegetation has been impeded."²⁸ As the hill and immediate region became

denuded, the partridges, deer, vicuñas, guanacos, wildcats, viscachas, and other animals also disappeared, either having been hunted down or fled in search of new habitat.²⁹

A decline in the quality of the ore paralleled the ecological decline. While initially miners could extract an amazing twenty or more pounds of silver from 100 pounds of ore, by the close of the sixteenth century they considered themselves fortunate to get one pound from the same amount. By the mid 1560s, it looked as if Potosí, like so many other boomtowns, was destined for ruin as miners had to dig ever deeper into the reddish mountain to get ever-poorer quality ore. As the decline continued, one chronicler remarked that by the 1560s “the settlement was almost unpopulated, and the buildings decrepit and the residents with little silver.”³⁰ Another, more wistful, writer observed about a decade later that “Potosí enjoys (or at least used to enjoy) the best merchandise, cloth, silks, linens and wines of all . . . the Indies, because . . . the best is brought to [Lima and], from there the flavor is brought to Potosí. Now it is no longer that way.”³¹

The residents of Potosí and the colonists in the region who supplied its markets were not the only ones dismayed by the decline in silver production; so was King Philip II, who was ever more indebted and embroiled in European continental conflicts. During Potosí’s initial wave of prosperity, the colony as a whole had gone through a period of political consolidation as the crown asserted its authority and brought the encomendero class, which never numbered more than about 500, to heel. During this time, the Spanish population in the viceroyalty had quadrupled from about 2,000 in 1536 to around 8,000 in 1555. Up to a quarter of this population was composed of vagrants, however, and overall the Iberian colonists were predominantly male, with Spanish women accounting for only about 15 percent of the total during this time.³²

A new race of Mestizos emerged from voluntary, and involuntary, relations between Spanish men and native women. Apart from the lure of riches, many Spaniards who immigrated to the New World did so because of primogeniture laws in Spain, which limited inheritance to the firstborn male in a family. Those not in that number often became soldiers, clergymen, lawyers, and artisans, and were attracted to the Americas by the prospect of quick riches which would enable them to return to Spain as wealthy men. As a result, the colonial society of Spaniards which emerged in the Andes largely replicated that in Spain. Eschewing the cultural stigma of physical labor, the colonists relied on a servile native population, and later, African slaves, to meet both their needs and their wants.³³

A Trial Marriage: Silver and “Its So Intimate Companion, Mercury”³⁴

The introduction of the mercury amalgamation process in the Andes took place in this context of Spanish political and military consolidation, native exploitation, and demographic implosion. The affinity of gold and silver to mercury has been known since Roman times, when quicksilver was used to amalgamate these metals. Although the amalgamation process appears to have subsequently fallen out of use for silver refining, it was not forgotten. The Italian metallurgist Vannoccio Biringuccio described it in 1540 in his book *De la pirotechnia*, and European silver refiners, especially in Italy and Spain, were also aware of the process.³⁵

It was in New Spain, however, that mercury amalgamation was first employed on what could be termed an industrial scale. There, in the town of Pachuca, about fifty miles outside of Mexico City, the Spaniard Bartolomé de Medina spent years experimenting with and perfecting the process, which he acknowledged having learned in Europe from a German known to history only as “Maestro Lorenzo.” Medina had more success with his experiments back home in Spain, as it appears that the salt he used in the process had traces of sulfuric acid, which aided the process. In New Spain, this element was absent, although after considerable experimentation Medina replaced it with *magistral*, which is a combination of sulfates of iron and copper, and by 1554 he had perfected the process.³⁶

The system was quickly adopted in New Spain, where its value in refining lesser-quality ores was clear to miners. It was also recognized by the crown, which lost little time in claiming all cinnabar deposits, from which mercury is refined, as state property in 1559. Eager to increase silver production in Peru, in 1555 King Charles I instructed Viceroy Marqués de Cañete to study and promote the system in the region. While there was an active mercury mine in Almadén, Spain, its production was not sufficient to meet the needs of all of the Spanish-American colonies, the risks and travails of transoceanic shipping aside. Viceroy Cañete recognized the importance of an Andean source of mercury for the development of silver mining in the region and promoted prospecting for cinnabar.³⁷

His efforts yielded some encouraging discoveries, the earliest being in 1558 by Gil Ramírez Dávalos, who discovered a modest deposit near Cuenca in present-day Ecuador. Farther south, a Portuguese prospector named Enrique Garcés and his partner and financial backer Pedro Contreras had seen women selling vermillion, which is derived from cinnabar and which they called *llimpi*, in a market in Lima. Reluctantly told by the

vendors that it came from the towns of Tomac and Guacoya, near Huamanga, the two set out to prospect. Their efforts bore fruit, and the two successfully refined mercury in Tomac before disagreements arose and the partnership ended.³⁸

Although the extent of Garcés' mining experience was limited to a visit to the mercury mine in Almadén, in 1558 Viceroy Cañete underwrote his journey to New Spain where he spent several months studying the amalgamation process. The following year he returned to Peru where he promoted the method at the viceroy's behest, while also continuing to prospect for mercury deposits. In recognition of his efforts, in June 1559, Viceroy Cañete granted him an exclusive license to extract mercury in Huánuco, Lima, and Huamanga, contingent on paying a 25 percent royalty to the state. Garcés would only enjoy the monopoly briefly, however, as the incoming Viceroy Conde de Nieva abrogated it in July 1561. During this time, however, he demonstrated the viability of mercury amalgamation in the region by successfully refining 200 pounds of silver with mercury in 1560, the first sizable quantity produced in this way in Peru. Despite this success, the mercury amalgamation process was not adopted by Andean miners as quickly as it had been in New Spain, mostly as a result of difficulties mastering the process.³⁹

Although Ramírez Dávalos, Garcés, and Contreras had found modest cinnabar deposits in the viceroyalty, as with the silver in Potosí's Cerro Rico, it was an Indian who identified the massive cinnabar reserves contained in what would be called the Santa Barbara hill outside of the future Huancavelica. Also like Potosí, there are diverging tales of discovery. Most agree, however, that during a party the encomendero Amador de Cabrera had entrusted his hat to the son of an Indian curaca named Gonzalo Navincopa from the town of Chachas. Fortunately for Cabrera, the boy lost the hat, and in an effort to mollify him over this trifling loss, Navincopa told Cabrera about the deposits in the Santa Barbara hill. Alternative accounts posit that the Indians in the town of Conayca knew of the site and alerted Cabrera to it, or that another cacique named Juan Tumsuvilca reported it to Cabrera. Whichever was the case, Cabrera ascended the mercury-laced mountain and confirmed the existence of the deposits on November 1, 1563, and registered his claim to them on New Year's Day, 1564. Just as the Indian Guanca was ultimately excluded from Villarroel's claim in Potosí, so was Navincopa barred from Cabrera's.⁴⁰

While the find at Huancavelica was news to the Spaniards, it had long been mined by the Inca, who called the place Sigsichaca, which roughly translates as the "pampas grass bridge."⁴¹ The Inca used cinnabar to produce

vermilion, which was applied as red face paint for warriors, idols, and women of the Inca royal family, known as *ñustas*, and also by indigenous women after the conquest. Using deer antlers to bore away at the rock, they would refine the ore by grinding it in a *maray*, which, like a mortar and pestle, consisted of a concave stone about three feet in diameter into which the ore was placed and which was then pulverized by a rounded grinding stone called a *quimbalete* of about a foot and a half in length. The ore was then washed at the riverside or at a spring, yielding vermilion, and leaving plenty of residue in the *lavaderos*, or processing sites, which the Spaniards would later further refine for their mercury. The Inca were aware of the toxicity of cinnabar, and there is evidence indicating that they also refined mercury.⁴²

With the discovery of the massive mercury deposits of Santa Barbara, and facing declining yields from the Cerro Rico's deeper ores, during the mid and late 1560s miners in Potosí began to experiment with the amalgamation process. Because of their unfamiliarity with it, however, they were disappointed by the results and again it failed to catch on. With no local market, Cabrera and other mercury producers in Huancavelica began to export it to New Spain. While much of this mercury was refined from ore extracted from the mines outside Huancavelica, a considerable portion was extracted from the pre-Hispanic lavaderos. Not only were they cheaper to refine as there was no ore extraction involved, but after 1574 they paid 12.5 percent as opposed to 20 percent in taxes.⁴³

Reining in a Realm: The Toledan Reforms

The destination of mercury produced in Huancavelica, and myriad other things in Peru, would begin to change in 1569 with the arrival of Francisco de Toledo as viceroy of Peru.⁴⁴ Born in 1515, Toledo was the third son of the count of Oropesa and a member of the Order of Alcántara. Founded in 1555, this military organization was initially dedicated to the expulsion of the Moors from the Iberian Peninsula, and later to the Counter-Reformation. As a member of this order, Toledo gained military experience in Europe and North Africa. With his appointment as viceroy of Peru in 1568, he received specific, somewhat quixotic, and often contradictory instructions from King Philip II. These included increasing silver production while putting an end to Indian servitude, seeing that curacas did not abuse their charges, reining in wayward clergy, relocating natives to Spanish-style towns and converting them to Christianity, and ending the fierce resistance by the Chiriguano Indians in what is today southern Bolivia. As

with most instructions to viceroys, Toledo was also ordered to make an extensive tour of the realm to better familiarize himself with its character and challenges. Toledo did not travel light, and was permitted to bring along twenty slaves, seventy-four paid servants, and their families.⁴⁵

Toledo was a determined and forceful administrator, as well as a prolific lawmaker. During his twelve years as viceroy, he introduced a host of reforms that would consolidate Spanish power in the region, have monumental repercussions on the indigenous population, and endure throughout the colonial period. Toledo had a hands-on approach to leadership, often drafting and implementing regulations on the spot, and did not shy away from imprisoning those who opposed him. He arrived in Lima, by way of Cartagena and overland via Panama, in November 1569. He soon organized an expedition against the Araucanian Indians in Chile and oversaw the establishment of the Inquisition.⁴⁶

Among Toledo's concerns was the aggressive defense of the legitimacy of the conquest, which the Dominican friar Bartolomé de Las Casas and other theologians had impugned. In Las Casas' *Apologética historia sumaria*, a natural and ethnographical history of the Americas published in 1556, he not only affirmed the humanity of the Amerindians but also placed them in a larger context by comparing them with other ancient societies such as the Egyptians. In his *Brevísima relación de la destrucción de las Indias*, Las Casas offered an account of the conquest of the Americas in which he vividly described numerous Spanish atrocities. In the work he attacked the "covetousness . . . ambition and cruelty of the Spaniards," contended that the Indians had waged a defensive and "very just war against the Christians," and, flinging with treason, questioned the legitimacy of the conquest.⁴⁷ To refute such assertions, Toledo supported the publication of works such as Pedro Sarmiento de Gamboa's *History of the Incas* and Juan de Matienzo's fantastical *Gobierno de Peru*, both of which presented the Inca as little more than usurping, idolatrous tyrants and the Indians as lazy but well treated under the Spanish.⁴⁸

Drawing on Aristotle and seeking to push back the rising tide of European criticism of the Spanish treatment of the natives, which would ultimately become known as the "black legend," Matienzo averred that the Indian's "poor treatment was entirely remediated in this kingdom." In a torrent of hypocrisy and delusion, he attacked the Incas as tyrants who had "by force or deceit and betrayal took and occupied a foreign kingdom" while criticizing them for their use of forced labor and for making them move to different settlements.⁴⁹ In contrast, he asserted that under the Spanish, the natives had not only been Christianized but enjoyed "great

contentment,” benefited from laws that were designed “in their favor and liberty,” and lived in a society where “no one takes . . . from them by force or against their will.”⁵⁰ Soon after describing the Indian’s supposed happiness, Matienzo explained how, because of their timidity, they were inclined to sadness, violent and unpredictable outbursts, and “become desperate and hang themselves when they are very young or very old, which happens every hour among the Indians, who for whatever small occasion or fear hang themselves.”⁵¹ Spanish abuse was not the cause of this, he asserted, because “they do not take offense when their chiefs publicly whip them, nor when the judges whip the chiefs.”⁵²

Unlike most Peruvian viceroys who were often reluctant to make a *visita*, or tour, of their jurisdiction to aid in its governance, Toledo did not shy away from the relative discomforts of the road. Instead, he would spend over five years traveling to the remotest reaches of the viceroyalty, studying local customs, adapting them to serve imperial interests, and asserting his, and royal, authority. Departing from Lima on October 22, 1570, on a journey that would cover over 5,000 miles, he was accompanied by jurists, such as Juan de Matienzo, and clergymen, such as the Jesuit José de Acosta, as well as his retinue of servants.⁵³

By the middle of February 1570, Toledo was based in the former Inca capital of Cuzco, where he would spend the next eight months issuing a plethora of edicts, ranging from those concerning municipal elections, prisons, and native work on coca plantations, to laws concerning provincial administration, water supplies, markets, taverns, and *tambos*, or roadside lodges operated by native communities. During this time, Toledo would also oversee the capture and execution of the last leader of the Inca vestige state in Vilcabamba, Túpac Amaru. Not only did the natives lose their hope of imminent Incaic restoration, they also lost their homes and towns as Toledo aggressively implemented a long-delayed and massive program to forcibly relocate Indians into Spanish-style villages, known as *reducciones*.⁵⁴

Apart from uprooting people from their communities, where the land and mountains had spiritual significance, and breaking up a spread-out system of sustenance based on local microclimates, the concentration of Indians in these new communities fomented the spread of disease, thereby reinforcing the ongoing population collapse. The *reducciones*, in which about 2,500 people were to live, not only facilitated the physical control of the natives, and hence the allocation of their labor, but also served to deculturate them by bringing them more closely under the control of the clergy.⁵⁵

Beyond the ongoing task of asserting Spanish authority in the realm, Toledo focused on increasing silver production, which in the case of Potosí had been experiencing a serious decline since the latter part of the 1560s. Instructed by Philip II to study the process firsthand and promote its adoption in Peru, Toledo had the metallurgist Pedro Fernández de Velasco demonstrate it for him. Velasco, like Enrique Garcés years before him, had studied and mastered the process in New Spain and impressed the viceroy with the results. Despite his recognition of the dangers of mercury poisoning, Toledo was convinced that he had found the key to unlocking the treasures contained not only in Potosí's Cerro Rico but also in mining centers throughout the realm. He then directed Velasco to go to Potosí to instruct the miners there in the method.⁵⁶ The implications for the future were enormous, not only in terms of silver production and the global economy but also in terms of the catastrophic impact that mercury amalgamation would have on native peoples, social relations, and the environment.

Toledo realized that the transition from a silver economy based on smelting to one based on amalgamation would require an updated legal and operational framework, considerable investment, and massive amounts of labor. As he was wont to do, Toledo acted with decision, dispatch, and determination, and when he arrived in Potosí just before Christmas 1572, he had already begun to implement the reforms and innovations needed to revolutionize Andean silver production.⁵⁷

These policies fell into five categories: general mining regulations, the introduction of hydraulic mills, and ensuring a consistent supply of water, mercury, and labor for their continuing operation. In the midst of this massive retooling project in Potosí, Toledo would also physically reorganize the haphazard city along more formal lines, ordering the construction of fountains and new roads, and demolishing all that stood in the way. The fountains were an important improvement, as although Potosí had numerous springs, Indians often drank from wells they constructed, which often resulted in "severe illnesses and many deaths."⁵⁸ Spring water became even more important once amalgamation began, as the water flowing in the channel that supplied the mills was highly contaminated with mercury. In addition, he established a mint to reduce the shortage of coins in the region and ensure better tax collection, and funded a hospital in the city.⁵⁹

Regulations and Reservoirs

Given the crown's long-standing claim on all subsoil rights, the colony already had fairly well-developed mining regulations. Like many colonial

laws, however, they were unwieldy and often contradictory. Toledo's advisor and the corregidor of Cuzco, Juan Polo de Ondegardo, had been a central figure in developing existing mining regulations in Peru, and Toledo directed him and fellow jurist Juan de Matienzo to use them as a basis for a streamlined, consistent, and comprehensive mining code. After over a year's work, the new regulations came into effect in Potosí in April 1574 before being applied more generally throughout Spanish America in 1584. Among their provisions, the regulations reaffirmed prohibitions against jailing miners for debts and protecting their mines and mills from seizure in such cases.⁶⁰

Among the challenges facing Toledo in terms of increasing Potosí's silver production was the prevalence of limited-capacity human labor and horse-powered mills, which were used to grind the ore before processing. Although there were around forty more efficient and larger-volume water-driven mills about eight miles outside of the city on the Tarapaya River that operated year-round, the transport costs to bring the ore there were significant. While water-driven mills were able to pulverize greater quantities of ore in considerably less time, any that would be constructed closer to the city were subject to the seasonal vagaries of rainfall, which generally fell from January to April. Toledo's solution was to order the construction of eighteen interconnected dams among the hills above Potosí, where rainwater could gather and ultimately provide a year-round supply for the mills. The water would then be released and run through the city in a canal known as the *ribera* which, by the 1580s, linked around 100 mills, like beads on a necklace, enabling water passing through one stamp mill to be used by the next one downstream.⁶¹

Toledo assigned about 20,000 Indians to this massive construction project, and work began in 1573. The lagoons, which were built in both moraine and solid rock, utilized the natural topography as much as possible to gather and contain rain and spring water, as well as hail and snow. The containment walls of the lagoons were up to thirty feet thick and constructed of five layers of mortared stone, and each lagoon was around fifteen feet deep. A series of slide gates and stone aqueducts controlled and channeled the flow of water between the lagoons and also released it to surge 1,900 feet downhill through the *ribera*. When this rock-and-mortar channel was finished in 1577, it was eleven miles long, twenty-five feet wide, and had taken 4,000 natives almost three years to build. Once at the mills, the water flowed at approximately sixty-six gallons a second to produce about 600 horsepower for crushing the ore. While water was, as one contemporary put it, the "soul of the . . . machines," it was highly toxic after

also being used to separate the amalgam from the ore mixture, and those who on occasion drank from the ribera often paid with their lives.⁶²

The transition to mercury amalgamation was facilitated by the abundance of tailings produced by twenty years of mining. While these were unsuited for smelting, they were excellent for amalgamation, and Toledo claimed them for the state. In essence he made them public property by allowing any refiner to take a two-week supply for processing. Although this stockpile would only last until around 1580 when production again became dependent on extraction from the Cerro Rico, it provided an important bridge between the dusk of smelting and the dawn of amalgamation.⁶³

Although Toledo had ordered the construction of eighteen lagoons, by 1621 thirty-two had been built, enabling refining on a twenty-four-hour-a-day, year-round basis. Although mills continued to operate on the Tariapaya River, their importance diminished as miners sought to avoid the ore transport costs associated with their use. Likewise, although some human- and horse-driven mills would continue to operate in Potosí and provided a good hedge against drought, they were very much in the minority. They were also much less efficient, as a water-driven mill ground about five times as much ore in an hour than did a horse-driven mill, and almost ten times more than one powered by natives. Greater efficiency had its cost, however, and a water mill was worth over three times as much as one that relied on people to operate, and about twice as much as one that was operated by horses.⁶⁴

The Potosinos were ever-cognizant that increased silver production and the renewed prosperity of the city depended on water almost as much as native labor or mercury. As one chronicler explained in 1590, in Potosí “men ask for a good year of rain . . . as in other parts they ask for bread.”⁶⁵ Just as a lack of wind in the days of smelting called forth processions and prayers for divine assistance, late or scarce rains yielded similar pleas once amalgamation had been introduced. As another contemporary succinctly put it, “we say that if it does not rain in February, goodbye Potosí.”⁶⁶

Although the lagoons were an integral part of the rebirth of Potosí’s mining industry, they were a constant menace to those living in the city below. The threat of a break was realized on March 17, 1624, at around 5:00 pm, when the San Salvador dam gave way, flooding the Indian part of town and killing around two hundred people. Destructive though that was, it was only a sign of worse to come. Almost two years to the day later, in the early afternoon of March 15, 1626, as many people were eating lunch, the San Ildefonso dam broke. A raging torrent of water was unleashed on the city below, destroying along the way seventy-nine mills

and heaving a mass of tangled, jagged debris into the city. The floodwaters—which were laced with tons of mercury, amalgam, and piñas—killed up to 4,000 people. Many, seeing opportunity in catastrophe, died as they tried to salvage silver and searched for jewels in the flood waters. Eight hundred Indian dwellings and 360 Spanish homes were destroyed, while a jailbreak contributed to rampant looting. The repercussions of the disaster went well beyond Potosí due to the death of many Indian forced laborers. For example, over 300 died from Tihuanaco, limiting the ability of the community to provide men for mine and mill service for many years to come. Long-chastened by such a catastrophe, even a rumor of a dam break would send people running to higher ground, something looters used to their advantage in 1661, 1688, and 1727.⁶⁷

“The Most Restless of Towns”: Huancavelica⁶⁸

Central to the transition to amalgamation-based silver refining in the Andes was an abundant and consistent supply of mercury. This need would result in significant changes in Huancavelica, which had been a desolate, sparsely populated mining camp since 1564. Heraldic its future was the official founding of the town by its new governor, Francisco de Angulo, on August 4, 1571. In a solemn ceremony, the community was named the Pueblo Rico de Oropesa, in honor of Toledo's hometown and noble lineage. At this time, it had only 300 Spanish residents, many of whom were there only part of the year, 2,400 Indians who labored in what was initially an open pit mine, and a church. If the residents hoped to curry favor with Toledo by naming the town in his honor, they were soon disappointed. Not only did the viceroy forbid the export of quicksilver to New Spain and elsewhere, but he also reasserted the crown's claim on subsoil rights and ordered the expropriation of the mines. In so doing he essentially converted the miners from owners to operators who could only sell to the state.⁶⁹

Based in Angoyacu near Huamanga, Toledo sent his trusted advisor Gabriel de Loarte to execute the expropriation order. After officials foiled a plot on Loarte's life by those who opposed the measure, the forty-three mines in the Santa Barbara hill reverted to the crown in 1573. The expropriation allowed the crown to more closely control mercury production and to establish a lucrative monopoly on its sale to miners throughout the region. As there was a correlation of between one and two pounds of mercury consumed per pound of silver produced, mercury sales to miners served as a guide to how much silver should be produced and hence brought to the treasury office for taxation. When mercury entered the

market as contraband, as it often did, the damage was triple, as not only did the crown lose the tax on its production and revenue from its sale, but it also lost the tax from the silver it ultimately yielded. Although Huancavelica was the primary source of mercury for the Andes, other sources, such as one between Potosí and Porco, may also have been illicitly mined.⁷⁰

Following the expropriation of the mercury mines, the former owners were reorganized into a *gremio*, or guild, to which mercury production was subcontracted on terms largely dictated by the state. Beginning with six members, by the eighteenth century the guild had approximately thirty, many of whom were descendants of the founders.⁷¹ Collectively, the *gremio* participated in the *asiento*, which was a fixed-term, renewable production agreement in which all mercury was required to be sold to the state. Initially the miners received 44 pesos per 100 pounds of mercury produced, after payment of the *quinto real*, or royal fifth, but the price fluctuated over the years as asientos were renegotiated and the government sought to encourage production of both mercury and silver. During an especially long asiento between 1683 and 1744, the price held steady at 74.25 pesos. As with production, the transportation of mercury was also subcontracted after 1576, and once it reached Potosí or other mining centers, government officials sold it to refiners. The sale price also varied with time, although generally held between 97 and 105 pesos for a hundredweight, yielding a consistent profit for the crown. Because the members of the guild had usufruct but not ownership of mines, they had little interest in investing in or maintaining them. The result of this was a short-term orientation and a tendency to mine the pillars that supported the passageways, which resulted in many accidents and deaths.⁷²

Although Huancavelica's economic importance increased markedly with the adoption of the mercury amalgamation process, it never reached the size of Potosí, nor did it rival its splendor. While approximately 160,000 people lived in Potosí in 1650, the population of Huancavelica never exceeded 10,000 and was generally closer to half that. Before the 1600s, when cinnabar extracting and refining operations became year-round, many of Huancavelica's residents preferred to live in Huamanga during the rainy season from January to April. Huancavelica was known for its tempestuous wet season, and as one chronicler explained, "its climate is very cold, its sky inconstant all year, it rains some days and ices others, even in the same day, sometimes with storms, hail and lightning."⁷³

Despite its modest size and humble buildings, this town at 12,108 feet above sea level was nevertheless a vital part of the imperial machinery. Contemporaries variously described it as the "most important jewel . . . in

the monarchy” and “the soul of all of the mining towns in the Kingdom” that brought “prosperity and wealth to the kingdom.”⁷⁴ In recognition of its importance, and in an effort to better control mercury production and limit contraband, in 1578 the treasury office in Huamanga were relocated there. Then, in 1581, Huancavelica was granted municipal status, which freed it from officials in Huamanga. Until 1735, the governor of the town was selected from the ranks of the *oidores*, or judges, of the Audiencia of Lima, serving a three-year term. It was a powerful position, as the corregidor not only served as civil governor but also oversaw mining administration, the treasury, and the gremio.⁷⁵

The seemingly endless opportunities for corruption and illicit enrichment compensated for the desolate nature of the posting and the unruly reputation of its overwhelmingly male inhabitants. Among the inveterate corrupt practices was for the governor to withhold royal funds which were dedicated to the purchase of mercury from the miners. Once the miner’s need for money had become sufficiently desperate, the governor would privately buy the mercury at a heavy discount, and then sell it to the treasury at the full price, pocketing the difference. Governors were also heavily involved in illegal mining operations and engaged in a wide range of black market activities. In a largely unsuccessful effort to stamp this out, the town was administered after 1735 by officials selected directly by the crown.⁷⁶

Given the near-perennial shortage of coin and even silver, mercury served as a common, albeit illegal, parallel currency. The shortage of specie and the miner’s spendthrift ways allowed a merchant class to quickly gain economic dominance over the seemingly ever-indebted mining elite. Like the governor, merchants would also purchase mercury or accept it as in specie at about a 30 percent discount from its official price, hold it until money arrived from Potosí or Lima, and later sell it at full value in the treasury office. Alternatively, they would sell it on the black market for above the official price.⁷⁷

Although in the 1580s Huancavelica had only 170 small, thatch-roof houses, by 1600 it had assumed an air of greater permanence as many Spanish residents constructed small stone houses, usually with a central patio and a corral. These houses were generally made from a soft yellowish rock produced by evaporation in nearby thermal springs. Straw roofs still prevailed, however, as roofing tiles made from the local clay were prone to cracking. Complementing this urban development was the construction of nine churches and three monasteries, run by the Dominican, Augustinian, Franciscan, and until their expulsion from the Americas in 1767,

Jesuit orders. Despite the abundant choices of houses of worship, Huancavelica, like many mining towns, had a reputation for violence, lax morality, promiscuity, profligacy, gambling, indebtedness, and heavy alcohol consumption, leading Viceroy Martín Enríquez Almanza to describe it in the early 1580s as “the most restless of . . . towns.”⁷⁸ Writing in the early 1600s, the Mercedarian Martín de Murua remarked that the “town is made up of rich people who spend money with prodigality and excessiveness.”⁷⁹ His Dominican colleague Reginaldo de Lizárraga added that although the miners initially amassed considerable wealth, by the early 1600s their profligate ways had led them to being “washed up, because just as mercury goes up in smoke, so has their wealth.”⁸⁰

As in Potosí, all goods were brought to Huancavelica by mule or llama train, and transportation costs contributed to Huancavelica being a costly place to live. While clothing and manufactured goods were carried inland from Lima, corn was imported from the Mantaro valley, and wheat and other cereals often came from Acobamba and Huanta. Farmers in Lircay, Tayacaja, and Abancay provided sugarcane, fruit conserves, and vegetables, while coca was shipped from Huanta, and even bread was imported from Huamanga. Cattle and sheep pastured in the environs of Huancavelica, and while this provided a steady supply of beef and cheese, they were probably contaminated by mercury fallout from Huancavelica’s refining operations.⁸¹

Although Huancavelica was for much of the colonial period less than one-tenth the size of Potosí, the two mining centers had a lot in common. Both were linchpins in Spain’s imperial machinery, benefited from forced Indian labor, chafed under and resented external control, and had corrupt local governments. Their mining elites were not only given to excess and gambling but were also financially dependent on merchants and money-lenders, all of whom were routinely engaged in black market activities.

Another parallel with Potosí was the environmental degradation caused by the fuel needs of Huancavelica’s mining and refining industry. Even as early as 1570, the robust, resinous kenua trees which had dotted its landscape had been sacrificed to serve as an ideal fuel to refine the mercury. As the trees became ever more scarce and miners had to venture up to twenty miles to obtain the wood, they assigned the native ore carriers, known as *chacaneas*, to bring the ore to the wood. This considerably increased transportation costs and opportunities for contraband, and while miners were eager to find an alternative fuel to save costs, the crown in Spain sought closer oversight of production. Searching for a solution, miners experimented with llama dung, called *taquia*, the results of which were

disappointing. Coal offered another option, and although there were coal mines about forty miles away in Pallalla, the expense of extraction and transport was prohibitive.⁸²

In 1570, a thirty-seven-year-old miner named Rodrigo de Torres de Navarra noticed Indians using the local, spiny straw called *ichu* for cooking, and after some experimentation, found that it served quite well for refining. Miners rapidly adopted the dried, honey-colored straw as a fuel. While it did not burn as hot as kenua, it did the job and its lighter weight made it much easier, and less costly, to harvest and transport to Huancavelica. The adoption of *ichu* also led to changes in the refining ovens. While previously they operated under a shelter, not only could *ichu*-fueled furnaces be fired in the open, but they cooled sooner, thus allowing two distillations in a day as opposed to one. As a result, this ubiquitous plant of the altiplano was voraciously consumed, such that by as early as 1586 there was none to be found in a four-mile radius of town. In an effort to introduce some degree of sustainability in its use, in 1589 Viceroy Conde de Villar regulated its harvest and mandated that it not be uprooted.⁸³

“Free” Men and Forced Labor: The Mita System

There could be no transition to an amalgamation-based economy without an abundant and consistent source of labor to extract and refine both mercury- and silver-bearing ores. To meet this challenge and to encourage the Potosí miners to invest in hydraulic mills, in 1573 Viceroy Toledo offered the miners a consistent labor force based on the Inca system of temporary forced labor for public works such as bridges, roads, and irrigation, called the *mita*.⁸⁴ As adapted by Toledo, Indians could be coerced to work for a fixed term, during which they would be paid, not only in the mines of Potosí and Huancavelica but throughout the viceroyalty in the construction of public buildings, churches, *obrages*, or textile mills, as well as in tambos, pasturing, and agriculture. Because they were located in hotter climates, coca plantations and vineyards did not benefit from mita allotments. The technical distinction between the mita and slavery is that the *mitayo*, or person serving the mita, served for a limited time and was, at least in theory, remunerated.

As applied in Potosí, about one-seventh of the males from the age of eighteen through fifty who were from and lived in sixteen surrounding provinces were to spend a year in Potosí where they would be assigned in rotating shifts to mining and refining operations. Roughly 13,500 men were initially pressed into this service in Potosí, although the official draft varied

with time, as did the percentages of their populations which communities were obligated to provide. The number of mitayos allocated to miners was also subject to periodic redistribution and was based on the length of the mine and, in Potosí, the number of stamps in the mill.⁸⁵ The system operated in a similar manner in Huancavelica and called up 3,289 Indians, or one-seventh of the tributary male population, for rotating service from the surrounding communities. Before production became a year-round process in the early 1600s, the mita burden was halved in the rainy season from January to April. Although excavation continued, smelting was suspended while the ovens were cleaned and repaired to be ready for the next season. The term in Huancavelica was, in theory, two months, the reduced time in comparison to Potosí reflecting the much more toxic nature of the work.⁸⁶

Beyond the exemption due to age, the eldest legitimate sons of curacas and members of the *hilacata*, or native council of community leaders, were excused from the mita, as were those in the service of the church. In addition, it was possible to petition for a recount of the tributary population in a given town to obtain a community-wide reduction in the assessment. Indians also could, and did, obtain exemptions on the basis of physical infirmity. For example, as Lorenzo Mateo explained in 1736, he had been tapped for the mita despite being “sick and . . . without use of a crippled foot and fearful of dying in said . . . hill.” After being examined by two doctors, he was excused from service.⁸⁷ Such petitions, however, involved considerable expense, travail, and, as with all court filings, risk of retribution from overlords.⁸⁸

In the 1600s, as mita and other extractive burdens on communities grew heavier, officials increasingly appointed pliable “interim” curacas who were generally Mestizos and not from the community they ruled. Among the results of this policy was that those Indians who had a hereditary claim to the office were progressively displaced and relegated, as one group of native nobles put it, to the ranks of “ordinary Indians.”⁸⁹ Although displaced, this elite often remained in the hilacata and generally continued to serve, and tried to defend, their communities. Nevertheless, as native villages continued to decay through flight, exploitation, and the erosion of traditional relationships and leadership based on reciprocity, it became progressively difficult to provide the requisite number of mitayos. As a result, some members of the traditional native nobility had to face the very real and distressing prospect that, although illegal, they too would be sent to the mines and mills of Potosí and Huancavelica. As two Indian leaders pleaded to the court, their position as hereditary, albeit displaced, curacas should have spared them from such “low and vile services.”⁹⁰

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The imposition of this system of compulsory labor would lead to immense population shifts, as it applied only to *originarios*, or those who lived in the communities in which they were born. The rationale was that the mita was in effect a tax on the use of community lands. When an Indian left his hometown and took up residence in another community, he became a *forastero*, or foreigner, there and did not have a right to cultivate or pasture on community lands and hence did not have to serve the mita. As one would expect, people fled by the tens of thousands to avoid this service. As the originario populations of communities declined, first mostly through disease and then through flight and also suicide to avoid the mita, the burden fell ever more heavily upon those who remained, as the mita was a community, not an individual, obligation and census counts were few and far between. Consequently, those who remained in their hometowns were obligated to serve every two or three years, as opposed to seven, thus reinforcing the dynamics of community depopulation and leading to greater exploitation of those mitayos who did arrive in Potosí or Huancavelica.⁹¹ Indian complaints in this regard were largely futile. For example, three Indians in the town of Chayanta described how they were being sent back to Potosí not even two years after they had returned, by their illiterate, interim curaca who “mistreats us with whips and blows, dragging us around by the hair with no pity, especially when he is drunk, which is most of the time.”⁹²

By the 1680s, in the region of Cuzco and Arequipa, forasteros comprised almost half of the population. In Upper Peru, over one-half of the Indians had fled their hometowns, and in the fertile district of Cochabamba, 82 percent of the inhabitants were forasteros. As the ranks of potential mitayos dwindled, Potosí’s miners, refiners, and civil authorities placed increasing pressure on curacas and governors to force forasteros to return to their original villages or pay for people to work in their stead. As Indians were a source of labor to all of the colonists, governors, priests, and *haciendados* did all they could to obstruct these efforts. Adding to the disappearance of originarios and the destruction of indigenous communities was that, ironically, many mitayos chose to remain in Potosí after completing their term, or they went to Oruro after the first silver strikes there in 1606. Both cities offered a range of economic opportunity, competition for labor, and relatively high wages for free laborers. Although Indians were legally required to return to their hometowns after completing the mita, the Potosí miners’ interest in having an abundant, ready, and skilled free labor supply trumped royal regulations.⁹³

Writing in 1689, Viceroy Navarra y Rocafull observed the massive population shifts produced by the mita. Although he believed that the Indians

"must be made to work by force," he recognized the consequences of this approach: "This realm, with all of its spread out provinces, from Paita to Potosí to Santa Cruz de la Sierra . . . with all of its towns so destroyed and without people . . . looks like it has suffered continuous wars and plagues. . . . Many attribute it to the work in the mines for two reasons, they either die there or they flee from this danger . . . but examining it closely it is clear that . . . the mita has been the cause that they have fled their homes."⁹⁴

It was the responsibility of the curaca to select who was to serve the mita and who would lead them as the *capitán de mita*. Although illegal, it was possible to pay a ransom to avoid the mita by paying the curaca, who would then remit some of the funds instead of people to the person to whom the mitayo was assigned. The fee was on a sliding scale of sorts and was based on the resources that a desperate future mitayo could gather. Usually the price ranged from 50 to 60 pesos, although it could be anywhere from 10 to over 230, with the cost increasing with the distance from Potosí, the wealth of the potential mitayo, and the level of exploitation to which mitayos were subject over time. These phantom workers were referred to as *indios en plata*, or Indians in silver.

When an Indian was dispatched to Potosí, if he had sufficient funds there was still the possibility that he could pay a ransom to the miner or mill owner directly, becoming an *indio de faltriquera*, or an Indian in the pocket, as the funds went to the pocket of the mine or mill owner.⁹⁵ Overall, as a result of the commercial opportunities in and around Potosí, those who lived closer to it were in a better position to buy their way out of the mita. Whatever the form of commutation, the idea was that the money paid by those selected to be mitayos would cover the cost of hiring a wage laborer, or *minga*, in their stead, generally at the rate of seven pesos a week. The result was that the burden of this most dreaded of services fell, as one group of Indians complained, on "the most unhappy and destitute" members of the community and also those who did not enjoy the favor of the curaca.⁹⁶

While the practice of making a payment for commutation appealed to miners and refiners because they could derive an income without producing an ounce of silver, the crown loathed it for the same reason. Despite its illegality, it was nevertheless common and highly lucrative for the miners. For example, in 1608 about 20 percent of those selected to be mitayos were paying some form of ransom, and by 1654 up to one-quarter of all mitayos were paying to avoid the service. In 1659, while the crown collected a quinto of 308,547 pesos, over 700,000 pesos had been paid in commutations, with a deleterious impact on silver production. When, in 1660, the

Viceroy Conde de Alba de Liste ordered the superintendent of the mita, the Dominican Francisco de la Cruz, to put an end to all commutations, the friar had hardly begun this task when he died suddenly and mysteriously after drinking an evening cup of hot chocolate.⁹⁷

The advantages of having an allotment of mitayos went beyond receiving ransoms, as the value of a mine or mill was to a considerable extent determined by their mita allotment, despite prohibitions on including mitayos in sales of mills. Although also illegal, miners and mill owners rented out mitayos to those who needed labor, receiving a peso a day per mitayo, which more than covered the mitayo's often theoretical wage of 2.75 reales. Just as mitayos could be rented, so could mines and mills, along with their human chattel. Generally, those renting a mine or mill exploited the mitayos much more harshly than the owners to ensure a profit beyond their rent. Some people simply rented a mine or mill to have access to the mitayos, either applying them elsewhere or renting the mitayos to others. People who had political influence but not a mine or mill also obtained allotments, providing them with lucrative opportunities to rent out their charges.⁹⁸

There were, in theory, safeguards for those sent to labor in Potosí and Huancavelica. All of the mitayos were to be drawn from provinces of similar climate, and they were to receive medical care when needed. While consistency of climate could minimize illnesses, the provision was largely irrelevant because the mines were considerably warmer than the usually chilly air outside. Not only were the mitayos subject to heat to which they were not accustomed, but they also experienced an abrupt temperature change when they emerged from the mine. To ensure the safety and proper exploitation of the mines in Potosí and Huancavelica, an *alcalde mayor de minas* served as a civil and criminal magistrate on mining issues. He was assisted by *veedores*, or inspectors, who were to work inside the mines and ensure their smooth and safe functioning, seeing that the miners worked where they were assigned, making sure that the tunnels were passable and that repairs were made when needed. These positions, like that of the *protector de naturales*, or native legal advocate, were purchased by their holders, and in Potosí their salaries were paid for by deductions from the mitayos' wages.⁹⁹ In Huancavelica, the mining guild covered the salaries of the *veedores*, creating a severe conflict of interest. Other legislation developed by Toledo limited mitayos to working in the summer from one and one-half hours after dawn until sunset, with an hour break for lunch. During the winter, those involved in washing the amalgam were only permitted to do so between ten in the morning and four in the afternoon to prevent frostbite and illness.¹⁰⁰

Contemporaries, in the Americas and in Spain, were well aware of many of the risks associated with mercury exposure, such as tremors, weight loss, excessive salivation, gum disease, anemia, and the teeth becoming loose or falling out. To minimize these perils, Toledo had mandated that, inside the silver refining compound, the chimney of the smelting ovens be eighteen feet high and separated from the main work area, to limit the exposure of workers to its toxic smoke. In a further recognition of the dangers associated with burning off the mercury from the silver, he ordered that those tending the ovens were to do no more than four fittings before being replaced, and that the ovens were to be opened only by the mill owner or his slave. When an Indian became sick, he was to be allowed three months to recover and to receive fifty pesos in compensation from the owner. Similarly, in Huancavelica, miners were to ensure that smelting ovens cooled before being opened, that furnaces not be located near the pit head, and that smelters not be in close proximity to one another to minimize the exposure of the refiners to smoke. Beginning in 1598, miners were to have three ovens, one of which was being prepared, one in use, and one which was cooling.¹⁰¹

Like many laws in the Americas, they were as widely ignored as they were detailed. Although refining ovens were generally at the edge of silver mills, Indians could legally protest abuses and on occasion were compensated or had conditions improved, but on the whole the regulations were not enforced and simply ignored. As we shall see, the mitayos worked in a profoundly exploitative and corrupt system where production was impelled by the cutting sting of the lash. Not only were the mitayos routinely denied their token wages, but those who had the courage, or desperation, to challenge the system often found deaf ears and brutal retribution in lieu of the laws they sought to have enforced. Although the Inca had employed the mita system, the term of involuntary labor was of shorter duration than Potosí and was dedicated to public works, which had much wider social benefit. Under the Spanish system imposed in Potosí and Huancavelica, however, mitayos were forced from their homes for up to a year and worked for the immediate benefit of individual miners. Because miners and refiners paid taxes on their production, or at least some of it, the crown asserted that the system was, like its Incaic antecedent, for the common good.

“The Resurrection of Potosí and All the Kingdom”¹⁰²

The transition to the mercury amalgamation system led to an astounding increase in silver production, an economic boom in Potosí, and a re-

affirmation of the Potosí mining guild's belief that they were entitled to preferential treatment from the crown. While in 1570 the royal fifth from mining and refining in the city of Potosí was a paltry 11,000 pesos, by 1575 it had swelled to 257,662 pesos and, by 1579, it had soared to 1,011,200 pesos. Between 1575 and 1600, Potosí produced around 70 percent of all Peruvian silver, and about half of all of the silver produced in the Americas. Such was the prosperity that the word "Potosí," in both English and Spanish, came to mean wealth itself, such as the expression "as rich as Potosí."¹⁰³ Inspired by Potosí's success and the hope or expectation that silver strikes would rival that of Potosí, miners elsewhere in the Americas named mining towns after the famed altiplano city, such as Nuevo Potosí in Upper Peru and San Luis Potosí in New Spain.

The renewal of the city paralleled this increase in production, as did its population. Whereas in 1576 fewer than 35,000 people lived in Potosí, by 1602 the city claimed 120,000 inhabitants (with about an equal number of dogs), and by 1650 it had peaked at 160,000, making it one of the largest and most prosperous cities in the world. Just as silver and mercury have a natural affinity, as one chronicler explained, so had the "force of silver, that calls with its covetousness other things . . . populated that hill . . . and has made it so abundantly supplied with foodstuffs . . . there is nothing one can want there that cannot be found in abundance."¹⁰⁴ Writing around 1600, the Dominican Friar Lizárraga declared that

He who has not seen Potosí has not seen the Indies. It is the wealth of the world, terror of the Turk, brake of the enemies of the faith . . . terror of the heretics, silencer of the barbarous nations. . . . With the wealth that has left Potosí, Italy, France, Flanders and Germany are rich, and even the Turk has in his treasury a bar [of silver] from Potosí.¹⁰⁵

Not long after, the Mercedarian friar Martín de Murua added that:

Without . . . exceeding the limits of the truth, I can affirm that . . . Potosí . . . is the richest, most opulent and famous city that is known in the whole world . . . and it can even be said that it enriches all of Europe, Asia, and Africa, because the residues of Spain are distributed to the other [provinces].¹⁰⁶

Potosí was indeed a global economic vortex, spinning fastest as it drew in goods and people in the Andes, yet casting its current as far away as Africa, the Middle East, and China, while showering the globe with a deluge of

silver. As Friar Lizárraga put it, of “all the towns that have been populated . . . in that province of Charcas, we can say that Potosí populated them, because it is with trust of taking [to Potosí] that which they cultivate and raise . . . [and it] inspires the Spanish to place themselves in the mountains of the Chiriguanos, and to found towns in very hot valleys full of . . . plagues, and all of it sustains Potosí.”¹⁰⁷

Potosí kept the Indians in obrajes chained to their looms and busy weaving in the region of Quito, and the flames burning in the distilleries around Arequipa. From Arica on the coast fresh grapes were brought upland to grace the tables of the elite, while fresh trout and other fish caught in Lake Titicaca were packed in snow and rushed to Potosí’s waiting market stalls. The region around Cuzco helped to satiate Potosí’s well-known sweet tooth, sending conserves, raw sugar, and fruit. From the warm and fertile valleys of Cochabamba came wheat, flour, and ham, while farmers in nearby La Plata provided a steady stream of fresh fruit, corn, and other cereals. From Tarija to the south came tobacco, ham, bacon, and lard, while the Jesuit missions of Paraguay cultivated yerba maté for the Potosí market. Tucumán and Córdoba competed to keep the city supplied with their famously sturdy mules, although Tucumán also sent cedar, cereals, fruits, cotton, and cattle. It also sent the byproducts of livestock such as leather and tallow to make the infinite number of candles which were in constant demand in Potosí, both inside and outside of the mines.¹⁰⁸

Despite Potosí’s isolation on a high, barren plain, it was “as if it was founded in the most fertile valley in this kingdom, because silver and money draws all towards itself.”¹⁰⁹ Merchants, miners, and refiners were not the only ones attracted to Potosí. An anonymous writer at the turn of the seventeenth century explained that there were many “friars and nuns and clerics . . . that always come to the smell of silver and where there is much fortune.”¹¹⁰

The force of this vortex encompassed the globe. Clothing, textiles, silk, and iron were shipped from Spain, as were French lace and hats, Flemish mirrors and tapestries, Dutch desks and linens, and Italian paper and paintings. From Turkey and Persia came carpets and spices, marble from Asia, diamonds from Ceylon, and shiploads of human cargo from Africa. While some Chinese goods came via the Philippines and Acapulco, on occasion ships brought spices, clothing, and silk directly from Manila. The merchants in Seville, sensitive to a challenge to their monopoly, tried to put an end to this trade. The fact that there were at least seven edicts between 1587 and 1636 prohibiting direct trade between Peru and the Philippines suggests that their efforts met with little success. Similarly, although in 1604

the crown prohibited direct trade between Peru and New Spain, where the Manila galleons landed legally, it appears the commerce continued, since by 1636 Kings Philip III and IV had issued four edicts seeking to stamp it out. It was hardly an exaggeration when the Dominican friar Reginaldo de Lizárraga waxed that “Potosí, we can say, is Spain, Italy, France, Flanders, Venice, México, China, because from all of these places come the best of their merchandise.”¹¹¹

As one writer observed at the close of the sixteenth century, “there is every day a perpetual fair of many people, Indians and Spaniards . . . and although all of the things are very expensive, it is the best supplied and well provided for town in all of Peru.”¹¹² Merchants conducted much of this trade on the city’s three large plazas as well as on twenty-nine smaller ones,

where are sold the necessary things, in each plaza its product; the plaza of corn kernels, the one of flour, the one of firewood, the one of charcoal, the one of barley and the one of ore, and [the] plaza where is sold the dung of the llamas. . . . [T]he main plaza is very well supplied where almost all year round are to be found grapes, all other fruits . . . apples, quince, peaches, cantaloupes, oranges and limes. . . . Even . . . the . . . hill has its plazas with all of these things and wine and bread.¹¹³

This commerce provided opportunities not only for Spaniards but also for Indians, as transporters, artisans, candle makers, blacksmiths, cooks, and chicha and charcoal producers. In addition to at least 22,000 Indians dedicated to transporting a plethora of provisions to the city, 8,000 more worked in the mines and mills, and 30,000 more were engaged in a variety of occupations in the city. Friar Lizárraga averred, “there is no one, if they want to work, that does not earn money, even children six or seven years old, chew corn to make . . . chicha . . . make money.”¹¹⁴ As a result of the barren surroundings, the altitude, and the fact that everything was brought in by mule or llama train, pasturing the animals on the way was a challenge. One writer in the mid 1770s described how mules would arrive “so worn out that they could barely carry the goods. Those of the Indians, who bring charcoal daily, are in even worse condition.”¹¹⁵

In addition to its many open air markets, in the early 1600s Potosí had many stores, including 80 general shops, 33 hat stores, 24 clothiers, 28 shoe stores, 6 candy shops, 6 pastry shops, 28 bakeries, 20 restaurants, and 100 laundry establishments. In addition, the city’s twenty-eight slaughterhouses kept a steady supply of meat on the tables of those who could afford

it, dispatching around 75 head of cattle and 1,000 llamas a week. Over the year, the inhabitants consumed 150,000 pounds of fish and 50,000 bushels of freeze-dried potatoes, or *chuño*. Such consumption naturally generated a significant amount of garbage. Writing in the late 1700s, one colonial official described the mounds of trash deposited outside of town as “forming some hills that are almost equal to the highest buildings in the city,” while others in the city itself almost reached the tops of the walls of the San Lorenzo Church. He credited the cold weather of Potosí with minimizing the spread of disease from these monumental garbage heaps.¹¹⁶

Among the innumerable goods sold in the city was the fermented corn drink called chicha. Not only was it (and still is) the beverage of choice for many Indians, but it also was the object of considerable criticism by the Spaniards. In Potosí around 1610, the trade in this beverage was estimated to be 20,000 pesos in one week alone, with so much being consumed “that it seems . . . impossible.”¹¹⁷ Another observer in the 1790s remarked upon “the incredible consumption in the city of spirits, chicha, wine, sweets and everything that they like.”¹¹⁸ Rivaling the trade in chicha was coca, which the Indians chewed (and chew) both for stamina and to suppress appetite. Before the conquest, its consumption, like that of chicha, was limited to the Inca nobility. While much coca came from the Yungas, or valleys outside of La Paz, such was the demand that it came from as far away as Cuzco, which was said to send about 680 metric tons a year. In many ways, the native population in Potosí ran on chicha and coca, and it was a vital, if underestimated and indirect, element in silver production. Although many non-Indians viewed coca consumption as a vice, some took a more pragmatic approach. As the jurist and colonial official Juan de Matienzo explained, “if you take the coca away . . . Indians would not come to Potosí, nor would they work or extract silver . . . to try to take away coca is to want there to be no Peru.”¹¹⁹

Despite Potosí’s immense wealth, well-dressed elite, and abundantly supplied and bustling markets, in 1600 the Spanish houses in the city remained modest and the city was dirty, smoky, dusty, and malodorous. In the mid 1580s, the miner and chronicler Luis Capoche described the buildings there as “the worst there are in these parts (as they are simple and low and disorganized), and small.”¹²⁰ Not much had changed twenty years later when Friar Martín de Murua described them as “not polished or worked with much expense . . . because those that live in them have placed their sights only in extracting silver and more silver, and to go and spend it in other places in this kingdom of better climate and of their nature . . . only the churches are of expensive construction.”¹²¹ Even in the late 1700s, many

people's homes did not have glass windows, instead covering the openings with cloth or paper.¹²²

“Unique in Opulence, First in Majesty and Ultimate Aim of Greed”¹²³

With so much wealth and temptation, and a get-rich-quick mentality, Potosí developed a well-deserved reputation for profligacy. As one writer noted around 1610, referring to artisans and tradesmen, “everyone earns and everyone becomes wealthy, and it is true that, if they saved what they earn, they could . . . in very few years, establish great estates; but with the same facility that the money enters into the house, it leaves, such that . . . [there is] a spirit of . . . spending and wasting without order.”¹²⁴ In the late 1700s, another chronicler described the artisan class as so poorly dressed that they looked like beggars, “caused by the inevitable disorder of consuming in a drunken binge Sunday and Monday all that they had earned during the week.”¹²⁵

While the artisans may have indulged their vices, they were no match for the wealthy. Writing of the mining elite in Potosí around 1618, the chronicler Francisco López de Caravantes wrote of “the superfluous expenses to which this type of people are inclined, indebted on the hopes of the mines that are so uncertain, as they so often find out.”¹²⁶ In 1629, the outgoing viceroy, Marqués de Guadalcázar, referred to the miners’ tendency to “borrow today what they need to spend tomorrow,” while in 1787, the governor of Potosí, Juan del Pino Manrique, characterized the mining elite as “unruly and wasteful.”¹²⁷ Around the same time, the naval office and former governor of Huancavelica, Antonio de Ulloa, cautioned that “The mines should be considered like a game of fortune, for whom it is favorable gets rich, and for whom it is against is destroyed and annihilated.”¹²⁸

Dowries and celebrations provided an excellent occasion for lavish displays of wealth. While some dowries exceeded 1,000,000 pesos, they generally paralleled the fortunes of the city and declined with time, such that by the late 1700s the highest was 50,000. Of greater expense were public commemorations and celebrations, such as the 6,000,000 pesos the city spent commemorating the death of Philip III in 1621, or the estimated 8,000,000-peso expense of celebrating the coronation of Charles IV in 1788. Among those who viewed extravagance as an obligation were royal officials. In the late 1700s, the colonial official Pedro Vicente Cañete y Domínguez referred to “the opulent dinners, refreshments and parties that they organize for their receptions, each one brings three and even four pages.”¹²⁹

As a result of their profligate and impetuous ways, penchant for gambling, and short-term orientation, miners were often chronically indebted. Many depended on credit both for daily expenses and for inputs such as tools and mercury to operate their mines and mills. This was the source of a brisk business for *aviadores*, or financiers, who advanced goods—and to a lesser degree, money—to miners who in return pledged unminted silver. Such was the commerce in mercury in Potosí that, as one writer noted in 1599, it “almost passed for money.”¹³⁰ Beyond borrowing from *aviadores*, another oft-used option was to obtain mercury on credit from the government and then sell it on the black market. In 1752, a new and promptly depleted source of credit emerged with the establishment of the Banco de Rescate, or Exchange Bank. After two bankruptcies it was ultimately nationalized in 1779 and reborn as the Royal Bank of San Carlos. Overall, when it came to credit, miners and refiners were a high-risk group, and lenders had few options when it came to collecting. Unlike most of the population, miners and refiners could not be jailed for their private debts, nor could private creditors seize their mills or mines.¹³¹

In addition to its wealth and profligacy, Potosí was known for its violence and criminality. Much of the criminal element was made up of *soldados*, which in the 1570s referred to people who had fought on one side or another during the civil war in the 1540s.¹³² A generation later, the term had lost its military meaning and, as an anonymous chronicler of the early 1600s explained,

they call them soldados not because they are [soldiers], but rather because they are on the move from one place to another, always with cards in hand, so as not to lose an opportunity to play with those whom they run into.

. . . [T]heir aim is nothing more than to master the art of deception. There are many of these people who go about Peru . . . and they desire nothing more than . . . arguments and disturbances . . . to rob and to get the things that they can only obtain by war and dissension. . . . They all go about well-dressed . . . [and] they never lack a female black slave or an Indian woman and a few Spanish women by their side.¹³³

Despite repeated orders and efforts to banish this disruptive element from the city, often by enticing or conscripting them into expeditions to unconquered regions, *soldados* formed an integral part of the social fabric of Potosí, more so than other cities and towns. While in 1603 there were about 700–800 idling there, by 1618 their numbers had thinned to about 500, although they nevertheless constituted just over 12 percent of the Spanish

population. They were regular, if rowdy, customers in the city's many bars, brothels, and gambling houses, where the consumption of alcohol led to "homicides, adultery, rapes, idolatries and many great vices."¹³⁴ These soldados were only part of Potosí's larger rootless and often criminal population, which in 1602 the Council of the Indies, which advised the king on American matters, estimated to number four thousand. In addition to roaming the streets of Potosí, criminals from throughout the realm were also found laboring in the mines and sweltering in the mint's eleven ovens serving sentences for crimes such as murder and robbery.¹³⁵

Also among Potosí's residents were thousands of African slaves, bought and sold in a daily market for up to 500 pesos. For the most part, they served as servants, cooks, artisans, assistants, guards, and enforcers for their masters and also worked in the royal mint. The fact that Indian children would serve as assistants to slaves underscores the social status of the natives in Peru. As the chronicler of Potosí, Bartolomé Arzáns, described, native children could be found "serving . . . almost naked, an ugly and terrible Ethiopian, with great humility, mistreated with terrible whips and sticks."¹³⁶ This, and the frequent role of male slaves as their master's enforcers, helps to explain why the Indians had "more horror . . . [of slaves] than any Spaniard," and why they were a regular target in Indian uprisings.¹³⁷ It was not just the Indians who feared African slaves; so did their masters, in Potosí and elsewhere. Arzáns also noted how "black slaves have sadly taken the life of their masters," often through poisoning their food.¹³⁸

Although some slave owners did assign their charges to work in silver refining, the slaves almost never worked in the mines. The reason was simple: a slave was a capital investment, unlike an Indian mitayo, whose injury or death would, in practice, generally have no financial impact on the mine owner. Always quick to defend their interests, mine owners in Potosí vehemently resisted any effort to force them to use slave labor in the mines, offering tendentious arguments such as that their physique was too large to fit in the shafts, that their diet was different from that of the Indians, that they were not accustomed to the hot climate of the mines, and that they knew nothing of mining. In a response to an inquiry from the king concerning the feasibility of substituting slaves for mitayos in the mines, the Audiencia de La Plata noted that even unskilled, first-time mitayos were often given tasks of some complexity, and that they "die and sicken quickly, and if it were slaves that had cost their money, [the miners] would treat them much differently."¹³⁹ The chronicler Arzáns shared this view and argued that many Indians would actually have been better off as slaves, as their owners would have had to feed and clothe them.¹⁴⁰

The rebirth of Potosí, and all that it entailed, was only beginning to unfold, however, when, in late November 1575, Viceroy Toledo arrived back in Lima, having traversed over 5,000 miles in five years. During this time he had led an unsuccessful expedition against the Chiriguano Indians in what is now southern Bolivia, where he may have contracted malaria, and had journeyed to Arequipa, where he reaffirmed the crown's right to make clerical appointments. Toledo had long been ready to return to Spain, having made his first request to be relieved of his duties in 1572 while in Cuzco. There would be many more entreaties in the years to come as his health deteriorated from malaria, liver problems, gout, and gallstones. He must have been relieved when he heard, in May 1580, that Martín Enríquez de Almanza had been named as his successor. Toledo's homecoming turned out to be bitter, however, as upon his arrival he encountered not praise but instead harsh criticism, especially for ordering the execution of the Inca Túpac Amaru. He would die on April 21, 1582, the first viceroy of Peru to make it home, the one who had consolidated the viceroyalty, and the one whose reforms would endure throughout the colonial era.¹⁴¹

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Toxic Travails

Mining in Huancavelica



“It Appeared as if the Kingdom Was Moving”: The Dreaded Dispatch¹

While Toledo was censured for his execution of Túpac Amaru, it was his adaptation and implementation of the mita which would have a much broader, longer lasting, and destructive effect on the daily lives of hundreds of thousands of Indians and their communities for generations to come. For those who lived in towns subject to either the Huancavelica or Potosí mita, the months before departure were a time of fear, force, negotiation, increasing desperation, and extensive preparation. Two months before the mitayos were to depart, a crier would announce the upcoming dispatch. So dreaded was this service that some Indian mothers would baptize their male children as females, or even maim them, to spare them the fate of the mines and mills, while others who had been chosen and had no way to buy their way out hanged or poisoned themselves. In 1670, Viceroy Lemos described how curacas would “use bloody and rigorous means, hanging the Indians by the hair and in many places they set up gallows, they throw them . . . in jails and whip them cruelly.”²

Once the final selection of mitayos had been completed, they assembled in order to be inspected and dispatched by the corregidor. The capitán, or leader, of the group took with him two copies of the names and hometowns of the mitayos, one for himself and another to present upon arrival to the corregidor of Potosí or Huancavelica. Although there was generally plenty of drinking prior to starting their journey, it was a festival of remorse, for few expected to return, and the farewells were often accompanied by the somber, funereal melodies of native musical instruments.³

In the 1590s, one chronicler described how

leaving their houses, lands and livestock, the mothers and fathers separating themselves from their children with many tears, thinking they will never see them again, being brought to do . . . tasks that they neither know nor understand . . . where they have heard of terrible accidents that happen so often, and seeing many women return distraught without their husbands, and many orphan sons . . . Fearful of these things, they leave . . . forced and very much against their will. . . . And some, to avoid this would give . . . all they own, to other Indians to go in their place.⁴

A group of Jesuits described how the mitayos departed “some crying and screaming, others lamenting, such that it looked like judgment day . . . [with] the governor [waiting] with whips and ready to tie their hands.”⁵ Viceroy Lemos also explained how in “some provinces they bring them in collars, tied to a tail of a horse, over a distance of 80 to 130 leagues, by which it is to be believed that they are dragged and arrive injured.”⁶ During one mita dispatch to Huancavelica around 1630, an advocate of the Indians related

how the Indians are brought in groups of fifty and one hundred, chained up like criminals, with branches and shackles of iron, the women and children and relatives bidding farewell from the churches, leaving their houses closed up, and they followed them, crying out to the sky, pulling their hair, singing sad songs and lugubrious laments in their language, saying goodbye to them, without hope of seeing them again, because there they will stay, to die sadly in the mines and labyrinths of Huancavelica.⁷

Since the dispatching of the first mita in 1573, it was generally not only the mitayos who went to Potosí and Huancavelica; they were often accompanied by their families who could work and help sustain them during their term. They brought with them their meager possessions and food supplies such as corn and chuño, carried by llamas, who themselves would be consumed while in Huancavelica or Potosí. Selected, unable to ransom themselves, and with little else to lose but their lives, mitayos commonly tried to escape during the journey. Referring to the Potosí mita in 1585, one observer described how “more than forty thousand people left their towns, with their wives and children. And the roads were so covered [with people] that it appeared that the kingdom was moving.”⁸

Maintaining the Mita: Captains, Curacas, and Coercion

As time went on and exploitation increased, fewer mitayos arrived to work in both Huancavelica and Potosí, reinforcing the cycle of increasing abuse and exploitation of those who did arrive. The pressure to produce mitayos was especially severe in the provinces that supplied them to Potosí. Not only did Potosí always require a larger workforce than Huancavelica, but the region upon which it drew was not as depopulated as that surrounding Huancavelica. Further, the Potosí mining elite and their governor were ruthlessly committed to ensuring that a steady stream of forced laborers, or their silver as a substitute, was on its way to Potosí.

Clergy, governors, and hacendados opposed the mita and were reluctant to assist in finding missing mitayos, generally not out of humanitarian concern but because the Indian was simply a valuable productive resource to be exploited. From the non-miner's perspective, an Indian working in Huancavelica or Potosí was an Indian who could otherwise be working for them in their fields and pastures, or as transporters, weavers, servants, or coerced consumers of manufactured goods. While the governor of Potosí could rail against Spaniards and Creoles who concealed potential mitayos, there was little more he could do to them. He could, however, bring very real pressure on the curacas, placing them literally under the gun. As a result, by the 1750s curacas were increasingly coercing forasteros to serve the mita, charging widows exemptions for their deceased spouse, or sending those who were crippled, underage, or otherwise exempt.⁹

For example, in Nuñoa in Lampa province around 1793, in order to fulfill the mita contingent, children of seven, eight, ten, and fourteen years of age were forced into the ranks, although they were rejected by the miner to whom they were assigned in Potosí. Some curacas would pay free wage laborers to masquerade as mitayos and show up for muster before returning to other tasks. Curacas would also often track down former community members and, unless they were under the protection of a Spaniard or Creole, force them to either ransom themselves or join the toiling ranks of the mitayos in Potosí.¹⁰

When a community failed to send the requisite number of mitayos, the mita captain who led them, and who had been appointed by the local chief, was initially held responsible. In Potosí after 1766, the captains reported to a superintendent of the mita; however, prior to that time they were supervised by a group of six, and later eleven, natives in charge of the mita. About the only advantage of being a captain was that they did not have to work in the mines or mills. They were, however, financially responsible for

the entire number of mitayos that their community was obligated to send, irrespective of depopulation, flight, or ransoms. In addition to a fine, they had to pay the higher wages of free laborers to work in the place of missing mitayos, which could in some cases cost over nine pesos a week per mitayo. Curacas, who were ultimately held responsible for their captains, usually tapped wealthy Indians to serve as such, and many captains would engage in commerce or illegal mining while in Potosí to cover these costs as well as the many religious fees to which they were subject. Wealth and supplemental work were often insufficient to meet expenses, and as two contemporaries explained, the captains were increasingly “poor [and] broken” and “regularly end up ruined and lost.”¹¹ As flight became more frequent and mita captains were increasingly unable to pay for replacements, they sometimes fled as well.¹²

The mita captain’s road to ruin often began with a warning and ended in an abyss of humiliation and abuse. In the mid 1780s, a captain named Esteban Ticona, from Andamarca in the province of Carangas, was desperate because every person under his charge had fled on the way to Potosí. Although he and his assistant had been able to cover some of the costs of replacements, this had led to “our total destruction and ruin.”¹³ The miner to whom he reported, Bernabé de Escurrenchea, had written him an ominous letter. Although the miner began by courteously addressing the captain as “My most esteemed chief wishing you and your house much health,” he quickly berated him for his shortcomings and ominously warned him of the “punishment that you can soon expect,” before signing the letter as “your fond boss.”¹⁴

When a mita captain could not cover the costs of missing mitayos, his property was seized and his family was often jailed in lieu of payment. To publicly underscore the importance of meeting the obligations that had been imposed on them, officials commonly jailed delinquent mita captains, placed them in a stockade, or tied the unfortunate captain to a llama and forced him as he was paraded through the city. In addition, captains were often further disgraced by having their hair shorn. During the colonial period, Indians often wore their hair in two long braids, and to have them cut was a severe form of humiliation.¹⁵

Mita captains would do and sell almost anything to avoid this fate. While Juan Churacapia, from San Sebastián de Sepita in Chuquito province, was reduced to selling his clothes to cover the cost of hiring people to work in lieu of his errant mitayos, another not only sold his clothes and livestock but pledged his daughter as collateral with a Spaniard to cover a debt of sixty-four pesos. In some cases, debts contracted from covering absent

mitayos were a prelude to an odyssey. In 1757, unable to bear the hardships of forced work in Potosí, five mitayos fled who had been under the command of Melchor Inga Aguilar, a mita captain of noble Indian descent. As Inga Aguilar was unable to continue covering the cost of hiring replacement workers, he was sentenced to work in a bakery, a common destination for debtors and criminals. From there, the baker sold him to a Mestizo for sixty pesos and it took Inga Aguilar four years to work off the debt. When he finally made it home to San Juan de Arapa in Azángaro province, he learned that, in the meantime, his family had gone into debt, resulting not only in the loss of his ten cows but also the imprisonment of his son.¹⁶

In addition to humiliating and extorting the captains, miners would prevail upon the governor of Potosí to dispatch a *juez*, or magistrate, along with an armed escort, to villages to forcibly collect the missing mitayos from that year, or even years past. In addition to coming up with the missing mitayos, or silver in their stead, the community was required to provide the food, drink, and lodging of the magistrate and his escort, as well as fodder for their animals.

The curaca was ultimately responsible for any missing mitayos or the cost of their replacement. With the arrival of the magistrate, the curaca and even members of his family were often jailed, essentially as debtors. In addition, it was not uncommon for curacas to be tortured by being hung by their hair or feet, or stripped and whipped at the *rollo*, a stone column topped by a cross which served as a symbol of Spanish authority and conveniently doubled as a whipping post. The roundup of missing mitayos often became a looting expedition, not only at their destination but also along the way. In the early seventeenth century, Viceroy Conde de Monterrey explained how the magistrates “do nothing more than charge their salaries from the chiefs and poor Indians . . . and return to Potosí [with their] clothes, horses, food and everything they have . . . they bring them in collars and tied.”¹⁷

In 1693, the community leaders of the village of Aymaia protested that the “tyrannies, cruelties and violence” of the mita had already led to their “total ruin.” They described how magistrates would come to town during Holy Week, having waited for the community to gather in church. They would then surround both it and the cemetery before seizing people either in the church or as they left, thus “converting Easter day to shouts and screams and cries, and the . . . holy church into a jail.” They would seize not only those liable for the mita but also the old, infirm, and exempt, and “tied and shackled [they were] . . . brought in this way to Potosí.”¹⁸

“The Slaughterhouse”: Inside the Mercury Mines¹⁹

As mitayos approached Huancavelica, one cleric described how “they made offerings to the hill according to their rites, requesting that they not be harmed . . . that they not return to their homes shaking and poisoned by the inhalation of fatal dust . . . but rather safe and sound.”²⁰ Offerings made, once they arrived at their destination, the mitayos were assigned to live in groups in shacks on the basis of their origins. In Huancavelica, although there was to be a day shift and a night shift, quota work soon relegated this to theory. After around 1600 when shaft mining predominated, the mitayos would enter through its solitary portal, single file in the company of the two veedores, their assistants, or *sobrestantes*, and the *mayordomos*, or overseers. There they would work in areas marked off by powdered lime under the oversight of one of ten Indian *alcaldes*, or foremen. There was considerable division of labor in the mines, with the *barreteros*, or those who extracted the ore from the rock face, generally being skilled wage laborers, being assisted by a group of forced workers called *los rosa* or *potabambas*, who were responsible for keeping the passageways clear of debris and for making repairs to the mine. Once the ore had been dislodged from the rock face, *carguiches*, or mitayo ore carriers, shuffled it to the surface. Working under a quota system, they were expected to carry one load, or *punchao*, per day during the forty workdays of their two-month term. The load was measured by the size of a leather bag, or *tapadera*, which was about four and one-half feet high and one and one-half feet wide, not much smaller than a person.²¹

From 1564, when work first began in the Santa Barbara hill, until around 1600, it was worked as an open pit. Although there were not the ventilation issues associated with shaft mining, because the ore was very rich and mercury volatilizes at ambient temperature, miners spent their shift breathing mercury vapors. In addition, as the pit became deeper, rockslides became more frequent, especially during the rainy season from January to April. The rains also brought an increase of cases of frostbite, as it was common for workers to be up to their knees, and otherwise covered, in a slush of ore, during which time they also absorbed mercury through their pores.²²

With the advent of shaft mining at the beginning of the seventeenth century, conditions literally took a turn into the abyss. All of the shafts, which went to the southeast, were accessed through the single entrance at the base of the pit. Not only did rockslides often make entry difficult, water would gather in the pit and run into the sweltering mine. Inside, not

only did the mercury vaporize from the ore, but the lack of ventilation also compounded its effects.²³

Writing around 1600, Friar Lizárraga understood how the lack of ventilation exacerbated a bad situation when he wrote that shaft mining brought about

the total destruction of the miserable Indians. . . . [T]hey did not make ventilation shafts so that the smoke and dust of the ore can escape; all of that . . . enters through the mouth, eyes, nose and ears of the Indians, the mercury dust is mercury. . . . [T]he poor ones come out poisoned, they don't cure them.²⁴

In 1604, the advocate of the Indians there, Damían de Jeria, noted that the mercury-laced, sulfuric dust in the mine, along with the smoke from candles, produced a “cough and a certain illness in the bones that is called the illness of Huancavelica.” He added that forcing people to work there was to send them “to the slaughterhouse.”²⁵

Jeria’s criticism and efforts on behalf of the Indians ultimately persuaded outgoing Viceroy Velasco to order the closing of the shafts and a return to open pit mining. This reprieve was, however, limited in both duration and effect. Recognizing that mercury and silver production were two of the most important measures of an administrator’s success, the subsequent viceroy, Conde de Monterrey, allowed shaft mining to resume when the guild agreed to rotate workers.

This was to no avail, as in 1630 one contemporary referred to Huancavelica as the place “where the Indians die, helped by the cruelty and inhumanity of the miners.”²⁶ Describing the mines, he commented upon

the rigor, the depth, the malice . . . the intolerable smoke of the wax candles, the narrowness of the place, the corruption of the air covered in breath and sweat of so many bodies that work, the dust that comes from the ore, the lack of air to breathe. . . . [T]he immense ascent to the mouth of the mine, the weight of the ore tied to their chest and throat, is too much for their weakened strength, rising by long . . . ladders, from which many fall, the thin and cold air that they find at the pithead, when they come out loaded and sweating. . . . [A]ll together it is a living image of death, and a black shadow of hell.²⁷

In 1609, the stage was set, slowly, for better ventilation and fewer accidents on the ladders, when construction began on an eastward-running

tunnel which would ultimately reach the bottom of the mine. Progress was painfully slow on the Our Lady of Bethlehem Gallery, especially when it was done by pickax. This moved along much more quickly, however, when blasting was introduced around 1635, and workers made as much progress in four years as had been done in the previous twenty-six. It finally opened in April of 1642, measuring around nine feet wide, around ten feet high, and over 1,500 feet long. With its completion and the subsequent loss of the primary cinnabar lode in 1645, a toxic corner was turned in Santa Barbara. Not only did the adit allow fresh air into the mine, thus diluting the atmospheric concentration of mercury there, but it also reduced the frequency of accidents on the ladders and allowed more ore to be carried out in a day.²⁸

Better conditions in the mine also served to attract more *alquilas*, or free wage laborers, compensating for the ever-decreasing numbers of mitayos who arrived while fomenting an expanded settlement near the tunnel's entrance. Despite these improvements, the Council of Indies in Spain was of the opinion that anyone who worked in the mine for six months would be either dead or suffer from severe mercury poisoning. They were largely correct, as up to one-third of those who worked there would perish in the town or soon after their term of service.²⁹

Although he did not personally visit the mines in Santa Barbara, the archbishop of Lima, Toribio de Mogrovejo, met a group of mitayos as they were returning from their term in Huancavelica. As a result of this encounter, in late April 1602, he related to the king that

being in the province of Jauja . . . they brought me a large group of Indians that had come from the mines of Huancavelica, showing me the many bodily injuries that they suffered there and [told me of] the large number of Indians who had died and when they bled the mercury came out in the blood and that, to not go there to work and avoid those illnesses, the Indians give a great quantity of pesos to others to go in their place and they flee to different parts.³⁰

An even brief descent into the mines of Huancavelica had a profound effect on those who advanced through its portal, and invariably led to calls for the abolition of the mita or for other reforms. In May of 1603, the Franciscan friar Miguel Agia ventured almost 800 feet into the mine to better understand the conditions in which people toiled there. He would later write how "I entered . . . and saw with my eyes . . . the way in which the Indians work and considering the place and its great depth and the harmful

nature of the ore. . . . I say . . . that the king has an obligation to order [it] closed . . . to avoid . . . such great damage and . . . so many deaths.”³¹ He also was struck by the thought of the “many thousands of Indians who are dead and buried there, without counting the many others who came out only to die . . . experience shows that those who perform these tasks are inevitably condemned to death.”³²

In 1608, the recently arrived viceroy, Marqués de Montesclaros, also visited the mercury mine and immediately noted the lack of oxygen inside and the pathetic state of the town’s hospital. Seeking to remedy the situation, he ordered the construction of vertical ventilation shafts and increased funding for the infirmary. In 1624, the bishop of Huamanga, Francisco Verdugo, also entered the quicksilver mine during a pastoral visit to his diocese. In a letter to Viceroy Marqués de Guadalcázar the following year, he noted the “insufferable nature of the mita and of the terrible consequences that it brings, the loss of lives, depopulation, dislocation of the Indians, and . . . the many frauds that are committed in the shadow of the system.”³³

During his time as a reforming and beleaguered governor of Huancavelica between 1758 and 1764, Antonio de Ulloa described the mine as being in “the most horrible disorder one can imagine.”³⁴ Although to some extent he may have been motivated by a desire to place his predecessor in a bad light, the exaggeration was probably minimal. He described “passages in ruinous condition . . . poorly formed worksites and . . . supports [that] were only an appearance.”³⁵ Inside the constantly dripping mine, it was sometimes necessary to move about by “dragging yourself with your stomach on the ground” only to emerge in “huge caverns that . . . were terrifying to see.” The maze of passages quickly disoriented Ulloa, who recalled that

after having walked a long way in the mine with the most indescribable discomfort, sometimes uphill and other times downhill, when one appeared to be far away from the place where one left, one finds that it is overhead, without more distance than that of a thin rock through which, where broken in a few places, you could see the light of a candle.³⁶

Those inside the mines, and especially the pick men, were not only exposed to mercury vapors but also became chronically affected by silicosis, which is incurable. The limestone and sandstone, which contained mercury and silver in Huancavelica and Potosí, respectively, released silicone dioxide, or silica, as it was broken. There is more silica on Earth than any other mineral, and when inhaled, it damages the alveoli and macrophages in the

lungs, producing scarring, limiting their ability to absorb oxygen, and tripling the risk of tuberculosis. Mild forms of silicosis include a persistent cough, sputum, fever, weight loss, shortness of breath, the skin turning blue, and an increased risk of respiratory infection and renal problems. As the condition worsens, breathing difficulties become much more severe and fibrosis develops, which can lead to a variety of connective tissue diseases such as hardening of the skin, arthritis, and lupus. Acute silicosis, which can result from a year or less of high exposure, such as working as a sifter or loader in a stamp mill, is fatal. All of these conditions were exacerbated by arsenic gas and carbon monoxide in the mercury and silver mines, malnutrition, intestinal parasites, and the altitude.³⁷

Apart from breathing silica and mercury vapors, as well as absorbing quicksilver through the skin, working inside the Santa Barbara mine was fraught with an array of other dangers. Rockslides and cave-ins were common, as were accidents from extracting or carrying ore, sudden death from carbon monoxide poisoning, and respiratory illnesses resulting from the sudden shift from the heat of the mine to the cold and often blustery exterior. The vast majority of lethal cave-ins, including those of 1608, 1616, 1639, and 1640, were a result of the incorrigible practice of mining the supports of the mine. The cave-in of 1640 not only reduced airflow into the mine but also closed its primary entrance, decreasing production as a result. Other cave-ins or rockslides occurred in 1681, 1759, 1760, 1761, and 1786. The cave-in of 1786 killed up to 300 people and resulted in flooding, the closure of the upper section of the Santa Barbara mines, and the imprisonment of the mine's technical director, Francisco de Marroquín. Although the intendant, Fernando Marquez, initially claimed the cave-in was caused by an earthquake and only affected an abandoned zone, it soon became clear that it had been caused, as usual, by the mining of the supports. Marroquín was jailed and, sixteen years later, would die a prisoner. Despite the closure of the Santa Barbara mine, the discovery of a new vein in 1790, called Sillacasa, allowed excavation and production to resume.³⁸

Despite the frequency of accidents, conditions did improve marginally after 1740 as the ore quality, and hence toxicity, of the mines began to decline. Better ventilation also ameliorated conditions with the completion of two additional adits in 1734 and 1760. These improvements, however, did not eliminate cave-ins, silicosis, the effects of the abrupt temperature change from inside the mine to the outside, or the toxicity associated with operating the increased number of smelters.³⁹

A Poisonous Pursuit: Mercury Refining

Running the gamut of dangers presented by toxic vapors, silica, carbon monoxide poisoning, disorientation, and the ever-present risk of being buried alive, the carriers would drag and carry the ore to the surface. Once there, workers broke it into smaller pieces and loaded it onto llamas that carried it to the furnaces for smelting. Although the general grade of ore could be assessed visually, only refining could reveal its true quality, which was measured by its yield per *cajón*, or 150-pound unit. While an average yield was around eight or nine pounds per *cajón*, extremely rich ores could yield thirty. Unlike silver refining, the smelting process was fairly straightforward, although minor adaptations were made over time. Once at the furnace, the ore was further pulverized and placed into a ceramic cauldron over which a conical top fit snugly, the joint being sealed with mud or clay to limit the vapor that escaped. Refiners set a fire beneath the vessel and as the ore was heated, sulfur dioxide and mercury vaporized, and what mercury did not escape with the smoke condensed on the inside of the top.⁴⁰

Among the challenges of this system was that each ceramic container could only hold around 125–50 pounds of ore, thus limiting the yield per refining. In addition, while much of the mercury would condense on the inside of the top, a considerable amount would fall back down into the ore. This latter problem was largely solved by the addition of a spout which channeled the vapor into a tube that then passed through water, condensing it before depositing the mercury in a receptacle. To achieve a greater efficiency of scale, in the late 1500s the prospecting pioneer Pedro Contreras developed the *jabecca* smelter system in which the bottom half of up to forty vessels protruded into a waist-high combustion chamber. As with the old system, the pots were covered with slightly narrower conical containers, and the joints were sealed by mud or clay. Inside each pot, the ground ore was covered with about two inches of compressed, damp ash, into which were punched holes to allow the mercury vapor to rise and either condense on the inside of the top or in the condensation tubes. Indians collected from the ash any mercury which fell back into the lower vessel.⁴¹

Not only did this system allow more mercury to be produced in a single refining, but, as it was done in the open air as opposed to under a shelter, the ovens cooled more quickly and more ore could be refined in a given period of time. When refining mercury with this system, two Indians would operate three ovens, often with assistance from family members. They would sort the ore, load it into and seal the vessels, seal the condensation tubes,

fire the smelter, gather the mercury that did not run to the collection vessel from the roof, tubes, and ash, and remove the waste.⁴²

Although the jabeca ovens were much more efficient, miners continued to experiment with other techniques. Around 1600, they began to refine their ore by heating it in open pots in a closed chamber, in effect substituting the cap on the vessel with the roof of the chamber, where the mercury condensed if it did not fall to the ground. While more efficient in terms of production, it was more costly in human lives due to the need to enter the chamber, often still hot and loaded with mercury vapor, to collect the mercury.⁴³

In 1633, a medical doctor named Lope de Saavedra Barba developed a further refinement, which would last for the rest of the colonial era. In this system, which was really a hybrid of the jabeca and chamber processes, a large combustion chamber contained a grill which sat about eight or nine feet above the fire and upon which was loaded the ore. The structure was enclosed by a conical roof which rose about nine feet above the grill. Near its pinnacle were four holes, from which protruded eight cooling tubes that in turn passed through water on their way to a collection point. The load was fired for around four hours before the air supply was cut off and the fire allowed to slowly extinguish. Within about twenty-four hours, the oven had cooled and the mercury had condensed. This system not only produced more mercury in a single firing but also used less fuel per unit of mercury produced, required less labor, and worked well with low-quality ores. Miners called these ovens *busconiles*, from *buscón*, or seeker, which referred to the fact that Saavedra was also a prospector.

In recognition of his contribution, and underscoring its impact in refining, the crown awarded Saavedra the value of 2 percent of all mercury produced in Huancavelica by this process. After he and his son drowned at sea on the way home to Spain, authorities dedicated this revenue to Huancavelica's hospital. In 1646, the system was introduced, and ultimately adopted, in Almadén after Juan Alonso de Bustamante observed it in Huancavelica. Claiming credit for the technique, the furnaces became known as "Bustamante furnaces" and would be used there until the 1920s.⁴⁴

Although the busconil ovens were more efficient than their predecessors, considerable amounts of mercury vapor still escaped from the refining chamber, the chimney, the many joints in the condensing tubes, and the ceramic tubes themselves. In a revealing account, an anonymous nineteenth-century writer familiar with the mercury production process described how the retorts were

poorly constructed, [and] with their porous materials occasioned considerable losses, due to the ease with which they absorb the mercury vapors; for this reason in the cracks, the bricks, and even in the straw roofs with which they are covered, mercury is found . . . in no small quantity, causing at the same time illnesses with sharp pains in the unfortunate worker. The joints of the pipes of clay . . . covered with a bit of ash or clay . . . are other . . . causes which influence the loss that occurs in the melting or distillation of the ores.⁴⁵

The inefficient nature of the refining process was often exacerbated by the practices of the refiners themselves. As the smelters burned overnight, the Indians tending them often took advantage of the opportunity to sleep in their warmth. When they periodically awoke, they would often overload the oven with ichu so that the overseer would not find a large amount of the straw and know that they had been asleep. The result of overloading the oven was that more mercury would escape from the vessels or cause it to leak from the condensation tubes. As the anonymous chronicler wrote, the result of this was that

In the proportion that these tubes heat up, the more easily the evaporation runs out of them, mixing the mercury in the smoke of the fuel. . . . Good proof of this is that in different times I have observed, and is evident in the . . . all of the . . . mouth of the last tube of all of the ovens, where the mercury vapor enters fresh air.⁴⁶

Much worse for workers was that their bosses, in order to process more ore in less time, would habitually order the Indians to open the ovens before they had completely cooled, a practice referred to as an “*endiablada*.” So common was this that the Indians “generally open the ovens when they are . . . exhaling mercury,” which led to “a considerable loss of mercury” and human life.⁴⁷ Other dangers resulted from the volatile weather in Huanacavelica. The chronicler explained that

It is . . . publicly known here, among employees and operators of the smelter, the risk there is in these ovens of the mercury escaping impelled by the wind, which enters sometimes through the tubes, and getting inside the oven, rejects and stifles the smelting, making it come out of the door of the oven with much damage to the oven workers. If, on the contrary, it enters the door of the oven and goes up the oven and violently burns through the tubes, with their easy and quick exit . . . which is called blowing, and it occurs also when there is smelting with too hot of a fire.⁴⁸

Both endiabladas and wind blasting through ovens could produce acute mercury poisoning and a quick death for the workers. While the death rate among miners and refiners likely decreased over the colonial period, up to two-thirds of the deaths in the provinces subject to the Huancavelica mita can be attributed to service there, and it appears that short-term work there was more lethal than long-term service in the mercury mines of Almadén. This reflected not only the ore quality, especially in the early days, but also a lack of expertise in mine construction, poor oversight, a lack of maintenance as a result of the lack of ownership by the miners, and a general disregard for Indian life.⁴⁹

Once the mercury had been distilled and collected, that which did not end up as contraband would be transported to the royal warehouse on the main square of Huancavelica where it was stored in ceramic containers and held under the constant supervision of three royal officials. The warehouse was a hub of toxicity as mercury was constantly volatilizing as a result of spills, evaporation, and constant leaking through the porous vessels. Whenever workers transferred quicksilver from one container to the other, a portion was lost both from vaporization and inadvertent splashing. Much of this loss may have gone undetected because not only are the droplets produced in such a transfer often minuscule and invisible to the naked eye, but the surfaces upon which they fall do not get wet, as the mercury tends to roll off as opposed to being absorbed by them. Even minute mercury droplets have a large combined surface area. For example, a mercury globule of one-inch diameter has a surface area of 3.1 inches. However, if this ball is broken down into droplets of one thirty-second of an inch, the surface area will be over 100 square inches.⁵⁰

From Service to Silver

Despite being torn from their homes and lands, being forced to live in squalid group shacks, and working in horrific conditions where their vitality was drained and lives cut short, mitayos in Huancavelica often never saw their below-subsistence wages. If the mine was deep or the rock especially hard, they often were unable to fill their quota of ore, and miners docked their wages as a result; other times, their loads were undercounted. As a result, it was not uncommon for them to have to work two or three days to get paid for one, and three to four months to complete their term. The fact the mitayos were often not paid somewhat belies the adage that in Huancavelica one “could not have mercury without silver . . . nor silver without mercury.”⁵¹

Another reason mitayos were frequently not paid was because, prior to 1600, their wages were brought with the silver on the return trip of the caravan which had brought the mercury to Potosí. Not only was the caravan almost always late, but further delays also resulted from the practice whereby the person charged with bringing funds to Huancavelica would invest them in commercial merchandise and then sell them at a profit once he arrived in Huancavelica, adding a few more weeks of delay to the mitayos' payment. As a result, mitayos could easily wait six weeks or longer to be paid for their services, and many Indians, eager to flee the town, forsook their wages for their freedom. These problems were mitigated somewhat around 1600 when Viceroy Luis de Velasco began the practice of sending funds directly from Lima. This policy had the additional benefit of reducing contraband, which increased markedly when the treasury office did not have the funds on hand to purchase mercury from the miners. Generally, however, when mitayos were paid in Huancavelica, it was often in such debased currency that it was rejected by merchants as well as by tribute and debt collectors.⁵²

Not only did Huancavelica's mita assessment generally decline throughout the colonial era, it always trailed the actual number of Indians who showed up for work there, many of whom promptly fled. Among the primary reasons for this decline was that if people did not die working in the mines and furnaces of Huancavelica, many died soon after from mercury poisoning, silicosis, or associated complications. Prospective mitayos, seeing the condition of those who returned, fled to other regions to avoid their fate. Alternatively, they could ransom themselves if they had the necessary 32.5 pesos, or they could pay their mita captain or curaca a bribe, or *guate-tancha*, to claim that the mitayo was either dead or missing. The curaca or captain would, in turn, pay some of this money to the person to whom the mitayo was assigned.⁵³

Because these financial avenues of escape were out of reach for most Indians, communities subject to the mita became increasingly deserted and authorities reluctantly made occasional adjustments to assessments. For example, in 1573, 3,289 people had been drafted for Huancavelica's mita, but by 1590 the human levy had been reduced to 2,274, and by 1604 the number was further trimmed to 1,600. By 1621, Viceroy Esquilache was forced to acknowledge that the districts of Azángaro, Aymaraes, Vilcas, Guachos, Ananguncas, and Soras y Lucanas simply did not have the quota of men to send to Huancavelica. In 1630, despite decreasing the demand to 1,400 mitayos, only about 1,000 actually showed up, and some areas had absentee rates of up to two-thirds. By 1645, authorities had slashed

the assessment to 620 mitayos, yet only about 300 arrived. By 1684, only 286 mitayos showed up for service, and in the following year only 44 arrived.⁵⁴

Among the effects of these dynamics was that by 1750, the Huancavelica mita had in essence been converted into a monetary tax in ten of the thirteen subject provinces, leaving Cotabamba, Chumbivilcas, and Angaraes as the only provinces which still sent people. The result was the annual transfer of around 40,000 pesos to the miners, some of whom used it to hire wage laborers, while others pocketed it, and some did both. When the gremio was eliminated as the collective mine operator in 1779, these funds were instead remitted to the treasury. To partially compensate for the declining numbers of mitayos, resident Indians in Huancavelica were also pressed into a week's labor on specific tasks determined by the governor, such as cleaning inside of the mines.⁵⁵

The decline in the numbers of mitayos in Huancavelica also reflects the increasing prevalence of a sizable voluntary workforce there. By around 1656, at least half of the labor force in Huancavelica was free, earning up to sixty pesos for forty days' work, three times that of a mitayo. Like their counterparts in the silver mines, they were particular in the tasks they performed, and in Huancavelica preferred surface work. The opening of the Our Lady of Bethlehem Gallery in 1642 led to more wage laborers working inside the mines, as not only had the gallery greatly improved ventilation but it also allowed most ore to be carried out via the tunnel, as opposed to carrying it on their backs up six hundred feet of ladders.⁵⁶

“Justifying the Injustice”: The Debate over the Mita⁵⁷

That dehumanization facilitates abuse and exploitation was abundantly demonstrated in Spanish America. Soon after the conquest of New Spain and Peru, theologians engaged in a spirited debate concerning whether the native peoples of the Americas were capable of reason, and hence human, or if they were not, and thus animals. Although this issue was settled by the crown in the favor of Indian humanity in the mid-sixteenth century, it did not signal any significant change in the way in which natives were treated or viewed by many contemporaries. Indeed, the tendency toward Indian dehumanization was widespread in society, embraced by civilians, clerics, and officials alike, and consistently held throughout and beyond the colonial era.⁵⁸

Writing in the 1560s, the judge Juan de Matienzo well illustrated the prevailing Aristotelian view of Indians as natural slaves, contending that

they were “no different than animals, who do not even perceive reason,” adding that “they are enemies of work and friends of laziness, only by force will they work. They are friends of . . . getting drunk and idolatry . . . they are liars and . . . very cruel . . . they, in sum, were born to serve.”⁵⁹ He also averred that the Indians were not only inclined to committing adultery, incest, and murder but also detested working in the mines and mills “because they are by nature lazy,” thereby resisting that which was “for their own good.”⁶⁰ So necessary was compulsion, Matienzo claimed, that “if the Indians were not compelled to work, not even bread would be baked, nor would there be anything to eat, nor silver or gold.”⁶¹ Not long after, the chronicler Luis Capoche affirmed that the Indians were “by their nature not very smart and lacking imagination,” while in 1615 Viceroy Montesclaros contended that the Indian’s “capacity is so limited that generally it cannot be measured with precepts of reason.”⁶²

In what can only be described as a tirade, the Dominican friar Reginaldo de Lizárraga declared that the

first thing [the Indians] have . . . is the vilest and lowest spirit that has ever been seen or found among any people; it really appears that they are of the nature to serve; they recognize black slaves as their superior . . . and what they order them they obey better than when we order them. They are cowardly people . . . [and as] all cowards, they are very cruel when they are victorious. They do not want to be treated except with rigor and asperity . . . when treated poorly they serve with great diligence . . . they are the most ungrateful people that have ever been discovered . . . to expect gratitude from them is in vain. . . . [They are] the most dishonorable people that have ever been seen . . . they are the greatest liars that can ever be imagined.⁶³

Like most of his peers, Lizárraga criticized the natives for their alcohol consumption, affirming that when they travel “they say they get drunk because if they die on the road, they will have died drunk, and when they return they get drunk because they did not die . . . their god is their stomach and chicha, there is no other world.”⁶⁴ Capoche noted the association between alcohol and indigenous rituals, averring that “many people, men and women, were accustomed to gathering and drinking in public, they would perform dances in which they would use ancient rites and ceremonies . . . and as these binges last days and nights, or better said, all their life, when they are finished the fathers do not recognize their sons nor the sons their mothers.”⁶⁵

By the 1770s, the prevailing view had not changed, and the former governor of Huancavelica and discoverer of platinum, Antonio de Ulloa,

embraced these views, insisting on the Indians' "similarity to animals [but] without their instincts . . . their barbarity, rusticity . . . not finding in them the accidents of reason, they are . . . worthy of being placed not far from the parallel of brutes."⁶⁶ Like Matienzo, he asserted that the only reason they did not want to work in the mines was due to the "natural repugnance they have to every type of work."⁶⁷ Dismissing the dangers and horrors of mining, he avowed that "the immoderate use of alcohol destroys more Indians in a year than the mines in fifty, even counting among these . . . [the deaths from] rockslides."⁶⁸

Some writers contrasted the natives' alleged indolence with the putative work ethic of the Spaniards, asserting that "eight Indians barely work like two Spaniards" and that native poverty was "voluntary, because it is born of their careless temperament . . . [which is] given to laziness and drunkenness."⁶⁹ Such racist discourse has even infused twentieth-century historians. For example, despite the fact that it was the native peoples who not only did the work in the mines but also in the fields, construction projects, transport, and just about every other form of labor in the Americas, Lohmann Villena refers to the supposed "scarce vitality of the indigenous race," to assert that they are such "an unindustrious people" that "an Indian did not work with the vigor and strength of a Spaniard."⁷⁰ He also largely dismisses the effect that the Huancavelica mita had on native communities, describes forasteros as people who "maliciously" benefited from the mita exemption, refers to the "philanthropic spirit" of Spain, and avers that Toledo "in every moment had in sight the conservation of the demographic capital."⁷¹

"The Poor Who Make Us Rich": Dissenting Defenders of Native Peoples⁷²

Despite this prevailing, dehumanizing, and self-serving view of the Indian in the Andes, there were some dissenting voices. Among the earliest and most vocal defenders of the Indians was Bartolomé de Las Casas, the Dominican friar who in the mid 1500s successfully challenged the notion that the Indians were not capable of reason. Although not nearly as impassioned as Las Casas, in 1590 the Jesuit José de Acosta also rejected "the false opinion that is commonly held of [the Indians] that they are brutish and bestial people without understanding. . . . From this deceit many and notable abuses have come to them, treating them as little more than animals."⁷³

Elsewhere, Acosta criticized the Spaniards for trying "more to persuade by the sword than by the word," arguing that "Christians cannot subjugate

them by force of arms, and . . . deprive them of their liberty and impose tributes as punishment. Because, how have they offended us when they had not even heard our name?”⁷⁴ Not only did Acosta view the Spaniards as being at fault, but he indignantly characterized them as “avaricious and inhuman men [who] . . . boast that they are the salvation of the Indians, when they seek nothing more than their own fortune!”⁷⁵

Writing around the same time, the cleric Balthasar Ramírez also defended the natives, writing that they were “humble . . . servile and fearful . . . and are content with little and aspire to few things. . . . They are liberal in giving what they have, punctual, truthful . . . and in terms of ability and talent they have much. . . . [They are] docile and friendly . . . [and it is] an invention of the devil, and for our own condemnation, the general opinion . . . that the Indians . . . are dogs, and that they do nothing.” It was in his opinion the Spaniards, including the clergy, who set a bad example and overburdened the natives with taxes, labor, and abuse, noting that they “live in poverty and lack what is necessary, and never finish paying their debts . . . and tributes; and we see that they are being finished off very quickly.”⁷⁶

In 1630, Friar Buenaventura Salinas y Córdoba not only lauded native accomplishments in buildings, bridges, and roads, as did the conquistador Pedro Cieza de León, but was also highly critical of his countrymen. Salinas y Córdoba recognized that “everything that is taken from the mines in this realm . . . is acquired with so much sweat and blood of the poor Indians” and censured the Spaniards for only wanting to “suck the money out of them” and return home “loaded with treasures.”⁷⁷ Describing the Indians as “the most humble, docile, facile, tractable, simple . . . peaceful, loyal . . . people there are in the universe,” he wondered “how many provinces and innumerable Indian towns have been taken apart only to build a house, to found an estate in Spain. . . . How many have arrived at the throne of honor by steps covered with the blood and sweat of the” Indians.⁷⁸ His consternation was clear when he confessed “that which most amazes me is that the evil people that ruin [the Indians] are . . . honored [and] rewarded.”⁷⁹

Unlike many of his peers, the Jesuit Manuel Toledo y Leiva, who was living in Huancavelica in 1724, did not hide from the fact that the Indians

do all the work . . . they bring the food to the cities, towns and villages, they cultivate the fields, cart in the wheat, the wine, the oil, the meat; they are the pastors and caretakers of innumerable farms . . . they penetrate the very hot valleys for our comfort. . . . Who have built the cities, towns and villages of the highlands except the Indians? The sumptuous temples

of Cuzco, La Plata and Potosí, La Paz, Juli and even Lima . . . except the Indians? Who have put together the bridges, roads, smoothed the hills and opened the jungle but the Indians? And they are lazy, they are vagabonds? If the Indians are missing in Peru the Spaniards will see how they suffer and lack everything.⁸⁰

Later, in 1794, a civil official would write that the Indians were the “unfortunate ones who make us our fortunes, the poor who make us rich, the unhappy ones who make us happy, and in recognition of [this] they have the right to our benevolence, of benefice, our recognition and our gratitude.”⁸¹

Criticism, Contradiction, and Complicity: The Clergy and the Mita

Although some clerics and officials did evince sympathy for the Indians, not only were they a minority in a culture steeped in the Aristotelian view of an organic society composed of masters and servants, but many of these same clerics also supported the mita. Ever since Viceroy Toledo established forced labor in the mines and mills of colonial Peru, it generated considerable controversy among theologians, jurists, civil officials, and in the royal court, as forced labor in mines had historically been reserved for convicts and slaves. Complicating the legal picture was the fact that there were a host of edicts, sometimes contradictory, which prohibited both the enslavement of Indians and forced mine work unless they had been convicted of a crime. For example, while in 1500 King Ferdinand II prohibited Indian slavery under any circumstances, in 1503 he allowed natives to be coerced to work for limited periods of time with pay. Although in 1534 Charles I allowed native enslavement in a just war, in 1541, as a result of pressure from Bartolomé de Las Casas, he changed his position and issued an edict prohibiting Indian forced labor. In 1549 and 1551 he upheld the ban on forced native labor in the mines, as did Philip II in 1568. By 1574, Philip II had changed course and determined that as “the Indians are naturally inclined to vice, laziness and drunkenness . . . it is just to assign Indians to the mines.”⁸²

It was in this somewhat confusing context that Viceroy Toledo imposed, and sought to justify, the mita system in Peru. Among the philosophical questions of the time was, as the Indians were technically free, whether they could justly be forced to serve in the mines, even for a fixed term, when they had committed no crime. In an effort to legitimate the mita, in October of 1570 Toledo convened a council of clergy, jurists, and civil officials to examine the issue from moral, legal, and administrative points

of view. After deliberating, and under pressure from Toledo to support the mita, the council unanimously ratified the system, largely concurring with the conclusions of a similar assembly which had been convened under Viceroy Mendoza in 1556. The archbishop of Lima, Francisco de Loaiza, along with the prelates of the Dominican, Augustinian, and Jesuit orders and others, then set about drafting thirty-five chapters of ordinances regulating native forced labor.⁸³

Soon afterwards, however, many of the clergy retracted their views. Among them was Archbishop Loaiza, who wrote in 1575 that the Indians endure “excessive work . . . without curing the sick, without payment except in such poor quality silver that . . . no one wants to receive it, finally without liberty.”⁸⁴ The Franciscans Jerónimo de Villacarillo and Juan del Campo supported Loaiza on this, acknowledging that the Indians “complain strongly and receive much unhappiness and harm” from mine work.⁸⁵ In a similar vein, Dominican friars specifically noted the exceptional dangers of the mercury mines of Huancavelica and complained that “it is so contrary to divine and natural rights that free men are forced . . . to labors that are so excessive and harmful to their health and lives.”⁸⁶ Despite their misgivings, which found voice after they had both endorsed the system and drafted the laws under which it would operate, it was too late and the mita would last until the end of the colonial period. The position adopted by the clergy overall, although casuistical and often contradictory, was in the end unambiguous. Even as early as 1559, the Jesuit, Dominican, and Franciscan orders accepted the legitimacy of forced mine labor.⁸⁷

It is interesting that some of these religious, such as Acosta and Agia, saw firsthand the conditions under which Indians labored in the mines and mills, and the effects of the mita on indigenous communities. They wrote about these experiences in moving and vivid terms, explicitly recognizing that forced mine labor had historically been reserved for convicts and slaves, and that the Indians had done no wrong and were inherently free. As Acosta put it, “it is a fact that the silver mines were a cemetery of Indians. Many thousands have died from this type of work. . . . [T]he Indians have to come exiled from their lands, often abandoning their children and their wife . . . they get sick easily and end up dying. And what are we going to say about the mining of mercury? By only breathing, even lightly, the vapors produced by the refining . . . produce instant death.”⁸⁸ Despite this, like the vast majority of his peers, he argued that if the laws were only followed then “there is nothing bad” about the mita.⁸⁹

The views of Acosta, and the clergy generally, were not only informed by their Aristotelian view of the world in which the Indians were born to

be servants but also by their conviction that Potosí, and other silver deposits in the region, had been placed by God for the Spanish to spread Catholicism and to counter Protestantism and heresy more generally. In their view, although the mita was hard on the Indians, they were only deprived of their liberty for a limited time, during which they were paid, and without silver the colonial economy would crumble and be subject to invasion. Even worse in their view was that a weakened Spain could lead to the triumph of Protestantism. While they recognized that it was a heavy burden indeed for the Indians to shoulder, the clergy as a whole contended that it was for the common good and if the Indians were paid fairly, the work moderate, and other provisions adhered to, the mita was morally acceptable. Philip II agreed and officially ratified the system in 1589.⁹⁰

What is ironic about these views is that the gap between theory and reality in the colony, and between laws and their application, was not only immense but obvious, and to simply call for the application of laws was naïve at best. As one official wrote in 1618, of the laws designed to protect the Indians, “none are obeyed or enforced . . . because the unfortunate ones do not even have either voice nor breath to complain, and most of these excesses are swallowed underground . . . where the overseers pile work on them and give them no rest.”⁹¹ The reality was clear to the Jesuit Antonio de Ayans, who in 1596 wondered, “how is it possible that silver can shine when it has been won with so many offenses to God?”⁹² Furthermore, the assertion that force was necessary was belied by the facts on the ground, as by 1600 at least half of the miners in Potosí were free wage laborers, as they were in almost all other mining centers, demonstrating that compulsion was not necessary if sufficient wages were paid.⁹³

Later consultations, in 1599, 1603, and 1630, only ratified the intellectual and economic status quo. During the council of 1599 which examined the morality of expanding the mita, most of the orders opposed subjecting more provinces to the mita. They did not, however, call for its abolition and fell back on the often-heard refrain that the Indians should be paid fairly, have moderate work, and be well treated. The partial exception were the Jesuits, who explicitly challenged the view that the mita was acceptable if the laws were followed, since those laws carried no weight and were routinely ignored. Despite their opposition to the expansion of the mita and despite everything else they wrote, they ended up endorsing the reallocation of the existing mita to new mines.⁹⁴

In 1601, King Philip III ordered Viceroy Luis de Velasco to endeavor to end the mita and substitute slave, convict, or free labor in its stead. Like many such orders sent to a distant land, Philip III gave the viceroy

considerable latitude whether or not to implement the edict, thus largely negating it before it was sent. Viceroy Velasco recognized the vehement opposition the measure would generate in both Potosí and Huancavelica, and convened yet another group of religious and civil officials in 1603 to study the abuses and problems of the mita, and to determine if it should be expanded. Among those consulted was the Franciscan Friar Agia, who had previously descended into the mines of Huancavelica and asserted that “experience has shown that those who perform these tasks are inevitably condemned to death.”⁹⁵ Despite his experience, and expressing the prevailing view of his peers, Agia also concluded that “it is permissible to compel them to work in mercury mines that already exist, because, without this metal, it is not possible to refine silver” which was so vital to both the realm and the Counter-Reformation.⁹⁶

As a result of these consultations and the political and economic implications, Viceroy Velasco did not abolish the mita, although he did reduce the mita assessment for Huancavelica to 1,600 people and ordered all mine shafts there closed. By limiting extraction to open pit mining he hoped to burrow down to the richer ore from outside rather than from inside the hill. The result of these measures was a precipitous decrease in mercury production and the reversal of the ban on shaft mining by his successor, Viceroy Monterrey, in late 1605.⁹⁷

The mita remained largely unquestioned by viceroys until the arrival in 1667 of the young Viceroy Conde de Lemos. Lemos, who would die at age thirty-eight in 1676, was appalled by what he saw during a trip to Potosí. Initially, he sought to reform the mita by prohibiting such inveterate practices as night work and holding mita captains responsible for their missing charges. In Huancavelica, Lemos also sought to reduce the burdens on the Indians by dispatching convict labor from Callao, just outside of Lima, and by ensuring that silver for the payment of mitayos arrived punctually. When these and other measures either failed or were simply ignored, Lemos tried, unsuccessfully, to abolish the system itself.⁹⁸

Despairingly, he wrote to King Charles II that “I did not come to the Indies to risk my salvation” and that it “is not silver that is brought to Spain, but rather the blood and sweat of Indians.” He declared that “I know for certain that the rocks of Potosí . . . are bathed with the blood of Indians, and that if the money which is extracted from them is squeezed, more blood than silver would flow.” He went on to avow that “silver acquired by such bad means cannot have a good purpose” and to warn the monarch that “if your majesty does not . . . end this forced mita which experience has shown causes so many problems, then the provinces will become finished and

annihilated.”⁹⁹ His desperate pleas were ignored, and whatever hesitations the crown had concerning the mita were washed away by a flood of silver.

After Lemos’ failed attempt to end the mita, it went largely unquestioned by viceroys for about forty years, until the arrival in 1716 of Viceroy Carmine Nicolás Caraciolo, prince of Santo Buono. Like his predecessor Viceroy Velasco over a hundred years before, Santo Buono advanced a project to simply close Huancavelica and import mercury instead. This suggestion was rejected by the crown, as it had been previously. King Philip V did, however, issue an edict in 1720 abolishing the mita, although it had no sooner arrived in Peru than it was suspended given the opposition to such a measure by the mining elite.¹⁰⁰

Traveling Toxicity: Mercury Transport

As with mercury production, the crown subcontracted out its transportation to mining centers. When it was to be dispatched from Huancavelica, the quicksilver was initially transferred into clay jugs capped in pitch, which held between twelve and twenty-five pounds. Their porous and brittle nature, and the ensuing losses, soon led to the introduction of sheepskin bags, most of which were made in Chile and held about twenty pounds of mercury. Their primary advantages were that they were flexible and did not react with and damage the mercury. They were, however, susceptible to leaking or bursting due to damage by worms, thin spots, and general wear and tear. In the 1570s, transporters loaded the mercury on llama trains and shipped it overland from Huancavelica to Cuzco, and then on to Potosí and other mining centers. Beginning in 1580, there was a shift to a sea route, and the liquid metal was first sent down overland from Huancavelica to the coast at Pisco, usually in shipments of between sixty-eight and eighty-six metric tons. On the way, in San Jerónimo, the load was transferred from llamas to mules for the final, hot descent to the coast. Once at the shoreline, workers loaded the cargo onto launches, rowed it out to waiting vessels, and placed it in leather-encased iron boxes which were then lowered into the ship’s hold to serve as ballast. From there it was shipped down the coast where it was similarly offloaded and carried by llama train up to Arequipa and points beyond.¹⁰¹

In 1594, seeking to minimize the losses from contraband, royal authorities introduced a new route that ran from Huancavelica to Chincha, just north of Pisco on the coast, and then on to Arica by sea. The construction of a wharf in Arica in 1607 increased both the safety and ease of operations there. Once on shore in Arica, workers loaded the mercury onto mules

for the first, very hot and dry forty-five-mile trek upland before transferring the cargo onto llamas, up to half of whom would perish during the upland journey to various mining centers. As the mercury made its way to its various destinations, Indian communities were required to assist in the transport. By around 1610, mules were exclusively used on the Arica–Potosí route, as they could carry a greater weight and had more stamina than llamas. The entire process required close coordination, from the timely provision of sheepskin bags from Chile to addressing the pasturage and water needs of the mules in the dry coastal zone. As a result, herdsmen had to nourish their pack animals up to 100 miles away, and required up to a month lead time to get them to Arica when the mercury arrived. Despite the efforts of royal authorities to ensure a steady and sufficient supply of mercury to Potosí and other mining centers, there were occasional shortages.¹⁰²

With the establishment of the viceroyalty of La Plata in 1776, Potosí and Upper Peru came under the jurisdiction of officials in Buenos Aires instead of Lima. As a result, Upper Peru began to receive mercury shipments from Almadén, while Huancavelica's dwindling production struggled to supply the rest of Peru. The quicksilver shipped from Spain was, until the late 1780s, also sent in sheepskin bags, each of which held about twenty-five pounds. When loaded aboard ships, they were placed in barrels which were, in turn, nestled in wooden boxes in groups of six and deposited low in the hold.¹⁰³

By 1790, a shift to twist-topped iron flasks to store and transport mercury was well under way. Although more expensive than sheepskin bags, their advantage was that they did not leak and poison the crew, would not decay, and held up better under the frequent transshipping to which mercury was subject. In addition, because iron was a vital ingredient in the silver refining process, they also could be sold to the miners. When loaded onto ships in Spain, they were sealed with pitch, placed on special frames, and stacked five high to serve as ballast. Despite the varying capacity of flasks, ultimately the measure of seventy-six pounds became a standard unit of mercury measurement, and by 1820 almost all mercury was shipped in iron flasks.¹⁰⁴

For both free and forced laborers, cinnabar extraction and mercury refining were considerably more perilous than mercury transport. For mitayos, the distress which accompanied the selection, organization, and dispatch of the mita was simply the high point of the constant angst that permeated communities subject to the service. Many mitayos would never come home, as they would escape on the journey, die in Potosí or

Huancavelica or remain there as wage laborers, or flee from the prospect of having to repeat the service.

Those working in the mines of Santa Barbara breathed mercury vapors emanating from the ore, as well as silica as it was broken. In addition, they were at constant risk of cave-ins, rockslides, falling into cavernous voids, and, before 1642, falling rocks as they dragged and carried the ore up shaky ladders to the surface. Although fewer people worked the ovens than inside the mines, they were at much higher risk of mercury poisoning as the ore was smelted, when vapors escaped through the primitive seals of the vessels and condensation tubes, and when they were forced to retrieve the liquid mercury before the ovens had cooled. The wives and children who often assisted them in their tasks suffered birth and developmental defects as well as infertility. Most of those workers who did not perish in Huancavelica would suffer pain, despair, and torment for months or at most a few years before they too succumbed to the ravages of mercury poisoning. When they were paid, they were routinely cheated out of their full wage, and what they were paid was generally in debased silver. As the population of the region declined through death and flight, the mita was progressively transformed into a regional ransom paid by communities to avoid the service.

Colonial authorities, both civil and religious, were well aware of the horrors and human cost of the mita system. They created many illusions, however, in their efforts to justify it. Although there were some people who stood up for the Indians, most viewed them as indolent, vice-ridden sub-humans who would only work under the shadow of the lash. Such dehumanizing stereotypes pervaded colonial perceptions of the native and assuaged any qualms they had concerning the nature of the service. Any doubts were further mitigated by their conviction that Huancavelica and Potosí had been placed there by divine will to aid Spain in its effort to spread their faith and turn back the rising tide of Protestantism, and hence it was all for the common good. To the extent that contemporaries were critical of the mita, most opposed how it was operated as opposed to its existence, with their naïve and feeble calls for existing laws to be followed falling on deaf ears. Although the mines and refining operations in Potosí were not as immediately lethal as those of Huancavelica, as we shall see, the scale of the suffering and the amount of mercury released into the environment were much greater.

thr ee

Blood Silver



“There Is Potosí because There Is the Mita”¹

So wrote the mining guild to the crown in 1702, revealing in a single sentence their tendency to exaggeration and their single-mindedness. Although Potosí in the days before amalgamation had thrived on the basis of free labor, the mining guild became addicted to this human subsidy that almost all other mining centers in the Andes had prospered without. The mita underwrote extravagance, inefficiency, abuse, and debt as much as it did silver production.

The arrival in Potosí of those mitayos who did not flee on the weeks-long journey was a time of commotion, as they were assigned to hovels located between the ribera and the Cerro Rico, where they lived with other members of their community. Not only did they pay rent during their servitude, but they were prohibited from living with their wives or daughters, who often worked as servants for, and were subject to the depredations of, the Spanish and Creole elite.²

On Mondays, the mitayos would muster in a series of human corrals, organized by province, on a hill called Huayna Potosí in Quechua, or little Potosí, beneath the Cerro Rico. In a process that took most of the day and was overseen by the governor, veedores, native chiefs, miners, and refiers, the mitayos would be dispatched to their respective mines and mills. Although the veedores were supposed to work inside the mine to ensure their safe operation, on Tuesdays they could often be found in Potosí's main plaza extorting money from Indians who had not shown up for work on Monday.³

Unless they were ore carriers, the mitayos would only emerge from the mine on Thursdays, when they would either buy food or have their wives bring it to them. When the mita was established in 1573, 2,308 Indians were initially assigned to the mills and 1,430 to the mines, the remaining 762 being assigned to associated tasks. This distribution would change over time, however, as the abundant tailings of the pre-amalgamation days were consumed and a greater percentage of Indians were then assigned to the mines. Each group was, in theory, to work one week and have two weeks off, in addition to Sundays and religious holidays.⁴

The mitayos were assigned unskilled tasks in the shafts, which primarily involved keeping the passageways clear of debris and carrying the ore to the surface in square wool mantles. As one writer noted around 1618, “when new Indians arrive at the mines, the horror caused by what they are told about them makes them lose” their spirit.⁵ Generally, Indians serving their first mita, or *mozorunas*, were more prone to accidents, less productive, and more frequently whipped. In the mills, mitayos primarily worked loading the ore into the stamp mill; sifting the ground ore; mixing, treading, and washing the pasty mass which contained the amalgam; and operating the ovens.⁶

Although the mitayos were a vital link in the chain of production, in both Potosí and Huancavelica the labor gang was generally led by a wage laborer, referred to as a minga in Potosí. Those mingas who extracted the ore from the rock face were called barreteros, and generally worked in groups of four. Once extracted, the mitayos would collect up to 100 pounds of the ore into a woolen mantle and drag, shoulder, shuffle, and carry it to the surface. There it was inspected by the overseer before being sorted on the basis of quality and broken up by *palliris*, who earned five reales a shift. Although the mine owner was to provide all workers with candles to see in the mine, they were generally of very poor quality and did not last the shift as they were supposed to. As a result, mitayos and wage laborers often had to purchase additional candles.⁷

“A Portrait of Hell”: Inside the Silver Mine⁸

As in Huancavelica, a journey into the mines of Potosí left a profound impression on those who experienced the concert of dark, narrow, twisting passageways, noxious fumes, and the disorientation which they produced. In 1550, over twenty years before amalgamation was introduced, Friar Domingo de Santo Tomás described “a mouth of hell through which enter every year . . . a great many people which the greed of the Spanish sacrifice

to their god, and it is a silver mine called Potosí.”⁹ Later, a colonial official described the mines as being “like the spaces in a sponge,” while another compared it to a “beehive with the innumerable entrances it has, and . . . the concavities . . . inside.”¹⁰ Unless they could access their assigned area from an adit, the workers would have to pass through one of the pitheads, which served as one of the “two thousand doors where men enter hell.”¹¹

From there, with only the wavering and uncertain glow of a candle tied to their thumb to guide them, they would descend via a series of wide ladders which were made of thick, braided rawhide into which were inserted wooden rungs. The width of the ladders allowed people to pass in both directions at once, and depending on the depth of the mine, they could stop on grates that served as landings and were spaced about every sixty feet. The Jesuit José de Acosta described his experience when he entered a mine in Potosí in the late 1500s. It was “perpetually dark . . . as they are places where the sun never visits, not only is it always dark, but also cold, and with a very heavy air and foreign to human nature and for that reason people get nauseous when they first go in, as happened to me, feeling ill and with cramps in the stomach.”¹²

Around 1610, Friar Martín de Murua described how the Indians would enter the mine and pass

through so many . . . dark and tenebrous places, that even the very experienced lose their sense and their way. There are some narrow places such that a man on his stomach can barely fit. In sum, what happens in the mine is a portrait of hell, in darkness and confusion. . . . Ordinarily more than twelve thousand Indians are working in the mines. Eight thousand are pick men and the rest are carriers. . . . Every day in the hill over one thousand five hundred pesos worth of tallow candles are burned, not counting those which are used in the town and mills. . . . All week llamas rise and descend the hill loaded with ore for the mills, they are there every hour.¹³

There were not only people in the mines but also hundreds of rats, “large and small . . . some brown and white, and others brown, white and russet.”¹⁴

Writing about the same time, the Jesuit priest Manuel Toledo y Leiva also expressed that

the horror of the mines is such that there are not words to describe it. It is . . . the most vivid image of hell, because there, 500, 1,000 feet in the abyss, without any light but that . . . of tallow candles and ichu . . . [Indians] enter by extremely narrow paths that by the force of pickaxes, crowbars and

blasting, time has created [inside there is] nothing more than the sound of crowbars being hit . . . accompanied by the sad song of the Indians, there they are all day and others all night, naked, fighting by the force of crowbars and pickaxes the strength of the rock, without sleep, poorly fed, whipped and in a continuous suffocation almost without air.¹⁵

Despite this horrific portrayal, like many of his peers, he argued that “it is necessary to continue the mita.”¹⁶

Hundreds of feet inside the mine, the pick men would work with thirty-pound crowbars to hammer and pry loose the ore, either working in a gallery or having been lowered into a vertical pit. Other workers would then sledgehammer the ore into smaller pieces, at which point the mitayos would load it into their mantles and, space allowing, tie it across their shoulders. A chronicler of Potosí, Bartolomé Arzáns, explained that when the mitayos would carry out the ore “sometimes they look like beasts walking on all fours with the load on their back, and other times dragging themselves like worms.”¹⁷ Once they arrived at the ladders, they would rise in groups of three, with the leader having a candle tied to his thumb. The paltry light it offered was often short-lived, as the wind coming down the shaft would often blow it out.¹⁸

In 1603 a priest described how, when carrying the ore to the surface, it was necessary to navigate “extremely dangerous descents and ascents, rising loaded with their sack of ore . . . taking four or five hours to come out by passes in which with one misstep they will fall five hundred feet; and after breaking themselves coming up, they find for comfort a miner who complains that they did not come out more quickly, because they did not bring out a bigger load, and then they make them go back” down below.¹⁹ Given such consistent accounts, it is difficult to believe a miner’s assertion that when the mitayos carried the ore, there was “great rejoicing among them in the work they do.”²⁰ Indeed, not only did Viceroy Torres de Portugal recognize, in the late 1580s, that the mitayos “suffer many injuries, harm and insufferable work,” but in 1728, the oidor of La Plata, Ignacio Antonio del Castillo, acknowledged that the mitayos were “the most miserable slaves” suffering “the most hard and cruel servitude.”²¹

Despite the conditions in which they toiled, mitayos were generally expected to bring up to 2,500 pounds of ore to the surface during each shift, and if they came up short, they were often whipped or they were fined up to a week’s salary. As the population implosion continued to take its toll in the 1500s, not only did fewer mitayos arrive but those who did were exploited more severely, often by people who rented mines and mills.

Even before 1600, to maintain production levels in the face of ever-deeper shafts and declining ore quality, miners began to abandon shift work and instead subjected mitayos to production quotas based on the quantity and quality of the ore they brought to the surface. Like the ransoming and renting of mitayos, the fact that quotas were illegal had no effect on the adoption of this practice. Although Viceroy Toledo ordered that mitayos carry two loads of ore to the surface per shift, by as early as the 1580s they were being forced in some cases to produce twenty-five. To meet these demands and avoid punishment many mitayos would, if they could, hire an assistant, or *yanapacu*, to help them carry the requisite amount of ore to the surface.²²

In 1727, a short-lived effort by native leaders to eliminate quotas was crushed when the mining guild closed the mines completely. By brusquely depriving free laborers of their employment, the guild and interested government officials were able to uphold the quota system. Ratified in practice if not in law, it was through increasing quotas that production in Potosí doubled between 1740 and 1790. While in 1750 the extraction quota for mitayos was generally five loads per shift, by 1767 this had doubled, along with the workload of those who worked in refining mills. By 1786 the quota was set at twenty-five loads, or approximately a metric ton of ore, per work period.²³

Writing around this time, a colonial official remarked,

[W]e know how one bad night breaks the strongest and well-nourished man. For these unfortunates, all of the nights are very bad. They rise and descend [the ladders] overloaded with one hundred pounds of weight, through caverns filled with horror and risk, that look like the rooms of devils. The mineral fumes break them in such a way, that due to the exhaustion from these heavy tasks, or from their copious sweat in the underground heat, and excessive cold when they emerge from the mine, they come out so languid and deathly that they appear as cadavers; and their rest for the morning is to carry around what they took out from the mine in the night . . . so then, we can say with truth that the abuse which they suffer has made them the most unhappy class of men in the world.²⁴

“Breaking the Heavens with Their Screams”: Misfortunes in the Mines²⁵

The work of mitayos and others in the mine was not just arduous, it was also extremely dangerous. As in Huancavelica, cave-ins, rockslides, and

injuries from falls and other causes were common in Potosí and other mining towns. In addition, as silver-containing ores often contain some mercury, miners were to some extent exposed to quicksilver, although to a minuscule extent compared with workers in the mercury mine. According to one estimate, one-half of those who entered the mine in a given week would be injured. Safety regulations were minimal and offered little protection. For example, in Viceroy Toledo's *Ordenanzas* of 1574, of the ninety laws concerning mining, three concerned safety issues: a prohibition on open pit mining, rules concerning mineshaft supports, and another concerning ladders, which could be no longer than eighty-two and one-half feet long with the rungs sixteen and one-half inches apart.²⁶

Writing in 1585, a miner and chronicler of Potosí made no attempt to conceal the perils that plagued those who worked in the dark entrails of the Cerro Rico, writing that of what was extracted "we could say that it is more blood than ore."²⁷ He explained that "ordinarily they come out dead and others with broken heads and legs . . . and every year more than fifty die, that this savage beast swallows alive."²⁸ He recognized

the danger to their lives due to the depth and poor passages. . . . [W]hat a rigorous executioner this hill has been for that nation, as every day it consumes and finishes them, and they have a life which is saturated by the fear of death. It is amazing that as they are naturally fearful . . . they do not hesitate to risk themselves where even the brave are unwilling to go. And every day they experience a thousand deaths and disasters.²⁹

Writing in 1596, Antonio de Ayans estimated that at least one person was wounded each day on the ladders as they were struck by ore falling from those carrying it above. These were sometimes the fortunate ones, as he referred to "others whose body is all ground up, and from week to week there are one or two deaths, not including those who remain in the depths of the mine, broken to pieces."³⁰ Writing in the early 1700s, the chronicler Arzáns described how "innumerable are those who have perished in its guts, every step that they make . . . brings them to the threshold of death. . . . Sometimes the candle goes out and there they die, other times the very ground they walk on swallows them . . . other times they are found buried in the loose rock that falls on them; others fall in those deep wells and lagoons . . . and drown."³¹

Apart from injuries, collapses of differing types were the cause of many tragedies inside the mines. In 1595, a sinkhole suddenly swallowed and killed at least three hundred Indians and two Spaniards, burying them in

a mass of rock and leaving a cloud of dust to settle on their dark and silent tomb. Similarly, in 1616 a cave-in crushed 186 Indians in the Descubridora mine. Some victims of these catastrophes did manage to survive. For example, in 1653 a cave-in resulted in eight Indians being trapped for two weeks, drinking the water in the mine, before being rescued against all odds. Likewise, in 1723, a collapse in the El Rosario mine trapped fourteen Indians who also managed to escape.³²

The chronicler Capoche portrayed the scene in the aftermath of one collapse in the late sixteenth century, which occurred overnight and killed twenty-eight miners. He related how in “the morning all of the officials went up the hill, along with a great number of Indians and the women, sons and relatives, who were breaking the heavens with their screams. And as there was so much soil and rock that fell on top of them, they did not even try to get them out, and there they stayed until with the passage of time things were cleaned, and they found them.”³³

He also related the circumstances of another cave-in, in which a Portuguese miner and seven Indians were trapped. They were able to escape immediate death by fleeing to two hollows, the Portuguese and five Indians in one and the other two Indians in another. Scores of people spent days frenetically digging to extricate them, but the more they would burrow, the more rock would fall. Despite this, they did manage to rescue the two Indians who had huddled in the one cavern, and they kept digging day and night to rescue the others. Capoche related how during this time

Those outside would encourage them, giving them hope . . . and the Portuguese [trapped inside] would tell them not to give up or get tired . . . that they could resist hunger, although the cold was making them very tired, and to sustain themselves they had eaten their shoes. And the Indians also spoke. And four or five days passed like this, always bringing fresh people so they would work with more energy. And when it was seen that it was not possible to get them out, a Father from the Company of Jesus came to confess them, and the Spaniard gave his testament, and they said farewell to one another with many sighs, the Indians saying some simple things to tell their women and children, and they died without being able to be helped. The one who lived longest was an Hispanicized Indian, who said that the Spaniard no longer spoke, that he had lain down to sleep, and that his other companions were dead beside him.³⁴

There was, on occasion, punishment in clear cases of negligence by miners. This was usually limited to fines, which could reach 200 pesos in the

event of the death of a worker, while an injury could cost a miner up to 350 pesos, with the injured worker receiving one-half of the fine. In exceptional cases, a miner could be jailed or even exiled from the city. Given the corrupt nature of the judicial system, the political and financial influence of the miners, and the generally low regard for Indians and their lives, punishment for negligence was the exception rather than the norm.³⁵

The perils and travail of ore extraction underscore the importance and appeal of gaining access to the mines through adits, which were generally around eight feet wide and six feet high. The workers benefited as the adits reduced accidents on the ladders, such as falls or being hit by plunging rocks from carriers above. For mine owners, the primary benefit was efficiency, as ore could be brought out much more quickly, thus increasing production. The person who constructed the adit received 20 percent of the ore that passed through it, as they took years to construct. For example, in the 1590s, one adit of 750 feet took twenty-nine years to construct, which averages out to about six inches a week.³⁶

With so many people working in the mine and carrying out ore, there was considerable activity at the pitheads, especially on Thursday mornings as people bartered for ore. When mitayos brought out and deposited their load, overseers measured its height by a staff. Given the demands of the miners, the realities of the mine, and human limitations, mitayos often failed to satisfy their overlords and were flogged on the spot. As the chronicler Ayans explained, “the miners are very hard and rigorous with the mitayos if they do not take out all the ore that they want and they whip and punish them with extraordinary asperity.”³⁷ In 1599, two Indians lamented that “the cruel miner has no compassion or care that the mines are so deep . . . nor that the Indian emerges broken. . . . [He] orders four Indians to tie him up and uncovering his privates they whip him without compassion nor pity . . . saying ‘dog, why didn’t you bring me more ore, you’re costing me silver.’”³⁸ Beatings of Indians sometimes resulted in death, such as in the town of Puno in late 1739. There, the native Juan Flores was ordered to work inside the mine, which he was evidently unwilling to do. In the face of such disobedience, the miner ordered him beaten with a long stick. During the beating, he briefly escaped, only to be caught and beaten more at the entrance of the mine. A few days later, with wounds to his torso and head, he died in his bed.³⁹

It was in these circumstances that hundreds of palliris, or sorters, divided the ore according to quality, while others put it into sacks, loaded it onto llamas and mules, and brought it downhill to the refining mills. Whereas a mule would carry about 125 pounds of ore, a llama carried 60 at

most. Also at the pithead were miners' wives who provisioned them with food, coca, and chicha. Joining them were merchants, who did a brisk business there. As one contemporary explained, "Everything . . . that can be eaten in the most well provisioned cities in Europe is brought up the hill by young and old Indian women, and they do not want money for it, but rather to barter for ore."⁴⁰ Much of that ore was then brought down to the Ghatu plaza, adjacent to the city's main plaza, where it was sold, especially from Thursday to Saturday.⁴¹

The Refining Mills: "Some . . . of Water, Others of Blood"⁴²

In colonial Peru, and for that matter New Spain, the production of silver through mercury amalgamation was a process of constant trial, occasional error, and continuing adjustment. Small errors in the refining process could have costly results, both in terms of mercury consumption and the yield of the ore. The first step in refining was to determine the quality of the ore. This, like the entire refining process, was a strictly empirical process. The proper classification was vital, for the richness of the ore determined the amount of other ingredients to add during the refining process, and once things went wrong they were very difficult to correct.⁴³

Ores were categorized primarily by their color and hardness. For example, the reddish *pacos*, or silver oxides, and *soroches* contained a considerable amount of lead, unlike the richer, reddish *rosicles* and the hard, dark sulfide *negrillos*. The brownish *mulato* ores, which were half oxides and half sulfides, ranked between pacos and negrillos in terms of quality. For 5,000 pounds of ore, also known in Potosí as a *cajón*, negrillos would yield between twenty and twenty-five pounds of silver, whereas mulatos generally yielded half that, and pacos only rendered around two and one-half pounds. Although in the early 1600s an average yield was about ten pounds per *cajón*, by the 1740s it had slipped to five pounds or even less.⁴⁴

The refining mills were dirty, loud, and extremely dusty complexes. As Bernabé Cobo wrote around 1630, in "every mill there is a large house with many rooms . . . both for office and for living space for those who work there, for which reason each mill looks like a small town."⁴⁵ Within its walls lived the mayordomo, or overseer, and often his family, along with a carpenter and various assistants. In addition to living quarters were various storage rooms, offices and often a chapel, all of which usually framed the areas where the ore was ground, sifted, mixed with chemicals, spread out and washed, and the resulting amalgam refined.⁴⁶

The single most costly component of a stamp mill was the axle which connected the twenty-five-foot waterwheel to the iron-tipped hammers that crushed the ore. An axle was usually about twenty-two feet long and two feet square, and could easily cost 1,500 pesos. Many were produced from trees felled in the Pilcomayo valley, while others came from the region of Cochabamba, or as far away as Tucumán. Although the cost of an average mill with one stamping assembly and six to eight 100-pound hammers could easily run up to 12,000 pesos, it could pulverize 15,000 pounds of ore in a day. A mill of this size would require between forty and fifty Indians to cover the various phases of the refining process, at least three of whom would be dedicated to sifting about 3,000 pounds of ore every twenty-four hours.⁴⁷

When the llama and mule trains loaded with ore arrived at the mill, workers off-loaded it, further broke it up, and, if it was damp, spread it out to dry. When ore was ready to be crushed, *morteros*, or mitayos who operated the stamp mill, would shovel it under the hammers, which moved alternately like pistons in an engine and came crashing down on the ore. Once it had been reduced to the consistency of flour, men, women, and children sifted it by shoveling it through angled sieves made of either wire or punctured steel. Any pieces which did not make it through the sieve were sent back to the stamp mill. As with the excavation of the ore, those loading it into the stamp mill and sifters worked under a quota system, measured by volume and enforced by the lash. While the number of mills more than doubled between 1692 and 1799, the number of mitayos to operate them declined by 40 percent, with the remaining ones working that much harder.⁴⁸

The pulverization of the ore generated an extraordinary amount of dust. Cobo noted that "So great is the dust which comes out from the grinders and sieves that those who work there stop up their noses with cotton or wool and put leather bags in their mouths, in order not to swallow the dust, because it is composed of many metals and very harmful."⁴⁹ In the 1790s, an official in Potosí described how the mills "raise up so much dust . . . that one who is not accustomed to breathe inside these facilities cannot suffer it."⁵⁰ These clouds of dust also contained silver, a loss of which one mining official estimated to be one-sixth of the total produced. He wistfully remarked that "the infinite atoms of silver that have settled on the floors of the mills . . . will have made all of them of silver; and I would be content to be rich if they gave them to me."⁵¹

“A Task So Dangerous for the Soul and So Terrible in This Life”: The Amalgamation Process⁵²

In 1781, in the wake of the Indian-led Great Rebellion which devastated the provinces of Peru and Charcas, a miner in the town of Oruro named Juan Alcalá y Amurrio carefully penned a manual on the refining process, ostensibly for his son but very useful for later generations. Acknowledging that amalgamation was not only an art but one about which refiners were loathe to share their secrets, he began by writing, “I well know, discreet reader, that the reward that they will give me for writing this book will be slander . . . and hate.”⁵³ For Alcalá y Amurrio, the amalgamation process was nothing less than a tragic love affair between mercury and silver, irresistibly attracted, briefly united, and ultimately separated. He explained that

such is [mercury’s] yearning to unite with silver, that it searches for it in the most hidden of places, overcoming the risks . . . that are knives which cut it to shreds and destroy it, and so much love does it have for silver, that in seeking its union, that it will even suffer the risks of fire . . . and as mercury is so gentle and delicate, it fears nothing in achieving the union it seeks.⁵⁴

The matchmaker for this amorous bond was the refiner,

as it is he who helps . . . the mercury through all of these risks and dangers to which it is exposed, guiding it on the safest roads, salving the wounds that its enemies . . . inflict upon it, through the refiner it achieves the goal of its beloved desire, and achieves the natural and desired union with silver, taking it out of the deep and old prison in which the author of all has placed it.⁵⁵

As the sponsor of many such unions, Alcalá y Amurrio knew from experience that many things stood in their way. In order for amalgamation to occur, the refiner had to balance many contradictory elements which, in that time, were categorized as to whether they were seen to be hot, cold, wet, or dry. He admonished his readers that “this science of refining is a sea, and to swim in it without drowning, you must follow these rules . . . buoyed by the good knowledge of mercury . . . you can overcome any danger that presents itself.”⁵⁶

The first step to refining was the thorough crushing of the ore. In the case of the very rich negrillos, these had to be spread out in an oven and toasted before being mixed with reagents. This was a delicate process, and

Alcalá y Amurrio urged his readers to first do some test burns before toasting an entire load. The trick was to sear, but not burn, the ore under a high heat, and then to lower the temperature and stir it frequently. When the ore had lost its sheen and the yellow sulfur smoke had ceased, it was ready to cool and refine. It was important not to overcook the ore, and Alcalá y Amurrio related a case in which properly toasted ore yielded 1,500 pounds of amalgam per cajón, but when the same ore was overcooked, it only yielded 1,200.⁵⁷

Once the ore was ground, and if necessary, toasted, Indians then shoveled it into a large stone tub, called a cajón, where it was mixed with mercury, water, and minerals. Before the days of amalgamation, ore was crushed in wooden boxes (hence the name *cajón*, or box), but with the introduction of mercury-based silver refining, the term became a unit of measure of 5,000 pounds. Often refiners mixed and processed together ores of differing quality, such as pacos and negrillos, as they found that this increased yields. The next step was the addition of the various catalysts, which always involved a bit of guesswork. This was kept to a minimum, however, by the expertise of the refiner and his initial evaluation of the quality of the ore. Alcalá y Amurrio not only emphasized caution throughout the refining process but also valued “experience because in the darkness of our knowledge it is the lantern which guides us.”⁵⁸ Due to the vagaries of refining, sometimes experience and caution were not enough, and to ensure “a good outcome,” he urged his readers to seek divine intervention.⁵⁹

Having loaded the 5,000 pounds of ore in the cajón, workers then added 500–600 pounds of salt and then water. If the mix was too wet, the mercury would sink to the bottom, and if it was too dry it would not spread evenly. To achieve the desired pasty quality, miners would also add the *relaves*, or leftover mercury- and silver-containing paste from previous processings. The refiner would then order the addition of 200–500 pounds of mercury, depending on the quality of the ore. This was squeezed through a cloth, and sprinkled over and then folded into the mass. “Hot” ores such as pacos contained lead and required less mercury, while rich “cold” ores such as negrillos contained lead, tin, and iron and required more mercury and also lime. After the salt, water, and mercury had been placed in the cajón, depending on the nature of the ore, the refiner would then add around six pounds of lime, three pounds of iron, and small quantities of tin or lead. In addition, 100 pounds of copper pyrites, also known as magistral, was added to the mass. Refiners produced magistral on site by toasting a mix of ground copper, salt, and relaves, in much the same way as negrillos were toasted.⁶⁰

Generally, rich sulfide ores such as the various types of negrillos used more magistral and ground iron, the latter of which reduced the amount of mercury needed to process these ores by up to 25 percent. Most of the iron in Potosí was imported from Vizcaya, Spain, and it was mixed in water before adding it to the *torta*, or ore mixture. This innovation was developed in 1586 by Juan Andrea and Carlos Corzo Leca, miners in Potosí who had earlier held the transport contract to bring mercury from Huancavelica to Potosí. The savings in mercury which this technique offered led to it being quickly adopted by other miners in Potosí. Royal officials, however, recognized that this would decrease mercury sales, and hence royal revenue. Although authorities briefly banned the practice, they could not stop it, and the addition of iron became an integral part of the refining process. By the mid 1590s, Potosí was consuming around ninety-one metric tons of iron a year, some of it later coming from pulverizing the iron flasks in which mercury was shipped from Almadén to Potosí in the 1790s.⁶¹

The goal of combining these elements in the ore was to ensure that the mercury was properly distributed in the mass and to thus achieve a balance between “hot” and “cold” elements. For example, mercury, iron, tin, and lime were characterized as “cold” and “wet,” while salt was considered to be hot and damp, and magistral as hot and dry. If one added too much magistral, it would limit the ability of the mercury to amalgamate with the silver. Lime, which miners began to add around 1603, was seen as neutralizing the hot and dry impurities in the ore. Alcalá y Amurrio urged refiners to add lime in small batches because it is slow to act and people often ended up adding too much.⁶²

Once the various ingredients had been thoroughly mixed in the cajón, the torta was then spread out in a stone patio, called a *buitrón*. Around forty feet long, ten feet wide, and enclosed by a wall six or seven feet high, a buitrón would hold anywhere from ten to fifty loads of the ore mix. Initially, they were constructed above a fire chamber, in what was called a *cajón de buitrón*, as the application of heat accelerated the amalgamation process. By the 1580s, however, the scarcity and expense of wood and ichu in Potosí led to the abandonment of this technique and its substitution by the cold process, which endured for the rest of the colonial period. As a result, the term *buitrón* became synonymous in colonial mining with a “patio,” as in the “patio process” of refining. As the cold process did not use heat, the patios cost less to construct because they did not require a furnace beneath. There was, however, an enormous downside for the Indians, as it added “the imponderable cost and work,” and health effects, of having to tread the mercury-impregnated mass to promote the amalgamation in lieu

of heat. In order to maintain an ongoing production cycle, many mills had four or more buitróns, and the more tightly the stones or tiles fit, the better, as mercury would escape from any spaces between them.⁶³

An alternative refining process was developed in the first half of the seventeenth century by Alvaro Alonso Barba, a priest with an interest in alchemy. His main innovation was to boil the torta in vibrating, copper-lined tubs, as opposed to placing them in a patio. As with the heated buitróns, the system was faster but more costly due to the need for fuel. In addition, if the copper lining in the barrels had impurities, it would react with and reduce the efficacy of the mercury, and what the system offered in celerity it often lost in yield relative to the cold patio process.⁶⁴

Despite experimentation and efforts of innovation, it was the cold process that endured for the colonial era and much of the nineteenth century in the Andes. Once the slippery torta had been spread out in the patio, it would undergo the first of many treadings, called the *repaso* process. Here Indians, known as *repasaris*, who were usually barefoot and often immersed up to their knees or thighs, would march systematically through the paste, while often mixing it further with a shovel. For each cajón of paste in the patio, at least one Indian would be assigned for the repaso. This was done up to five times a day, usually after the sun had somewhat warmed the mass. Overnight, a crust would form on the torta, and the treader would use a spade to open a series of holes in the torta into which water would be poured before beginning the day's treading. Generally, in the wintertime, the process took longer and required more treading. Some miners even ordered almost continuous treading so that the warmth from the Indian would warm the mass. As a result of their prolonged exposure to mercury, moisture, and cold, repasaris were frequent patients at Potosí's San Juan de Dios hospital, often arriving not only with symptoms of mercury poisoning but also frostbite.⁶⁵

At least once a day, the refiner would dip a ceramic bowl into the torta to examine the appearance of the mercury globules. If they had a dull leadish quality, as opposed to the desired sheen, it was considered too "cold" and he would add around fifty pounds more of salt. On subsequent testing, if the mercury was still leaden, he would add more magistral or other acidic solutions. If, on the other hand, the mercury had broken down into tiny globules, then the mass was considered to be too "hot," and could be "cooled" down by adding iron, lime dissolved in water, tin, or ash. The important thing was not to add too much of any ingredient and to be patient, for, as Alcalá y Amurrio counseled, "the medicines to treat the afflictions from which the mercury suffers must be given time."⁶⁶ At the end of a week, he

also called for the addition of up to forty pounds of mercury to the mass, spread out over a few days. By the end of the second week of daily repasos and testing, the amalgam would begin to form. It would, however, take between twenty-two and thirty days before it was ready for washing.⁶⁷

At this point, Indians carried the mass from the patio to the washing canals by heaping it into a mantle. For much of the colonial period, the torta was placed into a series of interconnected, leather-lined basins, called *lavadores* or *tinadores*, through which water gently ran while Indians stirred it. Often, some more mercury was sprinkled onto the mass just before it was brought for washing, in an effort to maximize the silver yield. As the water diluted the torta, the amalgam settled to the bottom and could be collected, a process that took about forty-eight hours. The process changed only slightly over the colonial period, when in the 1700s refiners began to wash the torta in three interconnected canals built into, as opposed to above, the ground.⁶⁸

Just as Alcalá y Amurrio urged his readers to use caution and patience to ensure the mixing, treading, and washing processes worked well, he also called for close oversight of the Indian workforce. In addition to reflecting his views, his advice also underscores the fact that Oruro, where he lived, did not depend on the mita except from 1610 to 1620, and otherwise relied on a voluntary wage labor force.⁶⁹ It was the Indians, he explained,

who do everything . . . by their hand the treading of the paste is done, or better said, by their feet, and it is they who add the ingredients, [and often] do it all wrong. Such that instead of making the most of it, they do much damage . . . they do everything backwards . . . and from them results our loss, but do not hate them for this, nor abuse them, nor punish them by deeds nor by words . . . they are not our enemies, [but] do not to rely on them for the least thing . . . pay them well and promptly for their work and their sweat, which is great, and love them on the inside, but do not show them this because they are not people who respond to love, when it is necessary, punish them without being cruel, and flatter them without being excessive . . . and with the memory of this advice and deeds . . . you can expect a tranquil life.⁷⁰

Once the amalgam had been washed and separated from the ore and other ingredients, it was referred to as *pella*. This was loaded into six-foot-long cloth cylinders where it was compressed and repeatedly swatted with paddles in an effort to recapture some of the mercury it contained. The remaining amalgam, which was now about one-sixth silver and five-

sixths mercury, was then formed in a conical ceramic mold which held 100 pounds, called a *piña*, or pineapple, due to its resemblance to this fruit. The indented bottom of the piña was placed upon a metal pole and placed above a fire. If charcoal was used, refiners would apply a fifty-pound charge. Refiners, however, used many fuels, such as ichu, llama dung, and *yareta*, a hard, highly resinous, very slow-growing evergreen plant that resembles and grows like moss. The piña would be enveloped by a larger, second mold. It was in this final stage of refining when the mercury was burned off that considerable amounts literally went up in smoke to be breathed by Potosí's inhabitants and settle on them, their foods, and their city.⁷¹

As the mercury volatilized over a period of eight to ten hours, much of it condensed on the top of the second cone covering the piña, ultimately flowing out through ceramic tubes which ran through water, condensing the mercury and channeling it to a small reservoir. Once removed from the mold, the resulting sixteen and one-half pounds of silver looked like a shiny, hard sponge. These were in turn reduced to eliminate air pockets, and two piñas would yield one bar of silver which weighed about thirty-three pounds, or 329 pesos of eight. Some refiners would smelt the piña for less time in order to have their product weigh, and be worth, more. In either case, most silver was reworked by the refiner, purchaser, or mint to make bars, ornaments, or coins.⁷²

Although refiners did all they could to recapture all the mercury during the washing and smelting process, much—easily a third—was lost during the whole production process. Even that which was not lost in one refining cycle was lost in the next or the following. Among the causes of the loss was the use of the ceramic piñas, into which the amalgam was placed before smelting, the ceramic hood which went over the piña, and the ceramic pipes through which the mercury ran after being condensed. As in Huancavelica, the porous nature of clay facilitated the escape of mercury, as did the generally inefficient and artisanal nature of the entire process. As the colonial official Pedro Vicente Cañete y Domínguez wrote in the late 1780s, "Not a small amount of harm would be avoided [if inspectors] checked the retorts or smelting vessels."⁷³ Writing in the mid 1500s, Georgius Agricola, in *De Re Metalica*, advised his readers that if, when smelting mercury, one detects a sweet smell, mercury is being lost.⁷⁴ This must have been a near-constant smell in both Potosí and Huancavelica, and one that residents were probably habituated to, for mercury was being volatilized there every day and night, all year round.

The washing process was a sloppy task, and both mercury and silver were lost as the water passed through, or splashed from, the series of

troughs. This valuable runoff was generally directed to wells or other settling areas where it was reprocessed. There were three grades of this runoff, the first and most diffuse called *lamas*, which consisted of amalgam and other impurities. The second grade was the *relavillo*, which was somewhat heavier than the lamas and as a result settled in the washing canals, while the third and heaviest byproduct was relave, a grainy, impurity-laden amalgam that settled on top of the pella. While the current carried the lamas along, an Indian would push along the relave and relavillo to the settling tank, where all three byproducts would be extracted and refined.

Such was the value of these byproducts that their reprocessing was an industry in itself in which over 3,000 Indians worked in Potosí alone. Once the runoff had dried somewhat, it was processed much like amalgam, although in larger-capacity ceramic vessels that held around 500 pounds. These were covered by ceramic hoods, sealed, and smelted for around six hours. The mercury was recaptured on the inside of the hoods, and the residue was added to another load of torta when a new batch of ore was processed. The lamas from a load of torta that had used lamas were termed *relamas*, and these were also reprocessed by smelting them for around thirty-six hours in large reverberating ovens. The resulting product, appearing like ground bricks, would be added to a subsequent load of torta in lieu of iron. The richer relavillo and relaves, which could contain as much silver as paco ores, would be rewashed and then smelted to extract the remaining mercury and to produce silver. In Potosí and near the Tarapaya River, there were at least fifty ovens dedicated to the treatment of these residues alone.⁷⁵

Much, but far from all, of the silver produced in Potosí was taken to the treasury office where it was tested for purity, or assayed, and taxed. In the assaying process, a small sample was taken and weighed before and after burning to determine its purity. After assaying, the owner had to pay a 1.5 percent assaying tax, in addition to the quinto of 20 percent. This latter impost was, in 1735, reduced to 10 percent after years of lobbying by the mining guild. After these payments, the silver bar was stamped indicating that the relevant taxes had been paid. If the silver was to be minted as coin, the owner then paid *señoraje*, or a minting tax, of one real per eight ounces of silver in addition to the *braceaje*, or minting fee, of two reales per eight ounces of silver. The remaining silver was then minted into coins in denominations of one-quarter, one-half, one, two, four, and eight reales. After taxation, every *marco* of silver yielded sixty-seven reales, or about eight and one-third ounces.⁷⁶

Although work in the mines presented a host of immediate dangers, mitayos who labored in the mills suffered fewer accidents but suffered

much more from mercury poisoning and silicosis from the mercury and dust-laden air. Accidents were, however, not uncommon. Capoche related that “in the mills every day people are injured. And only in working at night in such a cold land and attending the crusher, which is the hardest work due to the dust that they get in their eyes and mouth, it is enough to cause them much harm. And thus is the hospital [filled] with injured Indians.”⁷⁷ He also described how when a poorly constructed wall of a mill collapsed, “four Indians who were working the mill were crushed. And in another mill, as an Indian was going to load the mill, it got a hold of him and smashed him to pieces . . . and if one were to describe this extensively, one would use a lot of paper.”⁷⁸ Although the Augustinian friar Antonio de la Calancha was convinced that God had placed the riches of Peru for the Spanish, he recognized the human sacrifices that they occasioned. He averred that the “mills have ground more Indians than ore, every peso that is minted costs ten Indian lives that die in the guts of the mountain.”⁷⁹

Even those who could endure the tasks and avoid injury often would not long survive the consequences of silicosis. Referring to those mitayos who worked in the mills of Potosí, the intendant of Cochabamba remarked how the “sifting results in a subtle . . . dust . . . that damages their lungs such that most of them get sick with an incurable cough, a result of which most of them die soon after returning to their homes.”⁸⁰ The governor of Puno, Francisco de Viedma, also described how “those that do the grinding . . . of the ore necessarily contract mortal asthmas and [those who work] in the humid mines incurable” lung problems.⁸¹

In 1794, the lieutenant governor of Chayanta province noted that those Indians who were assigned to operate the stamp mills and sift the crushed ore would invariably come down with an “incurable cough, which in their language is called choco, from which many die . . . and others get sick; and in the end all those who are attacked by it are victims . . . in the flower of their youth. . . . [S]ince there has been a mita to Potosí, this illness has been known, and no one has dedicated themselves to do anything to prevent or remedy it, for that reason it is incurable in the provinces.”⁸²

Mines, Mills, and Malice

Work in the mines was, under the best of circumstances, grueling, perilous, and conducted under the constant threat of physical abuse by miners and overseers. Arzáns characterized the mill overseers as people who “lack charity [and] were cruel and tyrannical with the poor Indians, who the more humble and patient they are, the more the Spaniards are terrible

to them.”⁸³ His criticism went beyond the mill operators to the miners and refiners generally, writing that while it is

presumed that the Indians are born without honor, live without shame, and die without care, they cannot die without suffering, knowing well that their wives, children or relatives will be sold to pay for their burial which the priests demand with such force, they do not live shamelessly by nature but rather due to the tyranny with which the Spaniards treat them, publicly flogging them for minor things, taking away their daughters and often even their wives for their abominable depravities, not paying them much for their work. . . . [T]hey are not born without honor, God made them free and the abominable violence of the Spaniards has so unjustly made them slaves.⁸⁴

The day-to-day enforcement of this system often took the form of a flogging of fiery lashes, or a beating, intended not only to punish but to serve as an example for others. Among those working in the mines, a common pretext for whippings was the failure of the mitayo to bring his quota of ore to the surface in the time allowed. For example, in 1594, an overseer flogged Alonso Yana when, at the end of a week’s labor, he was one load short.⁸⁵

In the Huarihuari mine near Potosí, the continuing flight of mitayos not only reflected but aggravated a vicious cycle of abuse where mitayos were routinely abused “with sticks and also with whips until they were left crippled and . . . in bed.”⁸⁶ As more Indians fled the abuse, those who remained were exploited even more severely and were more inclined to flee. The situation was exacerbated by fact that the Spanish overseers did not speak Quechua, leading to a “Babylonian confusion” in the mine and mill. The mitayos especially feared the Negro overseer Mariano, whom they described as “the whipping executioner.”⁸⁷ Here, and elsewhere, the mitayos were forced to lower their pants, or have them cut off, when they were flogged. This was not only a severe punishment for the Indian but, like having their hair shorn, also a grave humiliation.

The mitayos in Huarihuari described how they had been marched to Potosí with their hands bound and then locked in the mine, and how the overseer would undercount the number of loads they struggled to bring to the surface. Not only were the Indians forced to work seven days a week and on religious holidays, but, to their dismay, they had been coerced to work without pay in the mill. They related to their advocate how no sooner would they “exit the mines . . . carrying such heavy ore, from so many dangerous paths, covered in mud” than they would be sent back “inside,

also loaded with rocks” to reinforce the supports inside.⁸⁸ They could not live on the wages they were due, and less so after they had been docked for not meeting their quota and having to purchase their own candles. It all added up to “intolerable work, fatigue, bad treatment by whipping, blows and other extremes of cruelty” which only became worse after they filed an initial complaint.⁸⁹

These Indians had recently died in the mine. One, Sebastián Tupuri, was a mitayo serving his first term who got lost while carrying some tools to an excavation point. It appears that he perished from *umpé*, or suffocation caused by either carbon monoxide or carbonic acid poisoning. A governor of Huancavelica, Antonio de Ulloa, described the symptoms of *umpé* as “a great tingling in the body, but particularly in the extremities, in the face and in the head; deafness and much ringing in the ears, the eyes swollen, as if they want to pop out of the head.”⁹⁰ Another mitayo, Melchor Mamani, died after emerging from the mines with “wounds and bruises on the body” and vomiting blood, while one of his companions, soon after coming to work one morning, was gripped by an incapacitating pain in his side, and expired on the spot.⁹¹

For his part, the Huarahuari mine owner, Salvador Fullá, flatly denied everything, insisting that the Indian who had died inside the mine had died from “natural causes.”⁹² The resident priest also supported Fullá, asserting that the Indians were well paid and treated fairly, going so far as to laud the miner’s “Christian purity.”⁹³ The protector of the Indians, Juan José de la Rúa, vigorously refuted these assertions, insisting that the Indians were treated “with more inhumanity than animals.” He added that “Everyone knows how much the Indians suffer working in the hill and mills of Potosí, but those that work today in Huarahuari would look upon work there as a rest.”⁹⁴ The governor of Potosí, Francisco de Paula Sanz, personally went to Huarahuari to investigate, and after receiving the petition from the Indians, he ordered them freed. In his capacity as native advocate, de la Rúa unsuccessfully sought to put an end to Indian abuses in Potosí. These included such inveterate practices as floggings without the governor’s approval, although permission seemed easy to obtain, as well as jailings without an order of a judge, the private seizure of Indians’ mules, and unremunerated *faena*, or task, work.⁹⁵ One can only wonder how sincere de la Rúa’s efforts were, as Indians had lodged complaints against him for failing to act on their behalf. More telling, and ironic, was his authorship in 1814 of a document on behalf of the mining guild urging that the royal order abolishing the mita be suspended. In so doing, he referred to the “miners, whose laborious arms have made America flourish” and went

so far as to argue that many Indians were clamoring to serve “as a point of honor” and that “Potosí, far from consuming the Indians, has increased them.”⁹⁶

Although mitayos were routinely abused in Potosí’s mines and mills, conditions were generally worse for them in those that were leased by their owners. With more overhead as a result of rent, the tenant miners generally demanded more productivity from mitayos and relied more heavily on coercion to get it. Even as early as 1599, one writer noted that renters make the Indians “work too hard . . . treat and punish them harshly and . . . pay them very poorly.”⁹⁷

In one mill on the ribera, the mita captain and four mitayos filed a complaint directly with the Audiencia in La Plata concerning their treatment by the overseer and the lack of action taken by officials who were to enforce regulations on such issues. It is interesting that they chose to file the case directly with the Audiencia in La Plata, rather than with the protector of the Indians in Potosí. They asserted that they were bypassing the protector due to the “urgency” of the case and because he had been unwilling to advocate on their behalf in Potosí. They may also have anticipated a more favorable ruling as the audiencia had no great fondness for the Potosí officials or the mining guild.⁹⁸

Among their complaints was that there was no rotation of the Indians who were working the stamp mill, and instead the burden was falling on only eight Indians “with damage to our health.” They explained that when the alcalde de minas investigated at the behest of the governor, the mill renter, Manuel Ursín, persuaded him to ignore the conditions. After the departure of the alcalde, an outraged Ursín ordered the overseer and three others to give “furious blows and kicks” to the complainants, which resulted in one of them “spitting blood.”⁹⁹ Once in La Plata, they explained that they were in fear of their lives as two years earlier the same overseer had beaten an Indian, Tomás Achata, to death with impunity. Despite their creative legal strategy, it led nowhere, as the audiencia only ordered the case remitted to the protector in Potosí.¹⁰⁰

Things were bad in Potosí and its surrounding district, but they could be worse in further outlying areas as there were even fewer impediments to Indian maltreatment. For example, in the Canto mill in Paria province, Javier Mamani had worked as a torta treader who, after fifteen days of work, sought his pay. As he explained it, upon requesting his recompense he was forced to the ground and “spread out by four Indians,” who held him down as he was flogged in the patio. Although the wife of the mill owner had ordered the lashing, it was cut short by her husband, Josef de

Casaos. According to Mamani and others, the mill was nothing less than a vortex of violence where people were routinely whipped, many after having been abducted from their fields during planting and harvest times and forced to work in the complex.¹⁰¹

Abuses outside of the mines were often accompanied by disregard for proper maintenance inside the shafts. In some cases, the accidents which resulted were attributed to suffocation as opposed to negligence. For example, in 1748 in Poopó, also in Paria province, an Indian perished in the mine of Celia de Orosco. When workers finally dragged him out, he had all the signs of having fallen, including a tool sticking from his lung, blood coming from his nose and mouth, and cuts on his forearms, suggesting he tried to drag himself out. Further, if he died from *umpé*, then those around him would have probably suffered the same fate. Despite this, the owner maintained that the Indian died from suffocation and that he, the owner, was hence not responsible.¹⁰²

Production, Payment, and the Calculus of Coercion

In colonial Spanish America, the profusion of laws and regulations often resulted in numerous legal contradictions. While this did provide flexibility in application, it also often resulted in judicial paralysis. Within this context, legal processes were subsumed in a profoundly corrupt, caste-based system in which government positions were sold, as were the actions, inactions, and decisions of officials. Viceroy and governors of Potosí and Huancavelica were evaluated not so much on the basis of their application of and adherence to laws but rather on the amount of mercury and silver produced and taxed during their administration. Because of this, the regulations concerning the mita were largely dead letters since the ink had dried on Toledo's *Ordenanzas*, and an intensely abusive system was itself abused from its inception.

Among the first such provisions to be jettisoned in practice was the stipulation that mitayos were to work for one week and then to have two weeks off to earn a wage with which they could sustain themselves. Depopulation, flight, and the ransoming of would-be mitayos resulted in the increasingly severe exploitation of forced workers in both Potosí and Huancavelica. For example, as early as 1594, only twenty-one years after the mita system was introduced, just one-half of the 13,000 mitayos who were then demanded in Potosí actually showed up. Although there was some recovery in mita service in the first half of the seventeenth century, even then a third were absent. By the middle of the seventeenth century, however,

only about 4,100 mitayos were serving in Potosí's mines and mills. In 1662, the president of the Audiencia of Charcas, Bartolomé de Salazar, estimated that over the preceding ten years the population of tributary Indians in the subject provinces had plummeted from 81,000 to 16,000 as a result of flight and mortality. The result was that the combination of fewer mitayos and an absence of effective checks against abuses inexorably led to greater exploitation. Indeed, even before 1600, mitayos had already been subject to a quota system and pressed into continuous service.¹⁰³

By exploiting the mitayos more severely and forcing them to work several shifts without interruption, miners and refiners did increase production. Reflecting this was the rise of silver output from 1740 to 1790, which was directly attributable to the quota system as neither the number of mitayos nor the quality of the ore increased during this time. In order to meet their quota, forced workers increasingly depended on their wives, children, or hired assistants to help them. As ore output increased, so too did crushing, sifting, and processing in the mills. Among twenty-five mills in Potosí between 1692 and 1799, capacity almost doubled, yet 40 percent fewer mitayos worked in them as grinders, sifters, and treaders. On average, a mitayo in the 1700s worked 285 percent more than was legally mandated. Part of the impetus for this increase in the 1730s was the blossoming of contraband trade with French traders, who exchanged their wares with an eager clientele in Potosí. In order to have silver on hand for this highly lucrative trade, creditors extended more favorable terms to miners and refiners. Production, and exploitation, in Potosí were further stimulated in 1735 when the royal "fifth" was reduced from 20 percent to 10.¹⁰⁴

Further contributing to the mitayos' workload was their application to a variety of other tasks, often during the period when they were putatively resting, or *de huelga*. Some Indians were pressed into the ranks of the 200 *indios meses*, who worked as wage laborers for a month, or as one of the 150 *indios de plaza*, or plaza Indians, who reported to the main plaza on Mondays in both Potosí and Huancavelica to be assigned to work in the hospital, monasteries, local government, and private homes. Authorities also assigned over 150 Indians to assist in the transport of foodstuffs, salt, and other products into Potosí and detailed 100 for the upkeep of the lagoons. In addition, up to a thousand Indians were designated to work in the mines and mills of Porco, while still others were dispatched to the hot southern lowlands to assist in the unending fight against the Chiriguano Indians. Beyond this, usually on Mondays and Wednesdays, they also were obligated to serve faenas, which involved such things as road work, mill repairs, transport, and carrying the torta from the buitrón to the lavadores.

In addition, while mitayos were initially to work, and be paid, for six days, this was soon reduced to five, as much of Monday was lost in the muster and assignment process. Although this took time out of the Indians' day, miners and millers were loathe to pay a wage when there was scant if any production.¹⁰⁵

With the rapid rise of ransoming, by 1600 about half of all of the mining and refining workers in Potosí were free wage laborers. Many would demand payment in advance, and given the demand for their services, it was not uncommon for them to "enter by one door and leave by another." In the case of mitayos in both Potosí and Huancavelica, while payment was to be witnessed by the governor and native advocate, recorded by a scribe, and placed into the hand of the mitayo, they were frequently paid in debased coinage, often had alms deducted from their wages, and were sometimes not paid at all.¹⁰⁶

In addition to their wages, mitayos were to be paid a relocation allowance, called *leaguaje*, based on the distance that they had to travel from their hometowns to Potosí or Huancavelica. Usually calculated on the basis of four to five *leguas* per day, the amount to be paid varied over time and ranged from one and one-quarter to five reales per day. Although half of the outward trip from the dispatch point was to be paid upon departure and the remainder upon their arrival, this was rarely the case in practice. Mitayos were to receive their *leaguaje* for the return trip at the end of their mita turn; however, this was usually deducted from debts—real, imposed, or contrived—and as a result they rarely saw any payment for their journey to or from Potosí.¹⁰⁷

The payment that mitayos received was insufficient to sustain a person, much less a family, in Potosí, especially when one considered the high prices at the company stores, the need to pay rent for their housing, religious fees, and the various deductions from their wages. In 1608, a mitayo had expenses of about 200 pesos per year, yet he only earned about two-thirds of that even if he worked the entire year, as opposed to the theoretical seventeen weeks he was technically obligated to serve. As a result, in order to survive, the entire family was drawn into mining or other work, often working as sorters, sifters, domestics, or petty merchants. Not only was the cost of labor borne by the mitayo and his family, but it was also passed along to the community, which surrendered its people, produce, and livestock to subsidize the miners and refiners in Potosí and the expanding frontier of global commerce.¹⁰⁸

A census could, in theory, alleviate the situation of fewer Indians doing ever more work by providing the structure to ensure that mitayos only

worked one year in seven. Censuses were, however, infrequent for several reasons. Among them was their complexity, cost, and the coordination required to conduct them. In addition, tribute and mita assessments were applied to the community as a whole and were based on numbers that bore little if any resemblance to reality given the demographic implosion and flight to avoid the mita. Before the native population began to rebound in the 1750s after devastating influenza, typhus, and perhaps smallpox or bubonic plague epidemics in 1719–1722, any accurate census would have resulted in reductions in tribute and mita numbers.¹⁰⁹

There were, however, some exceptions to these tendencies. Among them was that local authorities, such as parish priests and governors, often had a more accurate idea of the number of people in their community than did officials in Potosí, Lima, or Buenos Aires. When it worked to their advantage, such as in a town with many *forasteros*, they often maintained dual tribute rolls, one of which was official and the other, which guided their own taxation and extractive practices, was based on a local head count. As long as *forasteros* were exempt from the mita, miners had no interest in a census, although they had long lobbied for an end to this exemption. In the 1680s, as mita numbers continued to dwindle, the mining guild supported a census with the objective of drawing *forasteros* into the mita.¹¹⁰

It was with this goal that Viceroy Duque de la Palata ordered a new census in 1688, the first since Toledo's count over 100 years before. The plan was to have both priests and governors count the entire population, as opposed to only tributary Indians. Despite extensive preparations, the effort was undermined by the reluctance of some *corregidores* to reveal the true population of their *forastero-rich* districts, and occasionally late and contradictory instructions. Although the census was for the most part complete by the middle of 1685, it was not finalized until 1689, six years after it began. In the end, it confused and overcounted *forasteros* and *yanaconas*, many of whom fled to remote parts of the realm out of fear of being sent to the mines and mills. Because of these problems and the further dislocation they caused, the results were shelved in 1692 by Duque de la Palata's successor, Viceroy Conde de Monclova, and *forasteros* remained exempt from the mita.¹¹¹

“Permitted Pirates”: Surviving the Onslaught¹¹²

With a wage that they could not survive on, often paid in silver which few would accept, and facing ever-increasing exploitation and abuse, Indians in Potosí extracted and refined ore for their own benefit. Dating from at least the late 1500s and called *kapcha* in Potosí, *guasacho* in Huancavelica, and

corpa in Oruro, it was technically illegal but was grudgingly tolerated by the mine owners, renters, and the crown. The wage laborers insisted on this privilege, and in any case the miners were powerless to stop it. For its part, the crown recognized that much of the silver produced in Potosí came from kapcha producers, and that at least some of it made its way to the royal mint.¹¹³

Kapcha miners had an element of social banditry, in the sense that although what they were doing was illegal, their boldness, defiance, and success elicited admiration and respect, even by their adversaries. Some contemporaries, all too familiar with the conditions in which the Indians toiled, viewed kapcha mining essentially as a right, with one writer describing it as “honorable work.”¹¹⁴ It was their defiance which earned them their name, for “kapcha” referred to the snapping sound of their slings as they hurled rocks at those who got in their way.¹¹⁵

As the Indians were the ones actually working in the mine, they knew where the best ore was, and would wait until the weekend, when kapcha was tolerated by authorities, to extract it. By the mid-1770s, there were about 4,000 kapcha miners, and a royal official asserted that it was “certain that these permitted pirates take out more silver than the mine owners.”¹¹⁶ They would obtain their candles, coca, and other supplies from the owners of small, primitive mills, called *trapiches*, who would refine the rich ore that the kapchas were famous for extracting. Usually operating in a group of four to five, and led by a barretero, the group could include Mestizos, Negroes, Mulattos, and Spaniards, as well as mitayos seeking to complement their miserable wage. Curacas and mita captains were also often involved either in the extraction or refining of kapcha ore, seeking as always to cover the cost of absent mitayos.¹¹⁷

While kapchas often reserved the best ore in the shafts for themselves, if such was lacking there they would not hesitate to mine the supports and bridges in the mine. This was the cause of “large and frequent rockslides, cave-ins, [and] sinkholes . . . with inevitable Indian deaths.”¹¹⁸ Whatever the source of the ore, the results were striking. By the late 1750s, while kapchas extracted just over 3 percent of the ore, they produced almost 38 percent of all the silver in Potosí. While a miner was fortunate to obtain two pounds of silver per cajón, the kapcha miners often yielded thirty pounds. In 1774 Viceroy Manuel de Amat y Junient estimated that one-half of all the silver produced in Potosí was the result of kapchas. Despite periodic efforts, kapcha mining proved impossible to eradicate. Not only were kapcha miners violent in the defense of their privileges, but their work was vital for silver production, and hence the royal income. In addition, many trapiches which processed kapcha ore were owned by influential Spaniards and

Creoles, and wildcat mining served as a vital means to attract the free labor force which Potosí could not live without.¹¹⁹

Compared to the mines of Huancavelica, it was preferable to be a mitayo in the mines of Potosí. Those inside the Cerro Rico were not breathing mercury vapor, although they were otherwise subject to the same risks such as cave-ins, sinkholes, and falls from ledges and ladders. There was also considerably more economic opportunity in Potosí, not only through kapcha mining but in providing a host of goods and services to a bustling city several times the size of Huancavelica. Those assigned to the mills in both places were, however, exposed to high concentrations of mercury vapor. In Potosí, mitayos and others were exposed to mercury as it was transported in the mill, while treading the torta, carrying it to the troughs, washing it, handling and forcing the amalgam into the cloth tubes, swatting it, and tending the retorts which burned off the mercury from the silver. In addition to absorbing mercury through their skin and breathing its vapors, those who had the unhappy task of treading and processing the torta also suffered from frostbite. In addition, those working in or near the mills, especially those loading the ore crushers and sifting the ground ore, often suffered from acute silicosis, leaving them to waste away and frequently die soon after their term of service.

Beyond the effects on their health, mitayos regularly suffered whippings, insults, and an increasing workload. As the number of mitayos who came to Potosí declined, the exploitation of those who did arrive increased. In the 1700s, the rise of silver production was not a function of better ore or more workers, but rather the strict, and generally increasing, application of a quota system based on quantity and quality of ore. By the late 1700s, a mitayo in the mines only finished his shift when he had brought 2,500 pounds of ore to the surface. Deeper shafts, undercounted loads, and fear of the lash meant that many mitayos found themselves in the perversely ironic position of having to hire an assistant to help them meet their quota.

Because of the size of Potosí, which at its height in 1650 had 160,000 inhabitants, the scope of human exposure to mercury vapor, and with it physical and mental illness, was several times higher than that of Huancavelica, which at most had a population of 10,000. In addition, Potosí was enveloped in greater concentrations of mercury than was Huancavelica. While about 25 percent of the mercury escaped as it was being extracted from the cinnabar ore, about 85 percent of the mercury that entered Potosí ended up being volatilized. It is to the intertwined environmental and public health consequences of mercury and silver production that we now turn.

fo ur

Connecting the Drops

à e Wider Human and Environmental Costs



In order to gauge the health effects of mercury exposure on the residents and workers of Huancavelica and Potosí, it is necessary to understand how a multitude of dynamic factors interact. These include the amount of mercury and silver actually produced, how and under what climatic conditions quicksilver was lost to the atmosphere and waterways, and the effects of elemental mercury on people and animals when it is absorbed through different means. Fortunately, the Spanish authorities maintained detailed records concerning mercury and silver production, and contemporaries described the characteristics and inefficiencies of the respective refining processes, as well as the issue of contraband. By integrating the historical record with modern air-dispersion modeling and current medical knowledge of mercury's effects, we can approximate the nature and range of the human and ecological effects that mining had at different times during the colonial period.

A Tremulous Toxin

Although mercury has no known use in the human body, it is present in minute quantities in the soil we cultivate and the air we breathe. As an element, designated as Hg in the periodic table, mercury can neither be created nor destroyed, and it has been found in every continent, and even on the moon. There are two sources of this element in the environment: those released through natural weathering processes of mercury-containing rock, and man-made, or anthropogenic, sources. Today, the latter are usually associated with electricity production, industrial applications and byproducts, and municipal and medical waste incineration.¹

The largest single source of anthropogenic emissions in the United States are coal-fired electrical power plants, which account for 87 percent of the total. Between 1994 and 1995, total anthropogenic mercury emissions in the United States were about 158 metric tons, which is about seven tons less than what Potosí alone emitted in an average year.² Globally, natural and man-made emissions reach about 5,500 metric tons annually, of which anywhere from 500 to 1,000 tons is from mercury amalgamation in artisanal gold production in developing countries. Once released, elemental mercury can circulate in the atmosphere for up to a year, traveling thousands of miles either as vapor or attached to particulate matter. Ultimately it returns to Earth, most often with rain in a “wet deposition” process. Once back on the ground, it can either volatilize, bind with the soil and other organic matter, or be carried by rainwater runoff into bodies of water where it can bind with sediments and bioaccumulate in aquatic organisms. Of the mercury which has been discharged over the centuries, 95 percent has settled into soil and sediment, while 3 percent has been deposited in the oceans and 2 percent continues to circulate in the atmosphere.³

Historically, mercury has been used by many societies as a dye or skin colorant, with the earliest sample of ore containing mercury having been found in a tomb in Kurna, Egypt, which dates from the fifteenth or sixteenth century bc. By 700 bc, the Phoenicians were trading goods for cinnabar, and by around 300 bc Greek miners had mastered the art of extracting quicksilver from cinnabar ore. People in the Hellenic world used it for ceremonial and, like the Chinese, medicinal purposes. As with many Greek practices, the Romans made similar use of mercury, although they appear to be the first to apply it to gold and silver amalgamation. Following the defeat of the Carthaginians after the second Punic War (128–201 bc), Rome took control of Almadén, meaning “the mine” in Arabic, where they used slave and penal labor to extract and refine the ore. By 77 ad up to four and one-half metric tons of mercury were being shipped to Rome each year. An important use of mercury during this time, and later, was in gilding, whereby a gold–mercury amalgam was applied to an object, and then the mercury was volatilized, leaving only the gold. Later, mercury and silver were used in much the same way in the making of mirrors.⁴

The toxic nature of mercury vapors was documented as early as 1473 by Ulrich Ellenborg (1435–1499), and Gabriele Fallopius (1523–1562) observed that most mercury miners perished after fewer than three years on the job. In 1640, in his treatise on silver refining, Alonso Barba (1569–1662) also remarked upon its highly toxic quality. Like many toxins, physicians have for centuries recognized quicksilver’s medicinal value. Long used as a

medicine by the Chinese, Arab physicians were applying it for skin problems by 1000 ad , and five hundred years later the Austrian physician Paracelsus (1493–1541)prescribed it for the treatment of syphilis. Later, the physician Bernardo Ramazzini (1633–1714) brought together what was then known of mercury poisoning as it related to occupational exposure in 1713 in his work *De morbis artificum*. By the early 1700s, if not well before, mercury was recognized by physicians and others as a poison that produced tremors, cramps, excessive salivation, and loss of teeth.⁵

As the centuries passed, scientists, doctors, and industrialists found new uses for this restless metal. In the eighteenth and nineteenth centuries, mercury became an essential component in thermometers, barometers, detonators, and in the powder used to detect fingerprints. It was also extensively used in the manufacture of hats, giving rise to the term “mad as a hatter.” In this application, a mercuric nitrate solution was used to soften rabbit fur in the production of felt. The solution was often rubbed in by hand, leaving both the fur and the uncovered hands with a yellowish hue and giving rise to the term *carrotting*. Once processed into felt, it was stored and constantly emitted mercury vapor. Much more vapor was released, however, when steam was applied to the felt in order to moisten it before forming it into hats. In one study, two-thirds of the workers involved in carrotting showed symptoms of mercury intoxication.⁶

Traditional uses of cinnabar and mercury as a colorant, in makeup, as purgatives, and for the treatment of syphilis continued into the 1950s and 1960s. Recent applications of mercury and its compounds have found their way into many everyday items, ranging from fluorescent and mercury halogen lamps, furniture polish, paper, plastics, electrical switches, pharmaceuticals, pacemakers, calomel lotion, dental amalgams, and blood-pressure measuring devices to fungicides, slimicides, insecticides, bactericides, chlorine, and caustic soda. The increasingly diverse applications of mercury have been paralleled by a growing awareness of the full range of its toxicity, especially after 1970. As a result, its use in products and industry appears to have peaked and is increasingly being scaled back. The curtailment is significant, as between 1988 and 1996 the use of mercury in industry had fallen by around 75 percent, largely as a result of the phaseout of the metal in batteries, paint, and pesticides.⁷

Mercury Poisoning

Mercury can be divided into three categories: elemental mercury, inorganic compounds, and organic compounds. Elemental mercury is quick-

silver, which is used in amalgamation and is the focus of this book. Mercury, however, easily combines with over thirty other minerals to form inorganic compounds such as mercuric ions, mercurous salts and oxides, sulfides, bromides, selenides, cyanides, chlorides, sulfates, nitrates, and salicylates. Organic compounds, or those in which a covalent bond links mercury to a carbon atom, include highly toxic methyl and ethyl mercury, as well as aryl-, alkoxy-, and phenyl-mercury compounds.⁸

In the atmosphere, mercury is generally in the elemental vaporous form, the monovalent mercurous form, or the divalent mercuric form. When elemental mercury is released into the atmosphere from a chimney, its fate is determined by several factors. These include the temperature, which determines its rate of ascent, or exit velocity, the wind speed, and the wind direction. Other variables include humidity, whether the emissions are bound with particles, and whether emitted from a stack, where its height will influence the scope of deposition. Mercury's return to Earth is hastened when it binds with water in the atmosphere or is oxidized by the sun into the divalent form.⁹

Mercury and its compounds can enter the body through inhalation, ingestion, and with the exception of mercury vapor, through the skin. Once in the body, where it goes and its ensuing effects depend in part on the type of mercury or compound absorbed. All forms easily cross cellular membranes and tend to have the greatest effect on the central nervous system and the kidneys. For example, whereas inorganic mercury compounds are absorbed almost equally by red blood cells and plasma and concentrate in the kidneys, organic compounds concentrate in red blood cells and cross the blood-brain barrier much more readily. Just as the toxic effects are influenced by the form of mercury or compound, the manner in which it is absorbed also plays a vital role. When an organic compound is ingested, for instance, approximately 90 percent of it will be absorbed through the gastrointestinal tract, compared to only about 1 percent for elemental mercury. When elemental mercury vapor is breathed, however, about 80 percent is absorbed through the lungs, versus about 2 percent through unpunctured skin.¹⁰

Because of the high toxicity of mercury and its compounds, much of what we know about their effects comes from studying people who have had long-term occupational contact or who suffered from accidental acute exposures. Complementing this are numerous animal studies, especially with rats and primates. Such research has revealed not only the array of effects of mercury poisoning but also that these effects depend on the concentration, duration, route, and nature of the exposure, as well as individual

sensitivity, genetic predisposition, age, overall health, and nutritional status. Even when people are poisoned, the effects can be delayed for months or even years, and the symptoms are often similar to many other afflictions, complicating diagnosis and often delaying treatment. Generally, the younger someone is when he or she is exposed to mercury, the more at risk he or she is of developing severe effects of mercury poisoning. Not only do children have greater hand-to-mouth activity, but they are physically smaller, which increases the concentration of a given amount of mercury in their body relative to an adult. In addition, their brains are still developing and as a result are more vulnerable to the effects of mercury intoxication.¹¹

Among the most toxic mercury compounds is methyl mercury, which can be created both by chemical and biological processes and often causes irreversible damage. The gastrointestinal tract absorbs up to 90 percent of the methyl mercury that passes through it, and as a result its presence in food is a major public health concern. Methyl mercury poisoning is sometimes referred to as “Minamata disease,” after a mass poisoning in Minamata Bay, Japan, in the early 1950s. After hundreds of people had been intoxicated, investigators discovered that methyl mercury was a byproduct of the production of plastic in a plant which discharged hundreds of tons of contaminated effluent into the bay between 1949 and 1953. Researchers discovered that fish accumulated methyl mercury in their bodies at a rate tens of thousands of times more than the bay in which they swam. As the population of Minamata, both human and feline, had a high consumption of fish, a mass poisoning ensued in which at least 1,500 people were immediately affected.¹²

The use of methyl mercury compounds as fungicidal seed dressings to prevent spoilage once in the ground has also resulted in numerous cases of mass poisonings. For example, in Iraq (1956, 1960, 1972), Guatemala (1963–1965), and Pakistan (1963, 1979), thousands of people were poisoned and hundreds perished as a result of cooking and consuming treated seed, often in the form of bread. The latency period of just over a month before symptoms appear compounded the effects, as did the ability of methyl mercury to be transmitted in mother’s milk.¹³

Unfortunately, the initial symptoms of methyl mercury poisoning often occur when a near-lethal dose has accumulated in the body. The initial symptoms resemble inorganic mercury poisoning and include a loss of feeling in the extremities and difficulty walking and performing basic functions. As the bioconcentration builds, however, victims begin to suffer from tunnel vision, loss of memory and affect, and the abilities to hear and

speak. They also experience uncontrollable muscle spasms, facial contortions, emotional outbursts, and excessive sweating. Embryonic development is severely impaired, as the fetus is up to four times as sensitive to the compound as the mother, and concentrations in fetal blood can be 30 percent higher than in the mother, resulting in severe and irreversible developmental abnormalities.¹⁴

It was in Sweden, however, that researchers discovered that methyl mercury is most commonly produced through natural as opposed to industrial processes. When elemental mercury is released into waterways, it ultimately settles and may be consumed by microorganisms, especially those that thrive in sedimentary and anaerobic environments, which transform it into methyl mercury. These microorganisms release it back into the environment where it enters the food chain. There it bioaccumulates in fish, with the greatest concentration occurring in the longest-living predators at the top of the aquatic food chain, such as tuna and swordfish. Because methyl mercury is fat-soluble and readily crosses the blood-brain barrier to accumulate in the brain's gray matter, it concentrates in people, birds, and other animals who consume sufficient quantities of contaminated fish.¹⁵

In the case of elemental, or metallic, mercury, once it enters the body, it is oxidized into the divalent form in red blood cells, the lungs, and liver. The toxicokinetics of elemental mercury—or how it is absorbed, circulated, metabolized, and excreted from the body—is to a large degree a function of when and where it is oxidized in the body. In the case of elemental mercury, if it is oxidized before entering tissues, then it is less likely to cross the blood-brain and placental barriers and more likely to be eliminated from the body. If, however, it is oxidized after crossing these barriers it is more likely to be trapped in tissues. Overall, while organic compounds more readily cross the blood-brain barrier than inorganic compounds, both can accumulate in the brain. The half-life of metallic mercury and its compounds is generally around seventy days in the human body and is excreted in sweat, urine, feces, milk, and bile. It is interesting to note that lead and mercury poisoning produce similar symptoms, such as depression, exhaustion, agitation, aggression, neurotic behavior, and motor difficulties.¹⁶ As the richer ores in Potosí contained lead, the use of smelting in the days before amalgamation probably produced such effects among refiners.

Acute mercury poisoning occurs when a high dose is absorbed in a short period of time, usually less than twenty-four hours, and initial physical symptoms often consist of tingling or loss of sensation in the extremities,

uncontrollable shaking, and visual disturbances.¹⁷ Other symptoms include chest pains, coughing, vomiting, headaches, fatigue, chills, fever, renal problems, inflammation of the gastrointestinal tract, diarrhea, pulmonary edema, and an accelerated heartbeat. Acute exposure to cinnabar dust and mercury vapors, the latter of which has been reported at a concentration as low as one part per million, can result in difficulty breathing as a result of inflammation in the lungs, in addition to excessive salivation and oral inflammation. Among those who die from acute mercury vapor inhalation, the immediate cause of death is respiratory failure, preceded by coughing, tightness and often a burning sensation in the chest, airway constriction, and difficulty breathing.¹⁸

Chronic mercury poisoning occurs when an individual or animal is exposed to low doses of mercury over a long period of time. In the case of mercury vapor inhalation, chronic exposure leads to severe neurological effects. Although slower to manifest themselves, initial physical symptoms of chronic elemental and inorganic mercury poisoning are similar to those of acute poisoning, and include uncontrollable and excessive salivation, a metallic flavor in the mouth, gingivitis, and loose teeth, which are exacerbated by poor oral hygiene. Other symptoms include oral inflammation and ulcers and discoloration of the gums, swelling of the salivary glands, a loss of hunger and weight, difficulty speaking, anemia, pallidness, skin rashes, and necrosis, or tissue degeneration through cell death.¹⁹

As the nervous system becomes increasingly compromised, the victim begins to suffer from tremors, often in the eyelids, fingers, and arms and legs. He or she may also experience intention tremors, in which case the shakes become more severe as the person attempts to do a specific task, such as signing his or her name. Individuals also often suffer from loss of muscular control, called ataxia, impairing their ability to walk and perform basic tasks such as feeding themselves and dressing. Although people respond differently to mercury poisoning, it often compromises their immune systems and makes them more vulnerable to infection and allergies. In the case of exposure to mercury vapors, exposure for more than a few weeks often results in a chronic cough.²⁰

Both acute and chronic mercury intoxication are accompanied by erythromelalgia, which originally referred to mercury poisoning generically but today denotes a range of neuropsychological effects. While motor symptoms can be alleviated by removal from the source of mercury, psychological effects tend to be more persistent or irreversible. These can occur without tremors and include personality alterations such as psychotic breakdowns, irritability and violent outbursts, hypercriticism, hostility, impatience, loss of short- and

long-term memory, obsessive-compulsive behavior, problems in concentration, depression, anxiety, loss of confidence, shyness, blushing, indecision, lack of affect, and both extreme drowsiness and insomnia. Such symptoms, especially irascibility and lability, have been observed among people exposed to forty-four milligrams per cubic meter for less than eight hours.²¹

In one study of workers in a felt hat factory, researchers found that those employees who were poisoned had a high incidence of irritability and had difficulty accepting orders from superiors. These characteristics were recognized by some of the workers themselves. As one poisoned hatter put it, “people get on my nerves quickly. . . . I fly off the handle quickly.”²² While psychological manifestations may be readily observed, the insidious nature of mercury poisoning often produces subclinical symptoms, or those which are not as overt and hence often difficult to detect. These include some forms of neuroses and depression, as well as the loss of short-term memory and the inability to process information or to concentrate.²³

In Huancavelica, workers were exposed to mercury sulfide contained in the dust in the mines, which they breathed and probably ingested to some extent as well. While those working the ovens were exposed to much higher concentrations, the entire town breathed the vapors, some more than others depending on the season, humidity, wind direction, and level of production. Even poisoned workers who were able to escape the source of the mercury poisoning in Huancavelica and Potosí could not fully escape the consequences.

Modern studies give an idea of some of the effects that miners, refiners, and the wider population of Huancavelica suffered. A study of two adolescents who were inadvertently exposed to mercury vapor for three months found that they had continuing problems with abstract reasoning and memory a year later.²⁴ In a controlled study of seventy-six poisoned Japanese mercury miners, all suffered from reduced reaction time, short-term memory problems, and motor problems eighteen years after exposure stopped. In addition, they had an elevated incidence of lower back pain, high blood pressure, and lung disease. Miners in Huancavelica were not the only ones who literally carried mercury to the grave. Autopsies of four former mercury mine workers in Idria, Slovenia, revealed that the mercury in their bodies had concentrated in the thyroid and pituitary glands, followed by the kidney cortex and the white matter in the brain.²⁵

With one of the largest mercury reserves in the world, China not only produces mercury but often does so under artisanal conditions. Understanding the effects of smelting on Chinese refiners illustrates some of the consequences that refiners in Huancavelica probably experienced.

Controlled studies of Chinese mercury miners and refiners, none of whom wore masks, demonstrated a higher incidence of tremors, fetid breath, gum discoloration, and postural and kidney problems, all of which were exacerbated by consuming rice from methyl mercury-contaminated paddies.²⁶

Japanese former mercury workers self-reported symptoms of gingivitis, tremors, fatigue, insomnia, and irritability as their primary symptoms, in addition to observed conditions such as senility, slurring of speech, visual problems, and cough. During the time that they were actively working in the mines, the symptoms they most commonly reported were tremors, oral inflammation, depression, and irritability.²⁷ Among workers in California's mercury mills, common symptoms included oral lesions, dental problems, bleeding of and a black line on the gums, excess salivation, fatigue, weight loss, tremors, headaches, dermatitis, digestion problems, anxiety, irritability, sleeplessness, difficulty walking, and a generalized malaise.²⁸ Decreased visual sensitivity, including color and contrast, was also detected among employees exposed to mercury vapors at a fluorescent light factory.²⁹

In Potosí, the workers inside the mines were not exposed to mercury as were their brethren in Huancavelica, but those who worked in Potosí's mills were exposed as they treaded, washed, and otherwise processed the amalgam. As in Huancavelica, the residents of the city as a whole spent their time there, many their entire lives, breathing mercury vapor as quicksilver was burned off the amalgam. Not only were there more people in Potosí—at their heights, Potosí had sixteen times the population of Huancavelica—but more mercury was released into the atmosphere in Potosí. In Huancavelica, the pollution was a function of vapor lost due to the inefficiency of ovens; in other words, it was a proportion of the total mercury produced. In contrast, in Potosí approximately 85 percent of all the mercury utilized there ultimately was vaporized. While some mercury was lost in the washing process, miners went to great lengths to minimize this through intensive reprocessing of runoff, and what was recaptured from one refining process was used in the next.

In both Huancavelica and Potosí, mercury that was vaporized ultimately came back to Earth to settle in the region's soil or be washed by rainfall into the waterways. As livestock, pigs, and llamas both breathed and foraged in the contamination zone, and as people consumed those animals, they were poisoned. Compared to breathing vapors, where 80 percent of the mercury enters the bloodstream, the ingestion of elemental mercury is less harmful as only about 1 percent is absorbed. Mercury was flushed into waterways, such as the Ichu River which runs through Huancavelica and the Pilcomayo River into which Potosí's watershed drains. Even if it

did not become methylated, seasonally migrating fish such as shad were probably poisoned, along with those who ate them. Similarly, although crops irrigated with mercury-contaminated water suffer damage to their roots, inhibited growth, and even death, those that survive with only moderate damage would have been consumed by farmers and others. Horses, mules, cats, dogs, and other animals in Potosí and Huancavelica were also intoxicated by the air and their fodder. Mercury poisoning in such animals produces similar physical symptoms as in humans, such as oral inflammation, tremors, drooling, dental problems, stillbirths, and birth defects. In addition, in Huancavelica the llamas which carried the cinnabar ore to the refining ovens were likely poisoned, as were the camelids and mules that carried the refined mercury in often leaky sheepskin bags between Huancavelica and Potosí.³⁰

“There Is No Door So Closed That It Cannot Be Opened with a Key of Gold”: Colonial Corruption³¹

In order to approximate the health effects of mercury and silver refining on the populations of Huancavelica and Potosí, we must know how much mercury and silver were produced and how much mercury was lost in the furnaces. Mercury production in Huancavelica varied considerably over time and, before the 1600s, by season. Estimates of the total amount of mercury produced in Huancavelica during the colonial period range from 50,600 metric tons to 51,300 tons between 1570 and 1820, exclusive of contraband, or 68,200 metric tons assuming 25 percent of production was not recorded. In Latin America as a whole during the colonial period, approximately 136,000 metric tons of silver were produced, with about 26,000 metric tons of this, including contraband, being from the city of Potosí.³²

Although the amount of silver and mercury that escaped registration is, by nature, difficult to determine, there is no doubt that it was a significant amount. In the late 1580s, King Philip II not only suspected that over half of the silver produced was never brought to the mint but that treasury officials were involved in fraud. In the 1590s, the Jesuit José de Acosta estimated that between a third and a half of the silver produced in Potosí was never recorded. Writing in the 1630s, the Franciscan friar Buenaventura Salinas y Córdoba asserted that up to one-third of all of the silver produced was never taxed, while Friar Antonio de la Calancha, writing about the same time, put this figure at between 20 and 50 percent. By the 1770s, Viceroy Amat estimated that about 20 percent of silver produced was never taxed, although Alexander von Humboldt concluded it was 25 percent.

By the 1790s, some estimated that up to 66 percent of Potosí's silver went untaxed. Given this, it is reasonable to conclude that between 25 and 30 percent of the silver produced in Potosí was contraband. Concerning mercury sold on the black market, estimates range from 10 percent to 66 percent, although 25–30 percent also appears more accurate.³³ These numbers did, however, fluctuate in both locales and tended to increase when production was in decline, as miners were less willing to incur the additional expenses of taxation. In addition, while much silver never made it to the royal mint, some people did coin it themselves, risking execution for the crime. Debased and counterfeit coinage, export of unregistered piñas, and the theft and illegal sale of mercury were recurring problems and often involved treasury officials.³⁴

That between a quarter and a third of the mercury and silver produced in Huancavelica and Potosí escaped taxation appears all the more realistic when one considers both the corruption that pervaded colonial society and the opportunities to engage in what was a culturally accepted, albeit illegal, practice. Writing in 1597, the chronicler Balthasar Ramírez remarked that "In the . . . refining of the ore and the payment of the free workers, there are many tricks . . . because the malice of those that have ore and of those who refine it invents new ways every day, such that there are many traps, many lies and deceptions and many lawsuits . . . for the covetousness of money can invent anything."³⁵

In the early 1600s, Bernabé Cobo commented that the methods people had developed to skim "causes admiration." Not only would Indians engage in kapcha mining, but they would also take ore while sorting or transporting it to the mill. Cobo averred that "when the miner comes to collect his silver, it has been well taxed by those whose hands through which it passes."³⁶ Francisco López de Caravantes supported him on this, noting that during the treading and washing processes, the Indians would routinely take paste and amalgam for themselves. Once silver had been refined, if it was brought to the mint to determine its quality, not only would the assayers complement their earnings by carving off a larger sample than was necessary to determine its purity, but so would the officials who collected the quinto. Governors of Potosí and officials in the provinces, often in league with mine inspectors, were also engaged in a vibrant contraband activity involving the purchase of untaxed silver. Whatever its origin, much of this unregistered silver was smuggled to Buenos Aires, Arica, and the Peruvian coast where it was traded for French and British products.³⁷

Inside the mines of Huancavelica, and for that matter Potosí, the veedores were in an excellent position to engage in contraband, ordering mitayos who

were supposed to be assigned to upkeep operations to mine the rich supports. Working sometimes alongside them were free wage laborers whose production was often not recorded, except by their employer, who would then refine and sell the metal. When mercury was sold illegally in Huancavelica, it was generally to relatively close mining sites such as Lucanas, Angaraes, and Cerro de Pasco. As in Potosí, the treasury office were a contraband hot spot, where lax record keeping both encouraged and facilitated misdeeds. In 1668, Viceroy Lemos was struck by how the treasury operated “without order and in such a confused manner . . . that the account has been made almost incomprehensible. . . . There is much to remedy in Huancavelica.”³⁸ There was also much to remedy concerning the theft of mercury as it was transported between Huancavelica and Potosí. In 1760, one of the few honest governors there, Antonio de Ulloa, uncovered a contraband racket whose beneficiaries included Viceroy Manuel de Amat y Junient.³⁹

Up in Smoke

In order to approximate the mercury vapor concentrations that people were breathing on a day-to-day basis, it is also necessary to understand how much mercury escaped into the air when both cinnabar and silver were refined. This rate of loss during the refining process is often referred to as an emissions factor. Although an anonymous mercury miner admitted that “it is difficult to calculate” the loss of mercury in the refining process, he estimated that at a minimum 10 percent of the mercury was lost in this manner.⁴⁰ Some have estimated the loss at 50 percent, while others place it between 10 and 20 percent. Taking into consideration the porous nature of the refining vessels and condensation tubes, the poor sealing of joints, and the tendency to open the ovens before they had fully cooled, a loss of 25 percent appears both conservative and reasonable.⁴¹ This is further substantiated by a 2008 study of twenty-two artisanal mercury smelting operations in China which revealed emission factors ranging from around 7 to 32 percent.⁴²

In the refining of silver, the amount of mercury lost in the production varied according to several factors, such as the quality of the ore, the expertise of the refiner, the efficiency of the amalgamation and washing processes, the ambient temperature, and how well-sealed the retorts were when the mercury was burned off.⁴³ The loss occurred at three points of refining. One was during the treading process, as it was exposed to some degree to the air. As the mercury was generally immersed in the torta, losses at this stage appear to have been minimal.

More important, and noted by contemporaries, was the loss which ensued from the washing of the ore. Caravantes averred that around 10 percent of the mercury was generally lost in this process, except when it increased in January and February as refiners tried to expedite production to both pay off debts and to have silver ready for the departure of the Spanish fleet at the end of January. Much of these losses would, however, be recaptured in the repeated reprocessing of the lamas, relamas, and relavillo.⁴⁴

Overall, a given volume of very rich ore consumed more mercury relative to more modest ores. This variance was the source of some royal vexation, as it made it difficult to control contraband by establishing a firm correlation between how much mercury was dispensed and how much silver should be brought for taxation. As a general rule, however, royal officials estimated that after the introduction of iron in the amalgamation process in 1586, a minimum of one pound of mercury was necessary to produce one pound of silver. Others put the relationship at generally two pounds of mercury to produce one pound of silver.⁴⁵ An examination of mercury disbursement and silver production records for the Potosí district between 1706 and 1720 suggests that on average it took approximately 1.9 pounds of mercury to produce a pound of silver.⁴⁶ It is interesting to note that in the contemporary artisanal gold-mining operations that still use mercury amalgamation, the ratios of mercury consumption to gold production are similar, between one and one-third to one and two-thirds pounds of mercury to one pound of gold.⁴⁷ In the smelting of the piña, Caravantes calculated that for each five pounds of silver produced, one pound of mercury, or 20 percent, had been vaporized.⁴⁸

A Model Disaster⁴⁹

On the basis of an understanding of the mercury and silver production processes, the characteristics of emission sources, smelter locations, emissions factors, and production levels that account for contraband, it is possible to approximate the concentration of mercury in the air in Huancavelica and Potosí at different points of time. These levels can then be compared with present-day inhalation reference values which are correlated to health risks to estimate the perils to which the workers and wider populations in these cities were exposed. It is important to keep in mind, however, that although mercury vapor in the air is the most dangerous form of exposure, it was one of many other sources such as those ingested through the food chain and through exposure to contaminated soil.

The primary tool for this analysis is AERMOD, which is a state-of-the-art computer-based air-quality modeling program developed by the American Meteorological Society and the U.S. Environmental Protection Agency (USEPA). Utilized by the USEPA for a wide range of applications, AERMOD is designed to predict plume dispersion based on such factors as chimney height, emissions temperature, contaminant exit velocity, topographical characteristics, and meteorological phenomena, including air turbulence, temperature, wind, humidity, and solar radiation.⁵⁰ AERMOD can account for the combined and interrelated effects of numerous pollution sources, as was the case in both Potosí and Huancavelica.⁵¹

In Huancavelica, the locations of the thirteen smelter groupings that were in use for much of the colonial era were changed in the 1780s as the crown assumed direct control of mercury production.⁵² In the results below, separate model runs were conducted to account for both the original (pre-1780s) and late-colonial (post-1780s) locations, which also correlated with a period of reduced mercury production. In Potosí, the model focuses on those mills along the ribera. Although mills continued to operate along the Tarapaya River and there were nonhydraulic mills elsewhere in the vicinity, those along the ribera predominated in terms of overall mercury consumption, silver production, and human impact, given that they were located in close proximity to the population. In some cases, they were only a few blocks from the main plaza. To account for mercury consumption and silver production that did not take place along the ribera, an “area source” of emissions was modeled. In both Huancavelica and Potosí, the model runs are based on high, medium, and low mercury production and consumption levels, which correlate to different time periods and are representative of the range of concentrations to which people were estimated to have been exposed over time. In the case of Potosí, known mercury consumption levels were correlated with data concerning the number of mills along the ribera and the amount of mercury that entered Potosí during each period.

Based on animal and human studies, federal, state, and professional agencies in the United States have identified concentrations for a variety of toxins at which inhalation exposure for a specific duration of time are indicative of health risks. These inhalation health-effect reference values have been developed for different situations and target populations, including emergency response, occupational exposure, and the general public. General public values are designed to protect nearly all susceptible subpopulations and are hence conservative in nature, while emergency response values are based on a once-in-a-lifetime exposure.⁵³

14 mercury, mining, and empire

The reference values used in these comparisons for the modeled chronic exposure levels for the general public are represented by the U.S. Environmental Protection Agency Reference Concentration (EPA RfC), while the State of California EPA's one-hour California Reference Exposure Level (Cal-REL) is used for acute exposure. The RfC is an estimate of concentrations that a general population, including sensitive groups, can be exposed to over a lifetime with minimal risk of negative health effects. Similarly, the Cal-REL reflects a concentration at or below which no negative health effects are anticipated for a one-hour exposure that may recur on subsequent days. In addition, the National Institute for Occupational Safety and Health (NIOSH) REL is a time-weighted average (TWA) concentration that should not be exceeded during a ten-hour shift based on a work week of forty hours.

Another category of values to which the modeled exposures were compared are those developed for emergency response and are represented by Acute Exposure Guideline Levels (AEGL). These values are developed by the National Advisory Committee for AEGLs (NAC/AEGL), are intended for once-in-a-lifetime exposures, and include three severity levels for exposure durations ranging from ten minutes up to eight hours; however, for these comparisons, only the one-hour values were used. The severity ranges from level one, which produces mild and reversible health effects, to level two, which produces irreversible adverse health effects and may impede escape, and level three, which is the threshold for potential lethality.

As in any study utilizing modeling techniques, and especially those based on historical data, there are many uncertainties. In the present context, these include, but are not limited to, changes in climatic pattern over time, estimation of the amount of mercury lost in the washing process, the amount of contraband, the estimation of emissions factors, and in Potosí, the exact number and location of mills.

In addition, it is important to keep in mind that all of the maps approximate the maximum concentration levels that could be expected at a given time and in the most unhealthy meteorological conditions. Not all days were the same; for example, rain and a steady wind would tend to mitigate the effects of mercury air pollution, while a clear, still night would tend to exacerbate them. In addition, seasonal variation of wind direction and speed would tend to vary the effects within both cities. The valley location of both Potosí and Huancavelica tended to exacerbate the movement of air and the contaminants it contained. With the warming of the day, air mixing tends to increase, and then to decrease with the cool of evening and night. As a result, some of the worst conditions people experienced in these cities may have happened while they slept. The range of these and

other climatic variations are largely accounted for by the models and are reflected in the results which are presented in aggregated form.

Huancavelica Results

The results for Huancavelica offered below are organized into two groups, both of which reflect periods of high (1680), medium (1778), and low (1792) production levels. By 1792, although refiners continued to use busconil ovens, they had changed their locations, which is reflected on the map for that year. In addition, the number of ovens at each site in this period is known, which allows production to be weighted by location.⁵⁴

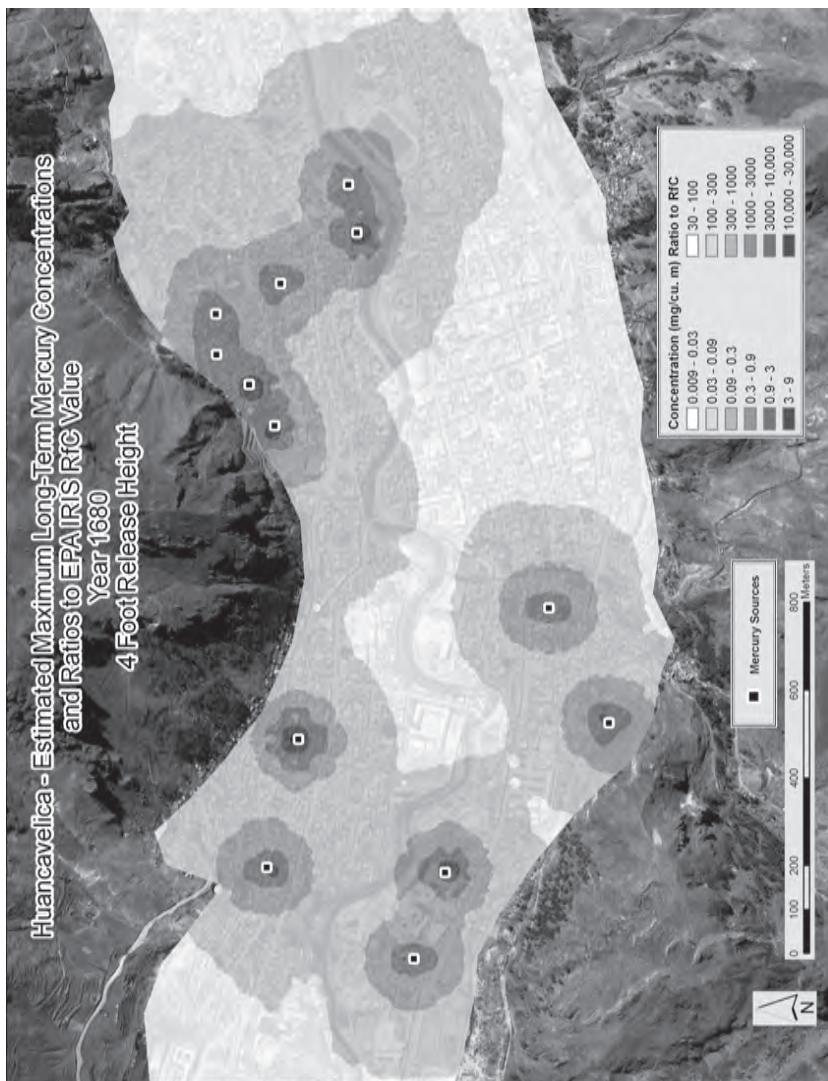
The first series of maps reflects the estimated maximum long-term mercury concentrations relative to the EPA Reference Concentration, or RfC.

Using a representative high production figure, map 4.1 depicts the estimated dispersion of mercury vapor using jabeca ovens relative to the reference concentration. Unlike the busconil ovens used after 1633 which had a chimney height of around eighteen feet and which are reflected in the subsequent maps in this first series, the jabeca ovens did not utilize stacks and refined in the open air. The result was a greater concentration of mercury vapor closer to the ground level relative to the busconil ovens. Reflecting this, while the model predicts that the entire city exceeded the RfC by a factor of 30–100, a majority of the city exceeded the RfC by a factor of over 100. In the immediate area of refining, concentrations could exceed the RfC by an astonishing factor of 30,000.

The results for 1680, as a high point of mercury production, suggest that the least-contaminated areas would exceed the RfC by at least a factor of 100–300 (see map 4.2). As one approached the smelters, however, the estimated concentrations increased dramatically, to the point where they could exceed the RfC by a factor of up to 1,000.

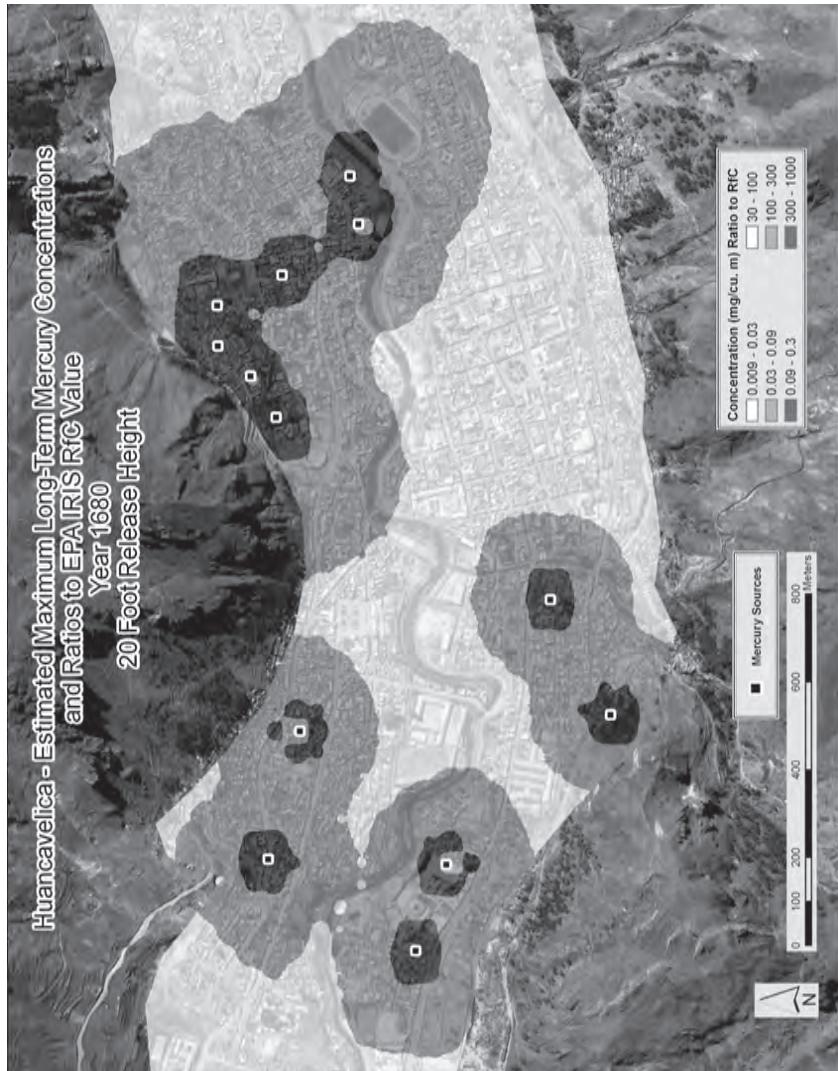
By 1778, selected as a midpoint of production, conditions had improved considerably in the central part of town, where estimated concentrations exceeded the RfC by a factor ranging from 10 to 30, as shown in map 4.3. Less production also meant less pollution in the vicinity of the smelters. Nevertheless, the population was still exposed to estimated concentrations ranging from a factor of 100 to 300 above the RfC.

By 1792, a further decline in production and the construction of new ovens in different locations combined to change conditions considerably (map 4.4). While the city center still experienced estimated concentrations from a factor of 10 to 30 above the RfC, concentrations had declined markedly throughout the city, with no exceedances over 100 estimated.

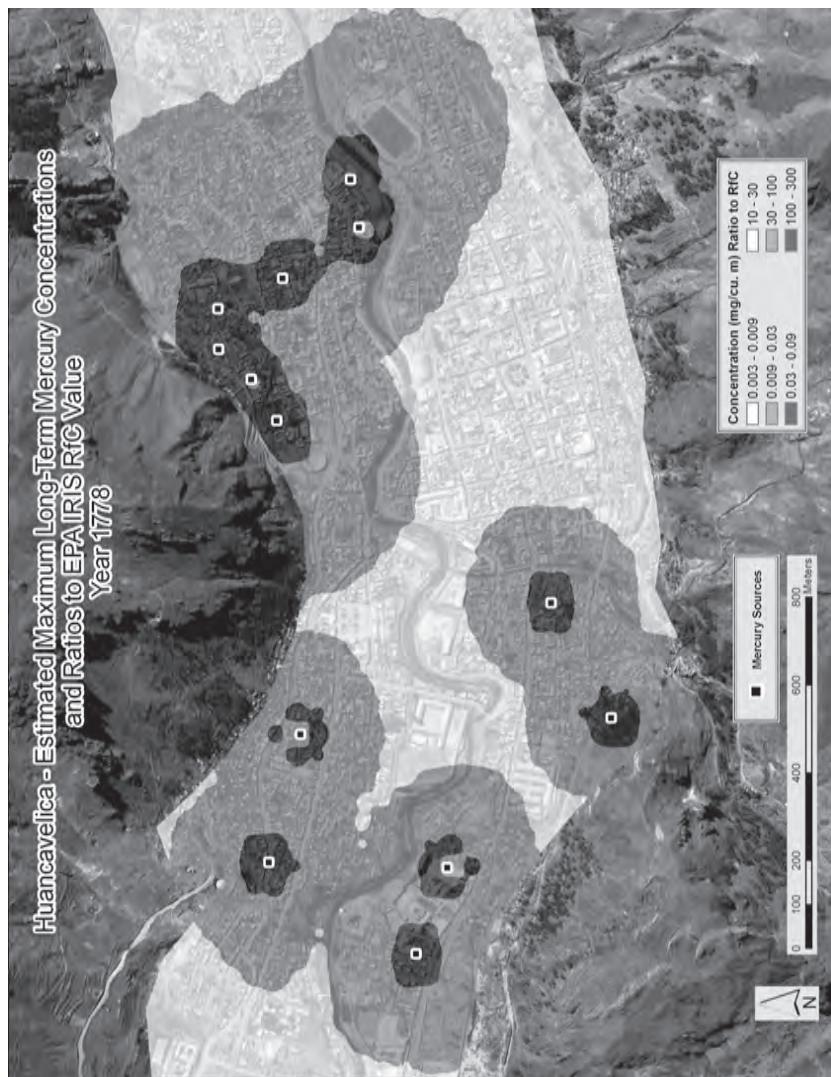


Map 4.1. Huancavelica—Estimated Maximum Long-Term Mercury Concentrations and Ratios to the EPA IRIS RfC Value, Year 1680 (4 ft. release Height).*

*Production in 1680, exclusive of contraband, is estimated to have been 594,154.794 grams. See Lohmann Villena, *Las minas de Huancavelicia*, 487. IRIS refers to the EPA's Integrated Risk Information System, which details the range of health effects of various substances.



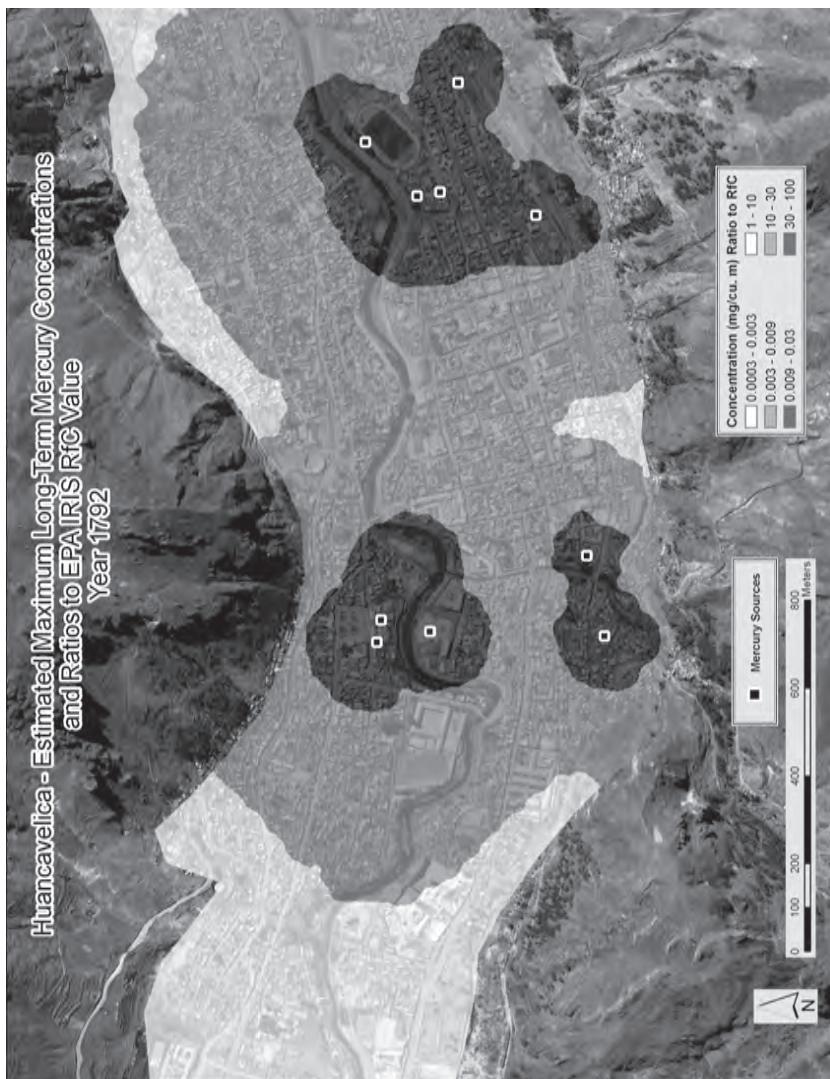
Map 4.2. Huancavelica—Estimated Maximum Long-Term Mercury Concentrations and Ratios to the EPA IRIS RfC Value, Year 1680 (20 ft. release Height)



Map 4.3. Huancavelica—Estimated Maximum Long-Term Mercury Concentrations and Ratios to the EPA IRIS RfC Value, Year 1778 (20 ft. elease Height)*

*Production in 1778, exclusive of contraband, is estimated to have been 196,144,000 grams.

See Fisher, *Silver Mines and Silver Miners, 76; Patiño Paul Ortiz, Huancavelica colonial, 159.*



Map 4.4. Huancavelica—Estimated Maximum Long-Term Mercury Concentrations and Ratios to the EPA IRIS RfC Value, Year 1792 (20 ft. elevation Height)*

*Production in 1792, exclusive of contraband, is estimated to have been 74,198,000 grams.

See Arena, *Las minas de azogue, 34; Fuentes Bajo, “El azogue en los postriamenteas,” 91.*

The next series of maps for Huancavelica reflect one-hour concentrations in relation to the Cal and NIOSH RELs and NIOSH ceiling levels and the acute exposure guideline levels (AEGLs). In all three examples, concentration levels in the entire city exceeded the NIOSH REL based on a ten-hour exposure.

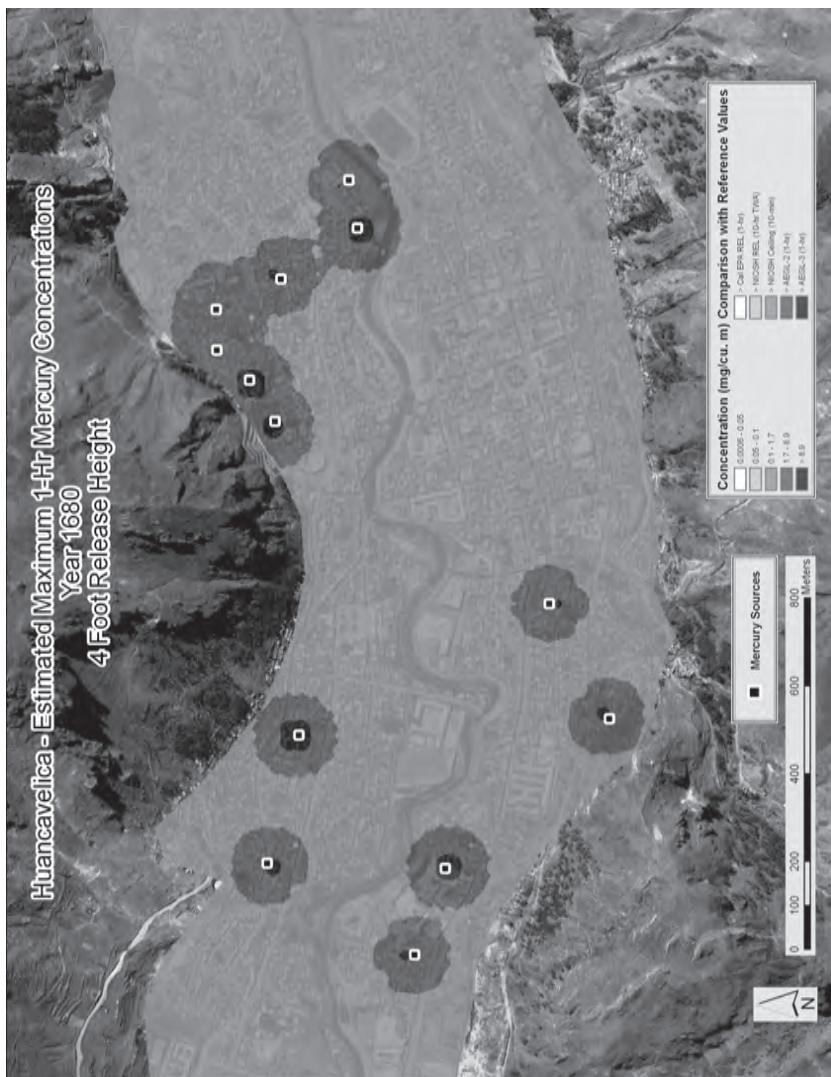
Map 4.5 reflects the estimated concentrations of a four-foot release height from jabecca ovens and a high production figure relative to differing inhalation reference values. It appears that the entire city exceeded the Cal and NIOSH RELs and the NIOSH ceiling; parts of the city would have experienced AEGL-2 and AEGL-3 level concentrations. The rich ore, high production, and low release height appear to have combined to create an exceptionally toxic and, in all likelihood for many, fatal environment.

In 1680, a high point of mercury production and contamination, all of the inhabitants were estimated to be exposed to mercury vapor concentrations that exceeded the Cal and NIOSH RELs and the NIOSH ceiling value (see map 4.6). In the vicinity of several of the smelters, estimated concentrations reached the level of AEGL-2, putting those working, living, or otherwise anywhere near the smelters at risk of irreversible harmful health effects.

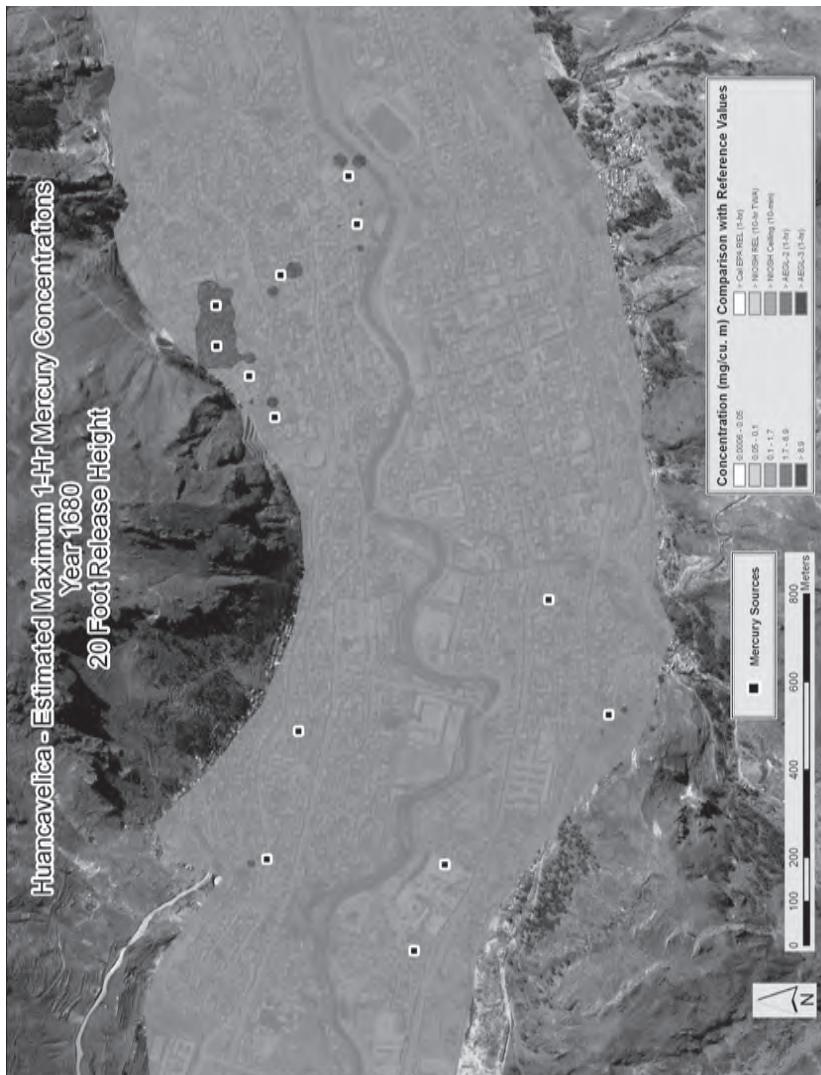
Reflecting a midpoint of mercury production, map 4.7 indicates that the entire population of Huancavelica was exposed to estimated concentrations of mercury vapors, with most of the city exceeding Cal and NIOSH RELs and the NIOSH ceiling value. As production had declined from its high point, the area exposed to AEGL conditions was considerably reduced. Instances of lower concentrations in the immediate zone of the smelters reflect that with the use of a twenty-foot stack vapors tend to rise before they settle, thus in some situations reducing the concentrations at the smelter site but increasing them at some distance.

At the low point of mercury refining, depicted in map 4.8, modeling predicted no AEGL-2 or -3 level concentrations. As in the previous maps, however, the entire city exceeded the Cal REL and much of the city exceeded the NIOSH REL and ceiling value.

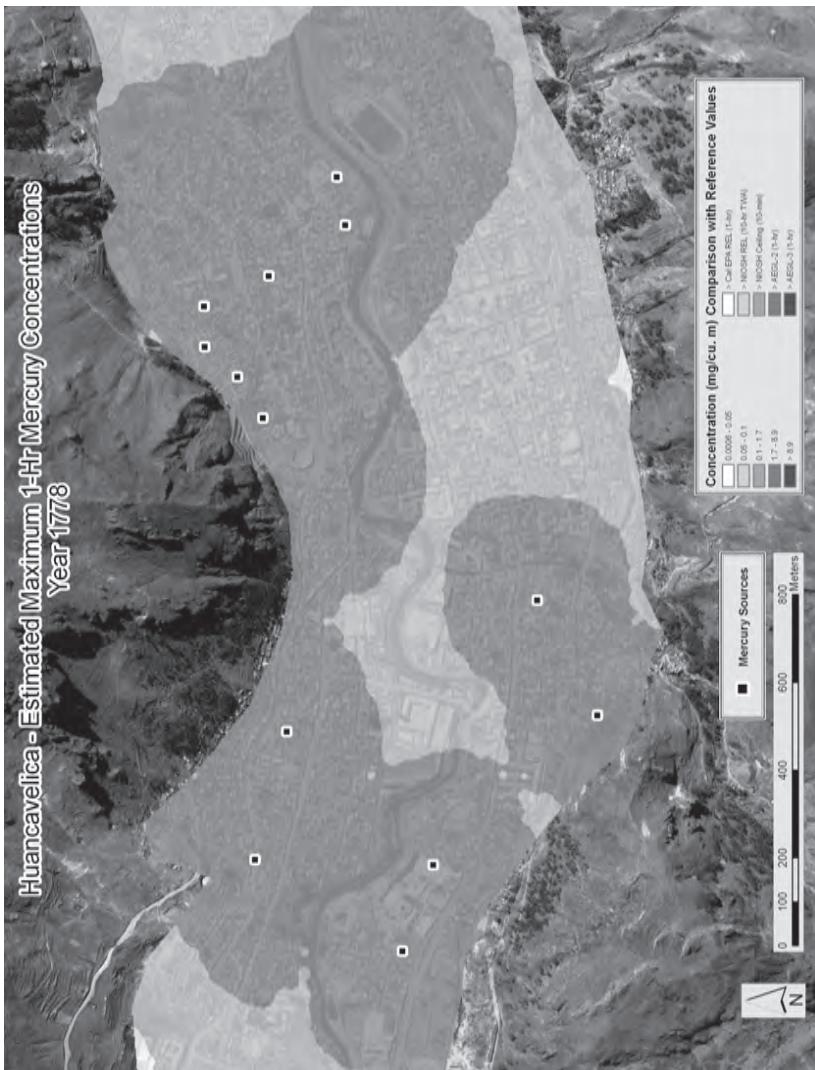
These models underscore the extremely toxic conditions that prevailed in much of Huancavelica, especially with the use of the open air jabecca ovens which had a low release height in a period of high production. In this early period, the health effects were especially severe and widespread, in all likelihood leaving thousands of people permanently disabled if not dead. Apart from the high concentrations of mercury vapor in the air, another striking characteristic of these results is the differential impact that contamination had on distinct sectors of the population. As in almost



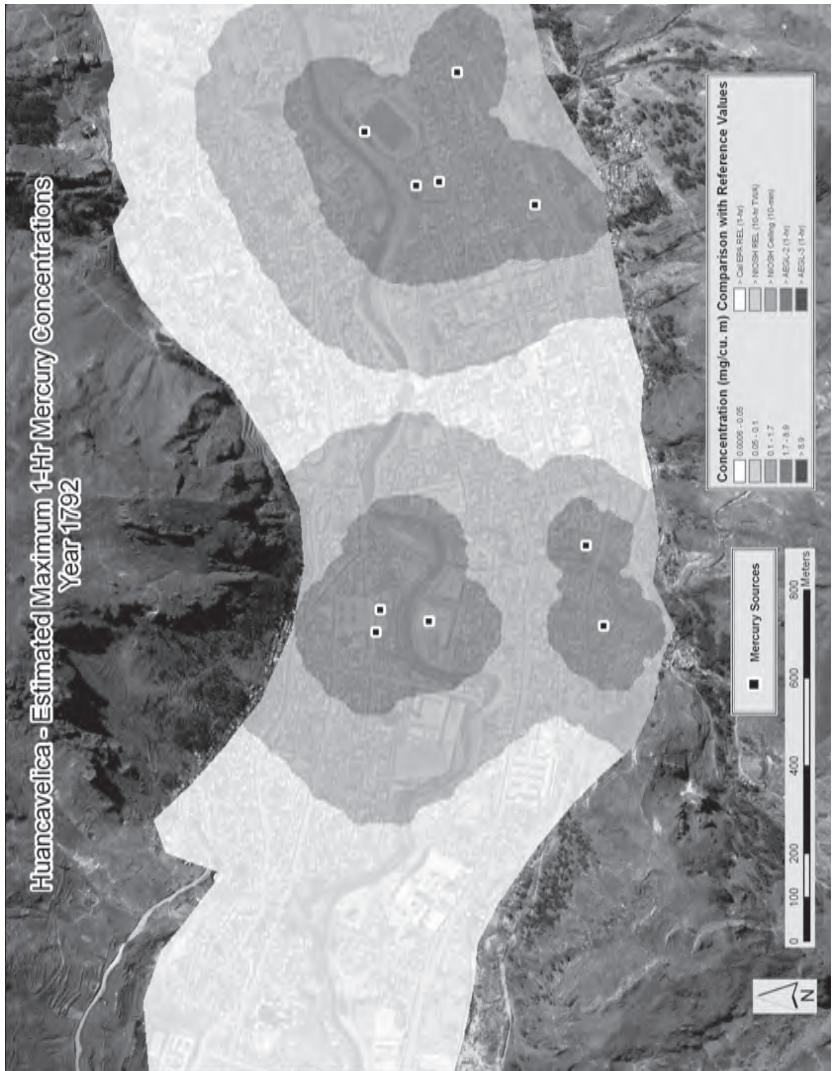
Map 4.5. Huancavelica—Estimated Maximum 1-Hr Mercury Concentrations, Year 1680 (4 ft. release Height)



Map 4.6. Huancavelica—Estimated Maximum 1-Hr. Mercury Concentrations, Year 1680 (20 ft. release Height)



Map 4.7. Huancavelica—Estimated Maximum 1-Hr Mercury Concentrations, Year 1778 (20 ft. elevation Height)



Map 4.8. Huancavelica—Estimated Maximum 1-Hr. Mercury Concentrations, Year 1792 (20 ft. release Height)

all colonial Latin American cities, in Huancavelica the Spanish and Creole elite tended to live on or close to the main plaza, while Indians, Mestizos, and the poor generally lived farther from it. In all of the model results, the main plaza and its immediate environs experienced markedly lower concentrations of mercury vapor. Despite this, estimated concentrations there consistently exceeded the RfC many times over. In addition, conditions were probably somewhat worse right on the plaza, where the liquid mercury was stored in the royal warehouse and volatilized. Although volatilizing mercury contaminated the immediate environment of the storehouse, it would have been only a very small fraction of that emitted while smelting. In contrast, until around 1790, many of the smelters were grouped around the Indian neighborhood on the other side of the river. Besieged by a semicircle of ovens literally in their neighborhood, the native workers were likely consistently and continuously exposed to much higher concentrations of mercury than their overlords.

Potosí Results

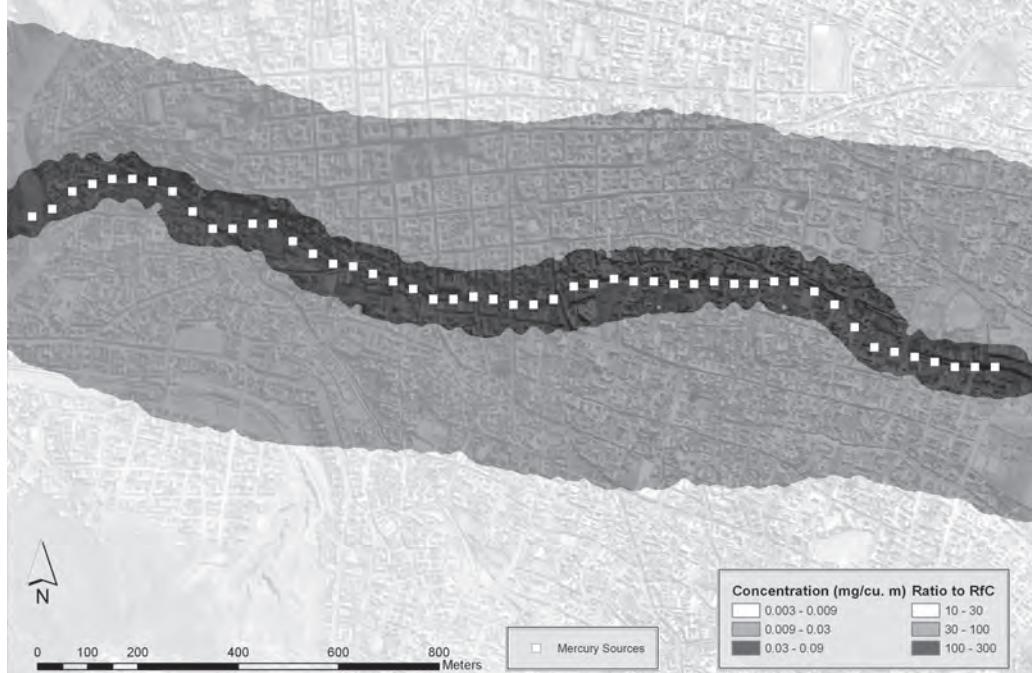
In contrast to Huancavelica, where the smelters were generally at the edge of town and dispersed, in Potosí most of the refining activity occurred along the ribera, which carried water from the lagoons and ran through the center of the city, powering the hydraulic mills where the ore was crushed and refined. Reflecting the geographical concentration of the mills, the concentration of mercury vapors also tended to follow the ribera.⁵⁵ The following three maps reflect the estimated maximum long-term mercury concentrations relative to the EPA reference concentration.

As in Huancavelica during the high point of mercury refining, most of Potosí's population was estimated to be exposed to mercury vapor concentrations ranging from a factor of 30 to 100 above the RfC during its peak of silver production (see map 4.9). Within around three hundred feet of the ribera, these predicted concentrations increased markedly, to a factor of between 100 and 300 above the RfC.⁵⁶

For 1655, a midpoint of silver production, the core of the city still appears to have exceeded the RfC by a factor of 30 to 100 times or more, and in some locations along the ribera the values exceeded the RfC by a factor of up to 300, as shown in map 4.10.

By 1712, a low point of silver production, concentrations along the ribera and citywide are predicted to have dropped considerably from previous years (see map 4.11). Despite this, the model estimates that concentrations consistently exceeded the RfC in the central zone of the city by a factor anywhere

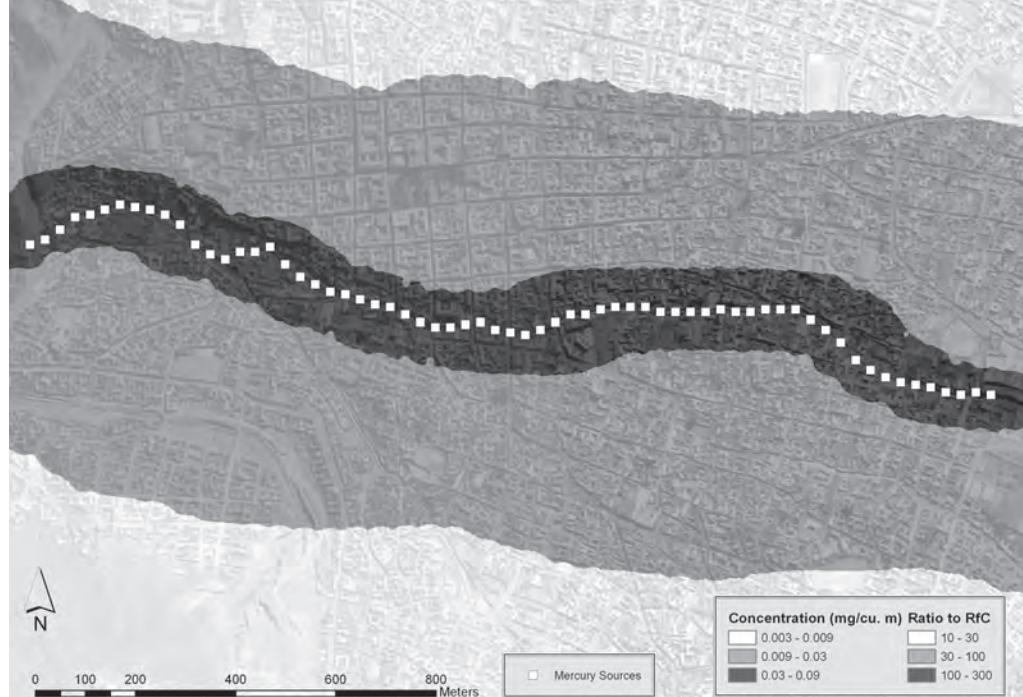
Potosí - Estimated Maximum Long-Term Mercury Concentrations
and Ratios to EPA IRIS RfC Value
Year 1593



Map 4.9. Potosí—Estimated Maximum Long-Term Mercury Concentrations and Ratios to EPA IRIS RfC Value, Year 1593 (20 ft. release Height)*

*Mercury emissions along the ribera in Potosí in 1593 were estimated to have been 81,939,563 grams, spread out among forty-nine mills along the ribera of the total of 108 mills in the city and along the Tarapaya River. This estimate is based on the average annual amount of mercury arriving in Potosí, which was derived from a ten-year period from 1593 to 1602. Mercury arriving during this time was 2,163,849,279 grams, which is an average of 216,384,928 grams per year. The estimate also takes into consideration that of the 59.4 percent of the mills which were not along the Tarapaya, 75 percent of these were along the ribera, the rest being trapiches of unknown location and being accounted for the use of an area source emission. Because the exact number and location of mills in and around Potosí at this time is uncertain, sensitivity analyses indicate that a reduction of the number of mills on the Tarapaya River and an increase in other, non-ribera mills have a negligible impact on model results. Capoche, *Relación general de la Villa Imperial de Potosí*, 118–2; Bakewell, “Registered silver production,” 98–99; Cobb, *Potosí y Huancavelica*, 91.

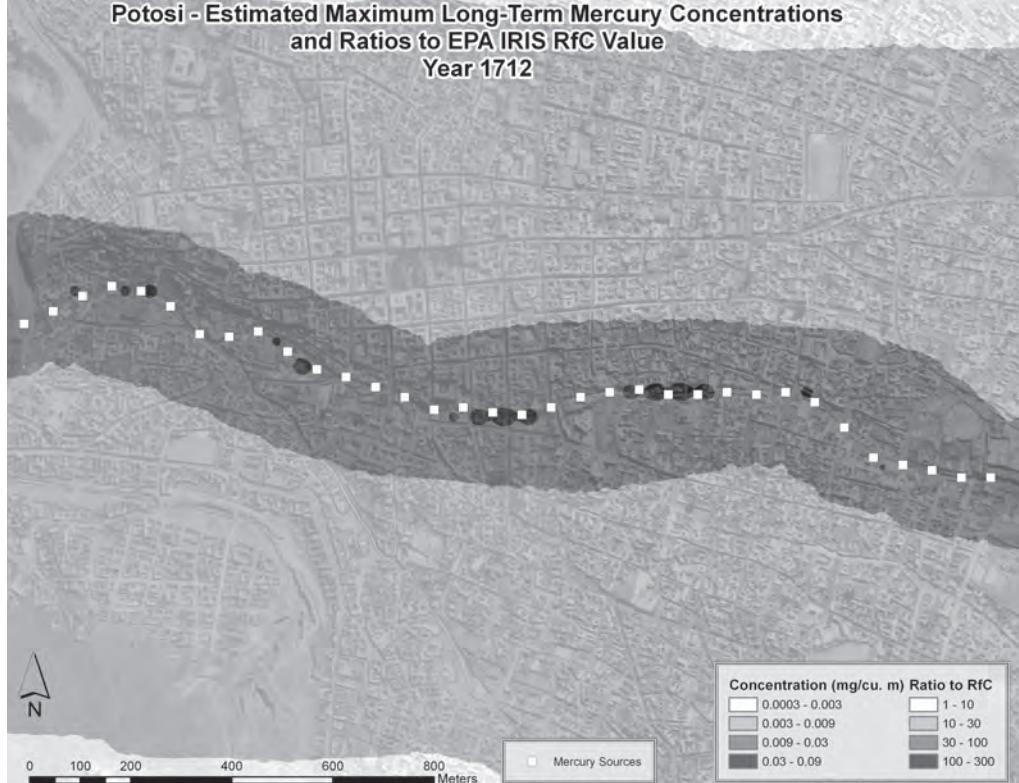
Potosí - Estimated Maximum Long-Term Mercury Concentrations
and Ratios to EPA IRIS RfC Value
Year 1655



Map 4.10. Potosí—Estimated Maximum Long-Term Mercury Concentrations and Ratios to EPA IRIS RfC Value, Year 1655 (20 ft. release Height)*

*Mercury emissions along the ribera in Potosí in 1655 were estimated to have been 120,625.51 grams, spread out among sixty-five mills. This estimate is based on the average annual amount of mercury arriving in Potosí, which was derived from a ten-year period from 1646 to 1655. Mercury arriving during this time was 1,892,166.84 grams, which is an average of 189,216.613 grams per year. The estimate also takes into consideration that the mills along the ribera were producing 75 percent of the silver in the district of Potosí, and by inference consuming 75 percent of the mercury which entered the city. Sarmiento de Sotomayor, "Relación del estado en que deja el gobierno," 248–51; Bakewell, "Registered silver production," 98–99.

Potosí - Estimated Maximum Long-Term Mercury Concentrations
and Ratios to EPA IRIS RfC Value
Year 1712



Map 4.11. Rotosí—Estimated Maximum Long-Term Mercury Concentrations and Ratios to EPA IRIS RfC Value, Year 1712 (20 ft. Release Height)*

*Mercury emissions along the ribera in Potosí in 1712 were estimated to have been 56,196,461 grams, spread out among thirty-four mills along the ribera. This estimate is based on the average annual amount of mercury arriving in Potosí, which was derived from a fifteen-year period from 1706 to 1720. Mercury arriving during this time was 1,322,269,674 grams, which is an average of 88,151,312 grams per year. The estimate also takes into consideration that the mills along the ribera were producing 75 percent of the silver in the district of Potosí, and by inference consuming 75 percent of the mercury which entered the city. See Cañete y Domínguez, *Guía histórica*, 93; Tandeter, *Coercion and Market*, 131; Bakewell, “Registered silver production,” 98–100.

from 10 to 100, with some concentrations along the ribera potentially reaching 300 times the RfC. The reduction also extended to the majority of the city, where it was estimated to have exceeded the RfC by a factor of 10 to 30.

In terms of health values, at the high point of silver production in 1593, almost the entire city is estimated to have exceeded the Cal and NIOSH RELs and the NIOSH ceiling values (see map 4.12).

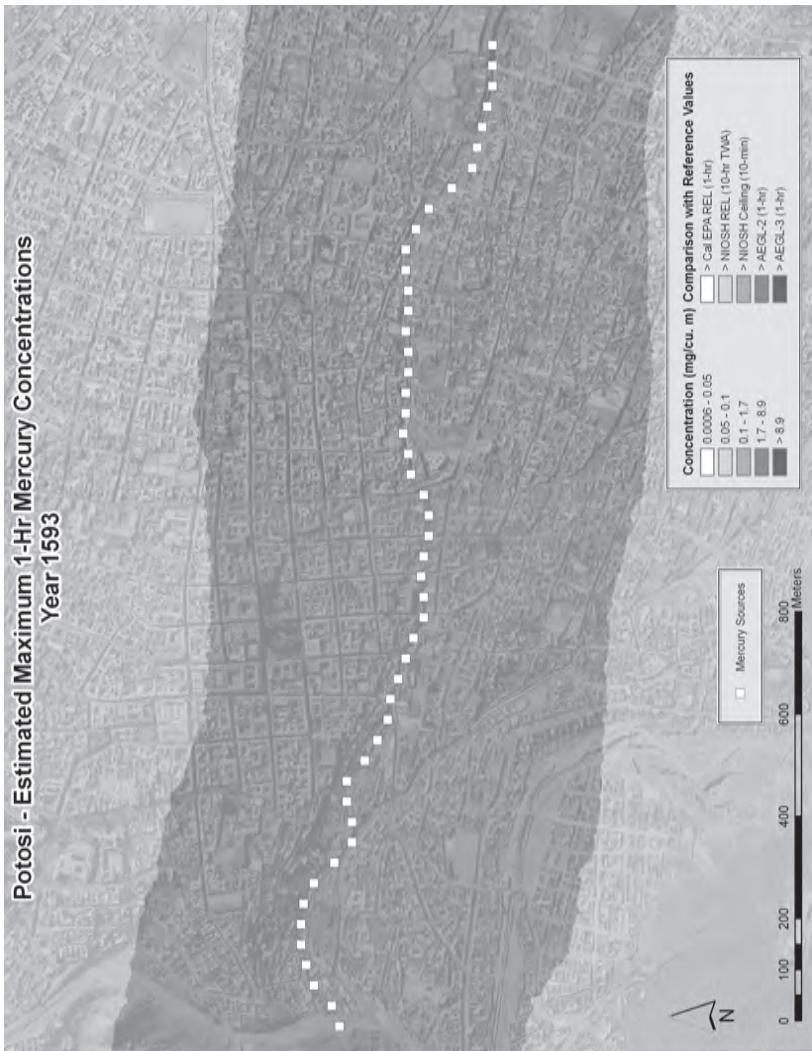
As with the high point of production, during a period of average production in Potosí, the Cal and NIOSH RELs and the NIOSH ceiling values are estimated to have been exceeded throughout the most populated parts of the city, as shown in map 4.13.

For a low point of production, such as in 1712, outlaying parts of the city are predicted to have been exposed to mercury vapor concentrations that were below the NIOSH values, as shown in map 4.14. As with all of the other scenarios modeled, however, the more populated urban areas were estimated to have exceeded the Cal and NIOSH RELs for one-hour exposures. Approximately six hundred feet on either side of the ribera, concentrations consistently exceeded NIOSH REL and ceiling values.

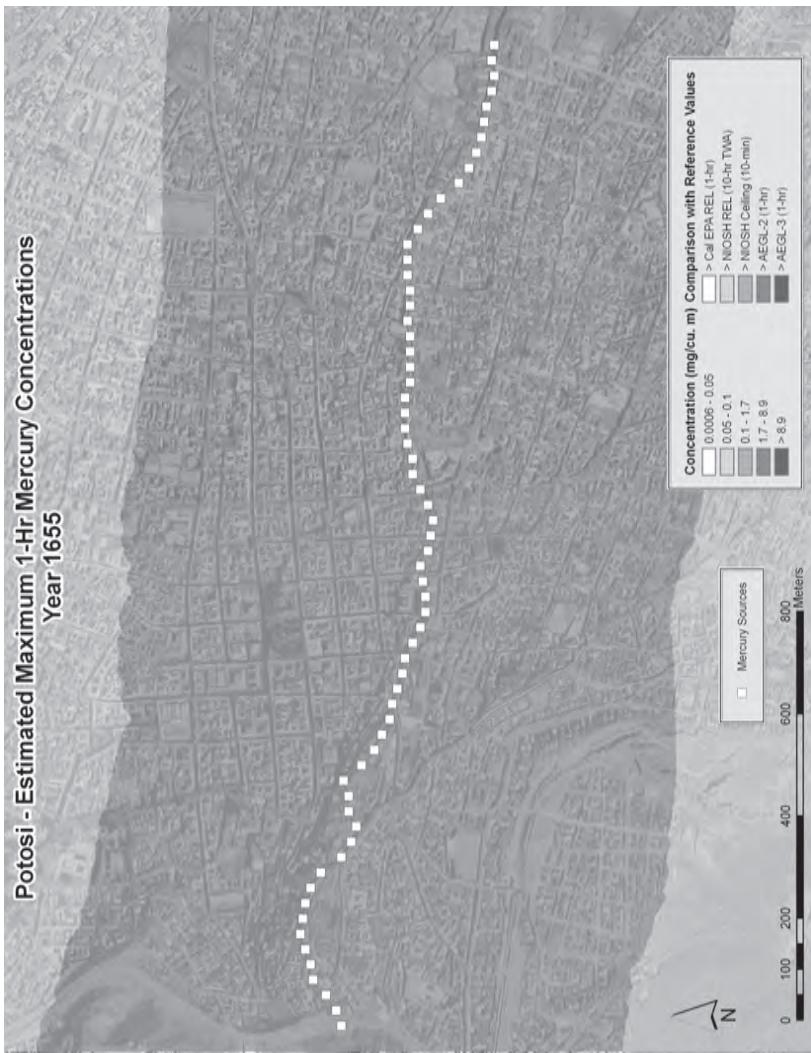
Overall in both Huancavelica and Potosí, these models underscore the differential health impact between natives and non-natives. Generally, native workers predominated in the smelters and mills, and consequently suffered greater exposure to mercury vapors and their negative health effects. For much of the colonial period this was especially pronounced in Huancavelica, where smelters formed a crescent around one of the Indian neighborhoods. In both Huancavelica and Potosí, the area surrounding the main plaza where the social and economic elites lived suffered consistently lower exposures than other populated areas. Despite this, these non-native sections of towns were still shrouded in a toxic cloud which exacted its toll, but one that was less than levied on the natives.

During the colonial period, Huancavelica experienced a consistently declining level of mercury production and, one can infer, negative health effects among its inhabitants. In contrast, Potosí's production was somewhat more variable and did not evidence as sharp and consistent a decline as Huancavelica. In both cities, however, the early years were the worst; rich ores and high production levels translated into astonishingly high estimated concentrations of mercury vapor in the air. Over the course of the colonial period, approximately 69 metric tons of mercury were, on average, annually emitted in Huancavelica, compared to approximately 165 metric tons in Potosí, and the incidence of AEGL values was much higher in Huancavelica. This reflects the greater number of emission sources in Potosí relative to Huancavelica, as well as Huancavelica's smaller overall size.⁵⁷

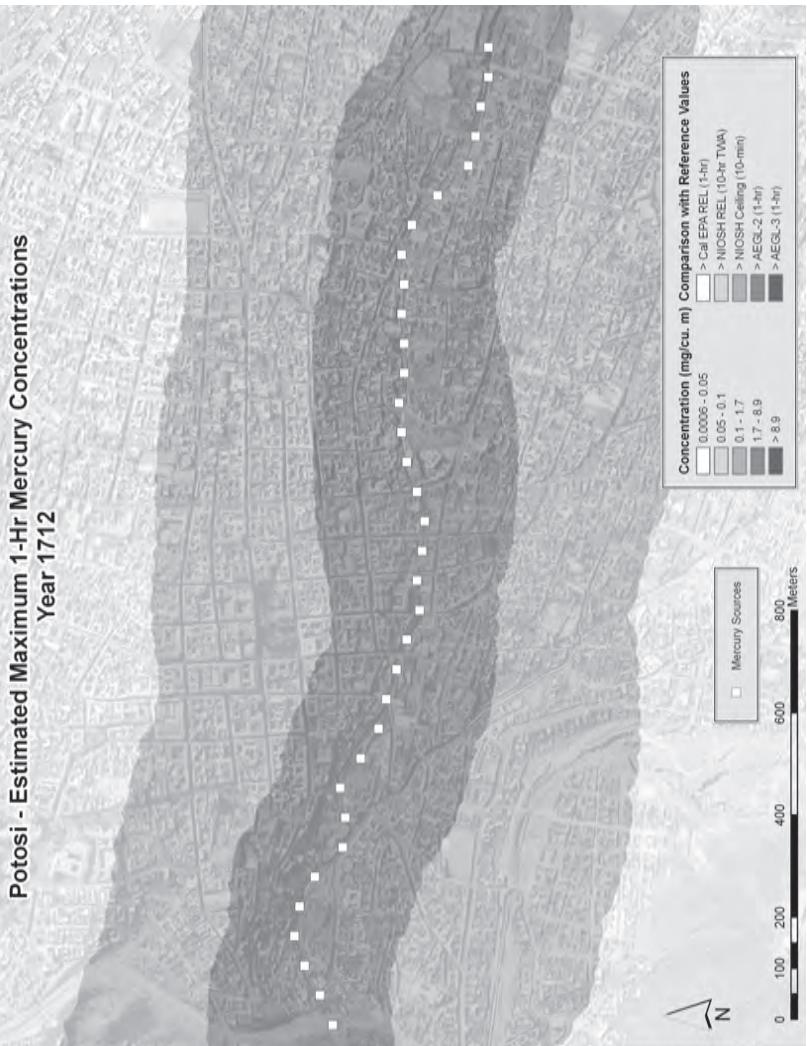
Potosí - Estimated Maximum 1-Hr Mercury Concentrations
Year 1593



Map 4.12. Potosí—Estimated Maximum 1-Hr Mercury Concentrations, Year 1593 (20 ft. release Height)



Map 4.13. Potosí—Estimated Maximum 1-Hr. Mercury Concentrations, Year 1655 (20 ft. release Height)



Map 4.14. Potosí—Estimated Maximum 1-Hr. Mercury Concentrations, Year 1712 (20 ft. release Height)

“Mercury Running among the Bones”: Health in Huancavelica⁵⁸

The documentary record underscores these effects, as the dangers of working or living in the toxic town of Huancavelica were well known during the colonial era, especially when surface mining was abandoned and shaft mining began. While recognizing that “if there was no mercury much less would there be silver,” Viceroy Luis de Velasco acknowledged in the early 1600s “the harmful nature of the ore,” referring to the “many who have until now got sick and died, of which there is a long and well known experience.”⁵⁹ Writing between 1600 and 1615, the chronicler Guaman Poma de Ayala described Huancavelica as “where the poor Indians receive so much punishment . . . torments and many deaths,” and highlighted the tragic irony of how when people became poisoned they would “dry up like a stick and have asthma . . . and . . . last a year or two in this way and die” while the miners “go around in silk . . . with the work of the poor Indians.”⁶⁰

Writing around 1600, Friar Lizárraga averred that

Huancavelica has consumed and consumes many tributary Indians, and if you do not believe me, look at the closest towns to Angares, and ask them in the valley of Jauja; the cause is working in the galleries of the mines, because as they don’t use a mask the vapor of the ore that they break gives them mercury poisoning, settling in their chest, and as the poor poisoned Indian is not cured, he comes, his mita completed, to his land, where they have no one to cure them or offer remedy, the mercury has settled in the chest, with great pains in the body they die, and no one comes away sick that does not die . . . some live longer than others, here and there they may last a year. . . . We write and advise those who can remedy this, but they do not respond, and of this no more, because, writing about Huancavelica, I do not know if we have said more than you want to hear.⁶¹

Lizárraga spoke from experience, writing that “I confess the truth that in the ten years that I have lived in this town of Chongos, the majority of those I have buried are from mercury . . . the Indians seeing this flee to not go to Huancavelica, just as they flee from death.”⁶²

Referring to Huancavelica around the same time, Friar Martín de Murua commented that

If this town has been the source of great wealth for the Kingdom, it has also been the cause of a great diminishment of the provinces, from which the

Indians come assigned to the mines, because those who enter the galleries, and even those who are refined . . . get poisoned by the smoke and from other accidents which result, and more of them die than can be explained. It happened that they opened a grave where there was an Indian buried, to put another, and they found mercury running among the bones.⁶³

The toxicity of Huancavelica's mines and mills was also clear to the cleric Pedro de Oñate. In 1629 he wrote of the "illnesses from which they die, which is poisoned by mercury and from that cough which they get and from which it is known that the mercury is killing them" and as a result "those that flee are fleeing from death."⁶⁴ He added "so it is . . . that the mercury mines of Huancavelica . . . have been the cause of death of the Indians and the destruction of that province," adding that they were "with such danger and risk to life that it appears that it is the same as to work there as to be sentenced to death."⁶⁵

Despite his support for the mita, Juan Solórzano y Pereyra also commented on "the harm and illnesses that are contracted in the mercury [mines], as I experienced in those of Huancavelica, where I was Visitor and Governor from the year 1616 to that of 1619, the dust alone does great damage to those who extract the ore, that is called there the illness of the mine and comes from the mercury, among those who . . . refine it, it quickly penetrates . . . weakening all of the appendages and causing perpetual shaking in them, such that although they may have been robust very few fail to die in four years."⁶⁶

In 1630 the protector of the Indians of Huancavelica, Diego de Luna, referred to the "great diminishment and consumption of the Indians . . . of those who are reduced to rigorous work, which, in ancient times, was only applied to delinquents meriting death . . . although all of these are innocent . . . if the mita continues the few that remain will die."⁶⁷ He also wrote to the king, asking him to

consider how much the Indians suffer in the mines of Huancavelica . . . they have to descend sixteen hundred and fifty feet underground, and in breaking the . . . ore, they get sick and die from the dust that comes out with the strike of the crowbar, which enters through the mouth and nose as they breathe, and they emerge loaded with the same ore from those depths, where the sun never shines . . . covered with sweat and blood, that many spit from their mouths, the air inside, as it never changes, is thick and the enemy of human life . . . and above all is the rigor and cruelty of the miners and overseers.⁶⁸

Such “rigor and cruelty” by overseers added to the intrinsically abusive nature of forced labor. In the mid-nineteenth-century mercury mines in California, among the reasons for the high turnover of foremen was that the longer they worked in the mine, the more ill-tempered they became.⁶⁹

Others in the seventeenth and eighteenth centuries recognized that deep inside the mercury mine “the dust and impurities of the ore [and] the smoke from the candles . . . was very harmful to the health of the Indians” and that the workers suffered from “continuous disasters . . . with the rockslides . . . not being of less consideration those that die from the rigors of the repeated convulsions that those who continue this type of work” suffer.⁷⁰ Even the mining guild of Potosí, which asserted that the Indians enjoyed working in the silver mines, acknowledged the perils of Huancavelica. They noted the dread of those sent to labor there, because they believed “they would not escape alive, and as a result the Indians that go to work in Huancavelica, are cried for in their towns as if they were dead.”⁷¹

During the refining of the mercury ore, José de Acosta remarked in 1590 how “if some smoke or vapor comes to the people who open the pots, they get mercury poisoning and die, or remain in a very bad state or lose their teeth.”⁷² It was not only mitayos who suffered high mercury exposures during smelting; often their wives and children did as well, as they assisted in operating the ovens and preparing and disassembling the condensation tubes to extract any remaining mercury. This led to an array of problems. Mercury has a heightened effect on children as their bodies and brains are developing, and results in severe physical and mental developmental abnormalities. The state doctor in Almadén, where children would also work in the smelters, described how they would “suffer from shakes, flaccidity . . . pallidity [and] mouth inflammation” as well as drowsiness.⁷³ Women working in these primitive conditions would suffer fertility problems, menstrual cycle irregularities, and neonatal poisoning if they were lactating. If they were pregnant, fetal deformations, spontaneous abortions, and stillbirths were likely, as not only does mercury easily cross the placenta, but fetal blood concentrations of mercury can be tenfold higher than those of the mother. In addition, all of these conditions can occur even when there are no overt signs of toxicity.⁷⁴

When he served as governor of Huancavelica between 1758 and 1764, Antonio de Ulloa described an illness which may have been associated with mercury intoxication. He noted that unlike native newborns, Spanish and Creole infants often began to suffer from a syndrome when they were three to four months old. He described it as a

cough . . . in the chest . . . it gets worse, and the medicines they give do not alleviate them: they then begin to swell up and after a while in this condition, they die. . . . [T]he popular opinion attributes their little resistance to the cold, and inclemency of the climate. That may contribute a lot, but a part of it also is . . . the sulphurous smoke that they continually breathe, coming from the ovens in which they extract the mercury, which are in such abundance, that in summer time with the freezes, form a dense cloud, that covers the area of the town.⁷⁵

Ulloa added that illnesses “of the chest are common in the highlands, as is also throwing up blood. . . . In Huancavelica it is quite common, and they live with it for some years . . . others die, without their being a fixed rule in terms of the duration.”⁷⁶ He also described an epidemic which struck Huancavelica in mid 1759 and lasted into August, which may have been exacerbated by Huancavelica’s toxic air. He described the Indians suffering an affliction centered on the chest but with a “long and painful recovery, because the bodies were weak, the vision disturbed, the affect sad, the spirit broken, needing more than a month” to recover. In his own case, he described “great . . . heaviness in the head, weakness in all the senses, strong pains in the body. . . . A low fever, general laxitude, blood in the mouth and nose, deafness and . . . a total loss of appetite.”⁷⁷

It appears that the vast majority of Indians were never treated for mercury poisoning. Although by 1588 Huancavelica had a hospital with 120 beds, it offered more comfort than cure, because, as one contemporary put it, “the ill were many and the nurses few.”⁷⁸ Those who were intoxicated and came to the hospital were probably already severely ill, and were only a fraction of those so afflicted. The Indians, perhaps rightly, viewed entering the hospital as a prelude to death. Because bleeding was among the treatments, which also included sweating produced by the consumption of hot drinks, few Indians were willing to pass through its doors. In addition, as the hospital was located in the town, its patients continued to breathe mercury-laden air. Those who were able usually would go to a warmer climate, where they would try to recover by sweating from working in the fields and drinking chicha.⁷⁹

Whatever relief Huancavelica’s hospital could offer was further compromised by limited funding. Although it was granted a stipend from the crown, it scraped by on 2,000 pesos a year between 1586 and 1608, lacked a doctor and surgeon, and “suffered extreme necessity.”⁸⁰ In 1608, when

Viceroy Montesclaros visited Huancavelica, he augmented the budget to 6,250 pesos and turned over its operations to the San Juan de Dios brotherhood, by which name the institution subsequently became known. Later, when Lope de Saavedra and his son died on the way to Spain in the 1680s, the 2 percent royalty which they enjoyed for developing the busconil ovens was dedicated to the hospital, although it more provided budget relief for the crown than improved care for the ill.⁸¹

Although there are few medical records which describe the effects of mine work and mercury poisoning in Huancavelica, the accounts offered by the state doctor in Almadén between 1761 and 1798, José Parés y Franqués, offer a startling glimpse of what things must have been like in Huancavelica. Parés y Franqués noted the prevalence of the common symptoms of mercury poisoning, such as tremors, excessive salivation, dry coughs, difficulty breathing, urinating blood, oral inflammation, nosebleeds, and dropsy. For treatment, he generally prescribed the removal of the patient from the source of the poisoning, and the consumption of milk, emulsions of acorns or almonds, and various unguents. Parés y Franqués described how his patients would often initially become pallid and lose weight before developing a cough, fever, and hemoptysis, or coughing up blood or blood with sputum. This he warned was “the first step to worse tortures . . . it already brings death in its hands” and described the bloody cough as “the coffin in which life lies dead or in which death lives.”⁸² As their condition progressed, patients began to sweat and tremble so violently that they needed to be bound and suffered “terrible pain in the heart, difficulty breathing . . . their spirit becomes confused, they beg for water, and cry for death.”⁸³ It was of little consolation to the ill that “with insanity the tremors go away.”⁸⁴

Overall, he noted that those who had served in and survived the mines “end up very stupid and almost lacking awareness,” and while some recover, others do not and “end up drowsy, slow in speech, with heavy gait and slow to conceive and explain their ideas.”⁸⁵ The effects of mercury poisoning in Almadén were not limited to the mines and refining area but extended throughout the town, which was often shrouded with “an unbearable pestilential odor.”⁸⁶ Parés y Franqués described how Almadén’s streets, plazas, hospital, and surroundings were filled with people suffering from dementia, who “set out running with no destination. They flee suddenly from their houses. They cry without reason. They laugh for no reason.”⁸⁷ The hospital itself “looked like a mad house . . . and a children’s school with so many boys and so much noise.”⁸⁸ One person who came to visit the region in the 1800s described those who lived near the mine as “cadavers that shake.”⁸⁹

“The Fatal State of Misery”: Health in Potosí⁹⁰

Like Huancavelica, Potosí also had a hospital, called the Royal Hospital of Veracruz, which the Indians “hate[d] like death.”⁹¹ Located across from the main church, it was constructed in the shape of a cross, which enabled patients to attend mass in their beds. In the late 1590s, after receiving enhanced funding from Viceroy Toledo, it was described by its former administrator as “low and humble. . . . In it are usually cured one hundred and twenty patients and above, of all types of people, but the most are Indians.”⁹² Subject to periodic inspections by the city government, not only did it treat accidents and general illnesses, often through bloodletting, but it also doubled as a sanatorium.⁹³

Although it had about the same capacity as its counterpart in Huancavelica, it was better funded and staffed. Administered by a cleric, day-to-day operations were overseen by a layman, and patients were cared for by a doctor, surgeon, and pharmacist. In the late 1500s, it had an income of approximately 22,000 pesos, of which around 5,600 came from mortgages, 6,250 from sixty mitayo Indians assigned by the city and whom the administrator rented out, and, until 1632, the rest derived from a six and one-half reales tax on mitayo wages. Sound lending practices paid off for the hospital, if not the patients, and its revenues increased with time, assisted by alms. In 1610 the San Juan de Dios hospital was established to care for the non-Indian residents of Potosí, and in 1619 a wealthy secular brotherhood took over administration of the royal hospital.⁹⁴

According to one chronicler writing around 1610, the royal hospital had so much income that the patients “could be dressed with silver and gold.”⁹⁵ Irrespective of their revenue, conditions appear to have deteriorated over the colonial era. In 1814 and 1815 the Potosí city council ordered inspections of the city’s two hospitals, averring that the “unhappy sick are found abandoned to the fatal state of misery” inside their walls. The scathing report following the inspection revealed a lack of medicines, putrid mattresses, a lack of covers, poor medical attention, and a general state of filth, with conditions being especially bad in that of San Juan de Dios, where the patients were “viewed like the excrement of humanity.”⁹⁶

Given the volume of documentation concerning Potosí and the tens of thousands of tons of mercury which were released into the atmosphere there, there are relatively few references to mercury poisoning by contemporaries. While this may be a result of symptoms being slow to appear or modest in manifestation, it may reflect other causes. Among them may be that the effects of mercury poisoning were so common and accepted as a part of

day-to-day life that contemporaries became habituated to them. In addition, the ill or insane may have migrated to other, warmer places in an effort to recover. Contemporaries did recognize tremors and loose teeth as common symptoms of mercury poisoning; for example, Arzáns described a man who was tempted by a naked woman as “shaking like one poisoned by mercury.”⁹⁷ It is highly unlikely, however, that contemporaries recognized the range of symptoms and effects which mercury produces, many of which have only recently been revealed. Finally, Potosí’s mining society revolved around producing and spending silver, not public health or Indian welfare, and it is not surprising that the mass of documents reflects this orientation.

What is clear is that Potosí was an immensely toxic place, saturated in a smoky mist much of the time. One anonymous writer in 1759 described the “thick cloud that forms . . . over the city, and is clearly seen on any clear moonlit night, this is without doubt . . . vapors and poisonous fumes . . . from dead animals, from trash heaps, and other fine dust from the ore and from the mercury smoke in the burning and reburning of the piñas. . . . [T]his . . . mix of bad vapors and fumes cannot be healthful.”⁹⁸ In addition, despite the efforts of miners to reprocess runoff, some ultimately was released to the streams and may have also have polluted the water table. In 1594, the Potosí city council noted that, in a time of drought, many Indians had taken to drinking water from one of the streams that ran through the city and had subsequently died. Others had dug shallow wells only to find that drinking the water caused “severe illnesses and many deaths.”⁹⁹ On the whole, these were probably exceptional cases, as most of the city’s public water supply was piped in from freshwater springs in the hills above.

Although they may not have dwelled on the topic, contemporaries did recognize the human toll that silver mining and refining exacted on the population. The cleric Pedro de Oñate remarked in 1629 how “we well know and have seen . . . how terrible are the effects of mercury and how dangerous to health and life, as only in smelting the piñas and treading in the vats. . . . [M]any are poisoned by mercury and we see those effects among those to whom we give last rites.”¹⁰⁰

Silicosis was also prevalent, and most of those who worked in the silver mills returned home chronically, if not mortally, afflicted with it. In 1793, Pedro Salcedo, the curaca of Nuñoa in Lampa province, described how the Indians assigned to the refineries would come back with “asthma, or dry cough, which has no other remedy than death.”¹⁰¹ The following year the lieutenant governor of Chayanta province offered several reasons for the illnesses and “extraordinary mortality” among mitayos. These included silicosis from working the stamp mills and sifting, and overwork, both inside the

mine and in the mills, which was especially severe in those that were rented. Another cause was that many Indians sought and obtained service in the church and the mita exemptions it offered, so that the labor burden fell on fewer people. As a result, the lieutenant governor averred that many Indians had severe respiratory problems, “incurable asthmas; many deaths, and a thousand other illnesses that are rapidly carrying the provinces to their total extermination and depopulation. . . . These statements may appear exaggerated, hyperbolic and even fabulous to minds . . . that have not seen nor observed the mitayos when they return from their labors.”¹⁰² The result, he wrote, was that there were “many unhappy Indians in the grave.”¹⁰³

Contemporaries only rarely commented on the incidence of birth defects in Potosí. Among the reasons for this may be the paucity of chronicles of the city or because they occurred out of town, were kept secret, or were so common as to not merit much attention. Such births do, however, surface in some accounts. Fernando Montesinos tells of a birth in Potosí of a “notable monster, it . . . had legs and arms like a person, a woman’s nature in its place, all of the body was covered in fine hair, the . . . shoulders with thicker hair, the face was formed, but without nose nor mouth. . . . its eye was always open, in the front it had a man’s organ . . . it lived three hours, was baptized, and died.”¹⁰⁴

Chroniclers have remarked upon the fact that no Spanish or Creole child was born in the first fifty years of Potosí’s history, something usually attributed to the altitude or cold climate. Because of this, it was customary for expectant mothers to retreat to the warmer valleys when they became pregnant. Just as Ulloa described in Huancavelica, the chronicler of Potosí, Bartolomé Arzáns, also commented that when infants were brought to Potosí they often died soon after.¹⁰⁵ Whatever role that climate or altitude played may have been exacerbated after 1574 by the prevalence of mercury in the air.

Although Arzáns has often been criticized for exaggeration, an over-reliance on oral history, and a somewhat novelesque style, he nevertheless offers a valuable window on Potosí society. As Gunnar Mendoza notes, some of his errors were intentional, to avoid repercussions for his writing, which he tried to keep under wraps.¹⁰⁶ It is also possible that the conditions in Potosí and the material that he had to work with were so intense as to appear exaggerated to later readers.

Whatever the case, he was working in a toxic environment. A hint of this is given when, referring to hypochondria, he remarked, “that in this city many people are ruled by this terrible accident.”¹⁰⁷ The toxicity of the area was also reflected in his references to stillbirths and birth deformities, the

latter of which he viewed as omens. Arzáns wrote of babies “born with two heads stuck together, or on the chest or the back, others with four arms or legs, and others with amazing monstrosities, as well as others which lacked some parts of their bodies.” He also referred to an Indian child “that had two heads (one natural and the other came from the chest) such that one looked at the other.”¹⁰⁸ The priest who came to baptize the child was uncertain as to whether he should perform one or two ceremonies. Bartolomé Arzáns’ son Diego carried on his father’s history of Potosí after either 1722 or 1735, and apparently had a fascination with deformities.¹⁰⁹ He referred to the birth of twins in 1719, one of whom died along with his mother, while the other “to the waist was perfect, but from there below it came to a point. It never spoke in the fifteen years that it lived, and when necessity required that it ask for something it cried, and not even the hands served for anything . . . and thus it looked like an animated trunk.”¹¹⁰ Diego Arzáns also wrote of “a little Indian boy who . . . lacks arms, and of this type I have seen another in this city.”¹¹¹

In addition to anecdotes concerning birth defects, chronicles reveal instances which are highly suggestive of mental illness. The elder Arzáns, always more interested in the city as a whole than the mines, recounted several cases of mental breakdowns in Potosí. One concerned Fulgencio Orozco, a Spaniard who arrived in Potosí in 1610 to work as an overseer in a silver mine. About a year and a half after beginning his job, he went insane,

saying a thousand blasphemies and casting as many curses, and he went to the royal hospital, for it looked like he soon wanted to end his life according to the things he said. When Friar Calancha came to perform an exorcism, Orozco began a dialogue with the devil, saying “with promises you have deceived me, and with lies and oppression you have me beaten.”¹¹²

It appears that what precipitated the breakdown was that Orozco had unsuccessfully tried to assemble a dowry for his daughter. Seeking to console him, members of the community gathered almost 3,000 pesos in donations before he died.¹¹³ Having performed an exorcism, Friar Calancha related how Orozco was a “corpulent man with a severe face” who believed that he had made a deal with the devil, whom he asked, “What do you want from me? I do what you order, what I promised you I have done, and of what you promised me, you have done nothing.”¹¹⁴

Arzáns also narrated a case of a young petty merchant in a hospital. In the middle of the night, he woke his youthful neighbor, telling him to get up as “it is time to go to the party.” His companion, seeing him naked

before him, told him to quiet down and go back to bed. Instead, the merchant woke the others, telling them the same thing, and then began to dance in the middle of the room before falling down dead.¹¹⁵ Another case involved a shopkeeper “who was out of his mind saying and doing crazy things . . . they brought him to the royal hospital, where gripped by his rage he was found dead after 26 days.”¹¹⁶ Rage seems to have been a common emotion in Potosí, and Arzáns related a tale of someone who “went around the streets cursing . . . complaining, blaspheming and calling loudly to demons to bring him to hell, a common destiny of those that lose at games, which leaves them crazy as if they totally lack understanding, and making such screams in the streets and houses as if they were drunk or lost their mind.”¹¹⁷

Although immune to civil authority, the clergy breathed the same contaminated air as everyone else. This may have contributed to the insanity of Father José Leaño, who in 1686 served as the chaplain of the royal hospital and sanatorium. After his honor was impugned, he sank into a deep depression and refused all food. His physical and mental condition continued to deteriorate, and one day when his servants went to check on him, they found he

was not himself . . . he did not respond to a single word . . . and cast himself furiously against his servants saying he was going to chop them to pieces . . . nothing served to placate the passion that had gotten a hold of him. It was very sad to see that kind priest . . . speaking sometimes to himself and other times giving terrifying screams, and things progressed such that it was necessary to tie his feet and hands to a post and not let him out of sight.¹¹⁸

In the end he escaped the vigilance of his caregivers and killed himself.¹¹⁹

While Spaniards and Creoles consistently condemned the widespread consumption of chicha among the Indian population, ironically it may have attenuated the effects of their constant breathing of mercury vapors. In a study of Japanese ex-mercury miners, there was a clear association between alcohol consumption and a reduction in psychological and central nervous system abnormalities. The consumption of alcohol actually reduces the amount of mercury vapor absorbed by the lungs by up to one-half, inhibiting its uptake in the blood. In essence, ethanol and mercury compete for the same red blood cells, limiting the oxidation of mercury and thus allowing more of it to be exhaled. This same process, however, allows the mercury that is absorbed to remain in the plasma for a longer

period of time, and ultimately be distributed to different organs, including the liver and brain.¹²⁰

A “Theater of Tragedies”: Violence in Potosí¹²¹

The friar Martín de Murua, writing in the early 1600s, believed that Potosí’s weather cast some spell on its inhabitants, asserting that “it must be the influence of the climate on that city and its district that, upon entering it, a poor, unfortunate and cowardly man, in the instant that he sets foot there . . . thinks that he alone can fit a battalion of armed men.”¹²² The elder Arzáns also wondered what “climate is yours, Potosí, under what curse are you? . . . Why are you the enemy of peace. . . . Why do you not permit there to be friendship among those who live there, but rather that everyone chops one another to pieces.”¹²³ Friar Antonio de Calancha also asked “is there a town in the world like Potosí where there are so many quarrels, and such routine killings, even between the best of friends . . . where against the Indians are seen so many cruelties by the covetous.”¹²⁴ An important part of the answer to their questions may literally have been in the air they breathed.

Many contemporaries remarked on the cyclical nature of violence in Potosí, correlating it with the strong seasonal southwest wind known as a “Tomahavi,” as it came from June to August from the direction of a town by that name. The effects of these winds may have been exacerbated by the presence of mercury in the dust and soil which they stirred up. Friar Lizárraga wrote that it would “come with such fury that in those days . . . there is nothing to do but to close doors and windows and not go out to the plaza. This wind . . . covers the town with a cloud which looks like one you can touch.”¹²⁵ Francisco López de Caravantes wrote that it was the “cause of pains in the side and dryness in the head, to which are attributed the fits . . . which are very common . . . at the time when these winds blow.”¹²⁶ Cobo also noted that it “ignites anger such that, for any small reason, men get very angry, and for this reason during this time . . . the fits and murders are more frequent.”¹²⁷

Seasons aside, Potosí was known throughout the colonial era for being an especially violent city where murder, robbery, and thievery prevailed.¹²⁸ The presence of a large, rootless, ambitious, and often armed population no doubt contributed to this. Much of the violence in Potosí took place in the *empedradillo*, a cobblestone court next to Potosí’s cathedral. According to Murua, it was the “theater . . . where ire had its throne . . . for being the busiest part of Potosí, and there are the challenges, the fits, the stabbings,

the injuries, the beatings and offenses and deaths, and it is almost a refrain in Peru, to call someone valiant and brave, to say: He is a soldier of the Empedradillo.”¹²⁹ Part of the cause of this violence was the “harmful custom . . . of most [non-Indian] residents . . . to publicly carry blunderbusses and pistols hanging from their belts.”¹³⁰

In the elder Arzáns’ history of Potosí, a prominent theme is the incessant violence in the city, which he characterized as an “irremediable plague,” “fatal habit,” and “a custom of the land.”¹³¹ He lamented that the majority of the “continuous unrest, quarrels, confrontations and bloodshed” there went unpunished.¹³² In one passage, he described “the ordinariness of bloody gangs, that stay alive like embers, and any little breeze of . . . insanity and passion . . . ignites large flames of disturbances.”¹³³ Often conflicts and deaths resulted from “things of little importance, ordinarily ire is not born . . . of high principles . . . [but rather] from ridicule, a smile, or a movement, a wink, or a light word or other things of so little account . . . the abominable custom of this city . . . is that for almost nothing they kill and destroy.”¹³⁴ Often murders were a result of adultery and gambling disputes, perhaps giving rise to the saying in Potosí that “it is better to kill than to owe.”¹³⁵

While Arzáns endeavored to keep track of the numbers of murders in Potosí, he noted that a great number went unrecorded. Some did, however, come to light later, as “wherever one opens foundations or ditches in houses, stables or fields, bones are always found of those miserable ones who perished at the hands of” murderers.¹³⁶ Some of the killings he describes were especially cruel, such as when a servant was whipped to death and then burned with gunpowder, or others which involved quartering, beheading, and using hot iron poles. In addition, he noted that while it was generally men killing men, there were frequent examples of women killing women.¹³⁷ And although the clergy was immune from civil authority, they were not immune from crime. For example, in early 1769, the priest Joseph de Iriate became one more victim during a spate of murders. Returning to his home on a January night, he was attacked in his entranceway by unknown people who lay in wait. Hearing his screams for help, neighboring shopkeepers tried to help him, only to find that the door had been secured from the inside.¹³⁸

Beyond crimes of passion and to avoid debts, overlapping ethnic and class antagonisms also played an important role in spawning violence. Although many of the conquistadores were from Andalusia and Extremadura, since the 1580s Basque commercialists and creditors had been consistently increasing their economic and political position in Potosí. By the

early 1600s, they owned 80 of the 132 mills there, and of thirty-eight officials in the mint, twenty-two were Basque. They also used their wealth to purchase political power, having obtained, often on credit, a majority of the sixteen permanent positions on the city council. Their rise to power was paralleled by increasing resentment by the Andalusians and Estremadurans, many with military traditions and a feeling of being shorted on the later fruits of conquest. In 1593, Potosinos got a glimpse of things to come when an outbreak of violence between Basques and Estremadurans and Creole adolescents left sixteen dead. Seven years later, a conflict between Basques and Andalusians also resulted in fatalities.¹³⁹

These outbreaks were, however, only presages of a paroxysm of ethnic violence that would engulf Potosí from 1622 to 1624. In 1618, an audit revealed that several Basque officials in both the mint and city council still owed money on the positions they had purchased and were subsequently ordered to be suspended from their jobs. As a result, the Basque councilmen would be unable to vote for their allies in the upcoming elections. The Basque bloc ignored the order and complained to King Philip III, who not only upheld the suspensions but extended them to any official who owed money to the crown. Despite their weakened position, the Basques retained their power on the council in the elections of 1621.¹⁴⁰

By June 1621, the anti-Basque faction expressed their frustration by murdering a prominent Basque, Juan de Urbina. Over the next two years, the two sides were engaged in internecine conflict, in which those opposed to the Basque faction identified themselves by their use of hats made of vicuña wool, and hence became known as “vicuñas.” The conflict not only involved Basques, Andalusians, Estremadurans, and Creoles but also Indian, Mestizo, and Negro proxies, and culminated in 1623 with a brazen vicuña attack against Governor Felipe Manrique, from which he narrowly escaped. The violence even spilled into La Plata, where many people from both sides had taken refuge or been sent as prisoners. In addition, vicuñas were camped outside of Potosí, waging a low-level insurgency while planning an attack on the city.¹⁴¹

By the end of 1624, the vicuñas had been largely defeated, more by royal authority than by the Basques, many of whom had taken refuge in Potosí's many churches and convents. The vicuñas, increasingly divided and the focus of summary executions, were vanquished by early 1625 after the betrayal of a last-ditch plot to attack Potosí. In just over three and one-half years, up to 2,400 Creoles and Spaniards and 3,300 Indians, Mestizos, and Negroes had been buried, while 2,172 houses had been sacked and 200 razed. Although the Basques retained their wealth, power, and influence,

ethnic tensions simmered and would again erupt in 1637, 1644, 1646, 1647, 1648, 1649, 1651, 1652, 1653, 1666, 1662, 1663, 1666, and 1679.¹⁴²

Although the mitayos in Huancavelica and Potosí suffered the most in terms of risk, abuse, and the health effects of mining and refining, they had plenty of company. These were toxic cities that, in modern times and under some conditions, might well have been evacuated, given the amount of mercury vapor in the air. Instead of evacuation, people were born, grew up, and lived in them year-round, for generations. Given the effects of mercury poisoning, among which are a tendency to violence, irritability, and anxiety, we can better understand why both cities had a reputation for violence and unruliness. Short tempers probably led to more frequent and harsher whippings of mitayos than would have occurred under different circumstances, as well as more arguments and duels among others. Short-term memory problems also would have impeded commerce and the payment of debts, and led to lawsuits and further conflicts.

Of course, not everyone reacted in the same way; while some were chronically agitated, inattentive, and sleepless, others shuffled and shuddered in a lethargic daze. While some lost all fear, others were consumed by anxiety, uncertainty, indecision, and panic. While some were suddenly gripped by elation, others were trapped in a void of depression, and still others were chronically impatient and hypercritical, and probably prone to physical violence. Incidences of headaches, stillbirths, fetid breath, high blood pressure, slow physical reactions, slurred speech, neuroses, and compulsive disorders were likely higher than in other places. The streets and plazas would not only have been populated by those injured in the mines and mills but also those born without limbs or who were retarded. The obviously poisoned, who moved along the streets shaking and drooling, had company in many of the dogs, mules, llamas, and other animals around them, who suffered similar symptoms.

Such symptoms would not only have been found in other mining centers but also in the cities and towns to which poisoned people migrated. While any population has its share of aberrations and misfortunes, what made Potosí and Huancavelica different was the probable prevalence of such disorders, and because of that, the range of extremes which prevailed. Ironically, many would look upon a drooling, trembling mitayo and recognize that they were poisoned—yet not recognize that mercury was the reason why they could not sleep properly and had such a short temper.

From Corrosion to Collapse

and the Destruction of Native Communities



“Neither Livestock nor Lands nor Houses”: A Horrific Homecoming¹

The mita, mercury, and silicosis did not just kill and maim individuals, they also did the same to countless indigenous communities throughout the altiplano and valleys as their effects reverberated throughout the region. As a key element in the colonial exploitative equation, the mita exacerbated both the ongoing abuses against Indians by their overlords as well as divisions among the elite as they competed for Indian labor. Further complicating the situation were the myriad physical and mental effects of quicksilver and silicosis previously described. In addition, while Potosí was for many years the most important mining town in the Andes, silver production and mercury pollution occurred throughout the region on both small and large scales. As a result, both free and forced laborers, mine owners, colonial officials, clergymen, artisans, and anyone or anything else in these areas that breathed were at a high risk of being poisoned. Governors, priests, officials, and commoners did not stay in one place but often moved as they sought better lives or purchased new jurisdictions, positions, and parishes. The result was that the human effects of mercury and silver production were by no means limited to Huancavelica, Potosí, and other mining centers, and those who were poisoned became carriers who imported their afflictions to towns and cities that did not produce silver or mercury. Such was the profoundly exploitative nature of colonial society, however, that mercury only exacerbated entrenched practices and abuses. Examining what natives had to contend with in their villages rounds out

the picture of what awaited them if they returned home from the mita, and underscores the broader, regional effects of the amalgamation economy.

Leaving one's hometown to become a *forastero* in another community was the best way of escaping the mita, although the burden of service fell that much harder and more frequently on those who remained. Other ex-mitayos stayed on in Potosí to work as free wage laborers, knowing what awaited them—or rather, did not await them—when they returned home. The resulting self-reinforcing process of depopulation of communities subject to the mita continued to devour communities long after the demographic implosion had taken its own toll. As early as 1597, Balthasar Ramírez commented that not only were the Indians “being fin shed off and consumed very quickly by the vexations that they suffer from tributes and personal service” but that “of ten Indians who go [to Potosí] six do not return, because some die, others stay in Potosí, and others stay in those valleys and farms, where . . . they do better than in their own lands.”²

Those Indians who had worked in mills and returned home usually arrived after a journey of weeks ill from mercury poisoning and silicosis. They often found their lands reassigned and a demand for the payment of the past and present years' tribute, which itself had increased on a per capita basis as a result of community depopulation. The issues of landlessness and land seizures were exacerbated after 1631 when it became possible for people to pay the government a fee to legalize ownership of lands which they had obtained through encroachment. At the close of the sixteenth century, Antonio de Ayans related how, as a result of the mita and being forced to serve as bearers, in “the provinces from Potosí to Cuzco the number of Indians has declined so much that the towns are deserted . . . the inns are without people or service and everything is so abandoned.”³

Fourteen years later, a group of Jesuits remarked how “of 100 Indians that come to Potosí not even forty return to their town and those that return, before they even arrive, are sent by the curaca to serve . . . the priest, the transport of goods for the governor and in the end they had a very sad life, without giving them time to rest.”⁴ Describing the region of Huancavelica around 1618, Caravantes described how as a result of “the harmfulness of mercury ore . . . many Indians have died, the subject provinces that were the most populous are already deserted, and the few that remained fl e to the Andes . . . seeing that there are so few to serve . . . and they have lost what little money they have trying to ransom themselves.”⁵ Seven years later, in a letter to the viceroy, the archbishop of Huamanga, Francisco Verdugo, described the people in his archdiocese, which included Huancavelica, as “so thin and sick and poor, that they have nothing more they can do.”⁶

News of these conditions traveled across the Atlantic. For example, in 1657 a judge in the Audiencia of Lima, Juan Padilla y Pastrana, wrote to King Philip IV detailing how the mita had “devastated” the provinces which were subject to the Huancavelica mita through death and flight. During a visit to the town of Santa Lucia, in Lucanas province, he found that women were tending the fields and only one Indian man lived in the town, a sacristan who by virtue of his position was exempt from the mita. All of the other men were dead or had fled. He also reported that women would maim their children to spare them the mita and asserted that there were many more deaths in the mines than were reported. He added that miners would also send people to Indian towns which were not subject to the mita, claiming to need guides or carriers, only to kidnap and march them in iron collars and chains to Huancavelica.⁷

Around 1660, Friar Buenaventura Salinas y Córdoba noted the abandonment of the towns in the region of Huancavelica which were “already . . . finished and the Indians consumed.”⁸ He reflected that “Truly costly, very costly, has the faith come to these miserable Indians . . . after receiving our Christian religion they are oppressed among us by more and heavier burdens than they had in the time of the . . . Inca kings. . . . [I]n less than one hundred years they have been finished, erased and consumed . . . [by] the covetousness and inhumanity with which the miners treat them in Huancavelica . . . where Indians are swallowed.”⁹ A decade later Viceroy Lemos reported to the king, Charles II, that the “provinces are so lacking and finished that there is no way that they can continue to provide the entire mita” and “most of the towns are deserted and abandoned.”¹⁰

Things did not get better with time in many communities. By 1794, as the colonial era began to wind down, the intendant of Puno, Francisco de Viedma, described his jurisdiction as “desolated” as a result of the mita and remarked on how community leaders would flee in fear of punishment when they could not gather the requisite number of mitayos. Concerning those who did return from the mita, he wrote that “they find in their towns neither livestock, nor lands nor houses . . . the desolation is true. . . . [T]he Indians have a horror of the mita perhaps greater than panic.”¹¹ Things were no better in Chayanta, where a priest also observed that of those who served in Potosí,

most died in [Potosí], others fled to remote places and the few that returned . . . died immediately or remained perpetually invalid. . . . The hard work to which they are destined along with the . . . mistreatment and the unjust withholding of their wages motivated their flight. The terror

with which they looked upon this destiny made them prefer to . . . abandon their houses than . . . return to the mita.¹²

“Bitter Sweat”: Catering to the Curaca¹³

Because the Inca generally retained the hereditary native leadership in the lands which they conquered unless they were prone to rebellion, when the region came under Spanish dominion traditional community structures were largely intact. Although the Spanish initially tried the same approach, they soon found that, as a result of the nature and frequency of their demands, it was more effective to appoint people on the basis of pliability as opposed to bloodline. Many of these new curacas were Mestizos who were not from the communities they ruled and were appointed on an interim, though often long-term, basis. Not only could the corregidores bypass certain bureaucratic procedures with this approach, but they could also remove their appointees at will. Curacas of noble lineage were displaced, although they often remained members of the hilacata, or native council, and continued to earnestly defend their communities.¹⁴

Whether hereditary or appointed on an interim basis, curacas were known for ruling with a heavy hand and were well aware that they would be subject to the same treatment if they did not deliver mitayos, tribute, and the host of other exactions demanded by their overlords. Coercion at a community level mirrored that in the colony generally.¹⁵ Acosta recognized the abuses endured by communities under their despotic rule, remarking that

by deceit and violence . . . many times the Indians are deprived of the fruit of their sweat, and other times are forced to pay much more than the law and reason authorize. . . . [S]o great is the fear of the people . . . that they would not even dare to gossip against . . . these satraps . . . and they would prefer to die . . . with their eyes wide open before they say a word against orders of the curacas.¹⁶

One colonial official averred that “the occupation of the [curacas] . . . is to laze around and drink, and count and distribute, in which they are very capable,” while another added that they have the Indians “so subject that there is nothing they order that does not have the force of law.”¹⁷ Some community leaders did, however, challenge their overlords. Often complaints focused on excess tribute charges, community land seizures, banishments, unremunerated work, being forced to serve the mita in Potosí

prematurely, and having no lands to return to when they came back. For example, in 1694 in Copacabana on the shore of Lake Titicaca, community members complained of whippings, being charged tribute while they were exempt, having their hair shorn, property seizures, making women weave without pay, and misappropriation of community property. In addition, the curaca and his brothers were accused of routinely abducting women to an island in the lake where they were raped. The audiencia supported their request to “free us from this captivity” at least temporarily, by suspending the curaca.¹⁸ Likewise in Moromoro, in Chayanta province, the community sought to remove their Mestizo chief who, apart from having the “notable defect of drunkenness” and frequent adulterous affairs, would force people to harvest his fields at the cost, as they put it, of their “bitter sweat.”¹⁹

Floggings and drunkenness also figured prominently in many complaints against native leaders. Such was the case in 1771 in the village of Irupana in Sicasica province, where Isidro Camastuna, a hereditary curaca, lodged a complaint against the nonlocal and interim curaca, Bartolomé Vázquez. Among the grievances was Vázquez’ violent nature, which was aggravated by the “irremediable vice of drunkenness, as there is no day when he is not drunk.” In this state, he could be found “unjustly capturing some, whipping others, and, finally, inflicting notable harm and incredible mistreatment on the miserable Indians.”²⁰ Such were Vázquez’ tendencies that it appears that both the corregidor and priest were ready to see him go.²¹

In the town of Italque, in Larecaja province, the incessant abuses of the Mestizo overlord, Julián Ramírez, had led to an unbearable situation. In 1755, community leaders petitioned for his removal, pleading for a chief who would govern with “love, charity and justice, and not with hate, rancor and temerity.”²² Ramírez was so given to using the lash that not only had one person died from a whipping but, they insisted, “from January to January the cries from the whip are heard,” and in one case he “finished off his tyranny making them drink putrid urine.”²³ Other complaints against him included charges of rape, unjust seizure of property for debts, forced labor on community lands which had been illegally taken, forcing the exempt to pay tribute, caring for his eighty mules, and being sent out of town on various errands. This was not the first time the community had protested. In a previous complaint, the investigating judge ignored the testimony of over sixty witnesses, while the curaca lodged in the house of the lieutenant governor instead of leaving town as he was legally obligated to do. Although the curaca was ultimately removed, he denied the charges, insisting that people worked for him out of “friendship” and that he only did what was “regular and ordinary.”²⁴

Theirs were only marginally better in Pucarani. There, in 1759, Indian leaders enlisted the help of a friar in their continuing efforts to rein in the rampant abuses of the four sons of the Mestizo curaca. In a crisply written letter, the friar noted that not only had the curaca been forced upon the community, but he had systematically seized the best crop and pasture lands. In addition, the sons were accused of raping local women, both single and married, and, after catching an Indian on the lands they had taken, they not only severely beat him but rode and spurred him like a mule.²⁵

It was into this environment that returning mitayos stepped. In 1596 the Jesuit Antonio de Ayans described how they would arrive “so poor and stripped” and as a result “by their dress everyone notices them without asking if they had come from Potosí, torn to pieces and dying of hunger begging from all they came across.”²⁶ He also noted how they would lose whatever religious indoctrination they had while in Potosí, remarking that “if you ask them how they do not remember anything that they have learned, they give no other answer than to say that they have been to Potosí.”²⁷

No sooner would mitayos have come home than they would often be dispatched to transport goods for the curaca, corregidor, or priest. These journeys could last six or seven months, and while, in theory, they earned five pesos a month, it cost them almost three times that to sustain themselves. Worse, if goods were broken or missing, the Indian was held responsible for the selling price of the damaged or lost item.²⁸ Such was their life that Ayans contended that the Indians were “in fact all captives and more slaves than the Negroes bought and brought from Guinea.”²⁹

Among the tasks that community members were obligated to perform was the staffing and upkeep of roadside inns, or tambos. Ayans related how “many Indians hide and flee from the Spaniards when they see them coming to the tambo, due to the many blows and floggings that they give them beforehand, for no reason, and they fear suffering even more of them while they are serving them. . . . [T]here is not a passenger, whether he is a Negro or Mulatto, who does not . . . whip and maltreat with more rigor and cruelty than if they were slaves.”³⁰ He also explained how those staying at tambos would seize Indian belongings to ensure that they returned with food, would refuse to pay for food or lodging, and accost and abuse Indian women there.³¹

Among the powers of the curaca was to essentially lease originario Indians into bondage for one or two years, thus becoming a *maharaque*. In addition to being an alternative to the mita, curacas could use this system to generate revenue, either for themselves or the community. In the 1650s,

haciendados, transporters, pastoralists, and even Indians and Mestizos in need of labor would pay around 150 pesos per year for such an Indian. A maharaque would usually end up as a debt peon as a result of obligations, real or imagined, contracted during his term, or as a result of lost or broken articles or livestock. As with all debt peons, if the debtor died, his family was responsible for the debt, and when a maharaque realized what he had gotten into, he would be found “crying because they had lost their land and liberty.”³²

Apart from the mita, the incessant work, unremitting oppression, and the ever-present possibility of becoming a maharaque back home caused many Indians to flee to urban areas, to unconquered lands, or to become forasteros in other communities. Sometimes even then they could not escape the mita or abuse, as curacas would force forasteros into mita service to have a full complement of men to send to the mines and mills. It was clear to Viceroy Mendoza y Luna, writing in 1615, why many Indians stayed in Potosí after their mita term had ended. Not only could they earn a relatively good living as free laborers, but they also stayed “due to the fear of the long road and poor reception that awaited them in their house with the vexations of the corregidores, priests and curacas, or all of them, the common opinion is that few return to the towns they came from, which is the principal cause of their total ruin and a very real threat of what will happen in the rest, for nature cannot restore in one generation such a large and continuous loss, if this ends everything ends.”³³

“As if I Were an Haciendado”: Corregidor Abuses³⁴

Apart from the motivation of enrichment and the corrupting influence of power, curacas were highly abusive because if they did not deliver on their obligations to the corregidor and priest, they would fall victim to the very same punishments they were wont to administer. Governors—and, as their agents, lieutenant governors—were responsible for the collection of tribute, the timely organization and dispatch of the mita, naming curacas on an interim basis, and overall civil administration while also serving as judges. Most of their income, however, came from a system whereby they would compel those in their district to purchase goods at inflated prices, known as the *repartimiento de mercancías*, or simply the *reparto*.³⁵

Governors viewed and operated their jurisdiction as an enterprise, which many had gone into debt to purchase. With their power largely unchecked, governors operated in much the same way as the curacas below them, demanding a range of unpaid services including pasturing, cultivation,

weaving, and transporting the many goods in which they traded. Hesitation, evasion, and resistance were met with the lash, imprisonment, seizure of goods, and sometimes banishment. Occasionally a fleeing ended in death, such as happened to Bartolomé Contreras in Chulumani in 1759. Because he was a servant of the local priest, Contreras insisted that he was exempt from tribute. When Governor Eusebio de Yepes came to town to take a head count and collect outstanding tribute debts, a dispute erupted concerning whether Contreras owed tribute. Contreras affirmed that he was exempt despite the fact that, although the priest was allowed two people in his service, he had eleven. The conflict which followed was resolved by Governor Yepes, who ordered his two slaves to drag Contreras to the rollo, where they tied him up and took turns whipping him. Three days later, Contreras was dead.³⁶

The reparto was among the most despised practices of the corregidores and was designed not only to supplement the governor's modest salary but also to force the Indians into a monetary economy and thus support the larger mercantilist enterprise through an expanded internal market. Although it was illegal for much of the colonial period, the reparto was commonplace in the 1600s and became institutionalized to the point where the desirability of districts was to a large part determined by their reparto potential. The legalization of the custom in 1751 led to a significant increase of the volume of goods distributed, the amount of money charged, the abusive methods of collection, and the resentment of those subject to the system.³⁷

Making matters worse was the fact that many of the items forced on the community as a whole were either defective or useless. Despite very well-founded fears of retribution, some communities did complain against the reparto and the abusive and violent collection procedures that accompanied them. These complaints not only reveal the nature and prices of the goods distributed but also their utility for the Indians. As the leaders of San Pedro de Chupe in Sicasica province explained, the corregidor had forced them to buy "Spanish clothing . . . that for us are good for nothing as . . . we do not wear silk stockings . . . nor other things of this type."³⁸ So much clothing, cloth, mules, and dull knives had been forced on the community that each member had been saddled with a debt ranging from 200 to 700 pesos, causing some to flee the town.³⁹

Likewise, in 1761 in Calacoto in Pacajes province, the community protested against the nature and quality of the 12,000 pesos' worth of reparto goods that had been forced on them, as well as the violence used in ensuring their acquiescence. As one community leader explained, the goods had been imposed upon them "by force of many extortions, threats of

jail, floggings and other punishments, against the will of the Indians . . . [in] articles of terrible quality and at exorbitant prices.”⁴⁰ Refl cting the expansion of the reparto system after its legalization in 1751, the Indians also complained that the amount of goods had increased from years past and included such things as cloth (which the Indians usually wove themselves), over 3,000 poor-quality knives, and paper. Noting that legally they were not obligated to accede to these purchases, they explained that many people had fled the town due to the violence used in collection, which included breaking down doors and constructing a gallows in the plaza.⁴¹

Among the goods commonly distributed were mules, which were often “very thin and moribund” and sold for exorbitant prices. Such was the case with Ascencia Barriga and her husband, who arrived home one day to find that four mules that were “tired from age and unserviceable” had been left at their door. Their efforts to return them were flatly rejected by the corregidor, Diego Gallega, who, to ensure payment of the 120-peso debt, seized twenty-five head of their cattle. In the lawsuit that followed, the corregidor not only rejected the notion that the mules had been forced on them but criticized Ascencia’s “insolence and fraudulent spirit” as well as her “deceit and audacity,” and called for her to be physically punished. Claiming that the Indians “beg” for reparto goods, the corregidor also was loathe to set a precedent by taking the mules back, which would bring “very bad consequences . . . [and his] total ruin and destruction.” Despite this and the abundant sympathetic testimony offered by the corregidor’s supporters, the audiencia ordered the seized cattle to be returned and for the corregidor to take the mules back.⁴²

Ascencia Barriga was exceptional, both in her courage in challenging the corregidor and in that she actually won the case. Whether or not she suffered reprisals or ever got her cattle back, however, we will probably never know, as many court decisions were ignored or otherwise subverted. Much more frequently, men, including their wives and children, were put in jail until a debt was paid. In Omasuyos province, the curaca Pasqual Arena was imprisoned for several months as a result of his inability to pay 3,200 pesos, which, in his position of guarantor of the community, was for outstanding reparto debts. Arena’s goods had also been seized and included a six-room home, a harp, numerous loads of crops, extensive agricultural lands, and well over 100 sheep. Such was the community resentment of the reparto that the corregidor’s previous efforts to collect tribute debts had resulted in a brief uprising in the town.⁴³

Facing the prospect of a dungeon, some Indians fled before they were captured. For example, in Arque, the Indian Vicente Bustillos complained

that he had been forced to accept 310 pesos in reparto goods “as if I were an *haciendado*.⁴⁴ Although he had managed to pay off almost half of the debt, the corregidor had seized his home and livestock. Fearing imminent arrest, he and his family had fled the village; three years later the issue still had not been resolved.⁴⁵

Disputes over repartos were not limited to civil officials and Indians but also could lead to intra-elite conflict. In 1768, three mine owners in Sicasica province complained that the governor, against whom there were already several complaints, had forced reparto goods on their miners. On payday, the corregidor appeared and, in a rage, ordered several employees tied to the rollo and flogged, purportedly for not attending catechism, before summarily dispatching the overseer to an *obraje*. This had reached a state where those who had been flogged were planning to burn down the house of the corregidor, and one of the mine owners had fled the town.⁴⁶

Although lieutenant governors were not permitted to operate their own reparto, this did not prevent them from doing so. In Sicasica province, an *haciendado* complained that the lieutenant governor had forced so many goods on the *yanaconas* on his estates that many had fled. In another case, a former lieutenant governor went so far as to petition the court to send a magistrate to collect his debt for him. The present governor opposed this, fearing that the funds which were destined to pay his own reparto would be used to satisfy the former lieutenant governor’s debts and, rather ironically, accused him of overcharging for the goods he was not allowed to distribute in the first place. Viceroy Amat became involved in the affair, and in an ambiguous response, noted that if the lieutenant governor were to be prosecuted for the illegal reparto, then authorities would have their hands full prosecuting all of the lieutenant governors of the land.⁴⁷

In some cases, governors developed innovative means of extorting money from the natives. In a highly creative effort to extract even more money from one community, a corregidor in Sicasica province established and drafted residents into “something like a militia and by being named in it each one has to pay” between fifty and one hundred pesos depending on their rank.⁴⁸ In another case, the governor in Lipes had opened a shop in town, which he kept stocked with a variety of goods he had seized from transporters passing through his domain. Rivaling these methods was that developed by a miller in the region of Cochabamba. He used his proximity to the royal road to ensure a vigorous, if coerced, business for his grist mill. He would station slaves or other servants to lie in wait for cereal-laden travelers to pass. The miller’s men would then accost them, rob them of any money, and then force them to have their grain milled. Reflecting the

traffi on the royal road, the fertile region, and steady business, there was a four-month backlog on grinding.⁴⁹

Such myriad and pervasive abuses would cause Friar Calancha to lament how the Indians are “mistreated, and each one has two thousand bosses. . . . As if our sight was a coin with which they are purchased . . . not to cure them, but rather to command them, not to dress them, but rather to strip them.”⁵⁰

“He Looks upon Us Not as a Pastor, but Rather as a Wolf”: Clerical Coercion⁵¹

In the course of their daily lives, especially in villages, Indians had considerably more interaction with parish clergy than the corregidor, or any other Spaniard or Creole for that matter. Not only was the cleric the only non-Indian legally allowed to live in an Indian town, but it was he who presided over the major events of an Indian’s life, from baptism to marriage, confession, and death. The priest was an immensely powerful nexus of colonial power, for he not only claimed spiritual authority but also commanded considerable political power and, due to his customary commercial activities, extensive economic influence. It was through the village priest that much of colonial control was exercised, and he was the first line of defense when it came to sedition and conspiracies, often revealed through the confessional. As a result, although curacas were appointed by and directly responsible to the governor, they also had to answer to the priest and see that his demands were met.⁵²

Beginning in earnest in the 1750s, the Spanish crown, first through Ferdinand VI and then through Charles III, implemented a series of reforms which were designed to revitalize and reinforce the mercantilist nature of the colonial arrangement. Collectively referred to as the Bourbon Reforms, as they were applied under the Bourbon kings, they revolved around improving colonial defenses against European encroachment, improving revenues through increased taxes and better collection, more efficient administration, and reining in the power, wealth, and influence of the Catholic Church. Although the expulsion of the Jesuits from Spanish America in 1767 was the most emblematic example of Bourbon anticlericalism, it was only a link in a long chain of such measures. In their effort to limit the wealth and income of the clergy, the crown insisted—largely unsuccessfully—that charges for certain services, such as masses, funerals, and saint’s day celebrations, be regulated by an *arancel*, or schedule of fees, and that other services, such as baptisms, be performed free of charge.⁵³

Among the effects of these initiatives was the exacerbation of customary practices, as the clergy sought to ensure a consistent income in uncertain times. In addition, the laws concerning the posting of and adherence to the arancel gave Indians new means to challenge their parish priests in court, and they provide vivid insights to habits which had been institutionalized by tradition. Generally, Indian complaints revolved around excessive fees for religious services, coerced contributions, forced and unpaid labor, commercial activity, physical punishment, and sexual abuse. Also on the list of native complaints were forced marriages in which the priest chose one's mate. The Andes has a long tradition of trial marriage, and not only did cohabitation allow potential spouses to assess each other's compatibility but single men were exempt from paying first fruits and tithes. In addition, when they were married, the groom was expected to provide the priest with extensive "gift" of livestock and produce, in addition to fees. Those who resisted an arranged marriage were often incarcerated until they consented, with the captive females generally forced to weave textiles which the priest would then sell.⁵⁴

Although clergy derived some revenue from baptisms and marriages, it was trifling when compared to saint's day celebrations and funerals. A saint's day celebration was organized and sponsored by a brotherhood, and while originally such sodalities functioned as mutual assistance societies, in Indian communities in colonial Spanish America they degenerated into a siphon of indigenous surplus. By the mid 1700s, the number of such celebrations, and the number of people compelled to serve in them, had multiplied, despite royal edicts to the contrary. Those selected for service were often left destitute, as they had to cover the costs of masses, candles, and other expenses associated with the celebration. In some cases, people were chosen in consecutive years, ensuring their financial ruin and also providing a vehicle for the priest to express personal animosities.⁵⁵

Some reluctant leaders of religious celebrations were in a financial bind even before the fine had taken place. For example, in 1776, when Pedro Anauri was chosen by Father Manuel Poso to lead the Holy Friday celebrations in Sicaia, in Cochabamba province, he resisted as he did not have the funds. In the face of such aversion, Anauri related how Father Poso "mistreated me, beating me, and telling me various insults with which he made me be quiet." Thus cowed, Anauri could only gather eight of the forty pesos demanded, and as the priest demanded complete payment, he seized three head of cattle, slaughtering and selling one. Although Anauri had journeyed to La Plata, filed suit against the priest, and obtained a favorable ruling, he feared retribution and for some time remained "in hiding . . .

and afraid of the harsh prison which awaited me in the very home of the priest.”⁵⁶

Similarly, Father José Antonio Reyes, in Quillaca in Paria province, became outraged in November 1771 when his parishioners resisted organizing more *fie tas* than were legally allowed. Diego Contreras, who had been tapped to lead such a celebration, had only paid one-half of the thirty-two pesos demanded by the priest. To collect the difference, after mass one day Father Reyes locked his parishioners inside the church, armed himself with two pistols and a whip, went outside, and with two servants who were armed with knives, ordered his parishioners to leave one by one. As they came out, Reyes, with a pistol in one hand and a whip in the other, forced “the guilty and the not guilty” to collect the debt, whipping Contreras twenty-five times.⁵⁷ As one parishioner recalled, Father Reyes exclaimed that “if they take from us the little *fie tas* . . . there will be nothing to maintain . . . me, and with this thought he became angry and went to the excess of the whippings.”⁵⁸

Like religious celebrations, funerals were an especially lucrative service which the recipient could not resist, and one whose fees were usually covered by whatever wealth they left behind. Like marriages, masses, and saint’s days celebrations, the arancel was ignored and those who sought its implementation were forced or jailed. Priests would generally demand payment of funeral and memorial mass charges up front, often in the meantime letting the corpse putrefy and be consumed by dogs. If partial payment was accepted, the bereaved, including children, would frequently be forced to work off the debt. A common means of maximizing funeral revenue was to perform an elaborate funeral when the deceased had requested a simple one.⁵⁹ Even offering hospice to the infirm carried financial risks, for if the person died, his or her caretaker was responsible for the costs of burial and masses. In Moho, community leaders protested in 1752 that Father Juan Valentín de Gamboa would sometimes charge up to twenty pesos for a funeral which should cost four. This was just the beginning, as he would also demand up to 180 pesos as prepayment for memorial masses. Prepaid or not, even a dead Indian could be a lively source of income, as priests would force community members to sponsor masses on the anniversary of the death of their relative.⁶⁰

In the village of Coroma in Porco province, the Indian Juan Marcos protested that his priest, Gregorio Josef de Merlos, would seize “everything that was left” of those who died, which in one instance included 100 llamas. On other occasions Merlos had demanded forty-five, fifty, and eighty pesos for a funeral, paying no heed to the “tears, pleas and humility” of

the bereaved, and jailing or seizing the property of those who resisted.⁶¹ In some cases he would charge for and perform the funeral without waiting for the family of the deceased to arrive. As the Indian Sebastián de Coca explained, if people did not acquiesce to Merlos' demands "he gets angry such that he puts them in the jail and from there . . . obliges the [Indian] to give that which he unjustly demands, this happening ordinarily."⁶²

As with extortionate fees, clerical promiscuity was institutionalized and tacitly accepted in the colonial church, and the source of many Indian complaints. As Jorge Juan and Antonio Ulloa wrote in 1749, the clergy in general "live very licentiously, scandalously and frivolously," and members of religious orders often "act[ed] like married men in every way." The result was that the "monasteries have become . . . brothels . . . [with] vices of a kind which stagger the imagination." They added that to fully recount what they had learned "a large volume would be necessary."⁶³ Within the isolated world of the Indian community, sexual abuse of female parishioners, often children, was common and frequently occurred under the cover of catechism.⁶⁴

In 1780, as Ambrosia Rodríguez was preparing for her wedding in the town of Chayanta, she encountered Father Dionicio Cortés in the street, along with a group of his servants. Beckoning Rodríguez toward him, Father Cortés kidnapped her and took her to his home in Aymaia where she was whipped, raped, and then shackled in his kitchen for the following six months. After escaping half-naked, she pressed her case in court, offering the shackles in which she shuffled to her freedom as evidence. Subsequently, similar cases concerning Father Cortés came to light in which women and girls were kept prisoner and sexually abused.⁶⁵ Similarly, in 1770 in Coroma, the Indian leader Juan Marcos testified that "it is true that . . . his priest would have . . . taken to his house . . . the daughters of his chiefs . . . whom it was widely said he violently ravished against their . . . will."⁶⁶ The victims, in their early teens, offered vivid, detailed, and compelling testimony concerning their rapes and subsequent captivity.⁶⁷

As in the rest of colonial society, those who challenged their priest were routinely whipped, jailed, or pilloried, although clergy were prohibited from ordering, or administering, such punishment. Common causes for castigation, which sometimes resulted in death, were failure to pay various fees, refusal to perform personal services, failure to confess, or the nature of what one confessed. In addition, filing suit in La Plata was an almost guaranteed means of suffering a severe flogging, incarceration, or banishment upon returning home.⁶⁸ In Potosí, the native leader Nicolás Roque and his children were accused of not having confessed in a timely manner. As a result, Roque's priest, Father Landivar, arranged for him to be forced

to work in a bakery for nine days before ordering him tied up, gagged, whipped, and marched through the streets of Potosí.⁶⁹ Like confession, catechism presented a series of risks, including sexual abuse of girls, and could be especially difficult to navigate under the tutelage of an erratic clergyman. For example, in Hulluma, in Pacajes province, community leaders complained in 1780 that not only was their priest, Juan Artajona y Eslava, prone to use the lash, but he would do so during catechism, when he could be found to be “moving or adding different clauses in the Christian doctrine anytime he so wishes, solely with the notion of punishing us and in this way unload his passions.”⁷⁰

As with the curaca and corregidor, Indians were also expected to pasture the priest’s animals, work his lands, cook for him, work on construction projects, and serve in the church as cantors, sacristans, and bell ringers, generally without pay. While such labor reduced the priest’s cost of living to almost nothing, many clergy complemented the income from their synod and fees with commercial activity, which often involved weaving, owning stores, and regional commerce. In Coroma, the Indian leaders complained that the commercial activities of their priest were so brisk that they were sent on “continuous errands . . . in the short time he has been a priest [here] they no longer have feet to walk so much, because if they are not going to Chuquisaca, they are returning from Potosí, and if they are not going to Potosí, they are already entering Chuquisaca.”⁷¹

Some clergy operated shops in their parish, such as Juan Valentín Gamboa in Moho, who obtained eight shops when he purchased his parish. As the community leaders explained, Father Gamboa did not seek “to teach us nor to preach to us . . . but rather to give out brandies and to force us to order masses and marry us by force.”⁷² Similarly, in San Antonio de Lipes, Father Pedro de Arcos demonstrated considerable entrepreneurial talent, offering in his store an array of wares ranging from yerba maté imported from Paraguay, dried meat, coca, sugar, flour, knives, clothing, and a variety of imported cloth available in different colors and qualities to iron, lead, tin, and brandy, which he was said to sell using a short measure. He also sold mules which he imported from Salta, to the consternation of the corregidor, who resented the challenge to his own commercial monopoly. Father Arcos had his Indian parishioners import and transport his merchandise throughout the region as it was purchased, sold, and traded for various products. The cleric did not deny his vigorous and expansive commercial activities, indignantly asserting that his parish was a desolate “exile” and “if Saint Francisco de Assisi were to have come here as a priest . . . he would have died of hunger” if he too did not engage in commerce.⁷³

“A Ridiculous Farce”: Judicial Recourse⁷⁴

Just as policies regarding the clergy could ultimately be traced to Rome, so too could colonial jurisprudence in Spanish America, emerging as it did from the Roman legal tradition. On paper, it was quite sophisticated and provided clearly defined channels for filing and hearing suits. With the help of the protector of the Indians, the humblest Indian could lodge a claim against not only other Indians or Mestizos but also their curaca, governor, and, in the ecclesiastical court, their priest. Once the suit was filed, civil or clerical magistrates would come to the town, the accused was ordered to leave the area, and the investigators, with scribes at hand, would take testimony in the presence of two interpreters, before sealing the declarations and remitting them to the appropriate court. Despite the fact that their testimony was worth a fraction of that of a Spaniard, Indians made the most of what the system had to offer and had a well-deserved reputation for being litigious, especially given that it was among the few nonviolent means they had to challenge the terms, if not the nature, of their oppression. Generally, Indians had better outcomes in intra-Indian disputes, such as those over land and water, than when they challenged their overlords. By providing avenues of hope, the colonial judicial system served as a gauge of social tensions and a means of relieving pressures when necessary.⁷⁵

As many native litigants discovered, however, what worked in theory often faltered in practice, especially when challenging their curaca, corregidor, or priest. Costs for scribes mounted, cases dragged on for years or were quietly shelved; protectors of the Indians accepted bribes from the accused; testimony was altered, forged, and gathered under threatening conditions; those who filed suits suffered retribution; and favorable rulings were ignored by governors or the archbishop. The fact that rulings supporting the Indians were rarely enforced paradoxically encouraged judges to find in their favor, simultaneously upholding both “justice” and the injustices of the colonial system. More often than not, however, decisions came down to a bidding war, and that was one Indians could not win.⁷⁶

If the proceedings in the court were a “farce,” then the taking of testimony in villages often became a tragicomedy. Whether it was a vicar investigating a priest or a civil magistrate investigating a curaca or corregidor, there were often personal relations and shared institutional interests between the investigator, who in some cases was under investigation himself, and the investigated. Many of the accused were forewarned of the impending inquiry and could make the necessary arrangements, through

bribes, threats, and exploiting community divisions, to ensure a favorable outcome. Indeed, this was the most important phase for the defendant, for favorable testimony, especially from Spaniards, could quickly turn the tide in his or her favor.⁷⁷ Even though the accused was required to go several miles away, a climate of fear nevertheless often prevailed as his assistants and sympathizers remained in the town and could keep tabs on who said what. The investigator could also choose from whom he would accept testimony or would take testimony on facts not germane to the case. In addition, the community had to house, feed, and provide drink for the investigating commission, as well as fodder for their animals.⁷⁸

In a suit against his priest, the hereditary curaca in the town of Toledo, Lorenzo Apu Bedoy, asked that “the judges . . . not [be] permitted to come to our town . . . as of seven judges that came they have destroyed us . . . in food and drink and [it is] very expensive in . . . goods, wine . . . brandy and barley.”⁷⁹ He also noted that the investigating judges insist upon “as their fee, some six hundred pesos and others four hundred pesos . . . [and others] two hundred pesos with [the threat of the] seizure of our property. . . [W]e are about to die to pay it . . . when we ask for justice . . . [investigators] threaten us with whippings and other harm . . . always leaving us poor . . . robbed and harmed.” The curaca explained how an investigator was unsatisfied with his assignment of a half-dozen servants during his stay in Toledo. Bedoy then related how, as a result, the investigator “grabbed me by the hair, beating and bloodying me, he tore my cloak and . . . broke my staff f offi .”⁸⁰

He also described how when one complainant responded to the call to offer testimony of floggings and unpaid labor, the investigator “grabbed [the complainant] by the hair . . . telling him that he was taking him to the jail because he is an enemy of the priest.”⁸¹ Naturally, neither this nor threatening Bedoy with 200 lashes for having the audacity to file the complaint created a very conducive environment for offering additional testimony. Reflecting on his extensive experience with both civil and ecclesiastical investigators, Bedoy had deduced that “we do not get any alleviation [from them] leaving us to [the] greater dangers of their vengeance.”⁸² These were customary practices, and as early as 1590 José de Acosta remarked how, to civil and religious magistrates, the Indians were “prey . . . which gives the impression that it does not so much concern restoring what is theirs as much as deciding who has more right to loot them.”⁸³

Apart from choreographing testimony, intimidating witnesses, and bribing investigators, the accused relied heavily on ad hominem attacks on their adversaries. While Friar Juan Gutiérrez described Lorenzo Apu Bedoy as

“an infamous and rebellious” Indian, he went on to characterize the Indians as a whole as “more despicable and vile than . . . the Negroes and the rest of the people in the world.”⁸⁴ Another insisted his accusers were “very bad . . . most arrogant, conceited, filled with other vices . . . rebels of the highest degree, seditious, [and] hated by all of the community (except for a few bad ones like themselves) for their notorious vices.”⁸⁵ Despite the odds stacked against them, Indians steadfastly pursued their rights in court. In 1752, the community of Moho reminded the audiencia that they had spent the last four years seeking redress against the abuses of their priest, to no avail. Later they ruefully related how “we presented more than sixty or f i y petitions and . . . [had received] neither a decree nor a favor.”⁸⁶

The Alternatives

Given what awaited Indians in Potosí and Huancavelica, as well as in their hometowns, many sought some alternative. Some simply stayed on in Potosí or even Huancavelica, where they were exempt from the mita, could choose their work, earn a better-than-average wage, and be largely free of curacas and the reparto, if not the clergy. Those inclined to mining and associated work also went to Oruro, where competition for wages was brisk, and they could still maintain contacts with their home communities if they were from the region. Some migrated to other cities where they could blend into an urban environment, working as domestics, artisans, petty merchants, and the like.⁸⁷

Others took work in haciendas, where they became yanaconas, which by the seventeenth century basically referred to serfs, whose master paid their tribute and shielded them from the mita and reparto. The downside was that the relationship quickly degenerated into debt peonage that not only lasted a lifetime but generations, due to the inheritability of both yanacona status and debt. Not only did hacendados derive value from the labor of yanaconas, but the serfs also added to the value of the estate. As a result, it was not uncommon for people to be forced into this “heavy yoke of perpetual servitude,” and for others to resist it by demonstrating that their parents had not been yanaconas.⁸⁸ As the increasing number of yanaconas contributed to the ongoing decay of the mita system, by the 1760s and 1770s hacienda owners, which included priests and religious orders, were increasingly challenged by Potosí’s mining guild in an effort to strip them of those yanaconas to which they were not legally entitled.⁸⁹

Abuses were rife in the largely self-contained world of the hacienda, as Estabán Tomás Cervantes and ten other yanaconas found in the 1750s. They

complained that not only did their master, Gregorio Cuéllar, fail to provide them with sufficient food or clothing, but he frequently abused them with “whips, blows and kicks.” Cuéllar, through his attorney, conceded that he ordered the occasional whipping when his “excessive patience” had run out but insisted that they were “more correction than punishment.”⁹⁰ In another hacienda, this one owned by a priest, two yanaconas complained of not only being whipped brutally but of having urine and salt rubbed in their wounds. They bemoaned that they were made to work from four in the morning until seven in the evening and that “the hacendados always view us as the most perverse slaves.”⁹¹

Some Indians sought to be released from yanacona status, such as two Chiriguano Indians, Lorenzo and Tomás Cuéllar, in 1759. In their court filing, they explained that when they were seven years old they became Christians and agreed to serve on an hacienda while they were catechized. Eighteen years later, they were seeking their freedom, complaining that they had been enslaved, and after the death of their master, the executor of the estate was trying to sell them along with the hacienda.⁹²

Among the fates that could be as bad, if not worse, than being a mitayo was work in a textile facility, or obraje. These were generally vertically integrated and largely self-sufficient enterprises that raised animals from which wool was shorn, which was then spun, dyed, and woven into textiles. Concentrated in but not limited to the region of Quito, they relied heavily upon penal and, until 1720, mita labor, in addition to debt peons and wage laborers. These enterprises had abysmal conditions, where weavers were commonly shackled to their place of work and otherwise imprisoned. As two royal officials noted, in “the obrajes . . . all the plagues that make life unbearable have been combined . . . here one finds the worst abuses and cruelties.”⁹³ They compared them to “galleys on a perpetual voyage, constantly struggling in a calm sea but never successful in reaching the distant port, even though the men in them labor unceasingly in the hope of getting some respite.”⁹⁴ So harsh were the conditions in some obrajes that in 1596 Antonio de Ayans commented that “in many of them some of the Indians have hanged themselves due to the great cruelty and tyranny” to which they were subject.⁹⁵

From Profligacy to Penury

The amalgamation-induced heyday of Potosí was between 1580 and 1650, although production was slowly declining during this time. By 1635, New Spain had completed its slow eclipse of Peru’s production, which

nevertheless remained vital to Spain and the continued expansion of global capitalism. By the early 1700s, however, silver production in Potosí had sunk to a level similar to just before the introduction of the amalgamation process, reflecting declining ore quality, fewer mitayos, and the willingness of many miners and refiners in Potosí to accept ransoms in lieu of workers. Shadowing the decline of silver production was that of Potosí and the regional economy which was so intimately linked with it.⁹⁶

As the clouds of decay darkened, the Potosí mining guild struggled to reverse the trend. In 1634, they presented a letter to the king that not only reiterated many long-standing requests, but also serves as an excellent example of their mentality, at once self-pitying, bombastic, presumptuous, and delusional. The “Pretensions of the Imperial City of Potosí” frames the miners’ requests by alluding to the perceived and oft-repeated divinely induced nature of Potosí’s existence; that it was put there for the glory of the Spanish monarchs to spread the Catholic faith and turn back the tide of Protestantism. Despite this, Potosí had, they averred, fallen on hard times, as “until now it has been the buttress upon which rests the weight of the monarchy with its great wealth, now it is prostrate at the feet of your Excellency, needing your help and requesting justice.”⁹⁷

To pave the way back to prosperity, the guild petitioned for more mercury to be advanced on credit, and that the quinto be reduced to 10 percent from 20. They also requested a reduction of taxes on wine, and although they claimed that “our poverty is notorious,” they sought a reduction of the taxes they were to pay on pearls and jewels.⁹⁸ Falsely claiming that the amalgamation process “was invented in Potosí,” they even called for the closing of all silver mines in Peru that did not receive a mita allotment, meaning all but Potosí and Porco, and a wholesale transition to a coerced labor force. Abolishing wage labor, they averred, was for the good of the Indians, because “it is true that [their] greed makes them work more than their strength allows.”⁹⁹

It was with the mita that their divorce from reality became complete. Acknowledging that the Romans sent convicts to work in the mines in lieu of death, they asserted that the Indians enjoyed working in the mines, and “although one cannot deny that the work is hard . . . it is made easy and light by the habit and custom that the Indians have . . . because custom, as San Augustín said, is second nature . . . that the poison turns into food and makes it such that they do not feel the work.”¹⁰⁰ Because the work was “very easy and tolerable,” it was not “the work in the mines . . . that causes the Indians to flee their towns” but rather because the “priests, chiefs and governors treat the Indians like slaves.”¹⁰¹

Their royal petition was largely ignored, and Potosí continued its gradual decline. By around 1730, its population had thinned to around 70,000 from its peak in 1650 of 160,000, and by 1776 it stood where it was just before amalgamation began there, at just over 32,000.¹⁰² By the late 1700s, Potosí's glory was largely a memory, its fortunes, as always, following the production of silver. As one colonial official put it,

Everything has declined in Potosí. The mines, the fortunes, the mita and the population. Of the five thousand pitheads that the hill once had . . . today there are not even one hundred. . . . Of five thousand Indians who came for the mita, three thousand do not arrive. Of one thousand five hundred Spanish homes, there is barely a tenth, and of one hundred and fifty thousand residents, at the most the number would reach . . . thirty thousand. . . . [It is] a destroyed town, and going from the mills on the bank towards the hill, one sees nothing but walls without roofs.¹⁰³

Potosí not only declined in the 1700s but fell under a new jurisdiction. In an effort to stem the constant flow of contraband through Buenos Aires and to thwart Portuguese expansion in the region, in 1776 King Charles III decreed the establishment of the viceroyalty of Rio de la Plata. As a result, Potosí, and the entire district of Charcas, came under the jurisdiction of the viceroy based in Buenos Aires, as opposed to Lima. Until this point, the vast majority of mercury used in Potosí's mills had come from Huancavelica, but by the late 1780s Potosí relied almost exclusively on Almadén, and to a lesser extent, Idria, in present-day Slovenia, as sources for mercury.

Despite the reliable sources of mercury, its transport to Potosí was on occasion erratic. Between 1801 and 1803, as a result of the outbreak of war between Spain and England in 1796, no mercury was sent from Europe and Potosí had to rely on stockpiles and whatever they could get from Huancavelica. On top of this came a drought between May 1803 and January 1805, leading not only to food shortages in Potosí but also a cessation of production and a marked reduction of pollution there.¹⁰⁴

Furthermore, the transport of mercury upland from Buenos Aires to Potosí was a long and leaky journey, in which timing was crucial. In order to arrive in Potosí in June, before the advent of cold weather and less pasturage, it had to leave Cádiz, Spain, no later than October the year before so that it would arrive in Buenos Aires by December. Unloading and repacking the mercury for shipment would take at least a month, and if it left Buenos Aires by oxcart in January, it could be in Jujuy and Salta, the midpoints of the journey, by March or April. With the liberalizing of

trade laws and the increase of commerce through Buenos Aires in 1778, oxcarts were often in short supply, and in some cases the government had to seize them to carry mercury. It was important that the mercury arrived in Salta and Jujuy on time, so that transporters could transfer it onto mules that had spent the previous months fattening up for the trek upland. If the schedule was not kept, which was often, then transporters needed a larger reserve supply of mules due to the lack of pasturage. Rain and high rivers often complicated the passage considerably.¹⁰⁵

The establishment of the new viceroyalty had an even greater effect on the now truncated viceroyalty of Peru, which had to contend with an influx of British textiles, the export of silver through Buenos Aires, and a general reorientation of trade flows in the region, including that of mercury.¹⁰⁶ In Huancavelica, production continued to falter and was oriented to supplying mining towns in the Peruvian viceroyalty such as Castrovirreina, Hualgayoc, Cerro de Pasco, San Antonio de Esquilache, Huantajaya, and the region of Huarochirí. In an ultimately futile attempt to foster more efficient operation of the mines, in 1779 José Antonio de Areche, who served as a *visitador*, or king's agent with broad powers to institute reforms, took the bold and unprecedented step of transferring the entire operation of the mine to Nicolás de Saravía. Although Saravía was a member of the gremio, his appointment ended the gremio-based system that had by then operated for almost 200 years.

While production did increase under Saravía's administration, he accomplished it, as had so many before him, by mining the rich supports in the mine. After his death at the end of 1780, the crown decided to operate the mines directly instead of returning to the gremio system. This went from bad to worse under this policy, which lasted from January 1782 through September 1795, as production declined significantly. Having tried subcontracting, agency, and direct administration, in 1795 the king permitted free exploitation of the mine, with the proviso that all production was to be sold to the government. This did lead to an increase of production and, on the eve of the independence movements in 1810, the Spanish Cortés ended most restrictions on the production, importation, and sale of mercury.¹⁰⁷

“It Is Better to Look Out for the Lives of Mortals Than the Increase of Metals”: New Refining Methods and the New Mita¹⁰⁸

As the colonial era wore on, community out-migration continued and fewer mitayos arrived in Potosí and Huancavelica; those who did serve, did so with both greater frequency and greater damage to their health. In 1788,

the superintendent of the mita in Potosí asserted that although the system was “the principal nerve and support of the happiness of the state,” it had declined to the point where it was well on its way to “official decadence.”¹⁰⁹ Several years later, the governor of Potosí acknowledged that there was little he could do about the fact that mitayo flight after a few months’ service was “so continuous and frequent that the mills were being left unmanned as was the work in the hill.”¹¹⁰

In the face of such decline, the mining guild redoubled its efforts to ensure a steady supply of mitayos while also experimenting with more efficient ways to refine silver. In the 1790s, to reward two miners in Potosí for having invested in machinery to implement the Born method, which used heat and vibrating barrels to refine the ore, the governor of Potosí, Francisco de Paula Sanz, promised them a combined increase of 500 mitayos to cover their expenses. In addition, updated mining regulations, called the Caroline Code and written by Paula Sanz’ assistant, Pedro Cañete y Domínguez, called for the regional expansion of the mita by up to 5,000 people. Of the 184 Indians subject to the “new mita” draft in Chayanta province, 43 of them claimed exemption as they were in the service of the clergy. This did not stop the lieutenant governor of the province from beginning a roundup of the mitayos in 1794, in the midst of swirling rumors of an imminent Indian rebellion. At the same time, the priest in whose service were the forty-three disputed mitayos, Pedro Antezana, marched to La Plata in the company of other clerics. There they challenged the draft before the audiencia, which was never sympathetic to Potosí interests, claiming that it was an illegal attack on the Church’s exemption from civil authority.¹¹¹

This vitriolic dispute among the colonial elite for Indian labor, and the attack on the Church’s exemption from civil authority, would lay bare the long-standing frictions between the Potosí mining interests and the clergy. Although the religious orders and clergy as a whole had supported the mita since its inception, albeit with reservations, it was against their immediate financial interests outside of Potosí and Huancavelica. Fewer Indians in a town simply meant fewer Indians to burden with fees associated with marriage, confession, religious brotherhoods, tithes, personal service, and funerals. Apart from exposing the rift between the mining elite and the Church, the dispute over the new mita also highlighted the degree to which indigenous communities had been decimated as a result of the service.

What was to change the nature of the dispute was the pivotal role played in it by the protector of the Indians, Victorían de Villaba. Historically in Peru, protectors had spent more time protecting powerful interests than advocating on behalf of the Indians, in no small part because it

was a position sold by the crown. Protectors had plenty of opportunity to shelve or delay cases in exchange for payments from miners, *haciendados*, *corregidores*, and priests, and there was no shortage of Indian complaints against their putative advocates. As early as 1582, the king fired every protector who worked in the jurisdiction of the Audiencia of Charcas, citing the “notable damage and harm . . . to the Indians” and sternly ordering that they immediately be removed “without other replies or contradiction.”¹² Others, however, would soon take their place and continue the same practices. As leaders in the village of Aymaia complained in 1693, the protector in Potosí was “in name only” because he and the governor were “united . . . against us.”¹³ When, in 1772 in San Antonio de Lipes, Father Pablo Arcos announced to the community that he was doubling the price of baptisms, which were to be performed free of charge, from four reales to one peso, he did so with the protector of the Indians, Luis Santelices, at his side.¹⁴

Unlike the vast majority of his peers, Villaba brought a passionate commitment to his job and the people he was to protect. Born in Aragón, Spain, and a former professor of law at the University of Huesca, he arrived in Buenos Aires in 1791. By 1793 he was in La Plata and, having seen the conditions which the Indians faced on a daily basis in Potosí, launched a frontal assault on the mita, systematically attacking the arguments that its defenders had relied on for centuries to justify it. In his “Speech Concerning the Mita of Potosí,” Villaba challenged the argument that the mita was for public good, pointing out that it was the miners and refiners who received the greatest benefit from it, not the crown or wider society. Even if it were for the public good, he argued, it was inherently unjust to force free men into this service. He disputed the notion that the natives were lazy, and argued that even if they were, that was insufficient reason to subject them to forced labor. Finally, he pointed out that the mines in New Spain had long had higher silver production levels than those of Potosí, and did so with much less forced labor.¹⁵

The response from the miners, presented in the name of Paula Sanz, was in all likelihood written by his assistant, Pedro Cañete y Domínguez, and penned in March 1793. Although somewhat less delusional than the “Pretensiones de Potosí,” there was some overlap, and the argument was framed on the premise that the production of silver, and hence the very existence of the realm, depended on the mita.¹⁶ Asserting that the Indians were “indolent” and characterized by “stupidity,” the miners contended the mita was not only “prudent and rational” but “useful and beneficial” to the natives as it incorporated them into Spanish society and advanced their religious education.¹⁷ Further, the guild insisted that the inspectors

diligently enforced all laws, that there was no quota system, and to whatever extent there had been abuses, the vast majority had long been consigned to the past. Entering even further into the realm of fantasy, they described the mita as a “voluntary practice” and averred that inside the mines “the workers . . . are laughing, playing and eating with the same freedom and abandon as if they were in a palace.”¹¹⁸

To strengthen his position in this debate, Villaba sent out an inquiry to several priests and civil officials concerning the effects of the mita in their communities. Despite the fact that these two groups had an interest in abolishing the mita because it limited their ability to exploit the natives, the results are nevertheless revealing. One colonial official asserted that many Indians would perish soon after their return home from Potosí, apparently from silicosis. The effects and their implications were striking and may have been exacerbated by mercury intoxication. He observed that if “you compare the originario Indians that are in this province with the forasteros without lands, you will come to realize that the mita of Potosí is bringing them at a quick pace to their total extermination.”¹¹⁹ He added that “the brilliant riches of the mines of Potosí hide the truth that . . . they are like a quick bolt of lightning that only presents us with its brilliant light that disappears, and the loss of so many vassals is a senseless bleeding that leaves the body annihilated.”¹²⁰

He urged that authorities “compare the revenue that until today his majesty has taken out as the quinto from those mines, with what he has lost in tribute from so many . . . Indians who have died in that hard work and those who had abandoned their towns and the less tribute they pay, and it will be deduced that perhaps it is much more one than the other.”¹²¹ In what could have been viewed as a personal attack on King Charles IV, he added that “the damage is extremely grave . . . his majesty is more interested in his tributes than his Indians.”¹²² As a result of his survey, in December 1794, Villaba prevailed on the audiencia to order that the forty-three mitayos from Chayanta who had been in the service of their priest be released from service in Potosí.¹²³

The communities that were subject to the mita and unable to fulfill it consistently found a sympathetic ear in Villaba. In Tomave, seeking to avoid sending thirty more Indians to Potosí, leaders explained how “our unhappy birth has been only so that we can do all of the work . . . [such that Indians there were] continually dying . . . we now see that our ultimate ruin is very close. . . . [A]s a result of the old mita, we have been deprived many times of our towns, our sons, our wives, our health and even worse, our own lives.”¹²⁴

As the debate wore on, in 1795 Villaba chided the miners, noting that “when the miners speak in favor of the mita the Indian is a brute, drunkard, thief, lazy . . . and should work by force, and when they speak against the service to the priests the Indian is miserable, neophyte, worthy of compassion and should only serve voluntarily.”¹²⁵ In Potosí, Governor Paula Sanz, with the support of the viceroy, Nicolás Antonio de Arredondo, not only attacked Villaba and his arguments but also attacked the Church. He contended, not incorrectly, that the large numbers of people the clergy had in their service and who claimed an exemption from the mita exceeded the numbers they were allowed.¹²⁶

By the turn of the nineteenth century, the mita and the communities that supplied it were in their death throes and subject to ever more pressure to provide them. In 1800, in the village of Turco in Carangas province, the lieutenant governor, Manuel María Garrón, ordered that the curaca fí d, hunt down, or otherwise produce the assessed number of mitayos, as he wrote in capital letters in his edict, “Alive or Dead.”¹²⁷ Antonio Uillca, a local leader, explained how, due to the many who had died in just the past four years in the town, there were simply not the people there. To prove it, he listed the names and ages of those who had perished from silicosis, as well as those who were ill and “incapable of any service,” others who were “in the last periods of their life,” and still others who were “about to die.”¹²⁸ The town had become so depopulated, Uillca insisted, that they were no longer able to even pay for indios en plata. The sixty dead and the twenty-one at death’s door accounted for 51 percent of the entire tribute-paying male population there, including forasteros, and a much higher percentage of those who were actually liable for mita service.

Seven years later, a different leader in Turco again sought remission of the mita assessment, due to the number of people who had died or who were “totally prostrate in bed . . . and who in a few days will be dead.” The cause was none other than “[a]sthma as a result of the hard and insufferable work in the royal mita of Potosí.”¹²⁹ Of the thirty-one people he indicated had died in the past three years, the average age was twenty-eight years old. This is in line with an analysis based on the census of 1683 in which the average life expectancy was approximately twenty-five years, with only 5 percent of the people living to sixty years.¹³⁰

While Turco’s lieutenant governor averred that the Indians had a “repugnance . . . to such a just contribution” as the mita, he also noted that “the illness of asthma . . . has [led to a] notable delay in the towns of Corque, Chuquicota, Guayllmarca, Totora, with Turco, which serve and are destined to the mills . . . due to the irremediable death which comes over them

from that illness in the second mita . . . at the latest, and many times before, when they do not even have the strength to return to their towns.”¹³¹ Similarly, Governor Paula Sanz of Potosí, during an inspection in Chayanta, noted that the “damn illness of choco,” or silicosis, had “affected that community, and it was going in big steps to its annihilation.”¹³² Despite this, as he oversaw the departure of the mitayos to Potosí, he claimed that there were many expressions of “happiness and fun.”¹³³

After 1809, the war for independence engulfed the region and disrupted labor supply to and productivity in Potosí. In at least one case, in an effort to sustain production, captive Indian boys and girls were taken there and forced to work in the mines. Although the mita was officially abolished by the Spanish Cortés on November 3, 1812, the end of the system was mandated and announced by rebel forces in Potosí in June 1818. Despite this, the practice endured until 1819, when Potosí, with a population of only 8,000, was almost as destitute as many of the communities it had drained and destroyed.¹³⁴

Conclusion



The silver mines of Latin America, and specifically those of Potosí, were a vital component in the rise of modern global capitalism. The tens of thousands of tons of silver that traveled the globe, and were exchanged in countless markets and salons, reflected the hopes of traders while eclipsing the despair of those who had produced the metal. This flow of silver transformed the world, prying open new trade routes and enabling people to experience the tantalizing flavors of exotic spices and teas, the smooth sensation of silk, and the translucent delicacy of porcelain. As Potosí and other mining centers began to produce literally fabulous amounts of silver, the peso of eight quickly became a ubiquitous currency by sheer force of numbers if not by consistent purity and quality.

Although exchanged in Europe, Russia, the Levant, the Middle East, Africa, India, and Indonesia, China served as the ultimate magnet and final destination of much of New World silver. While tons arrived there via Europe, silver often took the direct route from New Spain and Peru, impelled across the Pacific by the wind and the force of desire, where it was eagerly traded for China's mythical merchandise. Just as the mineshaft hollows out that which is inside, so too did the mercury and silver mining economies eviscerate communities and leave tens of thousands of people to die slow, painful, and anguished deaths. The use of mercury to refine silver also created one of the largest and longest-lasting ecological disasters ever known, and one that continues to this day in Huancavelica and Potosí.

In the first thirty years of Potosí's history, from 1545 to around 1575, silver was produced there through smelting, relying almost exclusively on

quasi-independent Indian miners and refiners. In the context of their world having been turned on its head through a conquest which was preceded and followed by civil wars, and a population implosion that was nothing short of apocalyptic, being an Indian miner or refiner in Potosí during this period had its advantages. Until the 1560s, not only were there economic opportunities in extraction, smelting, and a myriad of related activities in this ultimate of boomtowns, but the climate offered some, albeit limited, protection from the diseases which were killing people by the tens of thousands.¹

By the mid 1560s, when the ultra-rich surface deposits had largely been exhausted, the landscape of Potosí had been transformed. No longer was the Cerro Rico and town site blanketed with evergreen kenua trees and spiny ichu. In a first round of environmental destruction, it had all been consumed, mostly for fuel for smelting but also for construction. In the place of nature's virginity stood a haphazard, hastily constructed, rowdy, smoky, and filthy mining camp, with a now barren, ruddy, and perforated Cerro Rico overlooking it. Similarly, in the region of Huancavelica, the kenua trees were the first to go beginning in the mid 1560s. Having deflowered the region of kenua, the use of ichu for fuel beginning in the 1570s led also to its disappearance from the vicinity of Huancavelica by the mid 1580s. These events, however, only foreshadowed the forced labor, mass poisoning, mass migration, and mass market which were about to unfold.²

Although Potosí quickly achieved legendary status, it was quicksilver that enabled sustained silver production there, and elsewhere, as well as the continuing expansion and integration of the international economy. The global flow of silver depended almost entirely upon mercury, the silver that flows. In use at least since Roman times, mostly for gold refining, the mercury-amalgamation process remained as much of an art as science throughout the colonial period in Latin America. First introduced and rapidly adopted in New Spain, it took much longer for refiners in Peru to embrace the practice, notwithstanding the discovery of one of the world's largest mercury deposits just outside of Huancavelica. Despite efforts by Enrique Garcés to encourage the use of the system in Potosí, the prostrate nature of its mining industry by 1570, and the promise of the method, it was only as a result of the forceful promotion and the enabling mechanisms imposed by Viceroy Francisco de Toledo in the early 1570s that mercury amalgamation was ultimately adopted there and elsewhere in Peru.³

De Toledo's reforms not only revitalized silver production in the region but also had a catastrophic impact on the environment, the people, and

their communities, as well as a transformative effect on the global economy. By ordering the construction of lagoons above, and a channel to, Potosí and claiming the quicksilver deposits in the name of the crown, de Toledo ensured a consistent supply of water and mercury to the city. In addition, he refined the regulations that would govern the amalgamation-based mining industry for over two hundred years, offering protections to miners who took on debts in an effort to encourage them to invest in hydraulic mills. Most importantly in terms of human impact, he provided a highly subsidized labor force to the miners by adapting the Incaic mita system of forced labor to supply Huancavelica and Potosí, initially drafting 3,289 men to labor in Huancavelica and 13,500 to work in Potosí.⁴

In addition to causing countless deaths in the mines and refining operations, the mita system would provoke a massive population shift as people fled their towns to avoid the service. By taking up residence in a different community, and thus becoming a *forastero*, Indians could avoid the mita and pay less in tribute, although they also lost access to community lands. For tens of thousands of Indians, it was a small price to pay given the alternative of working as a draft laborer in a mine, mill, or smelter. Other Indians eluded the mita by becoming serfs on agricultural estates, by working for their priest, or by fleeing to unconquered regions.⁵

In Huancavelica, the effect of the mita on the surrounding district was astonishing. Those mitayos who did not die in the mercury mines or smelters returned home so broken, shuddering, drooling, and disturbed that they generally did not long survive. So many of those who were next up for the service fled in horror of what awaited them that by the late 1500s those provinces subject to the Huancavelica mita were for the most part depopulated. This did not change much in over sixty years, as in 1660 Friar Salinas y Córdoba described how the provinces that supplied mitayos to Huancavelica were “already . . . finished and the Indians consumed.”⁶ Describing the region a decade later, a group of Jesuits remarked simply that “in some towns there are no people.”⁷

The transition to amalgamation-based refining, with its legal, infrastructural, chemical, and human components, rescued Potosí from decadence and ushered in a new age of prosperity and profligacy there and elsewhere. It not only stimulated the regional economy but also drew in goods and people from around the world to its scores of vibrant markets and shops. The revitalized production of silver also reinforced Potosí’s importance as an integrating force in the global economy, as the silver extracted from the Cerro Rico again traveled the globe as it was traded for myriad goods and thousands of people.⁸ We will probably never know if slaves who labored

in Potosí were actually purchased on the coast of Africa with silver extracted by mitayos from the Cerro Rico, but such cases would be laden with a dreadful irony. Potosí came to them, and they came to Potosí.

There were many other tragic and enduring human and ecological costs associated with Potosí's renewal. The distinction between the mita and slavery was slight, lying in the limited length of, and token remuneration for, the service. It was made slighter still by the generally irrelevant nature of the laws that were to protect the natives during and after their service. Because of depopulation from disease and flight from the mita, and consequently obsolete censuses, even by the early 1600s those who remained in their community had to endure the service every two or three years, as opposed to the theoretical seven. In the 1590s, one chronicler described how at "the departure there is much emotion and everyone is sad . . . and with much reason they fear not to return. . . [T]here are others who are dispirited with the memory of the work they must suffer and the loss they will have to their property."⁹ Aggravating the situation was the fact that the service fell on the poorest, "most timid and humble" of the natives, unable to ransom themselves, fled if they resisted, and often marched in chains and collars and under armed guard to Potosí.¹⁰ With them on the road often were their wives and children along with their llamas, which carried their paltry possessions and as much food as they could bring. It was a yearly exodus, shrouded in dread, anguish, fear, and pain, as people bid farewell to their homes, lands, relatives, and communities.

When they arrived in Huancavelica or Potosí, their separation from their homes was made worse by being separated from any family members who had accompanied them. The mitayos, all males, lived together in shacks where they could be more easily controlled, while their wives and children worked as domestics, ore sorters, in the markets, or in any other occupation that they could find to complement their husband's earnings. The mitayo's wage was insufficient to live on, often not paid in full, subject to various deductions, and that which was paid was often disbursed in debased silver. Mita captains, although not subject to mine and mill work, had their own array of travails to deal with, most of which revolved around their financial responsibility for mitayos who either did not arrive in Potosí or who fled, were injured, or died once they got there. If the captain could not cover the cost of paying for wage labor to substitute for their missing charges, or once they had bankrupted themselves in the effort, they were routinely fled, jailed, or put in the stockade and further humiliated by having their hair shorn or being paraded through the city and physically abused. Although most of those chosen to serve as captains were selected

due to their financial ability to cover missing mitayos, the vast majority ended up destitute. As a cleric in Chaqui, in Porco province, explained, “infinite are the captains . . . that spend their life unhappily begging.”¹¹

Those mitayos forced into the mines in Huancavelica and Potosí did the most difficult and immediately dangerous work, which generally consisted of dragging and carrying to the surface bags of ore which could easily weigh 100 pounds, often struggling up ladders in the darkness, hoping not to fall or have their heads broken open by ore plummeting from above. The construction of adits did ease this process somewhat by facilitating ore transport and, in Huancavelica, allowing better ventilation of the poisonous air inside the mine. These benefits, however, were offset by the seemingly ever-increasing use of quotas, which were all the more difficult to achieve when the loads were deliberately mismeasured. Failure to meet the quotas was met with that ubiquitous first line of punishment which was so vital in binding the colony: flagging, verbal abuse, and humiliation.¹²

In Huancavelica, the conditions inside the mines, while they did improve over the centuries, remained atrocious and generally lethal. If an Indian was able to avoid toxic gases and dodge cave-ins, sinkholes, falling rocks, and precipices without getting lost, he would nevertheless suffer from mercury poisoning and silicosis. Worse than the mines was operating the primitive refining ovens. The vessels in which the mercury was refined and the tubes which carried it to receptacles were made of ceramic and were by nature porous, while the joints were often poorly sealed with mud, clay, or ash. Not only would copious amounts of quicksilver escape from the vessels and pipes during firing, but the mitayos were frequently ordered to open the oven chambers before they had fully cooled, literally hitting them in the face and lungs with a massive and sometimes lethal dose of mercury vapor. Those that perished from this would have noticed a sweet smell and a metallic flavor in their mouth, quickly followed by an acidic sense of burning in their lungs and difficulty breathing, and then they would have fallen to the ground and died gasping for air. There were other risks as well, such as wind forcing mercury vapor the wrong way out of the oven, or applying too much heat, a common occurrence, which led to much greater losses of mercury through the fragile seals of the oven and tubing.¹³

In 1603, the priest Pedro Muñiz described work in Huancavelica as “totally contrary to bodily health . . . because experience shows that . . . almost all get sick with very bad illnesses and many die in the mines, and of those who return to their lands . . . all come to die in a short time . . . no one escapes.”¹⁴ Inside the mines, the Indians “almost do not have air

with which to breathe and the vapors of the mercury ore and smoke from the candles are so dense that it makes them lose their breath and remain almost unconscious . . . from which are born the illnesses and deaths.”¹⁵ Worse was work in the smelters, which led to a “grave and incurable illness . . . from which no one escapes. . . . [W]ith certainty . . . it can be said that when those Indians are brought to the smelters, they go as people condemned to death.”¹⁶ Having entered the mines of Huancavelica, in 1604 Friar Agia put it succinctly when he wrote that “experience has shown that to send them to that work, is to send them to die.”¹⁷ Despite this, like many of his peers, he supported the continuation of the mita.

Those mitayos who managed to stagger home from Huancavelica were pallid, broken, trembling echoes of who they once were, and most would be dead in a few years if not months. The consistent increase of wage labor in Huancavelica came about from the gradually improving conditions in the mines there, the progressive conversion of the mita into a monetary tax on the desolated communities that were subject to it, and the increasing exactions levied on the natives, which could only be paid in silver. Despite this and the continually decreasing mita levy in the region, mitayos remained an important component in mercury production, and especially in the dreaded refining process.¹⁸

Once refined, the mercury was stored in the royal warehouse in the central plaza of Huancavelica, where it not only volatilized but was spilled and splattered into countless minuscule evaporating droplets during the transfer from one vessel to another. When it was transported by llama and mule train to Chincha, shipped down the coast to Arica, and then carried back upland to Potosí and other mining centers, the sheepskin bags in which it was generally transported were subject to leaks and ruptures. Toward the end of the eighteenth century, when Potosí began to get its mercury from Almadén in Spain, the use of screw-top iron flasks both reduced the loss of mercury and provided a ready source of iron for silver refiners. In both cases, the provision of mercury to the mining centers was a delicate process that required close coordination with the supply and pasturing of animals for transport and avoiding the complications of high rivers and washed-out roads during the rainy season.¹⁹

Compared to Huancavelica, conditions were somewhat better inside the mines of Potosí, if for no other reason than that the mitayos and others were not mining cinnabar. Beyond that, things were not much different, except for the scale of the suffering, as many more people labored inside the Cerro Rico than Santa Barbara. As in the mercury mines, they were subject to cave-ins, sinkholes, plunging into dark abysses, falling rocks,

and noxious gases. Perhaps describing his own experience in the early 1700s, Bartolomé Arzáns wrote that of those who enter Potosí's mines, many come out "robbed of color and unable to speak . . . [or] describe the horrors there are inside, as in some places . . . you look down and do not see the bottom, to one side there is horror, and on the other terror, and everything is confusion inside."²⁰

Once outside, the workers' loads were also undercounted, they were frequently whipped if they did not meet their quota, and they were often sent right back into the mine with rocks or other supplies used for reinforcing the shafts. Also as in Huancavelica, those who worked in the refining operations had much higher exposure to mercury, in both liquid and vaporous forms. Some of this occurred during the treading process, where, immersed up to their knees if not their thighs, they marched all day in the amalgam muck, often suffering frostbite and absorbing mercury through their skin, especially through any cuts, while also breathing any quicksilver that had volatilized.²¹

They and other workers were further exposed to liquid mercury as they shuffled the paste in mantles to the washing troughs, where over a couple of days the amalgam would settle and separate from the mass. Workers were perhaps most exposed to liquid mercury, however, when they transferred the amalgam into cloth tubes and repeatedly swatted it to push out and recapture any mercury they could. Those Indians who had the unpleasant task of preparing, tending, and cleaning the furnaces in which the mercury was burned off from the amalgam not only were exposed to mercury vapors during the firing and cooling of the ovens but also when they handled the volatilizing, liquid mercury recaptured from the process. Others were exposed when they handled and reprocessed the runoff from the washing canals. Even foremen and those not directly handling quicksilver were constantly exposed to the invisible, sweet-tasting cloud of mercury vapors that shrouded and emanated from the mills.

Those working the mills in Potosí often contracted acute silicosis from loading the stamp mills to crush the ore or, worse, when they sifted the processed ore, literally sending up, and breathing, clouds of dust. As officiators of the last rites, priests knew from experience the consequences of mill work. Of those Indians who returned home from working in the mills, one priest explained that they had "very little hope of living," while another noted that choco, known today as silicosis, had "no other remedy than death."²²

All of this work by mitayos, inside and outside of the mines, was not only coerced but occurred in a context of physical, verbal, and financial abuse

at the hands of miners, overseers, civil authorities, priests, native advocates, and their own mita captains. The practice of working for one week and then having two off was a memory by 1600, and for the entire colonial period the level of exploitation increased. Workers had to go deeper into the mines for ore whose quality was declining, and before the 1700s they were expected to bring 2,500 pounds, or twenty-five loads, to the surface every shift. The secret to increasing silver production in the 1700s was neither richer ore nor more efficient processing but rather the increasing amount of ore, measured in volume and quality, demanded from a mitayo. This increase was naturally accompanied by an escalation of ore crushing, sifting, and processing, and all of it occurred in the context of a decreasing number of mitayos. Among the effects of such increasing exploitation was that forced laborers often found themselves in the pathetically ironic position of having to hire wage laborers to assist them.²³

In Potosí's dusty, toxic, noisy world of exploitation and abuse, both wage laborers and mitayos had one card to play. This was wildcat mining, or kapcha, which accounted for much of the silver production in the 1700s. As the natives were the ones working inside the Cerro Rico, they knew where the best ore was, which was sometimes on the shaft buttresses, and would diligently extract it on weekends. Since the early days of Potosí, this practice had been grudgingly accepted by the miners, partly because they were incapable of stopping it and partly because it served as a means to ensure a consistent wage labor supply while also enabling mitayos to subsist. In addition, a part of the mining elite had found a means of profiting from kapcha mining as they advanced supplies to those miners and owned many of the primitive mills which refined their ore.²⁴

Apart from the human catastrophe of death, infirmity, abuse, suffering, dread, and flight which the amalgamation economy precipitated among those who labored in the mines and mills, it also resulted in a monumental and ongoing ecological disaster. The denuding of the regions of Potosí and Huancavelica of the kewa trees and ichu was only the opening act of a much larger and longer-lasting process whose toxic residues lace the soils of the region to this day. Over the course of approximately 240 years in Huancavelica, and utilizing an emissions rate of 25 percent, approximately 17,000 metric tons of mercury ultimately settled on the land and in the waterways of the region. In Potosí, more people were exposed. Although around 45,000 tons of mercury were consumed between 1574 and 1810, approximately 39,000 metric tons, or 85 percent, were burned off, either in an initial processing or as reprocessed runoff. The remaining 6,000 metric tons was released directly into the soil or local waterways. In both places,

the vast majority of the quicksilver ultimately settled in the region, entering the food chain as animals foraged or pastured, and through irrigating crops.²⁵

It was not just those who worked the smelters in Huancavelica or the mills and ovens in Potosí; the entire populations of these communities took in a dose with every breath. While some people no doubt died from acute mercury intoxication, such as those who operated and serviced the smelters, hundreds of thousands of people over the course of time suffered chronic intoxication. Although people at the time recognized tremors and loose teeth as symptoms of quicksilver poisoning, they do not appear to have been aware of the role that mercury plays in mood changes, mental illness, female infertility, and birth defects.²⁶ Even today, the diagnosis of mercury poisoning is often difficult and elusive, given the plethora of symptoms, their similarity to other illnesses, and the wide range of individual sensitivity. What is certain is that it is not possible to release tens of thousands of tons of mercury into a limited environment and not have an effect on the people, animals, and plant life for generations to come. Potosí and Huancavelica had well-deserved reputations as unruly, violent places populated by impetuous people. In this respect, they were like many other mining centers, attracting ambitious individualists who chafed under authority. Like Potosí, most silver and gold mining centers before the twentieth century also used the mercury amalgamation process, and exposure to mercury in liquid and vaporous form may have played an important and underestimated role in the character of these towns.

Those who lived in either Huancavelica or Potosí, whatever their position, in all likelihood suffered from an array of maladies related to chronic mercury poisoning, ranging from insomnia to drowsiness, from timidity to violent outbursts, from sudden glee to deep depression, from bravado to overwhelming anxiety, fretfulness, and despair. Many people probably also had memory problems, which, when combined with commercial relations, was likely the source of no small number of quarrels, assaults, and duels. The streets were not just dirty and the air dusty and laced with mercury, they were inhabited by people some of whom shuffled, shuddered, drooled, and slurred their words. Others were deformed or retarded since birth, or deranged, torpid, and senile, and still others were suddenly and without reason seized by panic or possessed by audacity. People who suffered chronic mercury poisoning may have looked upon a tremulous mitayo and recognized that he was poisoned, yet had no idea that they themselves were as well. While all populations have variability, what made Huancavelica and Potosí different was the scale and nature of it. Toxicity was the norm,

as were its effects, which to some degree explains why there is so little mention of such things in the documents. People were simply accustomed to what to others would have been a surreal world, where aberrations were in fact the norm.

Exacerbating this situation was the intrinsically violent and profoundly racist nature of society, where Indians were seen by many as, at best, barely human. Typical for his time, the Spanish jurist Juan de Matienzo opined that the “Indians are by their nature lazy . . . [and] they are born for [service] and to be ordered . . . generally for their own good and for the public good.”²⁷ Although there were people who stood up to defend the Indian, many of those who offered such compelling descriptions of the life of a mitayo were the same ones who defended, and sought to legitimate, the mita.²⁸ When one takes a person who is seen as inherently inferior and vice-ridden, and poisons him with mercury such that he walks around in a daze, his teeth fall out, he drools uncontrollably and has putrid breath, it will only reinforce the initial perception.

In the colonial Andes, violence was as much a currency as silver, because the production of silver and the operation of the entire colonial enterprise depended on coercion, physical abuse, and humiliation. Violence, and the ever-present threat of it, was what made the colonial world go around. It was the common denominator of many unequal relations, and it is likely that mercury made many violent and abusive people even more so. People react differently to mercury poisoning, but overall such intoxication may have exaggerated ongoing tendencies within a strictly defined, caste-based society, such as violence by masters and servility by the oppressed and physically weak.

Whatever the effects, they were not limited to Potosí and Huancavelica but spread throughout the land as people moved to new cities and towns. Father de los Santos, mentioned at the beginning of this book, may have been just one of those people. Over the edge, having squandered the indulgence of those around him, known to be insane in Potosí, he was dispatched to a desolate parish, carrying his belongings on a mule and mercury in his blood and brain. Not only did clergy often change parishes but so did government officials and the wealthy, who often preferred to retreat to a more hospitable climate than that offered by the altiplano. In addition, those mitayos who did not remain in Potosí also moved on, to a home either old or new, and, even though free from the source of poison, they carried the effects with them for years.

Ironically, many Indians also chose to remain in Potosí, even though they had been forced to go there. As a free laborer, wages were good,

demand was brisk, and they were free from the mita and the depredations of their curaca. Those who returned to their hometowns simply went from one form of servitude to another. Many would arrive to find a desolated community, their modest house shorn of its contents, their livestock gone, and their access to land delayed at best. They would have missed at least one and perhaps two crop cycles, have had to pay up to two years of tribute, and be promptly put to work by their curaca transporting goods on yet another months-long journey or sent to work in his fields or to pasture his animals. Even a relatively simple task as staffing the tambo was punctuated by the almost ritualistic abuse by those who lodged there.²⁹

Adding to the torment was the repartimiento de mercancías, where Indians would be forced to purchase grossly overpriced products that they wanted, chose, or had any use for, such as blue hair powder, silk stockings, and sick mules. A reparto debt could easily reach hundreds of pesos, adding a new level of despair to the natives' lives. Used throughout the colonial period, the reparto was the basis for governors to evaluate the desirability of a specific posting and their primary source of income. As the position was purchased, many governors arrived not only in debt to the crown for the position but also to merchants in Lima who had advanced them goods on consignment. When the law faced reality and the reparto system was legalized in 1751, the amount of goods distributed, and the associated abuses, increased markedly. Like other privileged members of colonial society, governors also benefited from the unpaid services of Indians who worked their lands and served as transporters, pastors, cooks, and the like.³⁰

While an Indian dreaded the reparto, he or she did not generally have to contend with the governor or his lieutenant on a daily basis. In contrast, the clergy were the only non-Indians legally allowed to live in a native town. As a result, the priest was a much more intrusive element in the daily life of the Indians, from their baptism, to their marriage, and to their last rites and funeral. Not only was there a cost for such mandatory services, but there were a host of other obligations that the native had to meet. These included participation in religious brotherhoods, which proliferated in the mid-1700s as the Church resisted the Bourbon crown's efforts to limit their income and power. Being tapped to participate in a brotherhood involved a year's service and generally led to the financial ruin of those who were forced to lead them.

Funerals were an especially lucrative racket for parish clergy, and the practice of charging what would have been a modest inheritance for funeral fees left many bereaved families not only broke but often in jail for debts. On top of all of this, the community was to provide the usual array

of personal services free of charge such as cooks, transporters, agricultural work, and pastors in addition to “gift” of animals and produce. Like governorships, parishes were evaluated on the basis of their income or potential income. Revenue from the many religious fees was often enhanced by various entrepreneurial endeavors, such as operating shops in villages or turning one’s church into a textile mill. About the only thing that service in the Church offered was an escape from the mita.³¹

The life of a serf on an estate offered some advantages, as one was generally free from the reparto, the mita, and the curaca, although not the priest. The cost was not only one’s freedom, but also that of future generations. Yanacona status was permanent and inheritable, and even if one was not officially a yanacona, most Indians on estates would become indebted, voluntarily or otherwise, and the debt was inheritable. Pinning their hopes on a benign master, many Indians fled to the haciendas, where they had some protection from the world around them. Other Indians moved to different communities or cities, where they became forasteros, and were freed from the mita and had a reduced tribute burden. In many communities, however, the curaca often ignored the mita exemption and forced forasteros to serve in the mines and mills, along with the lame and underage, in an effort to avoid the consequences of not sending a full complement of mitayos to Potosí or Huancavelica.³²

The increase of native exploitation as a result of the Bourbon reforms, including new and increased taxes, legalization of the reparto, increasing mitayo work quotas, clerical fees, and curaca demands, all increased the oppression and desperation in communities throughout Peru in the eighteenth century. It was a cycle which fed on itself and ultimately resulted in the Great Rebellion of 1780–1782. A series of loosely confederated insurgencies centered in the regions of Cuzco, La Paz, and La Plata, it sought the abolition of the mita, the reparto, abusive civil and religious fees, and the many Mestizo “interim” curacas who held sway over Indian towns. In the case of Túpac Amaru, who led the rebellion in the region of Cuzco, and Tomás Catari, who operated in the region of La Plata, the insurgency quickly escaped their grasp as mass demands exceeded the multiethnic goals of the former and the more reformist objectives of the latter. In the region of La Paz, the rebel leader Túpac Catari laid siege to the city for seven months, resulting in the death of about 10,000 people, or about a third of its population. Most died from starvation, having been reduced to eating shoe leather, dogs and cats, and, apparently, people.³³

By early 1781, the insurgency had become an independence-oriented race war, with whites, Mestizos and those who had adopted Hispanic

culture being killed on the basis of skin color, ethnicity, dress, and language, as the mass movement sought not only independence from Spain but also the reascendence of indigenous culture. Those who did not escape to the cities often took refuge in the church, generally the strongest building in a town and a traditional sanctuary. Throughout much of the region, those inside—men, women, children, whites, blacks, Mestizos, and Hispanicized Indians—were bludgeoned and hacked to death after the rebels broke into the church or the defenders surrendered themselves to their fate. Ultimately, native divisions, an excessive dependence on sieges, and superior Spanish firepower led to the defeat of the insurgency, after the loss of over 100,000 lives. So enduring were the memories of this event, and so great the fears of mass mobilization, that Peru and Bolivia were among the last countries in Spanish America to gain independence.³⁴

The rebellion exacerbated the ongoing fragmentation, depopulation, destitution, and desolation of the communities subject to the mita, making the system increasingly harder to sustain. The Potosí mining guild was prepared to go to extraordinary lengths to avail themselves of mitayos, ranging from threats and the organization of posses to round up Indians, to debts to make them stay, to delusional appeals to the king for assistance. As the system continued to decay, their efforts became more desperate, and elite frictions turned into a rupture. Emblematic of this split was the years-long dispute over the new mita between the mining guild, with the governor of Potosí, Francisco de Paula Sanz, as its advocate, and those who opposed the mita, led by the protector of the Indians, Victorián de Villaba. This debate, with its public and mutual recriminations, reflected the utter decay of the mita system while exposing the devastating toll it had levied on Indian health. It was only with the war of independence that the mita was finally abolished, which by that time had become a feeble shadow of itself, just like the communities that had provided men for the service and the city of Potosí.³⁵

The mita, and its toxic companion mercury, were only components of the larger process of human, cultural, and ecological destruction which ravaged the Andes during the colonial era. Traditionally, there have been two views concerning the Spanish conquest of the Americas, which are subsumed in the “black” and “white” legends. The “black legend” portrayal of Spain as an avaricious, brutally exploitative, and intolerant power in large part emerged with the circulation in Europe of Bartolomé de Las Casas’ *Brief History of the Destruction of the Indies*, published in 1526, in which he chronicled the conquest in somewhat hyperbolic terms. As early as the 1570s, the defenders of Spanish colonialism, such as Pedro Sarmiento

de Gamboa in *History of the Incas* and Juan de Matienzo in *Government of Peru*, vigorously challenged this portrayal, advocating instead what would become known as the “white legend.” This ethnocentric view holds that the Spanish brought civilization and Catholicism to the Americas, and sought humane treatment of the Indians. Proponents of this perspective further asserted that abuses against the natives were the exception and not the rule, and to the extent that they occurred, they were common for their time.³⁶

The white legend held much historiographical sway throughout the nineteenth and much of the twentieth centuries, and in no small part reflected a selective focus on legal structures rather than their application, subsumed in a denigratory view of native peoples, their cultures, and their heritage. As later twentieth-century historians began to examine the actual operation of the colony, the black legend again gained ascendancy. As Benjamin Keen wrote, the black legend is “no legend at all.”³⁷

Twentieth-century concepts of genocide have superseded this debate, and the genocidal nature of the conquest is, ironically, evident in the very Spanish laws that the advocates of the white legend used in their efforts to justify their position. Such policies in Latin America had a defining influence on Rafael Lemkin, the scholar who first developed the term *genocide* in *Axis Rule in Occupied Europe*. As developed by Lemkin, “Genocide has two phases: one, destruction of the national pattern of the oppressed group; the other, the imposition of the national pattern of the oppressor,” which often included the establishment of settler colonies. Because of the intimate links between culture and national identity, Lemkin equated intentional cultural destruction with genocide.³⁸ It was in no small part a result of his tireless efforts that in 1948 the United Nations adopted the definition of genocide which, despite its shortcomings, serves today as international law.³⁹ The fact that genocide is a modern concept and that colonists operated within the “spirit of the times” in no way lessens the genocidal nature of their actions. It was, in fact, historical genocides, including those in Latin America, that informed Lemkin’s thinking and gave rise to the term.

Dehumanization of the victim is the handmaiden of genocide, and that which occurred in Spanish America is no exception. Although there were those who recognized the humanity of the natives and sought to defend them, they were in the end a small minority. The image of the Indian as a lazy, thieving, ignorant, prevaricating drunkard who only responded to force was, perversely, a step up from the ranks of nonhumans in which they were initially cast. The official recognition that the Indians were in fact human had little effect in their daily lives, as they were still treated like animals and viewed as natural servants by non-Indians. It is remarkable

that the white legend could ever emerge from this genocidogenic milieu. With the path to genocide thus opened by the machete of dehumanization, Spanish policies to culturally destroy and otherwise subject the Amerindians as a people were multifaceted, consistent, and enduring. Those developed and implemented by Viceroy Francisco de Toledo in Peru in the 1570s have elevated him to the status of *genocidier extraordinaire*.

Once an Indian group had refused to submit to the Spanish crown, they could be legally enslaved, and calls for submission were usually made in a language the Indians did not understand and were often out of earshot. In some cases, the goal was the outright physical extermination or enslavement of specific ethnic groups whom the authorities could not control, such as the Chiriguano and Araucanian Indians. Another benefit from the crown's perspective was that restive Spaniards and Creoles could be dispatched in such campaigns, thus relieving cities and towns of troublemakers while bringing new lands and labor into the kingdom. Ironically, de Toledo's campaign to wipe out the Chiriguano contributed to his own ill health.⁴⁰ Overall, however, genocidal policies in the Andes and the Americas centered on systematic cultural, religious, and linguistic destruction, forced labor, and forced relocation, much of which affected reproduction and the ability of individuals and communities to sustain themselves.

The forced relocation of Indians from usually spread-out settlements into *reducciones*, or Spanish-style communities, had among its primary objectives the abolition of indigenous religious and cultural practices and their replacement with those associated with Catholicism. As native lands and the surrounding geographical environment had tremendous spiritual significance, their physical removal also undermined indigenous spiritual relationships.⁴¹ Complementing the natives' spiritual and cultural control was the physical control, and thus access to labor, offered by the new communities. The concentration of people also inadvertently fostered the spread of disease, giving added impetus to the demographic implosion. Finally, forced relocation was a direct attack on traditional means of sustenance, as many kin groups settled in and utilized the diverse microclimates of the region to provide a variety of foodstuffs and products for the group.⁴²

Integrated into this cultural onslaught were extirpation campaigns designed to seek out and destroy all indigenous religious shrines and icons and to either convert or kill native religious leaders. The damage matched the zeal and went to the heart of indigenous spiritual identity. For example, in 1559, an extirpation drive led by Augustinian friars resulted in the destruction of about 5,000 religious icons in the region of Huaylas, Peru,

alone.⁴³ Cultural destruction, or ethnocide, also occurred on a daily basis in Indian villages, where the natives were subject to forced baptism as well as physical and financial participation in a host of Catholic rites. As linchpins in the colonial apparatus, the clergy not only focused on spiritual conformity but also wielded formidable political and economic power in the community. Challenges to their authority were quickly met with the lash, imprisonment, exile, or the confiscation of property.⁴⁴

Miscegenation, often though not always through rape, also had profound personal, cultural, and genetic impacts on indigenous people. Part of the reason was the relative paucity of Spanish women in the colony, while power, opportunity, and impunity also played important roles. Genetic effacement was, in the 1770s, complemented by efforts to illegalize and eliminate native languages. A component in the wider effort to deculturate the indigenes, such policies were implemented with renewed vigor following the Great Rebellion of 1780–1782. Such laws contained provisions making it illegal to communicate with servants in anything but Spanish, and any servant who did not promptly learn the language was to be fined.⁴⁵ The fact that there are still Indians in the Andes does not diminish the fact that they were victims of genocide, for few genocides are total.

The effects of mining on the native population must be seen within this larger context. For its part, the mita and the forced relocation it entailed played a role at several levels. Many contemporaries recognized that it affected reproduction, as spouses were not allowed to live together while in Potosí or Huancavelica. In addition, it was not uncommon for women to miscarry during the hardships of the journey from or to their hometowns. As Caravantes explained, the mita prevented men from being with their wives and “procreating, as they almost always are brought out of their houses . . . to so many and so dangerous tasks, which is to the detriment of the . . . Indians as . . . it is necessary to give space so that they engender and raise children that can in time replace their parents.”⁴⁶ Adding to the problems caused by the mita was the fact that the mitayo’s absence from his town often covered two crop cycles, with the loss of the sustenance that it provided. Permanent migration, seen by many Indians as a solution, was fraught with its own risks. A change in altitude could have a harmful effect on natives, especially if they went to the coast or lowlands, while those who sought refuge in the cities were considerably more exposed to the spread of disease.⁴⁷

In terms of the mortality of mining, there is a distinction between death in the mines and mills and death from them. Relative to disease, forced labor in the mines, although the source of horror, innumerable abuses, and

tens of thousands of deaths, played only a minor role in the overall depopulation of Peru. Mine work exacerbated community depopulation as people fled their communities to avoid it, and those who remained had their lives cut even shorter as they were forced to return to the mines within two or three years.⁴⁸ Work inside the shafts of Potosí was fraught with innumerable dangers, and injuries and deaths were frequent from falls, falling rocks, sinkholes, and cave-ins. While hundreds or even thousands probably died there each year, and many more were injured, this was not sufficient to have a significant demographic impact. Similarly, while accidents were common in the mills, deaths were not.⁴⁹

Death in the mines and mills, however, should not be confused with mortality and morbidity from mining and refining, which had, and continue to have, a regional impact. The colonial level of exploitation of the worker, both in terms of duration, effort, and frequency with which they had to serve the mita, combined with a generally low level of nourishment and residence in a profoundly polluted zone, were all nails in the coffin of both individuals and their communities. Mill work was especially noxious in this regard, given the silica-laden dust generated by the stamp mills and sifting processes, and along with smelter work, the continual exposure to, and direct contact with, mercury both as a liquid and a vapor.⁵⁰

Although the mita was part of a package of genocidal policies and despite the massive and sustained human and environmental toll extracted by Andean mining, its effects paled in comparison to those wrought by disease, especially in the lowlands and coast.⁵¹ Nevertheless, the genocidal nature of the colonial Spanish enterprise affected every part of indigenous society throughout the Americas. Attempts to exterminate specific, non-compliant Indian groups were coupled with a host of laws and practices concerning involuntary relocation, deculturation, coerced religious conversion, marriage and reproduction, familial separation, holding children for debts, and language, all of which had a profound effect on physical reproduction and mental health.⁵² These policies were directed toward the goals of Spanish domination and the generation of wealth for Spain through the exploitation of the natives and the natural resources of the land, conducted under the veil of putative religious salvation.

This strategy was, however, entirely dependent on the continued existence of the native population, albeit in a weakened, decultured, and subservient state. Although the Spanish had neither the interest nor intent to physically eliminate the Amerindians as a whole, the demographic implosion that accompanied the conquest was in a literal sense genocidal: In many places, over 90 percent of the Indian population died, while in others

entire communities disappeared.⁵³ Disease and the conquest were intertwined. Not only did disease facilitate the conquest through weakening the ability of communities to resist and also by breaking their morale, but once established, Spanish policies exacerbated the effects of disease and the demographic decline. Coerced relocation into concentrated human settlements facilitated the transmission of pathogens and undermined traditional patterns of sustenance, while overwork and physical abuse reduced resistance to infection and the ability to convalesce.

It is a tribute to the physical and cultural resiliency of the Andean peoples that they were able to survive such a prolonged, complex, and multi-faceted attack on their existence. Sickened and killed by the millions from disease, the population did not begin to recover until the eighteenth century, and then only slowly. With the conquest they were also forced from their communities, coercively converted, and the victims of a concerted effort to erase their culture, language, heritage, and historical memory. Essentially enslaved, whipped, beaten, raped, humiliated, poisoned, and viewed by their overlords as little more than animals, it is amazing that anything remains of indigenous life or culture. Native survival was, however, a result of adaptation, and ultimately transformation. While Catholicism modified the Andean cosmovision over the centuries, it too was altered as it was integrated into and overlaid with indigenous concepts. The indigenous genetic pool was diminished, often by force, yielding the Mestizo race, much of which is ethnically Indian. Along with these alterations have come others in language, dress, music, and even eating habits.

Despite these changes, there are still indigenes in the Andes who adhere to their ancient beliefs, languages, and traditions. Forced from the beginning into the capitalistic world, they ironically enabled it to have a global embrace, while being sacrificed in the mercury and silver mines and mills of the Andes. Now, the modern global economy which they helped to produce is insistently knocking at their doors on the altiplano and valleys, through enchanting consumer products, the wonders of the Internet, and telephones and television. New roads, bridges, airports, satellite dishes, and cellular telephone towers bring new opportunities yet also new cultural trials. Ironically, in parts of Bolivia and Peru today, many indigenous people and their descendants, having played such an important role in the making of global capitalism, are now simply trying to make it by panning for gold and refining what they find through mercury amalgamation, poisoning themselves, the air, and the rivers in the process.

Others are poisoned by the ongoing toxic legacy of the colonial amalgamation economy. Every day, people in Huancavelica and Potosí breathe

or ingest the mercury that was so crucial to the rise of the global economy. It has not only settled in the soils and been washed downstream of these cities, but it literally forms the building blocks of many homes. While the contemporary health effects of this legacy have yet to be fully explored, the levels of contamination are cause for grave concern. Indeed, they indicate that far from being consigned to the past, many residents in these cities are experiencing a continuing catastrophe affecting their and their children's health, development, and future.

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Glossary



Alcalde Mayor de Minas	A civil and criminal magistrate on mining issues.
Alquila	A free wage laborer in Huancavelica.
Apiri	A mitayo whose job was to carry ore from the mine to the surface in Potosí.
Arancel	A schedule of legally permitted fees for specific goods or services, both civil and ecclesiastical.
Asiento	A fixed term, renewable production or transport agreement, in this context, for mercury.
Audiencia	A judicial court with executive and administrative powers within a specific jurisdiction.
Aviador	Financiers who advanced goods and money to miners who in return pledged unminted silver.
Azoguero	An individual who owned a mill and often a mine.
Barretero	A skilled, free wage laborer who extracted ore in a mine.
Benefic ador	A skilled silver refiner.
Bota	A measure of 100 Spanish pounds, or four arrobas, of ore.
Braceaje	A minting fee of two reales per eight ounces of silver.
Buitrón	The area where the amalgam mix was treated by treading. Usually around forty feet long, ten feet wide, and six or seven feet high, it was paved with stones and would hold between 50,000 and 250,000 pounds of the mix. The buitrón was also referred to as the “patio” in the patio process of amalgamation.
Buscón	A prospector.
Busconil	Developed in 1633, a mercury refining oven which consisted of a large combustion chamber with a grill upon

	which the ore was loaded and that stood around eight or nine feet above the fire. The structure was enclosed by a conical roof which rose about nine feet above the grill. Near its pinnacle protruded eight cooling tubes which in turn passed through water on their way to a collection point. After its introduction, this type of smelter was the primary means of refining mercury throughout the colonial era and was also adopted in Almadén, Spain, where it was known as an “horno de bustamante” and “horno de aludeles,” and was used there until the 1920s.
Cajón	Originally referring to the box in which silver-containing ore was crushed, it later became a unit of measure. In Huancavelica it referred to 150 pounds, and in Potosí, 5,000 pounds.
Cajón de Buitrón	A stone-lined patio, or buitrón, with a fire chamber underneath. Due to the dearth of fuel in Potosí, these were not used there after the 1580s.
Capitán de la Mita	The person who was responsible for bringing and overseeing mitayos to Potosí or Huancavelica, and who, along with the curaca, was financially responsible for them in the event of their flight, death, or absence.
Carbonero	A person who produced and provided charcoal.
Carguiche	A mitayo ore carrier who brought ore from the mine to the surface in Huancavelica.
Chacanea	A mitayo who carried ore from the pithead to the refining ovens in Huancavelica.
Chicha	An alcoholic drink made from fermented corn.
Choco	Silicosis.
Chuño	A freeze-dried potato.
Corpa	The tolerated and customary practice in Oruro whereby generally Indian miners would extract ore on their own account from the mine of their employer.
Corregidor	A governor for a specific jurisdiction with executive, judicial, and administrative duties. In addition, he operated the repartimiento de mercancías system in which Indians were forced to purchase generally unwanted goods at inflated prices.
Council of the Indies	The entity in Spain that advised the king on, drafted legislation regarding, and had overall responsibility for American colonial administration.

Creole	A person of pure Spanish descent born in the Americas.
Curaca	A chief of an Indian village or area.
De huelga	The period of time when mitayos were, in theory, resting. This was generally to be for a period of two weeks after one week of work. The use of quotas and additional labor demands largely eliminated this practice by 1600, if not before.
Empedradillo	A cobblestone court next to Potosí's cathedral where duels were customarily held.
Encomendero	The recipient of an encomienda.
Encomienda	A grant of labor or the right to collect tribute conceded to a conquistador or colonist in exchange for Christianizing natives.
Endiabladas	The practice of expediting mercury refining which involved the opening of the ovens before they had fully cooled, exposing the worker to a potentially lethal dose of mercury.
Enterador	<i>See Capitán de la mita.</i>
Faena	Unremunerated tasks in addition to a mitayo's responsibilities.
Fanega	A unit of measure of approximately one and two-thirds bushels.
Forastero	An Indian who did not reside in the village of his or her birth.
Gremio	A guild; in Huancavelica and Potosí, it usually referred to that of the miners.
Guanaco	A generally brownish camelid related to llamas and alpacas.
Guasacho	The tolerated and customary practice in Huancavelica whereby Indian miners would extract ore on their own account from the mine of their employer.
Guatancha	A ransom paid by a designated mitayo destined for Huancavelica to their curaca or mita capitán to avoid service.
Guayra	Indigenous smelters for refining silver, generally made of stone in the pre-Hispanic period and clay after the conquest. They were most effective in refining rich ores, and their use was largely abandoned after the introduction of the mercury amalgamation process.
Hacendado	The owner of an hacienda.
Hacienda	A large agricultural estate, usually with a resident labor force of yanaconas.
Hilacata	An Indian village council elected by people who were born in the community.

Hornero	Also known as a quemador, this was a person who operated the refining ovens in Potosí
Horno de Aludeles	<i>See</i> Busconil
Ichu	A stiff, spiny grass that grows about a foot high on the altiplano. It was used for fuel, especially for refining mercury in Huancavelica, and also for roofing material.
Indio de Faltriquera	A mitayo who remitted money to the person to whom he was assigned to avoid service.
Indio en Plata	A mitayo who paid his curaca a ransom to avoid service.
Indio Vara	An independent or quasi-independent Indian miner before the introduction of amalgamation.
Indios de plaza	Mitayos who reported to the main plaza of Huancavelica or Potosí on Mondays, to be assigned to work in the hospital, monasteries, local government, and private homes.
Indios meses	Mitayos who were assigned to work for wages for one month.
Jabeca oven	A system for refining mercury, developed in the late 1500s, which consisted of about forty ceramic pots containing cinnabar, of which the bottom half protruded into a waist-high combustion chamber. The tops were covered with slightly narrower conical containers, and the joint was sealed by mud or clay. Condensation tubes directed the mercury to receptacles.
Juez (Comisionado)	An investigator who took testimony and presented it to his commissioning agent, generally the audiencia, corregidor, or archbishop.
Kapcha	The tolerated and customary practice in Potosí whereby Indian miners would extract ore on their own account from the mine of their employer.
Kenua	An evergreen tree found in the Andes that grows above an elevation of 12,000 feet. The scientific name is <i>Polylepis</i> , and it is a member of the Rosaceae family.
Lamas	A byproduct of the washing process which separates the silver-mercury amalgam from the mix in which it was contained. This byproduct was usually separated and reprocessed to extract the silver and mercury that it contained.
Lavaderos	Pre-Hispanic sites where Indians extracted vermillion from cinnabar, and which contained mercury that the Spanish subsequently refined.

Lavadores	A series of interconnected, leather-lined basins into which the amalgam-containing paste was placed and through which water gently ran to separate the amalgam from the impurities in which it was suspended.
Leaguaje	Payment, which was rarely disbursed, to mitayos for the distance they had to travel from their hometowns to and from Potosí.
Leñero	A person who supplied fi ewood.
Los Rosa	Workers in Huancavelica, generally mitayos, who were responsible for keeping the mine clear of debris and for making repairs to the mine.
Llimpi	The Quechua word for vermillion extracted from cinnabar.
Magistral	A combination of sulphates of iron and copper used in the silver refin i g process.
Maharaque	A form of servitude where a person would rent himself, or be rented by his curaca, for a variety of services for one or two years. Often this was converted into permanent debt-peonage.
Maray	Functioning in a similar manner to a mortar and pestle, this was a concave stone about three feet in diameter into which was placed cinnabar ore, which was then pulverized by a rounded grinding stone of about a foot and a half in length.
Marco	Eight Spanish ounces, or one-half of a Spanish pound, or 230.0465 grams.
Mayordomo	A foreman or overseer.
Mestizo	An individual of Indian and either Spanish or Creole origin.
Minero/Minero Soldado	A person who owned a mine only, as opposed to a mine and refin i g mill.
Minga	A free wage laborer in Potosí.
Mita	A system of obligatory labor service for Indians apportioned on a community basis. While theoretically the length of service was limited and intermittent, the decline of the native population, obsolete censuses, and fli ht from the service led to people serving more frequently than originally designed.
Mitayo	A mita laborer.
Mortero	A person, generally a mitayo, who loaded the ore into the stamp mill in a silver refin i g operation.

Mozoruna	A mitayo experiencing their first term of service.
Mulato	A brown silver-containing ore which was half oxide and half sulfid .
Mulatto	A person of Negro and Caucasian descent.
	Negrillos Rich, hard, dark sulfide argentiferous ore.
Ñusta	A female member of the Inca nobility.
Obraje	A center for the production of textiles, rope, or similar woven goods by penal, debt-based, or, prior to 1720, mita labor.
Oidor	A member of the audiencia.
Originario	An Indian who resided in the village of his or her birth.
Pacos	Silver oxide argentiferous ore of intermediate quality.
Palla	A measure of 2,500 pounds of ore, or twenty-five botas.
Palliris	Free-wage argentiferous ore sorters who usually worked near the pithead.
Pella	Mercury-silver amalgam.
Peso	A unit of currency equal to eight reales.
Piña	Silver which had been refined after having been placed in a conical mold and fired to burn off the mercury, so called because of its resemblance to a pineapple.
Pongo	An Indian foreman who supervised a group of twenty apiris.
Potabamba	A worker in Huancavelica, generally a mitayo, who was responsible for keeping the mine clear of debris and for making repairs to the mine.
Principal	A native of high status, whether derived from heredity or community service.
Protector de Naturales	The advocate of an Indian or group of Indians in the colonial courts.
Punchao	A load of cinnabar ore measured by the size of a leather bag, or tapadera, which was, in theory, about four and one-half feet high and one and one-half feet wide.
Quemador	Also known as an hornero, this was a person who operated the refining ovens in Potosí.
Quimbalete	A rounded grinding stone of about a foot and a half in length used for grinding cinnabar.
Quinto Real	The 20-percent tax paid to the crown on the production of silver and mercury. In 1735, this was reduced to 10 percent in Potosí.
Real	A unit of currency of which eight make up a peso.
Reducción	A Spanish-style settlement in which Indians were forced to live following the conquest. Designed to facilitate their physical control, allocation for labor, and conversion, they

	usually had a population of approximately 2,500 people. The concentration of people facilitated the spread of disease and many were abandoned over time as people returned to their original settlements.
Relamas	The amalgam-containing byproduct of a torta to which lamas had been added.
Relave	The heaviest byproduct of the amalgam washing process, this was a grainy, impure amalgam which settled in the washing trough and was usually separated and reprocessed to extract the silver and mercury that it contained.
Relavillo	A byproduct of the washing process that separates the silver–mercury amalgam from the mix in which it was contained. Somewhat heavier than lamas, this settled in the washing trough and was usually separated and reprocessed to extract the silver and mercury that it contained.
Repartimiento de Mercancías	The system operated by the corregidor in which Indians were forced to purchase goods at inflated prices. It is also known as the reparto.
Reparto	Alternate word to describe the repartimiento de mercancías.
Repasari	A mitayo who was assigned to tread the torta in the patio in the amalgamation process.
Repasso	The act of treading the torta in the patio in the amalgamation process.
Ribera	The stone-lined canal that carried water from the lagoons above Potosí to the refining mills.
Rollo	A stone column topped by a cross which symbolized Spanish authority and was often used as a whipping post.
Rosicler	A very rich, reddish argentiferous ore.
Señoraje	A minting tax of one real per eight ounces of silver made into coin.
Sobrestante	An assistant to a veedor.
Soldado	Technically, a soldier. In the 1570s, it referred to people who had fought on one side or another during the civil war in Peru. By around 1600, the term generally referred to a rootless and generally unruly Spaniard or Creole.
Soroche	Argentiferous ore containing considerable amounts of lead.
Tambo	A roadside inn, staffed by community members.
Tapadera	A leather bag used to carry cinnabar ore out of the mine that was, in theory, about four and one-half feet high and one and one-half feet wide.

Taquia	Llama dung, used as fuel
Tinadores	See Lavadores
Tocochimbo	A round stone furnace about a yard in diameter which was used by native silver smelters in the last phase of silver refining to remove impurities from the silver.
Torta	The pasty mix of ore, mercury, water, salt, lime, and other ingredients in which silver–mercury amalgamation took place.
Trapiche	A primitive, human-powered ore grinding mill.
Umpé	A lethal gas inside mines, either carbon monoxide or carbonic acid.
Vara	A measurement of approximately one yard.
Veedor	Inspector who was to work inside the mines and to ensure their smooth and safe functioning.
Vicuña	Technically, a camelid, related to but smaller than an alpaca, with extremely soft wool. During the ethnic conflicts in Potosí in the 1620s, the anti-Basque faction distinguished themselves by wearing hats made of vicuña wool, and were hence referred to as “vicuñas.”
Visita/Visitador	A tour or inspection, or inspector, ordered by or answering to the king, viceroy, archbishop, or prelate.
Vizcacha	Rodent members of the chinchilla family, resembling a hare.
Yanacona	Under the Inca, yanaconas were a servant and artisan class without community affiliation who served the Cuzco nobility. With the conquest they became servants to Spaniards who were not encomenderos. By the late 1600s, the term generally referred to serfs on agricultural estates, although it could also refer to Indians who did not have community links and worked as artisans, vendors, servants, miners, and transporters. The tribute of yanaconas on haciendas was paid for by the hacendado, and the serfs were generally considered part of the property when it was sold.
Yanapacu	A free-wage laborer hired to assist a mitayo to complete his quota.
Yareta	A hard, highly resinous, very slow-growing evergreen plant that resembles and grows like moss on stones. Its scientific name is <i>Azorella compacta</i> and is a member of the Apiaceae family.

Notes



INTRODUCTION

1. Archivo y Biblioteca Nacionales de Bolivia (hereafter ABNB), EC.1757.135, 1–2.
2. ABNB, EC.1757.135, 2.
3. ABNB, EC.1757.135, 2, 5, 8.
4. ABNB, EC.1757.135, 3.
5. ABNB, EC.1757.135, 4.
6. ABNB, EC.1757.135, 6.
7. ABNB, EC.1757.135, 7.
8. ABNB, EC.1757.135, 4–5.
9. ABNB, EC.1757.135, 5, 8.
10. Reginaldo de Lizárraga, *Descripción del Perú, Tucumán, Río de la Plata y Chile* (Buenos Aires: Union Académique Internationale/Academia Nacional de la Historia, 1999), 186, 188; David Brading and Harry Cross, “Colonial silver mining: Mexico and Peru,” *Hispanic American Historical Review* 52, no. 4 (November 1972), 547–48; “Descripción de la villa y minas de Potosí. Año de 1603,” in *Relaciones geográficas de Indias*, vol. 2, ed. Marcos Jiménez de Espada (Madrid: Ediciones Atlas, 1965), 375; Juan de Mendoza y Luna, Marqués de Montesclaros, “Relación del estado del gobierno de estos reinos que hace el excmo. Señor Don Juan de Mendoza y Luna, Marqués de Montesclaros, al excmo. Señor Príncipe de Esquilache su successor,” in *Memorias de los virreyes que han gobernado el Perú durante el tiempo del coloniaje español*, vol. 1, ed. M. A. Fuentes (Lima: Librería Central de Felipe Bailly, 1859), 37; Peter Bakewell, *Miners of the Red Mountain: Indian Labor in Potosí, 1545–1650* (Albuquerque: University of New Mexico Press, 1984), 8.
11. Dennis Flynn and Arturo Giraldez, “China and the Manila galleons,” in *World Silver and Monetary History in the 16th and 17th Centuries* (Brookfield, Vt.:

Variorum, 1996), 86; Earl Hamilton, *American Treasure and the Price Revolution in Spain, 1501–1650* (Cambridge, Mass.: Harvard University Press, 1934), 46; Harry Cross, “South American bullion production and export 1550–1750,” in *Precious Metals in the Later Medieval and Early Modern Worlds*, ed. J. F. Richards (Durham, N.C.: Carolina Academic Press, 1983), 397, 404.

12. Carlos Marichal, “The Spanish-American silver peso: Export commodity and global money of the ancien régime, 1550–1800,” in *From Silver to Cocaine: Latin American Commodity Chains and the Building of the World Economy, 1500–2000*, ed. Steven Topik, Carlos Marichal, and Zephyr Frank (Durham, N.C.: Duke University Press, 2006), 29; Flynn and Giraldez, “China and the Manila galleons,” 71; G. N. Clark, “The Early Modern Period,” in *The European Inheritance*, vol. 2, ed. Ernest Barker et al. (London: Clarendon Press, 1954), 79; Stanley Stein and Barbara Stein, *Silver, Trade and War: Spain and America in the Making of Early Modern Europe* (Baltimore: Johns Hopkins University Press, 2000), viii, 27, 104–5; Arthur Attman, *American Bullion in the European World Trade, 1600–1800*, trans. Eva Green and Allan Green (Goteborg, Sweden: Kungl. Vetenskaps—och Vitterhets-Samhallet i Goteborg, 1986), 33, 68; Hamilton, *American Treasure*, 72, 192–211, 261, 281, 301–2, 305. Hamilton’s work has been increasingly criticized, especially by Dennis Flynn in “A new perspective on the Spanish price revolution: The monetary approach to the balance of payments,” in *World Silver and Monetary History in the 16th and 17th Centuries* (Brookfield, Vt.: Variorum, 1996), 388–406; “Fiscal crisis and the decline of Spain (Castile),” in *World Silver and Monetary History in the 16th and 17th Centuries* (Brookfield, Vt.: Variorum, 1996), 139–47; and “The ‘population thesis’ view of inflation versus economics and history,” in *World Silver and Monetary History in the 16th and 17th Centuries* (Brookfield, Vt.: Variorum, 1996), 361–82. See also Cross, “South American bullion production,” 418–9.

13. Stein and Stein, *Silver, Trade and War*, 8, 15, 36, 27, 52–53; Marichal, “The Spanish-American silver peso,” 37–38; Carlo M. Cipolla, *Conquistadores, piratas, mercaderes: La saga de la plata española*, trans. Ricardo González (Buenos Aires: Fondo de Cultura Económica de Argentina, 1999), 52–53; Hamilton, *American Treasure*, 44; Attman, *American Bullion*, 7–8, 23, 30, 35, 39, 53, 58, 60–61.

14. Attman, *American Bullion*, 5–6, 9, 67, 77; Marichal, “The Spanish-American silver peso,” 27, 38, 40–41; Cipolla, *Conquistadores, piratas, mercaderes*, 66.

15. Marichal, “The Spanish-American silver peso,” 25–26, 35, 46; Attman, *American Bullion*, 101; Cipolla, *Conquistadores, piratas, mercaderes*, 57, 65, 72; Hamilton, *American Treasure*, 51.

16. Marichal, “The Spanish-American silver peso,” 40; Flynn and Giraldez, “China and the Manila galleons,” 71; Cipolla, *Conquistadores, piratas, mercaderes*, 63–64.

17. Marichal, “The Spanish-American silver peso,” 41–42; Cipolla, *Conquistadores, piratas, mercaderes*, 63–64; Flynn and Giraldez, “China and the Manila galleons,” 72, 85; Stein and Stein, *Silver, Trade and War*, 24; Gwendolyn Cobb, “Supply and transportation for the Potosí mines, 1545–1640,” in *Hispanic American Historical Review* 29, no. 1 (1949): 28; Cross, “South American bullion production,” 412–B.

18. Flynn and Giraldez, "China and the Manila galleons," 86; Stein and Stein, *Silver, Trade and War*, 262; Cross, "South American bullion production," 397, 404; Bartolomé Arzáns de Orsúa y Vela, *Historia de la Villa Imperial de Potosí*, vol. 2, ed. Lewis Hanke and Gunnar Mendoza (Providence, R.I.: Brown University Press, 1965), 161.
19. Luis de Velasco, "Relación del Sr. Virrey, D. Luis de Velasco, al Sr. Conde de Monterrey sobre el estado del Perú," in *Colección de las memorias o relaciones que escribieron los virreys del Perú*, vol. 1, ed. Ricardo Beltrán y Rózpide (Madrid: Imprenta del Asilo de Huérfanos del S. C. de Jesús, 1946), 111.
20. Martín de Murua, *Historia general del Perú*, ed. Manuel Ballesteros Gaibrois (Madrid: Historia 16, 1987), 549–50; Juan de Matienzo, "Carta a S. M. del licenciado Matienzo, con noticia de la residencia, que por encargo del Virrey, había tomado al corregidor, alcaldes, oficiales y otros jueces de la Villa de Potosí," Potosí, December 23, 1577, in *La audiencia de Charcas: Correspondencia de presidentes y oidores; Documentos del Archivo de Indias*, vol. 1, ed. Roberto Levillier (Madrid: 1918), 457.
21. Pedro Álvarez de Toledo y Leyva, Marqués de Mancera, "Relación del estado del gobierno del Perú que hace el Marqués de Mancera al Señor Virrey Conde de Salvatierra," in *Colección de las memorias o relaciones que escribieron los virreys del Perú*, vol. 2, ed. Ricardo Beltrán y Rózpide (Madrid: Imprenta del Asilo de Huérfanos del S. C. de Jesús, 1921), 137–38; Guillermo Lohmann Villena, *Las minas de Huancavelica en los siglos XVI y XVII* (Lima: Pontificia Universidad Católica del Perú, 1999), 5. See also Potosí, May 14, 1596, ABNB, CPLA, vol. 7, 13.
22. Lizárraga, *Descripción del Perú*, 134.
23. José Antonio Manso de Velasco, Conde de Superunda, "Relacion que escribe el conde de Superunda, Virrey el Perú, de los principales sucesos de su gobierno, de Real Orden de S. M. comunicado por el Excmo. Sr. Marqués de la Ensenada, su secretario del Despacho universal, con fecha 23 de Agosto de 1751, y comprende los años desde 9 de Julio de 1745 hasta fin del mismo mes en el de 1756," in *Memorias de los virreyes que han gobernado el Perú durante el tiempo del coloniaje español*, vol. 4, ed. M. A. Fuentes (Lima: Librería Central de Felipe Baily, 1859), 158; "Memorial y relación de las minas de azogue del Pirú," in *Colección de documentos inéditos, relativos al descubrimiento, conquista y organización de las antiguas posesiones españolas de América y Oceanía, sacados de los Archivos del Reino, y muy especialment del de Indias*, vol. 8 (Madrid: Imprenta de Fries y Compañía, 1867), 441.
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27. ABNB, ALP Minas 41/5,2; Pedro Arena, *Las minas de azogue del Perú* (Lima: Imprenta de “El Lucero,” 1901), 82–83; Francisco López Caravantes, *Noticia general del Perú*, vol. 4, ed. Marie Helmer (Madrid: Ediciones Atlas, 1989), 224; Mariano Patiño Paúl Ortiz, *Huancavelica colonial: Apuntes históricos de la ciudad minera más importante del Virreinato Peruano* (Lima: Huancavelica 21,2001), 163; Kendall Brown, “La crisis final cierne peruana al comienzo del siglo XV, la minería de plata y la mina de azogue de Huancavelica,” *Revista de Indias* 48, nos. 182–83 (1988): 352, 375; Arthur Whitaker, & Huancavelica Mercury Mine (Boston: Harvard University Press, 1941), 6–7, 104; Virgilio Roel Pineda, *Historia social y económica de la colonia* (Lima: Gráfica Labor, 1970), 105; Lohmann Villena, *Las minas de Huancavelica*, 485–87; Peter Bakewell, “Registered silver production in the Potosí district, 1550–1735,” *Jahrbuch für Geschichte Geschichte von Staat, Wirtschaft und Gesellschaft Lateinamerikas* 12 (1975): 84, 93–100. The approximate total of 39,000 metric tons reflect an annual average of 165 metric tons volatilized in the city of Potosí between 1574 and 1810. This is calculated on the basis of the total registered silver production

in the district of Potosí between 1574 and 1735. Twenty-five percent is added to this figure to account for contraband, and 80 percent of that total is the approximate amount of silver produced in the city of Potosí. To the resulting sum of almost 18,000 metric tons of silver, a conversion ratio is applied of 1.7 pounds of mercury volatilized per pound of silver produced, which reflects approximately 15 percent lost in runoff. The result is an average of approximately 165 metric tons of mercury volatilized in the city of Potosí per year, or 30,600 metric tons between 1574 and 1735. Using the same methodology, from 1735 to 1760, the city of Potosí volatilized approximately 2,700 metric tons of mercury, or 112 metric tons of mercury per year. To estimate mercury consumption between 1760 and 1810, the annual average of 1735–1760 was extrapolated. The result is nearly 39,000 metric tons of mercury volatilized in Potosí from 1574 to 1810, or 165 metric tons of mercury per year, out of a total of approximately 45,000 metric tons consumed, 41,400 of these being from Huancavelica. Data for these calculations are drawn from Bakewell, "Registered silver production," 93–100, and Cross, "South American bullion production," 397, 404.

28. Soil samples were taken by the author along three transects in both cities in April and June 2009, and analyzed by atomic absorption spectrometry at Duke University. The results of this research are being prepared for publication.

29. Bakewell, "Registered silver production," 84. A Spanish pound was equivalent to 460.09 grams.

30. Modesto Bargallo, *La amalgamación de los minerales de plata en hispano-america colonial* (Mexico City: Compañía Fundidor de Fierro y Acero de Monterrey, 1969), 110–12; Fray Buenaventura Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú* (Lima: Universidad Nacional Mayor de San Marcos, 1957), 305; "Pareceres de los Padres de la Compañía de Jesús de Potosí (1610)," in *Pareceres jurídicos en asuntos de indias (1601–1718)*, ed. Rubén Vargas Ugarte (Lima: CIP, 1951), 120.

31. Bargallo, *La amalgamación*, 110–12; Bakewell, *Miners of the Red Mountain*, 148–49.

32. Don Rodrigo de Mendoza y Manrique, administrador y arrendatario que fue de las minas y los ingenios de don Pedro Sorez de Ulloa en el cerro y la ribera de Potosí, con el maestro de campo don Rodrigo Campuzano, hermano de doña Francisca Campuzano, viuda y heredera que fue de dicho don Pedro, sobre la liquidación de los pesos impendidos en el avío de las haciendas mencionadas durante el tiempo de su administración y arrendamiento, La Plata, February 5, 1656–1669, ABNB, ALP Minas 15/1, 9.

33. Melchor Liñán y Cisneros, "Relacion de Don Melchor de Liñán y Cisneros, dada al Señor Duque de la Palata, del tiempo de tres años y cuatro meses que gobernó, desde 1678 hasta 1681," in *Memorias de los virreyes que han gobernado el Perú durante el tiempo del coloniaje español*, vol. 1, ed. M. A. Fuentes (Lima: Librería Central de Felipe Baily, 1859), 304; Alberto Crespo Rojas, "El reclutamiento y los viajes en la 'mita' del cerro Potosí," in *La minería hispana e iberoamericana*, vol.

1 (Leon, Spain: Cátedra de San Isidoro, 1970), 472–73; Alberto Crespo Rojas, “La ‘mita’ de Potosí,” *Revista Histórica* (Lima) 22 (1955–56), 171; Jeffrey Cole, *À e Potosí Mita, 1573–1700: Compulsory Indian Labor in the Andes* (Stanford, Calif.: Stanford University Press, 1985), 12; Brian M. Evans, “Census enumeration in late seventeenth-century alto Perú: The Numeración General of 1683–1684,” in *Studies in Spanish Population History*, ed. D. J. Robinson (Boulder: Westview, 1981), 27. The term *mita* translates as a “turn” of service, and the provinces subject to the Potosí mita were Azángaro y Asillo, Cabana y Cabanilla, Canas y Canchis, Carangas, Chayanta, Chucuito, Cochabamba, Omasuyos, Pacajes, Paria, Paucarcolla, Porco, Quispicanches, Sicasica, Tarija, and Tinta. Exempt cities were Cuzco, La Paz, Potosí, and Arequipa and the provinces of Paucartambo, Carabaya, Larecaja, Atacama, Mizque, Pilaya y Pasipaya, Lipes, Tomina, Oruro, Yamparaez. On this, see Evans, “Census enumeration,” 27–28.

34. “Contestación al discurso sobre la mita de Potosí escrito en La Plata 9 de marzo de 1793 contra el servicio de ella,” in “Una polémica en torno a la mita de Potosí a fines del siglo XVIII,” María del Carmen Cortés Salinas, *Revista de Indias* 30, nos. 19–22 (December–January 1970), 173; ABNB, Ruck 11,23–37,32; Cole, *À e Potosí Mita*, 12.

35. There are at present no books published in English or Spanish which exclusively focus on the human and ecological effects of the mercury amalgamation process either in the Andes or in the Americas. Foundational works concerning forced labor include those by A. Zulawski (1995), J. Cole (1985), P. Bakewell (1984), T. Saignes (three in 1984, one in 1980), E. Tandeter (1993), N. Sánchez Albornoz (1983), S. Zavala (1978), P. Casteñada Delgado (1970), and R. Levene (1946). Also providing vital context for this study are studies of the demographic collapse which followed the conquest, such as those by N. D. Cook (1998 and 1981), H. Bonilla (1992), T. Canedo-Arguelles Fábrega (1988), B. Evans (1981), N. Sánchez Albornoz (1974), C. T. Smith (1970), and H. Dobyns (1963). Please see the bibliography for complete citations. These works, however, treat mercury toxicity only tangentially, if at all. The only article in English which examines the health effects of mercury production, written by Kendall Brown (2001), was both a milestone and a tacit challenge for a broader study of the topic. Concerning Huancavelica, the classic works of Lohmann Villena (1948, reissued 1999) and Arthur Whittaker (1941) focus on administrative, legal, and, to a limited extent, technical issues, while almost entirely overlooking the human and environmental impacts. Indeed, despite its strengths, Lohmann’s work is disparaging of native peoples in general and largely dismissive of the effects of mercury on their health and environment.

There has been much more written on Potosí, with studies tending to focus on labor systems, including those cited above, and the city’s economic ambit and silver production such as those by T. Platt (1999), B. Larson (1990), N. Manrique (1985), S. Assadourian (1983), S. Assadourian and T. Platt (1980), J. Murra (1978), P. Bakewell (1975), and D. Brading and H. Cross (1972). Other works focus on administration issues: for example, those by J. Fisher (2003), G. Mira Delli-Zotti, (1997), R. Buechler

(1981), G. Cobb (1977), and R. Vargas Ugarte (1966). Mining technology and innovation is explored by T. Platt (2000), P. Bakewell (1997), A. Probert (1997), J. Sánchez Gómez (1997), J. Barnadas (1986), R. Buechler (1973), G. Lohmann Villena (1970), W. C. F. Purser (1971), and M. Bargallo (1969, 1955). The social history of Potosí has been studied by J. Lockhart (1994), L. Hanke (1970), M. Helmer (1960), and A. Crespo Rojas (1956). There are a limited number of articles on the transport of mercury, such as those by K. Brown (1992), G. Mira Delli-Zotti (1988), M. Dolores Fuentes Bajo (1986), and G. Cobb (1949). Concerning the vital link between Huancavelica and Potosí, see P. Bakewell (1986), C. Contreras (1982), and G. Cobb (1977, 1949). None of these works, however, whether in English or Spanish, focus specifically on the effects of mercury on miners, the wider colonial society, or their ecosystem.

I. AMALGAMATING AN EMPIRE

1. James Lockhart, *Spanish Peru, 1522–1560: A Social History* (Madison: University of Wisconsin Press, 1994), 11.
2. Christine Hunefeldt, *A Brief History of Peru* (New York: Facts on File, 2004), 34–40, 43–50.
3. Pedro de Ribera and Antonio de Chaves y de Guevara, “Relación de la Ciudad de Guamanga y sus terminos. Año de 1586,” in *Relaciones geográficas de Indias*, vol. 1, ed. Marcos Jiménez de Espada (Madrid: Ediciones Atlas, 1965), 18; Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 312; Josep Barnadas, *Charcas: Origines históricos de una sociedad colonial* (La Paz: Centro de Investigación y Promoción del Campesinado, 1973), 321–23, 326–32; Nicolás Sánchez-Albornoz, *& e Population of Latin America: A History*, trans. W. A. R. Richardson (Berkeley: University of California Press, 1974), 54–56, 61; David Noble Cook, *Demographic Collapse: Indian Peru, 1520–1620* (Cambridge: Cambridge University Press, 1981), 96; Heraclio Bonilla, “1492 y la población indígena de los Andes,” in *Los conquistados: 1492 y la población indígena de las Américas*, ed. Heraclio Bonilla, Robin Blackburn, et al. (Bogotá: Tercer Mundo Editores/Facultad latinoamericana de ciencias sociales, 1992), 106; Henry F. Dobyns, “An outline of Andean epidemic history to 1720,” *Bulletin of the History of Medicine* 37, no. 6 (November–December 1963), 494, 496.
4. Noble David Cook, *Born to Die: Disease and New World Conquest, 1492–1650* (Cambridge: Cambridge University Press, 1998), 13.
5. Cook, *Demographic Collapse*, 14, 116, 143–44, 197, 252–54; Barnadas, *Charcas*, 321; Bakewell, *Miners of the Red Mountain*, 109; Sánchez Albornoz, *& e Population of Latin America*, 54–56; Nicolás Sánchez Albornoz, *Indios y tributos en el Alto Perú* (Lima: Instituto de Estudios Peruanos, 1978), 73; Carlos Sempat Assadourian, “La crisis demográfica del siglo XVI y la transición del Tawantinsuyo al sistema mercantil colonial,” in *Población y mano de obra en América Latina*, ed. Nicolás Sanchez Albornoz (Madrid: Alianza Editorial, 1985), 74; Ann Zulawski, *& ey Eat from & eir Labor: Work and Social Change in Colonial Bolivia* (Pittsburgh: Pittsburgh University Press, 1995), 63–66.

6. "Carta al Presidente y Oidores del Real Consejo de Indias, escrita desde Lima el 1 de Julio de 1550," in *Fr. Domingo de Santo Tomás: Defensor y Apostol de los Indios del Perú. Su vida y sus escritos*, ed. José María Vargas (Quito: Editorial Santo Domingo, 1937), 3.

7. Casa Nacional de Moneda, Archivo Histórico (hereafter CNMAH), CR 484/286, 1.

8. Fernando Montesinos, *Anales del Perú*, vol. 2, ed. Victor M. Maurtua (Madrid: Imprenta de Gabriel L y del Horno, 1906), 94; Gabriel Fernández de Villabos, *Vaticinios de la pérdida de las Indias y mano de reloj* (Caracas: Instituto Panamericano de Geografía e Historia, 1949), 29; Pedro Vicente Cañete y Domínguez, *Guía histórica, geográfica, física, política, civil y legal del gobierno e intendencia de la provincia de Potosí* (Potosí, Bolivia: Editorial Potosí, 1952), 15; "Carta de fray Domingo de Santo Tomás al Consejo de Indias," in *Fr. Domingo de Santo Tomás: Defensor y Apostol de los Indios del Perú. Su vida y sus escritos*, ed. José María Vargas (Quito: Editorial Santo Domingo, 1937), 74; Patiño Paúl Ortiz, *Huancavelica colonial*, 220; Lizárraga, *Descripción del Perú*, 209.

9. Pedro Cieza de León, *Crónica del Perú* (Lima: Pontificia Universidad Católica del Perú, 1984), 288–89; Nicolás del Benino, "Relacion muy particular del cerro y minas de Potosí y de su calidad y labores por Nicolás del Benino, dirigida a Don Francisco de Toledo, Virrey del Perú, en 1573," in *Relaciones geográficas de Indias*, vol. 1, ed. Marcos Jimenez de Espada (Madrid: Ediciones Atlas, 1965), 366; Luis Capoche, *Relación general de la Villa Imperial de Potosí*, ed. Lewis Hanke (Madrid: Ediciones Atlas, 1959), 77; José de Acosta, *Historia natural y moral de las Indias*, ed. José Alcina Franch (Madrid: Historia 16, 1987), 229–30; Lizárraga, *Descripción del Perú*, 185; Murua, *Historia general del Perú*, 563; Joseph Baquijano, "Historia del descubrimiento del cerro de Potosí, fundación de su Imperial Villa, sus progresos y actual estado," in *Mercurio Peruano* 7 (1793): 31; Caravantes, *Noticia general del Perú*, 2:138; Arzáns de Orsúa, *Historia de la Villa Imperial de Potosí*, 1:34–35; Juan del Pino Manrique, "Descripción de la Villa de Potosí y de los partidos sujetos a su intendencia," in *Colección de obras y documentos relativos á la historia antigua y moderna de las provincias del Río de la Plata*, 2nd ed., vol. 2, ed. Pedro de Angelis (Buenos Aires: Librería Nacional de J. LaJouane & Cia, 1910), 13; Montesinos, *Anales del Perú*, 1:56; José Eusebio Llano Zapata, *Memorias histórico, físicas, crítico, apologéticas de la América Meridional*, ed. Ricardo Ramírez Castañeda et al. (Lima: Instituto Francés de Estudios Andinos, 2005), 163; Antonio de Ulloa, *Viaje a la América meridional*, ed. Andrés Saumell (Madrid: Historia 16, 1990), 2:174–75; José de Mesa and Teresa Gisbert, "Oruro, Origen de una villa minera," in *La minería hispana e iberoamericana*, vol. 1, 59; Modesto Bargallo, *La minería y metalurgia en la América española durante la época colonial* (Mexico City: Fondo de Cultura Económica, 1955), 73; Barnadas, *Charcas*, 146; W. C. F. Purser, *Metal Mining in Peru, Past and Present* (New York: Praeger, 1971), 27; Gwendolyn Cobb, *Potosí y Huancavelica, bases económicas, 1545–1640* (La Paz: Banco Minero de Bolivia, 1977), 19; Lockhart, *Spanish Peru*, 249; Manuel Ballesteros Gaibrois, *Descubrimiento y fundación del Potosí* (Zaragoza: Delegación del Distrito de Educación Nacional, 1950), 13, 16–23.

10. Arzáns de Orsúa, *Historia de la Villa Imperial de Potosí*, 1:36; Capoche, *Relación general de la Villa Imperial de Potosí*, 77–8; Acosta, *Historia natural*, 230–31; Ulloa, *Viaje*, 2:175; Baquijano, “Historia del descubrimiento,” 32; Montesinos, *Anales del Perú*, 1:156; Alberto Crespo Rojas, *La Guerra entre vicuñas y vascongados (Potosí, 1622–1625)* (Lima: Tipografía Peruana, 1956), 14; Bargallo, *La minería y metalurgia en la América*, 73.

11. Caravantes, *Noticia general del Perú*, 2:138. There are differing interpretations of the origin of the word *Potosí*. While some aver it is a corruption of the Aymará *Poxtochi*, meaning a large or high place, others assert that it comes from *Potocsi*, meaning “that which makes thunder.” See Cieza de León, *Crónica del Perú*, 290; Murua, *Historia general del Perú*, 565; Caravantes, *Noticia general del Perú*, 2:137; Arzáns de Orsúa, *Historia de la Villa Imperial de Potosí*, 2:27; Baquijano, “Historia del descubrimiento,” 30.

12. Benino, “Relacion muy particular,” 365; Baquijano, “Historia del descubrimiento,” 33–34; Lizárraga, *Descripción del Perú*, 186–87; Caravantes, *Noticia general del Perú*, 2:139; Cole, *à e Potosí Mita*, 66.

13. Arzáns de Orsúa, *Historia de la Villa Imperial de Potosí*, 1:42; Lizárraga, *Descripción del Perú*, 186–87; Caravantes, *Noticia general del Perú*, 2:139; “Descripción de la villa y minas de Potosí. Año de 1603,” in *Relaciones geográficas de Indias*, vol. 3, ed. Marcos Jiménez de Espada (Madrid: Ediciones Atlas, 1965), 374; Llano Zapata, *Memorias histórica*, 162; Ballesteros Gaibrois, *Descubrimiento y fundación*, 58–59; Crespo Rojas, *La Guerra*, 18; Cobb, *Potosí y Huancavelica*, 26–27; Capoche, *Relación general de la Villa Imperial*, 76.

14. Cieza de León, *Crónica del Perú*, 292–93; Crespo Rojas, *La Guerra*, 17, 20; “Descripción de la villa y minas de Potosí. Año de 1603,” 373; Barnadas, *Charcas*, 147; Ballesteros Gaibrois, *Descubrimiento y fundación*, 49; Cobb, *Potosí y Huancavelica*, 28; Baquijano, “Historia del descubrimiento,” 34.

15. Capoche, *Relación general de la Villa Imperial*, 109.

16. Donald Wiedner, “Forced labor in colonial Peru,” *Americas* 16, no. 4 (April 1960): 358; Ann Zulawski, “Wages, ore sharing and peasant agriculture: Labor in Oruro’s silver mines, 1607–1720,” *Hispanic American Historical Review* 67, no. 3 (1987): 410, 426; Patiño Paúl Ortiz, *Huancavelica colonial*, 213; Arthur Zimmerman, *Francisco de Toledo, Fifth Viceroy of Peru, 1569–81* (Caldwell, Idaho: Caxton Printers, 1938), 192–93; Bakewell, *Miners of the Red Mountain*, 33–35, 48–52.

17. Cieza de León, *Crónica del Perú*, 290–91; Capoche, *Relación general de la Villa Imperial*, 109; Barnadas, *Charcas*, 368; Octavio Puche, “Influencia de la legislación minera, del laboreo, así como del desarrollo técnico y económico, en el estado y producción de las minas de Huancavelica, durante sus primeros tiempos,” in *Minería y metalurgia: Intercambio tecnológico y cultural entre América y Europa durante el período colonial español*, ed. Manuel Castillo Martos (Seville: Muñoz Moya y Montraveta, 1994), 471; Enrique Tandeter, *Coercion and Market: Silver Mining in Colonial Potosí, 1692–1826* (Albuquerque: University of New Mexico Press, 1993), 74, 76; Lockhart, *Spanish Peru*, 248; Peter Bakewell, “Technological Change in Potosí:

The Silver Boom of the 1570s,” in *Mines of Silver and Gold in the Americas*, ed. Peter Bakewell (Brookfi Id, Vt.: Variorum, 1997), 79; Bakewell, *Miners of the Red Mountain*, 46.

18. Arzáns de Orsúa, *Historia de la Villa Imperial*, 1:107; Bakewell, *Miners of the Red Mountain*, 137.

19. Juan López de Velasco, *Geografía y descripción universal de las Indias* (Madrid: Establecimiento Tipográfico de Fortanet, 1894), 504; Robert West, “Aboriginal Metallurgy and Metalworking in Spanish America: A Brief Overview,” in *Mines of Silver and Gold in the Americas*, ed. Peter Bakewell (Brookfi Id, Vt.: Variorum, 1997), 50.

20. Lizárraga, *Descripción del Perú*, 187; Caravantes, *Noticia general del Perú*, 2:138; Capoche, *Relación general de la Villa Imperial*, 110–11; Acosta, *Historia natural*, 238; Balthasar Ramírez, “Descripción del reyno del Pirú del sitio, temple, provincias, obispados y ciudades; de los naturales, de sus lenguas y traje,” in *Juicio de límites entre el Perú y Bolivia*, vol. 1, ed. Víctor Maurtua (Barcelona: Imprenta de Heinrich y Compañía, 1906), 349–50; Bernabé Cobo, *Historia del Nuevo Mundo*, ed. Francisco Mateos (Madrid: Ediciones Atlas, 1956), 144; Llano Zapata, *Memorias históricas*, 165; Bakewell, *Miners of the Red Mountain*, 15–16; Cobb, *Potosí y Huancavelica*, 84–87; Tandeter, *Coercion*, 75; Barnadas, *Charcas*, 364; Bargallo, *La minería*, 40–41, 97; Purser, *Metal Mining in Peru*, 24; Julio Sánchez Gómez, “La técnica en la producción de metales monedables en España y en América, 1500–1650,” in *La savia del imperio: Tres estudios de economía colonial*, ed. Julio Sánchez Gómez, Guillermo Mira Delli-Zotti, and Rafael Dobado (Salamanca, Spain: Ediciones Universidad Salamanca, 1997), 49.

21. Ramírez, “Descripción del reyno,” 350; López de Velasco, *Geografía y descripción universal*, 504; Lope García de Castro, “Carta a S. M. del Licenciado Castro acerca de las minas y del trabajo de los indios; la sucesión de encomiendas; guerra contra los indios en Chile; fundación de un monasterio de monjas; y otros asuntos de menor importancia,” in *Gobernantes del Perú: Cartas y Papeles siglo XVI*, vol. 3, ed. Roberto Levillier (Madrid: Sucesores de Rivadeneyra, 1921), 288; Cieza de León, *Crónica del Perú*, 291–92.

22. Lizárraga, *Descripción del Perú*, 187; Capoche, *Relación general de la Villa Imperial*, 111.

23. Benino, “Relacion muy particular,” 368.

24. Pino Manrique, “Descripción de la Villa de Potosí,” 14.

25. Murua, *Historia general del Perú*, 563; Lizárraga, *Descripción del Perú*, 184; Acosta, *Historia natural*, 229; “Descripción de la villa y minas de Potosí,” 373; Ballesteros Gaibrois, *Descubrimiento y fundación*, 26. The scientific name of kenua is *polylepis*, a member of the Rosaceae family.

26. Lizárraga, *Descripción del Perú*, 186; Edberto Oscar Acevedo, “Estudio Preliminar,” in *Descripción del Perú, Tucumán, Río de la Plata y Chile*, ed. Reginaldo de Lizárraga (Buenos Aires: Union Académique Internationale/ Academia Nacional de la Historia, 1999), 18.

27. “Descripción de la villa y minas de Potosí,” 373.

28. Cañete y Domínguez, *Guía histórica*, 50.
29. Benino, "Relacion muy particular," 363.
30. Lizárraga, *Descripción del Perú*, 186, 188; Capoche, *Relación general de la Villa Imperial*, 135; Llano Zapata, *Memorias histórico*, 165; Bargallo, *La amalgamación*, 172; Cobb, *Potosí y Huancavelica*, 88.
31. Lizárraga, *Descripción del Perú*, 189.
32. Lockhart, *Spanish Peru*, 12-B.
33. Lockhart, *Spanish Peru*, 154, 169–V1, 251.
34. Cobo, *Historia del Nuevo Mundo*, 148.
35. Sánchez Gómez, "La ténica en la producción," 84; Lohmann Villena, *Las minas de Huancavelica*, 15; Jerome Nriagu, "Mercury pollution from the past mining of gold and silver in the Americas," *Science of the Total Environment* 149 (1994): 168–69; Georgius Agricola, *De Re Metalica*, ed., trans. Herbert C. Hoover and Lou H. Hoover (New York: Dover, 1950), note on 297.
36. Bargallo, *La minería y metalurgia*, 17–20; Bargallo, *La amalgamación*, 100; Alan Probert, "Bartolomé de Medina: The patio process and the sixteenth century silver crisis," in *Mines of Silver and Gold in the Americas*, ed. Peter Bakewell (Brookfi Id, Vt.: Variorum, 1997), 96, 107, 110–11; Sánchez Gómez, "La ténica en la producción," 84–86; John A. Fisher, *Silver Mines and Silver Miners in Colonial Peru, 1776–1824*, monograph series no. 7 (Liverpool: Center for Latin American Studies, University of Liverpool, 1977), 3.
37. Lohmann Villena, *Las minas de Huancavelica*, 16; Cobb, *Potosí y Huancavelica*, 32, 35; Patiño Paúl Ortiz, *Huancavelica colonial*, 19; Bargallo, *La minería y metalurgia en la América*, 77; Cook, *Demographic Collapse*, 203; Fisher, *Silver Mines and Silver Miners*, 3. Although most of the mercury consumed in Potosí before 1778 came from Huancavelica, there were on occasion shipments to Potosí from Almadén when production in Huancavelica faltered or demand otherwise exceeded supply, such as in 1632–1634, 1651, and between 1766 and 1777. Mercury also came from Idria, in present-day Slovenia, in the late 1780s, and by 1800 Potosí relied on these latter two sources almost exclusively. See Lohmann Villena, *Las minas de Huancavelica*, 309, 372; Whitaker, *de Huancavelica Mercury Mine*, 54, 64; Fisher, *Silver Mines and Silver Miners*, 20; Enrique Tandeter, "Crisis in Upper Peru, 1800–1805," *Hispanic American Historical Review* 71, no. 1 (1991): 51.
38. Lohmann Villena, *Las minas de Huancavelica*, 16; Cook, *Demographic Collapse*, 203.
39. Antonio de la Calancha, *Crónica moralizada del orden de San Augustín en el Perú, con sucesos ejemplares en esta monarquía*, vol. 5 (Lima: Universidad Nacional Mayor de San Marcos, 1974), 1679; Montesinos, *Anales del Perú*, 2:18–9; Bakewell, "Technological change," 78; Guillermo Lohmann Villena, "Enrique Garcés, descubridor del mercurio en el Perú, poeta y arbitrista," *Studia* 27–28 (August–December 1969): 15–20, 41–2, 61; Leonard J. Goldwater, *Mercury: A History of Quicksilver* (Baltimore: York Press, 1972), 46; Cobb, *Potosí y Huancavelica, bases económicas*,

1545–1640, 32; Patiño Paúl Ortiz, *Huancavelica colonial*, 274; Lohmann Villena, *Las minas de Huancavelica*, 19.

40. Llano Zapata, *Memorias histórico*, 217; Rodrigo Cantos de Andrade, “Relación de la Villa Rica de Oropesa y minas de Guancavelica,” in *Relaciones geográficas de Indias*, vol. 1, ed. Marcos Jiménez de Espada (Madrid: Ediciones Atlas, 1965), 303; Acosta, *Historia natural*, 243; Sebastián Lorente, *Historia del Perú bajo la dinastía Austriaca* (Paris: Imprenta de Poissy, n.d.), 292; “Memoria sobre la mina de azogue de Huancavelica,” in *Colección de memorias científicas, agrícolas é industrielles publicadas en distintas épocas*, vol. 2, ed. Mariano Eduardo de Rivero y Ustáriz (Brussels: Imprenta de H. Goemaere, 1857), 85; “Memorial y relación de las minas de azogue del Pirú,” 423; Caravantes, *Noticia general del Perú*, 2:134; Juan Solórzano y Pereyra, *Política Indiana*, vol. 4 (Madrid: Ediciones Atlas, 1972), 314; Montesinos, *Anales del Perú*, 2:19; Ulloa, *Viaje*, vol. 2:148; Arena, *Las minas de azogue del Perú*, 6; Patiño Paúl Ortiz, *Huancavelica colonial*, 22; Lohmann Villena, *Las minas de Huancavelica*, 21; Federico Salas Guevara, *Villa Rica de Oropesa* (Peru: 1993), 18–9; “Historia de la mina de Huancavelica,” *Mercurio Peruano* (January 30, 1791):66; Cobb, *Potosí and Huancavelica*, 33; Luis J. Basto Girón, “Las mitas de Huamanga y Huancavelica,” *Perú Indígena* 5, no. 13 (December 1954): 223; Cook, *Demographic Collapse*, 203; Roel Pineda, *Historia social y económica*, 101; Túlio Carrasco, *Cronología de Huancavelica (Hechos, poblaciones y personas)* (Lima: Compañía de Minas Buenaventura, 2003), 91.

41. Chaca refers to bridge and sigsi refers to *Cyperus eragrostis*, or tall flat sedge, and is similar to Pampas grass.

42. Cantos de Andrade, “Relación de la Villa Rica de Oropesa,” 304; Caravantes, *Noticia general del Perú*, 2:34; “Memoria sobre la mina de azogue de Huancavelica,” 85; “Memorial y relación de las minas de azogue del Pirú,” 422–23; Cobb, *Potosí and Huancavelica*, 33; Cook, *Demographic Collapse*, 203; Lohmann Villena, “Enrique Garcés,” 15; Lohmann Villena, *Las minas de Huancavelica*, 13–14, 29; Llano Zapata, *Memorias histórico*, 216; Carrasco, *Cronología de Huancavelica*, 91; Patiño Paúl Ortiz, *Huancavelica colonial*, 21; Whitaker, *the Huancavelica Mercury Mine*, 9; Brown, “Workers’ health,” 468; Walter Hermosa Virreina, *Breve historia de la minería en Bolivia* (Cochabamba: Amigos del Libro, 1979), 22; Colin Cooke, “Over three millennia of mercury pollution in the Andes,” *Proceedings of the National Academy of Science* 106, no. 22 (June 2, 2009): 8830–34; William E. Brooks et al., “Mineral pigments at Huaca Tacaynamo (Chan Chan, Peru),” *Bulletin de l’Institut Français d’Études Andines* 37, no. 3 (2008): 444–46; William E. Brooks, G. Schworbel, and L. E. Castillo, “Mercury and small-scale gold mining in ancient Peru,” *Geological Society of America Annual Meeting, Abstracts with Programs* 41, no. 7 (2009): 435. For more on pre-Hispanic mining in Peru, see Georg Petersen, *Minería y metalurgia en el antiguo Perú* (Lima: Museo Nacional de Antropología y Arqueología, 1970).

43. Cobb, *Potosí y Huancavelica*, 35, 49; Bakewell, “Technological change,” 78; Lohmann Villena, *Las minas de Huancavelica*, 29–30, 63, 109. A quintal is one hundred pounds, and one Spanish pound was 460.09 g rams.

44. Zimmerman, *Francisco de Toledo*, 48.
45. León Gómez Rivas, *El virrey del Perú Don Francisco de Toledo* (Madrid: Instituto Provincial de Investigaciones y estudios toledanos, 1994), 45–47, 49–50, 55–56; Zimmerman, *Francisco de Toledo*, 45–46, 49–52.
46. Zimmerman, *Francisco de Toledo*, 54–55, Q, 66–67, 80.
47. Bartolomé de Las Casas, *Apologética Historia Sumaria*, 2 vols., ed. Edmundo O’Gorman (Mexico City: Universidad Nacional Autónoma de México, 1967); Bartolomé de Las Casas, *Brevísima Relación de la Destrucción de las Indias*, ed. Isacio Pérez Fernández (Bayamón, Puerto Rico: Universidad Central de Bayamón, 2000), 403, 525.
48. Zimmerman, *Francisco de Toledo*, 92, 104–5, 107.
49. Juan de Matienzo, *Gobierno de Perú* (1567), ed. Guillermo Lohmann Villena (Lima: Institut Fracncais D’Études Andines, 1967), 3, 7, 16, ¶.
50. Matienzo, *Gobierno de Perú*, 14–15.
51. Matienzo, *Gobierno de Perú*, 16. See also Antonio de Ayans, “Breve relación de los agravios que reciven los indios que ay desde cerca del Cuzco hasta Potosí, que es lo mayor y más rico del Perú, hecha por personas de muchas experiencia y Buena conciencia y desapasionadas de todo interés temporal y que solamente desean no sea Dios N.S. tan ofendido con tantos daños como los indios resciven en sus almas y haciendas y que la conciencia de Su Megestad se descargue mejor y sus Reales Rentas no sean defraudadas en nada sino que antes bayan siempre en continuación (1596),” in *Pareceres jurídicos en asuntos de indias (1601–178)*, ed. Ruben Vargas Ugarte (Lima: CIP, 1951), 39.
52. Matienzo, *Gobierno de Perú*, 17; “ni tienen por injuria que les azoten publicamente sus caciques, ni a los cacique los jueces.”
53. Zimmerman, *Francisco de Toledo*, 84, 86–90.
54. Zimmerman, *Francisco de Toledo*, 109–17, 121–24.
55. Zimmerman, *Francisco de Toledo*, 140–69; Zulawski, & ey Eat from their Labor, 67.
56. Francisco de Toledo, “Memorial que D. Francisco de Toledo dió al Rey nuestro señor, del estado en que dejó las cosas del Perú, después de haber sido en él Virrey y Capitán General trece años, que comenzaron en 1569,” in *Colección de las memorias o relaciones que escribieron los virreys del Perú*, vol. 1, ed. Ricardo Beltrán y Rózpide (Madrid: Imprenta del Asilo de Huérfanos del S. C. de Jesús, 1921), 101; Acosta, *Historia natural*, 244; Fisher, *Silver Mines and Silver Miners*, 3; Bakewell, “Technological change,” 76, 81; Patiño Paúl Ortiz, *Huancavelica colonial*, 167.
57. Bakewell, Peter. “Technological change,” 80–82; Zimmerman, *Francisco de Toledo*, 131, ¶5.
58. Potosí, April 2, 1594, ABNB, CPLA, vol. 7, 278.
59. Capoche, *Relación general de la Villa Imperial*, 76; Arzáns de Orsúa, *Historia de la Villa Imperial*, 1:42; Cobb, *Potosí y Huancavelica*, 25, 29; Zimmerman, *Francisco de Toledo*, 202, 204.
60. Zimmerman, *Francisco de Toledo*, 177, 188, 185; Patiño Paúl Ortiz, *Huancavelica*

colonial, 105. The regulations are contained in Francisco de Toledo, “Ordenanzas que el Señor Viso Rey Don Francisco Toledo hizo para el buen gobierno de estos Reynos del Perú y Repúblicas de él,” in *Relaciones de los Virreyes y Audiencias que han Gobernado el Perú*, vol. 1, ed. Sebastian Lorente (Lima: Imprenta del Estado, 1867), 267–348; ABNB, ALP Minas 19/10, 1, 5; Crespo Rojas, *La Guerra entre vicuñas y vascongados*, 41–42, Archivo Departamental de Cuzco (hereafter ADC), Fondo Corregimiento, Legajo No. 42, no. 890, Cuaderno 5, 1–3.

61. Ramírez, “Descripción del reyno,” 349; Cañete y Domínguez, *Guía histórica*, 90; Acosta, *Historia natural*, 248; Joseph Baquijano, “Historia del descubrimiento,” 36; Bakewell, “Technological change,” 85; Cole, *à e Potosí Mita*, 47; Cobb, *Potosí y Huancavelica*, 94.

62. Cañete y Domínguez, *Guía histórica*, 90; Capoche, *Relación general de la Villa Imperial*, 17; Rose M. Buechler, *à e Mining Society of Potosí. 1776–1810* (Syracuse, N.Y.: Syracuse University, Department of Geography, 1981), 39; Cobb, *Potosí y Huancavelica*, 91; William E. Rudolph, “The lakes of Potosí,” *Geographical Review* 26, no. 4 (October 1936): 531–2, 535–36, 543; Arzáns de Orsúa, *Historia de la Villa Imperial*, 1:67, 1:166; Bakewell, *Miners of the Red Mountain*, 13; Wiedner, “Forced labor in colonial Peru,” 372; CNMAH, CGI/M-64/29, 2; ABNB, CPLA, vol. 7, 277.

63. Toledo, “Ordenanzas,” 339–40; Lizárraga, *Descripción del Perú*, 281; Bakewell, “Technological change,” 82–84, 93; Cole, *à e Potosí Mita*, 18.

64. Murua, *Historia general del Perú*, 570; Capoche, *Relación general de la Villa Imperial*, 118; Enrique Tandeter, “Forced and free labor in late colonial Potosí,” *Past and Present* 93 (1981): 110; Bakewell, “Technological change,” 89, 92; Rudolph, “The lakes of Potosí,” 529, 532, 545; Ramírez, “Descripción del reyno,” 349; Montesinos, *Anales del Perú*, 2:61.

65. Acosta, *Historia natural*, 248.

66. ABNB, CPLA, vol. 20, 332; CNMAH, CGI/M-64/29, 2; Arzáns de Orsúa, *Historia de la Villa Imperial*, 2:293.

67. Cook, *Demographic Collapse*, 237; Arzáns de Orsúa, *Historia de la Villa Imperial*, 1:16, 2:1–3, 2:9–15, 2:286, 2:488–89, 3:250–51; ABNB, Ruck 1/9, 77; Rudolph, “The lakes of Potosí,” 537; “Informe del corregidor don Juan Medrano Navarrete sobre la situación de los pueblos que componen la provincia de Pacajes,” in *Potosí: La versión aymará de un mito europeo; La minería y sus efectos en las sociedades andinas del siglo XVII (La Provincia de Pacajes)*, ed. Teresa Cañedo-Arguelles Fábrega (Madrid: Editorial Catriel, 1993), 110.

68. Patiño Paúl Ortiz, *Huancavelica colonial*, 43; Lohmann Villena, *Las minas de Huancavelica*, 116.

69. Cantos de Andrade, “Relación de la Villa Rica de Oropesa,” 305; Llano Zapata, *Memorias históricas*, 217; Murua, *Historia general del Perú*, 549; Zimmerman, *Francisco de Toledo*, 96; Caravantes, *Noticia general del Perú*, 2:69; Carrasco, *Cronología de Huancavelica*, 104; Patiño Paúl Ortiz, *Huancavelica colonial*, 24; Carlos Contreras, *La ciudad del mercurio: Huancavelica, 1570–1700* (Lima: Instituto de Estudios

Peruanos, 1982), 15; Lohmann Villena, *Las minas de Huancavelica*, 67, 72; Bakewell, “Technological change,” 82–84; Zimmerman, *Francisco de Toledo*, 97–99; Cole, *à e Potosí Mita*, 9.

70. Caravantes, *Noticia general del Perú*, 4:135; Carrasco, *Cronología de Huancavelica*, 111, 1B; Bargallo, *La minería y metalurgia*, 256; Lohmann Villena, *Las minas de Huancavelica*, 46, 75, 78; Cobb, *Potosí y Huancavelica*, 41; Cole, *à e Potosí Mita*, 8, Luis Jerónimo Fernández de Cabrera, Conde de Chinchón, “Relación del estado en que el Conde de Chinchón deja el gobierno del Perú al Señor Virrey Marqués de Mancera,” in *Colección de las memorias o relaciones que escribieron los virreyes del Perú*, vol. 2, ed. Ricardo Beltrán y Rózpide (Madrid: Imprenta del Asilo de Huérfanos del S. C. de Jesús, 1921), 90; Lizárraga, *Descripción del Perú*, 183.

71. Whitaker, *à e Huancavelica Mercury Mine*, 10–11.

72. ABNB, CPLA, vol. 9, 72–73; ABNB, Ruck 1/9, 53–55; Cañete y Domínguez, *Guía histórica*, 78–80; Zimmerman, *Francisco de Toledo*, 97–98; Brading and Cross, “Colonial silver mining,” 578; Whitaker, *à e Huancavelica Mercury Mine*, 12, 1B; Guillermo Mira Delli-Zotti, “El Real Banco de San Carlos de Potosí y la minería Altoperuana colonial, 1779–1825,” in *La savia del imperio: Tres estudios de economía colonial*, ed. Julio Sánchez Gómez, Guillermo Mira Delli-Zotti, and Rafael Dobado (Salamanca, Spain: Ediciones Universidad Salamanca, 1997), 334, 341; Lohmann Villena, *Las minas de Huancavelica*, 78, 88, 90, 169, 432; Kendall Brown, “La distribución del mercurio a finales del periodo colonial, y los trastornos provocados por la independencia hispanoamericana,” in *Minería colonial Latinoamericana*, ed. Dolores Avila, Inés Herrera, and Rina Ortiz (Mexico City: Instituto Nacional de Antropología e Historia, 1992), 156; Guillermo Mira Delli-Zotti, “Reformas borbónicas en América. La provisión de azogue en el Virreinato del Río de la Plata,” *Cuadernos Hispanoamericanos* 2 (1988): 215; Pedro Fernández de Castro y Andrade, Conde de Lemos, “El Conde de Lemos da cuenta a S. M. del estado en que hallo el reino del Perú cuando entró a gobernarlo y el remedio que ha comenzado a poner en las materias más principales de su Gobierno,” Lima, March 3, 1668, in *Los virreyes españoles en America durante el gobierno de la casa de Austria. Perú*, vol. 4, ed. Lewis Hanke and Celso Rodríguez (Madrid: IMNASA, 1978), 271.

73. Contreras, *La ciudad del mercurio*, 42–45; Lohmann Villena, *Las minas de Huancavelica*, 223, 335; Whitaker, *à e Huancavelica Mercury Mine*, 12; Patiño Paúl Ortiz, *Huancavelica colonial*, 36, 38, 44; Crespo Rojas, *La Guerra entre vicuñas y vascongados*, 18; “Memoria sobre la mina de azogue de Huancavelica,” 96; Boleslao Lewin, ed., *Descripción del virreinato del Perú: Crónica inédita de comienzos del siglo XVII* (Rosario, Argentina: Universidad Nacional del Litoral, 1958), 83; Cosme Bueno, *Geografía del Perú Virreinal (Siglo XVIII)*, ed. Carlos Daniel Valcárcel (Lima: 1951), 73.

74. Contreras, *La ciudad del mercurio*, 41; Whitaker, *à e Huancavelica Mercury Mine*, 3; Luis Enríquez de Guzmán, Conde de Alba de Liste, “Relacion que el Conde de Alba hace del estado del Perú al Excmo. Señor Conde de Santistéban, su sucesor, en los cargos de virey de estos reinos,” in *Relaciones de los Virreyes y Audiencias*

que han Gobernado el Perú, vol. 2, ed. Sebastian Lorente (Madrid: Imprenta y Estereotipia de M. Rivadeneyra, 1871), 140; Solórzano y Pereyra, *Política Indiana*, 4:318; Bueno, *Geografía del Perú Virreinal*, 72.

75. Caravantes, *Noticia general del Perú*, 2:69; Carrasco, *Cronología de Huancavelica*, 15–16; Contreras, *La ciudad del mercurio*, 25, 31–33; Lohmann Villena, *Las minas de Huancavelica*, 70, 17, 163; Ulloa, *Viaje*, 2:148; Bargallo, *La minería y metalurgia*, 261; Patiño Paúl Ortiz, *Huancavelica colonial*, 43; Miguel Molina Martínez, *Antonio de Ulloa en Huancavelica* (Granada, Spain: University of Granada, 1995), 35.

76. Contreras, *La ciudad del mercurio*, 46–47; Whitaker, *&e Huancavelica Mercury Mine*, 22, 24–25; Lohmann Villena, *Las minas de Huancavelica*, 451–52; Brown, “La crisis fi anciera,” 367; Patiño Paúl Ortiz, *Huancavelica colonial*, 138; Ulloa, *Viaje*, 2:148.

77. ADC, Fondo Corregimiento, Legajo No. 42, no. 886; Cuaderno 1, 1–3; Contreras, *La ciudad del mercurio*, 54, 106, 15, 118; Lohmann Villena, *Las minas de Huancavelica*, 158; Whitaker, *&e Huancavelica Mercury Mine*, 16.

78. Bueno, *Geografía del Perú Virreinal*, 73; Lewin, *Descripción del virreinato del Perú*, 83; Ulloa, *Viaje*, 2:147; Patiño Paúl Ortiz, *Huancavelica colonial*, 33, 35–36, 43–45, 47, 49, 51–52, 54–56, 62; Contreras, *La ciudad del mercurio*, 46–7, 51–52, 72; Lohmann Villena, *Las minas de Huancavelica*, 69, 116, 224, 448; Cantos de Andrade, “Relación de la Villa Rica de Oropesa,” 307–8; Carrasco, *Cronología de Huancavelica*, 127; Contreras, *La ciudad del mercurio*, 51; Whitaker, *&e Huancavelica Mercury Mine*, 12–B; Brown, “La crisis fi anciera,” 366.

79. Murua, *Historia general del Perú*, 550.

80. Lizárraga, *Descripción del Perú*, 134.

81. Cantos de Andrade, “Relación de la Villa Rica de Oropesa,” 308; Bueno, *Geografía del Perú Virreinal*, 72; Lewin, *Descripción del virreinato del Perú*, 83; Contreras, *La ciudad del mercurio*, 79, 82–85, 88, 95–96, 100; Lohmann Villena, *Las minas de Huancavelica*, 7, 69; Patiño Paúl Ortiz, *Huancavelica colonial*, 45.

82. Cantos de Andrade, “Relación de la Villa Rica de Oropesa,” 304.

83. “Memorial y relación de las minas de azogue del Pirú,” 437–38; “Confimación de Su Magestad del Asiento que hizo el Excelentísimo Señor Duque de la Palata con los mineros de Guancavelica sobre la labor, y beneficio de la mina de azogue con las condiciones y calidades que se refiere en, Madrid, June 10, 1685,” in *Minas e indios del Perú, siglos XVI–XVIII*, ed. Nadia Carnero Albarrán (Lima: Universidad de San Marcos, 1981), 191; Cantos de Andrade, “Relación de la Villa Rica de Oropesa,” 304; Acosta, *Historia natural*, 245; Llano Zapata, *Memorias históricas*, 219; Contreras, *La ciudad del mercurio*, 20–21; Lohmann Villena, *Las minas de Huancavelica*, 52–55; Patiño Paúl Ortiz, *Huancavelica colonial*, 190–91, 193.

84. Crespo Rojas, *La Guerra entre vicuñas y vascongados*, 41–42; Zimmerman, *Francisco de Toledo*, 183.

85. Capoche, *Relación general de la Villa Imperial*, 135, 141; Crespo Rojas, “El reclutamiento y los viajes,” 469; Wiedner, “Forced labor in colonial Peru,” 369; Bakewell, *Miners of the Red Mountain*, 69, 71–73, 94–95.

86. Audiencia de Lima, "Relacion que la Real Audiencia de Lima hace al exceilentísimo Sr. Marqués de Castel-Dosrius, Virey de estos reinos, del estado de ellos, y tiempo que ha gobernado en vacante," in *Relaciones de los Virreyes y Audiencias que han Gobernado el Perú*, vol. 2, ed. Sebastian Lorente (Madrid: Imprenta y Este-reotipia de M. Rivadeneyra, 1871), 294–95; Arena, *Las minas de azogue del Perú*, 12–B; Lohmann Villena, *Las minas de Huancavelica*, 76, 104, 109, 139; Bargallo, *La minería y metalurgía*, 257. Provinces subject to the Huancavelica mita included Tarma, Jauja, Yauyos, Angaraes, Huanta, Castrovirreina, Lucanas, Vilcashuamán, Andahuaylas, Chumbivilcas, Cotabambas, and Aymares. See Brown, "Workers' health," 470; Lohmann Villena, *Las minas de Huancavelica*, 268–69, 355.

87. ABNB, Ruck 11,1, 3, 15, 22; Cole, à e Potosí Mita, 17, 67; Crespo Rojas, "El reclutamiento," 468; Patiño Paúl Ortiz, *Huancavelica colonial*, 208, 210; Wiedner, "Forced labor in colonial Peru," 364–67; Jorge Basadre, "El régimen de la mita," *Letras* (Lima) 3 (1937): 325–28, 334–35, 339, 354; Sánchez Albornoz, *Indios y tributos*, 93; Bakewell, *Miners of the Red Mountain*, 69. The percent of the male tributary population pressed into mita service varied, depending on the province, between 13 and 17 percent, although the Uru groups was assessed between 30 and 34 percent between 1573 and 1578. See Crespo Rojas, "El reclutamiento," 472–73; Bakewell, *Miners of the Red Mountain*, 69, 71, 73; ABNB, ALP Minas 123/5,1; ABNB, ALP Minas 126/16, 1.

88. ABNB, ALP Minas 127/5, 1, 3; ABNB ALP Minas 127/7 1–2; ABNB, ALP Minas 127/3, 1–2; ABNB, ALP Minas 126/7, 1–3.

89. ABNB, ALP Min 129/16, 13; ABNB, ALP Minas 128/2, 1; ABNB, EC 1753.125, 1; ABNB, EC. 1755.56, 2; ABNB, EC.1755.91,2–5; ABNB, EC.1755.44, 1–4; ABNB, EC.1757.138, 1–3; ABNB, EC.1771.40, 1–5, 7–13; ABNB, EC.1758.64, 1, 10–20; ABNB, ECAd 1771.39, 1–2; ABNB, ALP Minas 127/8,1; ABNB, ALP Min 129/10, 1–3.

90. ABNB, ALP Minas 127/8, 1–2; ABNB, ALP Minas 127/9, 1–3; ABNB, ALP Minas 126/7 1, 4–5; ABNB, ALP Minas 127/4, 1–2.

91. ABNB, ALP Minas 149/14; ALP, Minas 127/12; ABNB, ALP Minas 127/2,1–2; Ayans, "Breve relación de los agravios," 37–39; Alfonso Mesía Venegas, "Memorial del P. Alfonso Mesía Venegas, sobre la Cédula del servicio personal de los indios. 1603," in *Pareceres jurídicos en asuntos de indias (1601–1718)*,ed. Ruben Vargas Ugarte (Lima: CIP, 1951), 120; Arias de Ugarte, "Carta a S. M. del nuevo oidor doctor Arias de Ugarte dando cuenta del estado en que halló la Audiencia de Charcas," Potosí, February 28, 1599, in *La audiencia de Charcas: Correspondencia de presidentes y oidores*, vol. 3, ed. Roberto Levillier (Madrid: Imprenta de Juan Pueyo, 1922), 364; Caravantes, *Noticia general del Perú*, 2:84; Felipe Guaman Poma de Ayala, *Nueva crónica y buen gobierno*, vol. 2, ed. Luis Bustios Galvez (Lima: Editorial Cultura, 1966), 333; Pedro de Oñate, "Parecer del P. Pedro de Oñate sobre las Minas de Huancavelica 1629," in *Pareceres jurídicos en asuntos de indias (1601–1718)*,ed. Ruben Vargas Ugarte (Lima: CIP, 1951), 143; Liñan y Cisneros, "Relacion de Don Melchor de Liñan y Cisneros," 305; Luis de Velasco, "Relación del Sr. Virrey, D. Luis de Velasco,"

109; Victorián de Villaba, "Vista del fiscal Victorián de Villaba, sobre los abusos de la mita," in *Vida y obra de Victorián de Villaba*, ed. Ricardo Levene (Buenos Aires: Instituto de Investigaciones Históricas, 1946), lvii; "Pareceres de los Padres de la Compañía de Jesús de Potosí," 120–21; Fisher, *Silver Mines and Silver Miners*, 10; Paulino Castañeda Delgado, "Un capítulo de ética Indiana española: Los trabajos forzados en las minas," *Anuario de Estudios Americanos* 27 (1970): 815; Wiedner, "Forced labor in colonial Peru," 368, 372; Roberto Choque Canqui, "El papel de los capitanes de indios de la provincia de Pacajes 'en el entero de la mita' de Potosí," *Revista Andina* 1,no. 1 (September 1983): 120–21, 124; Cañedo-Arguelles Fábrega, *Potosí: La versión aymará de un mito europeo*, 81, 83, 84–85; Sánchez Albornoz, *Indios y tributos*, 70; Sánchez Albornoz, "Mita, migraciones y pueblos," 37; Buechler, à e *Mining Society of Potosí*, 44; Thie ry Saignes, "Las etnias de Charcas frente al sistema colonial (siglo XVI). Ausentismo y fugas en el debate sobre la mano de obra indígena (1595–1665)," *Jahrbuch für Geschichte von Staat, Wirtschaft und Gesellschaft Lateinamerikas* 21 (1984): 28; Cook, *Demographic Collapse*, 210; Evans, "Census enumeration," 27; Cole, à e *Potosí Mita*, 26–27. During the colonial period, if ed-term forced labor was also applied to the construction of public buildings, agriculture, pasturing, in obras, and to staff tambos, or roadside inns. In addition, at varying times other mining centers were assigned mita laborers, such as Castrovirreina, Caylloma, Carabaya, Pasco, Nuevo Potosí and Laicota. See García Sarmiento de Sotomayor, Conde de Salvatierra, "Relación del estado en que deja el gobierno de estos reinos el Conde de Salvatierra al Sr. Virrey Conde de Alba de Aliste," in *Colección de las memorias o relaciones que escribieron los virreyes del Perú*, vol. 2, ed. Ricardo Beltrán y Rózpide (Madrid: Imprenta del Asilo de Huérfanos del S. C. de Jesús, 1921), 239, 253; Luis de Velasco, "Relación del Sr. Virrey, D. Luis de Velasco," 110; Mendoza y Luna, "Relación del estado," 36; Patiño Paúl Ortiz, *Huancavelica colonial*, 210; Jorge Basadre, *El Conde de Lemos y su tiempo* (Lima: Editorial Huascaran, 1948), 132.

92. ABNB, ALP, Minas 127/12, 1.

93. Cook, *Demographic Collapse*, 85; Sánchez Albornoz, "Mita, migraciones y pueblos," 37–38; ABNB, ALP Minas 145/5, 1; ABNB, ALP Minas 126/8, 1, 4; Sánchez Albornoz, *Indios y tributos*, 93–94; Cole, à e *Potosí Mita*, 7, 26–27, 32, 34, 49; Saignes, "Las etnias de Charcas," 35, 53; John V. Murra, "Aymara lords and their European agents at Potosí," *Nova Americana* (Turin) 1 (1978), 240; Choque Canqui, "El papel de los capitanes," 120; Mesía Venegas, "Memorial del P. Alfonso Mesía Venegas," 120; "Informe del corregidor don Juan Medrano Navarrete," 109; Fisher, *Silver Mines and Silver Miners*, 10; Bakewell, *Miners of the Red Mountain*, 111–3; Ann Zulawski, "Mano de obra y migración en un centro minero de los Andes: Oruro, 1683," in *Población y mano de obra en América Latina*, ed. Nicolás Sanchez Albornoz (Madrid: Alianza Editorial, 1985), 1B; Tandeter, *Coercion and Market*, 79.

94. Melchor Navarra y Rocaful, Duque de la Palata, "Relacion del estado del Perú," in *Memorias de los virreyes que han gobernado el Perú durante el tiempo del coloniaje español*, vol. 2, ed. M. A. Fuentes (Lima: Librería Central de Felipe Bailly, 1859), 239–40.

95. ABNB, ALP Minas 130/10, 1; CNMAH, CGI/M-65/I, 1; ABNB, ALP Minas 126.20, 3; ABNB, Cédulas Reales 545, 2; ABNB, ALP Minas 127/22, 2; ABNB, ALP Minas 151/10, 3; ABNB, ALP Minas 129.8, 6, 9; ABNB, ALP Minas 127/I, 1–4; ABNB, ALP Minas 127/12, 1; ABNB, ALP Minas 129/16, 28; ABNB, ALP Minas 149/3, 5; Fisher, *Silver Mines and Silver Miners*, 10; Bakewell, *Miners of the Red Mountain*, 124; Tandeter, “Forced and free labor,” 123, 128; Tandeter, *Coercion and Market*, 67; Sánchez Albornoz, *Indios y tributos*, 103; Cole, *à e Potosí Mita*, 63; Crespo Rojas, “La ‘mita’ de Potosí,” 176.

96. Thie ry Saïgues, “Nota sobre la contribución regional a la mita de Potosí a comienzos del siglo XVII,” *Historiografía y bibliografía americanistas* 28 (1984): 56; ABNB Ruck 1/4:451; ABNB, ALP Minas 125/I, 1–10; ABNB, ALP Minas 129/16, 27; Sánchez Albornoz, *Indios y tributos*, 102.

97. ABNB, ALP Minas 125/I, 1–2, 5–6; CNMAH, CGI/M-65/I, 1; ABNB, Cédulas Reales 545, 2; Crespo Rojas, “La ‘mita’ de Potosí,” 177; Fisher, *Silver Mines and Silver Miners*, 10; Cole, *à e Potosí Mita*, 37, 44, 92–93; Tandeter, *Coercion and Market*, 5; Arzáns de Orsúa, *Historia de la Villa Imperial*, 2:190; Ramón Ezquerro Abadia, “Problemas de la mita de Potosí en el siglo XVIII,” in *La minería hispana e iberoamericana*, vol. 1 (Leon, Spain: Cátedra de San Isidoro, 1970), 486.

98. ABNB, ALP Minas, 122/1, 1; ABNB, ALP Minas 125/I, 1; ABNB, ALP Minas 123/3, 1; Potosí, April 2, 1594, ABNB, CPLA, vol. 7, 277; Capoche, *Relación general de la Villa Imperial*, 168; Crespo Rojas, “La ‘mita’ de Potosí,” 175; Cobb, *Potosí y Huancavelica*, 68; Bakewell, *Miners of the Red Mountain*, 158; ABNB, Cédulas Reales 258, 1; ABNB, ALP Minas 122/6, 1; Ramírez, “Descripción del reyno,” 347.

99. Caravantes, *Noticia general del Perú*, 4:143, 4:147; Crespo Rojas, “El reclutamiento,” 472; Silvio Zavala, *El servicio personal de los indios en el Perú*, vol. 1 (Mexico City: El Colegio de Mexico, 1978), 31; Mendoza y Luna, “Relación del estado,” 4:146; Caravantes, *Noticia general del Perú*, 4:146, 4:152; Cobb, *Potosí y Huancavelica*, 65; Bakewell, *Miners of the Red Mountain*, 169–70; Laura Escobari, “Potosí: Social Dynamics, Labor, and Mining Technology,” in *Potosí: Colonial Treasures and the Bolivian City of Silver*, ed. Pedro Querejazu and Elizabeth Ferrer (New York: Americas Society Art Gallery, 1997), 21. For the legal context of protectors, see Constantino Bayle, “El protector de indios,” *Anuario de Estudios Americanos* 2 (1945): 1–180.

100. Molina Martínez, *Antonio de Ulloa*, 67–68; Whitaker, *à e Huancavelica Mercury Mine*, 48; Toledo, “Ordenanzas,” 340; Cobb, *Potosí y Huancavelica*, 56; Zimmerman, *Francisco de Toledo*, 188; Crespo Rojas, “La ‘mita’ de Potosí,” 173; Lohmann Villena, *Las minas de Huancavelica*, 156.

101. Brown, “Workers’ health,” 480; Toledo, “Ordenanzas,” 343; Zimmerman, *Francisco de Toledo*, 184; Cobb, *Potosí y Huancavelica*, 58; Bakewell, *Miners of the Red Mountain*, 150; “Confi mación de Su Magestad del Asiento que hizo el Excelentísimo Señor Duque de la Palata,” 190–91.

102. Juan de Matienzo, “Carta a S. M. del licenciado Matienzo,” 457.

103. Zimmerman, *Francisco de Toledo*, 132; Brading and Cross, “Colonial silver

mining," 571; Lewis Hanke, "The social history of Potosí," in *La minería hispana e iberoamericana*, vol. 1 (Leon, Spain: Cátedra de San Isidoro, 1970), 462; Lewis Hanke, & *e Imperial City of Potosí: An Unwritten Chapter in the History of Spanish America* (The Hague: Martinus Nijhoff, 1956), 1.

104. "Descripción de la villa y minas de Potosí," 382; Arzáns de Orsúa, *Historia de la Villa Imperial*, 1:10; Cañete y Domínguez, *Guía histórica*, 36; Crespo Rojas, *La Guerra entre vicuñas y vascongados*, 18; Hanke, & *e Imperial City of Potosí*, 1; Basadre, *El Conde de Lemos*, 130; Bakewell, *Miners of the Red Mountain*, 112; Carlos Contreras, "Vida y trabajo en las minas del Perú de la época colonial," in *Territorio, cultura y historia: Materiales para la renovación de la enseñanza sobre la sociedad peruana*, ed. Patricia Oliart (Lima: Instituto de Estudios Peruanos, 2003), 99; Acosta, *Historia natural*, 228–29.

105. Lizárraga, *Descripción del Perú*, 184.

106. Manuel Ballesteros Gaibrois, *Introducción to Historia general del Perú*, ed. Martin de Murua and Manuel Ballesteros Gaibrois (Madrid: Historia 16, 1987), 5, 7–8; Murua, *Historia general del Perú*, 563.

107. Lizárraga, *Descripción del Perú*, 189–90.

108. Bartolomé Martínez y Vela, *Anales de la Villa Imperial de Potosí* (La Paz: Imprenta Artística, 1939), 165–66; "Descripción de la villa y minas de Potosí," 378; Lewin, *Descripción del virreinato del Perú*, 98–99; Lizárraga, *Descripción del Perú*, 189; Brading and Cross, "Colonial silver mining," 546; Luis Vilma Milletich Acosta and Enrique Tandeter, "El comercio de efectos de la tierra en Potosí, 1780–1810," in *Minería colonial Latinoamericana*, ed. Dolores Avila, Inés Herrera, and Rina Ortiz (Mexico City: Instituto Nacional de Antropología e Historia, 1992), 137, 148; Cobb, "Supply and transportation," 30; Zulawski, & *ey Eat from & eir Labor*, 50–52; C. Sempat Assadourian, *El sistema de la economía colonial* (Mexico City: Editorial Nueva Imagen, 1983), 15, 51, 55, 63; C. Sempat Assadourian, Heraclio Bonilla, Antonio Mitre, and Tristan Platt, *Minería y espacio económico en los Andes: Siglos XVI–XX* (Lima: Instituto de Estudios Peruanos, 1980), 13, 23–24.

109. Cobo, *Historia del Nuevo Mundo*, 76.

110. Lewin, *Descripción del virreinato del Perú*, 99.

111. Martínez y Vela, *Anales de la Villa Imperial*, 168–69; Cobb, "Supply and transportation," 28; Lizárraga, *Descripción del Perú*, 193.

112. Ramírez, "Descripción del reyno," 345; Crespo Rojas, *La Guerra entre vicuñas y vascongados*, 17.

112. Lizárraga, *Descripción del Perú*, 190; Murua, *Historia general del Perú*, 572. See also Murua, *Historia general del Perú*, 567; Capoche, *Relación general de la Villa Imperial*, 76; and Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 265.

114. Matienzo, *Gobierno de Perú*, 133; Murra, "Aymara lords," 234–38; "Descripción de la villa y minas de Potosí," 377–78; Bakewell, *Miners of the Red Mountain*, 112; Lizárraga, *Descripción del Perú*, 190.

115. Alonso Carrión de la Vandera, *El Lazarillo de ciegos caminantes* (Caracas: Biblioteca Ayacucho, 1985), 111.

116.“Descripción de la villa y minas de Potosí,” 379–80; Ballesteros Gaibrois, *Descubrimiento y fundación*, 60–61; Crespo Rojas, *La Guerra entre vicuñas y vascongados*, 18; Cobb, *Potosí y Huancavelica*, 143; Cañete y Domínguez, *Guía histórica*, 40.

117. Murua, *Historia general del Perú*, 571; Caravantes, *Noticia general del Perú*, 1:146; “Descripción de la villa y minas de Potosí,” 380; Manuel Toledo y Leiva, “Parecer del P. Manuel Toledo y Leiva, Rector del Colegio de la Compañía de Jesús de Huancavelica sobre la Mita de Potosí, a petición del Sr. D. D. José Santiago Concha Oidor de Lima y Gobernador de Huancavelica, en virtud de R.C. expedida en Madrid el 6 de Diciembre de 1719,” in *Pareceres jurídicos en asuntos de indias (1601–178)*, ed. Ruben Vargas Ugarte (Lima: CIP, 1951), 176; Fernando de Torres de Portugal, Conde de Villardompardo, “Memoria gubernativa del Conde del Villardompardo,” Lima, May 25, 1592 or 1593, in *Los virreyes españoles en America durante el gobierno de la casa de Austria, Perú*, vol. 1, ed. Lewis Hanke and Celso Rodríguez (Madrid: IMNASA, 1978), 209; Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 264–65; Crespo Rojas, *La Guerra entre vicuñas y vascongados*, 18.

118. Cañete y Domínguez, *Guía histórica*, 43.

119. Thie ry Saignes, “Capoche, Potosí y la coca: El consumo popular de estimulantes en el siglo XVII,” *Revista de Indias* 48, nos. 182–83 (1988): 213–14, 227; Lizárraga, *Descripción del Perú*, 191; Matienzo, *Gobierno de Perú*, 163–64.

120. Martínez y Vela, *Anales de la Villa Imperial*, 161; Carrión de la Vandera, *El Lazarillo*, 111; Capoche, *Relación general de la Villa Imperial*, 76, 179. For background on Capoche, see Lewis Hanke, “Luis Capoche y la historia de Potosí, 1545–585,” in *Relación general de la Villa Imperial de Potosí*, ed. Luis Capoche and Lewis Hanke (Madrid: Ediciones Atlas, 1959), 41–68.

121. Murua, *Historia general del Perú*, 567.

122. Cañete y Domínguez, *Guía histórica*, 41.

123. Galancha, *Crónica moralizada*, 1:25–26.

124. Murua, *Historia general del Perú*, 571; Hanke and Mendoza, “Bartolomé Arzáns de Orsúa y Vela,” 6.

125. Cañete y Domínguez, *Guía histórica*, 42–3.

126. Caravantes, *Noticia general del Perú*, 4:225.

127. Diego Fernández de Córdoba, Marqués de Guadalcázar, “Relación del estado en que el Marqués de Guadalcázar deja el gobierno del Perú al Sr. Virrey Conde de Chinchón, la cual se divide en cuatro materias, que son las principales a que se reduce la correspondencia con el Real Consejo de las Indias,” in *Colección de las memorias o relaciones que escribieron los virreyes del Perú*, vol. 1, ed. Ricardo Beltrán y Rózpide (Madrid: Imprenta del Asilo de Huérfanos del S. C. de Jesús, 1921), 31; Pino Manrique, “Descripción de la Villa de Potosí,” 16.

128. Antonio de Ulloa, *Noticias Americanas: Entretiemientos phisicos-históricos, sobre la América Meridional y la Septentrianal Oriental* (Granada, Spain: Universidad de Granada, 1992), 238.

129. Martínez y Vela, *Anales de la Villa Imperial*, 71; Cañete y Domínguez, *Guía histórica*, 37.

130. Fisher, *Silver Mines and Silver Miners*, 298; Tandeter, *Coercion and Market*, 9; Arias de Ugarte, "Carta a S. M.", 357.

131. Luis de Velasco, "Relación del Sr. Virrey, D. Luis de Velasco," 14–15; Luz María Méndez, "Los bancos de rescate en Hispanoamérica (1747–1832). El proceso histórico y sus fundamentos ideológicos. Estudio comparado para México, Perú y Chile," in *Minería colonial Latinoamericana*, ed. Dolores Avila, Inés Herrera, and Rina Ortiz (Mexico City: Instituto Nacional de Antropología e Historia, 1992), 118; Buechler, & e *Mining Society of Potosí*, 13, 18–9; Mira Delli-Zotti, "El Real Banco de San Carlos," 333; Tandeter, *Coercion and Market*, 12; ABNB, ALP Minas 19/10, 214; ABNB, ALP Minas 112/9/1; Ulloa, *Noticias Americanas*, 238; ABNB, ALP Minas 112/181; Fisher, *Silver Mines and Silver Miners*, 8, 100, 121; Bakewell, *Miners of the Red Mountain*, 159; Crespo Rojas, *La Guerra entre vicuñas y vascongados*, 41–43; Cole, & e *Potosí Mita*, 25, 48, 64; Brading and Cross, "Colonial silver mining," 567; María Dolores Fuentes Bajo, "El azogue en las postimerías del Perú colonial," *Revista de Indias* 46 (January–June 1986): 104; Carlos Contreras, "Mineros y habitadores en Hualgayoc en las décadas finales del régimen colonial," in *Minería colonial latinoamericana*, ed. Dolores Avila, Inés Herrera, and Rina Ortiz (Mexico City: Instituto Nacional de Antropología e Historia, 1992), 17, 20.

132. Barnadas, *Charcas*, 149.

133. Lewin, *Descripción del virreinato del Perú*, 69.

134. ABNB, Cédulas Reales 300, 1; Arzáns de Orsúa, *Historia de la Villa Imperial de Potosí*, 2:169; Barnadas, *Charcas*, 149; Lockhart, *Spanish Peru*, 155; Lewin, *Descripción del virreinato del Perú*, 99; Castañeda Delgado, "Un capítulo de ética Indiana española," 822; Hanke and Mendoza, "Bartolomé Arzáns de Orsúa y Vela," 169; "Descripción de la villa y minas de Potosí," 379; Caravantes, *Noticia general del Perú*, 2:138; Guillermo Lohmann Villena, "Estudio preliminar," in *Noticia general del Perú*, vol. 1, ed. Francisco López Caravantes and Marie Helmer (Madrid: Ediciones Atlas, 1989), ix; Buechler, & e *Mining Society of Potosí*, 248–49; Ballesteros Gaibrois, *Descubrimiento y fundación*, 69; Hanke, & e *Imperial City of Potosí*, 2; Ramírez, "Descripción del reyno," 355. The term *soldado* has various connotations and was often associated with people from Andalucía, Extremadura, or Castile. In addition to the meanings referred to in the text, the term could refer to a mine owner or operator who was not involved in refining, sometimes referred to as a "*minero soldado*," or "soldier miner," for whom a limited number of mitayos were assigned. Such miners are to be distinguished from *azogueros*, from the Spanish word *azogue* meaning mercury, who were mill owners and often mill and mine owners. See Álvarez de Toledo y Leyva, "Relación del estado del gobierno," 134, 136; Mendoza y Luna, "Relación del estado," 34, 36; Barnadas, *Charcas*, 149; Brading and Cross, "Colonial silver mining," 567; Crespo Rojas, *La Guerra entre vicuñas y vascongados*, 128; Cobb, *Potosí y Huancavelica*, 74; Cole, & e *Potosí Mita*, 12.

135. Arias de Ugarte, "Carta a S. M." 356; Crespo Rojas, *La Guerra entre vicuñas y vascongados*, 30; ABNB, Minas 150/18, 1–2; ABNB, ALP Minas 156/4, 1, 5; ABNB, ALP, Minas 39/8, 2–6; ABNB, ALP Minas 39/7, 1–3, 11; ABNB, ALP Minas 39/8, 1,

4–5; ABNB, ALP Minas 76/11,1; Shiela Billrau, museum director of Casa Nacional de Moneda, Potosí, personal communication, July 16, 2008.

136. Cobb, *Huancavelica y Potosí*, 122; Lolita Gutiérrez Brockington, *Blacks, Indians and Spaniards in the Eastern Andes: Reclaiming the Forgotten in Colonial Mizque, 1580–1782* (Lincoln: Nebraska University Press, 2006), 131, 137; Hanke, “The social history of Potosí,” 455; Bakewell, *Miners of the Red Mountain*, 192; Arzáns de Orsúa, *Historia de la Villa Imperial*, 2:190.

137. Arzáns de Orsúa, *Historia de la Villa Imperial*, 3:40. See also “Relación hecha al Obispo Fray Bartolomé de Las Casas, por el Padre Fray Domingo de Santo Tomás, de lo conviene proveer para el mayor aumento y conservación de los naturales en los Reinos del Perú,” in *Fr. Domingo de Santo Tomás: Defensor y Apostol de los Indios del Perú: Su vida y sus escritos*, ed. José María Vargas (Quito: Editorial Santo Domingo, 1937), 100–101.

138. Arzáns de Orsúa, *Historia de la Villa Imperial*, 3:40; Bakewell, *Miners of the Red Mountain*, 193.

139. Cole, à e *Potosí Mita*, 4; ABNB, ALP Minas 123/4, 1.

140. Arzáns de Orsúa, *Historia de la Villa Imperial*, 2:190.

141. Gómez Rivas, *El virrey del Perú*, 151–54; Zimmerman, *Francisco de Toledo*, 270–74.

2. TOXIC TRAVAILS

1. Capoche, *Relación general de la Villa Imperial*, 135.

2. ABNB, CACH 728, 5; Montesinos, *Anales del Perú*, 2:205; Pedro Fernández de Castro y Andrade, Conde de Lemos, “Carta del Conde de Lemos a S. M. sobre la Mita de Potosí,” in *Pareceres jurídicos en asuntos de indias (1601–1788)*, ed. Ruben Vargas Ugarte (Madrid: IMNASA, 1978), 155; Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 277; Cobb, *Potosí y Huancavelica*, 72.

3. Sarmiento de Sotomayor, “Relación del estado,” 246; Arzáns de Orsúa, *Historia de la Villa Imperial*, 3:68; Buechler, à e *Mining Society of Potosí*, 137; Basadre, *El Conde de Lemos*, 133; Basadre, “El régimen de la mita,” 344; Crespo Rojas, “El reclutamiento y los viajes,” 474; Crespo Rojas, “La ‘mita’ de Potosí,” 176, 180; Wiedner, “Forced labor in colonial Peru,” 368; María del Carmen Cortés Salinas, “Una polémica en torno a la mita de Potosí a fines del siglo XVIII,” *Revista de Indias* 30, nos. 19–22 (January–December 1970): 178.

4. Capoche, *Relación general de la Villa Imperial*, 158.

5. “Pareceres de los Padres de la Compañía de Jesús de Potosí,” 118.

6. Fernández de Castro y Andrade, “Carta del Conde de Lemos a S. M.,” 155.

7. Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 295–96.

8. Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 264; Capoche, *Relación general de la Villa Imperial*, 135; Ramírez, “Descripción del reyno,” 348; Baquijano, “Historia del descubrimiento,” 37; Crespo Rojas, “La ‘mita’ de Potosí,” 172–73; Cobb, *Potosí y Huancavelica*, 63. See also Ayans, “Breve relación de los agravios,” 35–38.

9. ABNB, ALP Minas 127/10, 1–2, 4–5.
10. Navarra y Rocaful, “Relacion del estado del Perú,” 241; ABNB ALP Minas 129/15, 171; CNMAH, CGI/M-09/19, 1–2; ABNB, ALP, Minas 129/1, 1; ABNB, ALP Minas 127/2, 1–2; ABNB, ALP Minas, 126/5, 1; ABNB, ALP Min. 126/2, 1–3; CNMAH, CGI/M-65/14, 7, 11; ABNB, ALP Minas 126/8, 1, 4; ABNB, ALP Minas 149/14, 1–2; ABNB, ALP Minas 151/12, 2; ABNB, ALP Minas 128/7, 2; Sánchez Albornoz, *Indios y tributos*, 93–94.
11. Ramírez, “Descripción del reyno,” 347; Capoche, *Relación general de la Villa Imperial*, 136–37; Bakewell, *Miners of the Red Mountain*, 70, 93, 96, 98; Choque Canqui, “El papel de los capitanes,” 17; Crespo Rojas, “La ‘mita’ de Potosí,” 172, 179; Tandeter, “Forced and free labor,” 118; Tandeter, *Coercion and Market*, 22; Cañedo-Arguelles Fábrega, *Efectos de Potosí sobre la población indígena del Alto Perú, Pacajes a mediados del siglo XVII*, 240; ABNB, ALP Minas 125/182; ABNB, ALP, Minas 129/1, 1; ABNB, ALP Minas 129/8, 2; CNMAH, CGI/M-09/19, 1–2; ABNB, ALP Minas 127/2, 1–2; ABNB, ALP Minas, 126/5, 1; ABNB, ALP Min. 126/2, 1–3.
12. ABNB, ALP Minas 129/5, 3; Miguel Polo de Iriarte, denuncia la fuga de indios mitayos, mandados de Paria para el trabajo de las minas y ingenios, Potosí, 1750, CNMAH, CGI/M-65/03, 1.
13. ABNB, ALP Minas 128/7, 2.
14. ABNB, ALP Minas 128/7, 24.
15. ABNB, ALP Minas 127/20, 1; Arias de Ugarte, “Carta a S. M.” 363, 365; Matienzo, *Gobierno de Perú*, 80; Ayans, “Breve relación de los agravios,” 37; Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 283; ABNB, ALP Minas 129/8, 9; Fernández de Castro y Andrade, “Carta del Conde de Lemos a S. M.” 156, 158; ABNB, ALP Minas 130/1, 41; ABNB, ALP Minas 129/8, 2; Basadre, *El Conde de Lemos*, 133; Choque Canqui, “El papel de los capitanes,” 123; Crespo Rojas, “La ‘mita’ de Potosí,” 179–80; Crespo Rojas, “El reclutamiento y los viajes,” 473; Tandeter, “Forced and free labor,” 128; Tandeter, *Coercion and Market*, 69; Buechler, *& e Mining Society of Potosí*, 138; Cole, *& e Potosí Mita*, 36, 92; Thie ry Saignes and Carmen Beatriz Loza, “Pleito entre Bartolomé Qhari, Mallku de los Lupaqa y los corregidores de Chucuito (1619–1643)” *Historia y Cultura* (La Paz) 5 (1984): 36–37; Cañedo-Arguelles Fábrega, *Potosí: La versión aymará de un mito europeo*, 73–74, 78–79.
16. ABNB, ALP Minas, 126/9, 1–2; ABNB, ALP Minas 127/8, 1–3; Bakewell, *Miners of the Red Mountain*, 94.
17. ABNB, ALP Minas 122/11; ABNB, ALP Minas 122/3, 17; ABNB, ALP CACH 1322, 1–2; Sarmiento de Sotomayor, “Relación del estado,” 248; Ayans, “Breve relación de los agravios,” 37; Guaman Poma de Ayala, *Nueva crónica y buen gobierno*, 2:32, 2:334; Fernández de Castro y Andrade, “Carta del Conde de Lemos a S. M.” 159; “Pareceres de los Padres de la Compañía de Jesús de Potosí,” 121; Mesía Venegas, “Memorial del P. Alfonso Mesía Venegas,” 121; Cole, *& e Potosí Mita*, 43, 92–93; Basadre, *El Conde de Lemos*, 133; ABNB, ALP, Minas 122/11, 1.
18. ABNB, ALP Min 126/4, 1–4; Navarra y Rocaful, “Relacion del estado del Perú,” 241; ABNB ALP Minas 129/15, 171.

19. Brown, "Workers' health," 73.
20. Diego de Avendaño, *& esaurus Indicus*, ed., trans. Angel Muñoz García (Pamplona, Spain: Ediciones Universidad de Navarra, 2001), 262.
21. Lohmann Villena, *Las minas de Huancavelica*, 175–76, 433, 448–49; Patiño Paúl Ortiz, *Huancavelica colonial*, 157; Brown, "Workers' health," 471; Bargallo, *La minería y la metalurgia*, 262–63; Patiño Paúl Ortiz, *Huancavelica colonial*, 158; Armendaris, "Relacion del estado de los reynos del Perú," 153.
22. Brown, "Workers' health," 471.
23. Brown, "Workers' health," 471, 474.
24. Francisco Doña Nieves, "Trabajo y salud en las minas de plata americanas del siglo XVI," *Anales de la Real Academia de Medicina y Cirugia de Cádiz* 28, no. 1 (1992): 277.
25. José Sala Catala, "Vida y muerte en la mina de Huancavelica durante la primera mitad del siglo XVIII," *Asclepio* 39 (1987): 195; Brown, "Workers' health," 472–73.
26. Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 328.
27. Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 295–97.
28. Lohmann Villena, *Las minas de Huancavelica*, 210, 332; Brown, "Workers' health," 482; Montesinos, *Anales del Perú*, 2:189.
29. Audiencia de Lima, "Audiencia de Lima al Señor Virrey Conde de Lemos, que le entró á gobernar en 21 de noviembre de 1667," in *Relaciones de los Virreyes y Audiencias que han Gobernado el Perú*, vol. 2, ed. Sebastian Lorente (Madrid: Imprenta y Estereotipia de M. Rivadeneyra, 1871), 202; Navarra y Rocaful, "Relacion del estado del Perú," 166; Brown, "Workers' health," 481–88, 490, 495; Purser, *Metal Mining in Peru*, 44; Patiño Paúl Ortiz, *Huancavelica colonial*, 137; Lohmann Villena, *Las minas de Huancavelica*, 333, 353; Molina Martínez, *Antonio de Ulloa*, 89.
30. Patiño Paúl Ortiz, *Huancavelica colonial*, 222.
31. Angel Muñoz García, Introducción to *& esaurus Indicus*, trans., ed. Diego de Avendaño and Angel Muñoz García (Pamplona, Spain: Ediciones Universidad de Navarra, 2001), B1.
32. Patiño Paúl Ortiz, *Huancavelica colonial*, 218.
33. Montesinos, *Anales del Perú*, 2:189; Patiño Paúl Ortiz, *Huancavelica colonial*, 220–22.
34. Miguel Molina Martínez, *Antonio de Ulloa*, 57; Whitaker, *&e Huancavelica Mercury Mine*, 34, 45.
35. Molina Martínez, "Tecnica y laboreo," 399.
36. Molina Martínez, "Tecnica y laboreo," 401.
37. Marvin Balaan and Daniel Banks, "Silicosis," in *Environmental and Occupational Medicine*, 3rd ed., ed. William Rom (New York: Lippincott-Raven, 1998), 438, 440–44; Brown, "Workers' health," 475–77; Cook, *Demographic Collapse*, 205; Dobyns, "An outline of Andean epidemic history," 515; Tandeter, "Crisis in Upper Peru," 66; Tandeter, *Coercion and Market*, 54.

38. Patiño Paúl Ortiz, *Huancavelica colonial*, 71, 89, 91, 144; Cook, *Demographic Collapse*, 250; Lohmann Villena, *Las minas de Huancavelica*, 218, 258–59, 326–27; Llano Zapata, *Memorias histórico*, 221; Navarra y Roaful, “Relacion del estado del Perú,” 163; “Memoria sobre la mina,” 91–92; Arena, *Las minas de azogue del Perú*, 9–11, 31; Molina Martínez, *Antonio de Ulloa*, 77; Molina Martínez, “Tecnica y laboreo,” 405; Mervyn Lang, “El derrumbe de Huancavelica en 1786: Fracaso de una reforma bourbónica,” *Histórica* 10, no. 2 (December 1986): 222, 224; Fisher, *Silver Mines and Silver Miners*, 9.
39. Calancha, *Crónica moralizada*, 3:879; Brown, “Workers’ health,” 484–86; Patiño Paúl Ortiz, *Huancavelica colonial*, 137, 144; Sala Catala, “Vida y muerte,” 196; Whitaker, *à e Huancavelica Mercury Mine*, 18.
40. Arena, *Las minas de azogue del Perú*, 26; Molina Martínez, *Antonio de Ulloa*, 84; Purser, *Metal Mining in Peru*, 45; Bidstrup, *Toxicology and Mercury*, 5. Mercury is extracted from cinnabar at a temperature of 580 degrees Celsius. See Goldwater, *Mercury: A History*, 49.
41. Purser, *Metal Mining in Peru*, 45–46; Mendoza y Luna, “Relación del estado,” 44; Montesinos, *Anales del Perú*, 2:128; Lohmann Villena, *Las minas de Huancavelica*, 55–56; Brown, “Workers’ health,” 479.
42. Lohmann Villena, *Las minas de Huancavelica*, 56; “Memoria sobre la mina de azogue de Huancavelica,” 130.
43. Brown, “Workers’ health,” 479.
44. Navarra y Roaful, “Relacion del estado del Perú,” 175; Llano Zapata, *Memorias histórico*, 218; Purser, *Metal Mining in Peru*, 46–47; Lohmann Villena, *Las minas de Huancavelica*, 139; Brown, “Workers’ health,” 479; Fuentes Bajo, “El azogue en las postimerías,” 92; Antonio Matilla Tascón, *Historia de las minas de Almaden*, vols. 1 and 2 (Madrid: Instituto de Estudios Fiscales/Minas de Almaden y Arrayanes, 1987), 89–96; Patiño Paúl Ortiz, *Huancavelica colonial*, 184, 186–87.
45. “Memoria sobre la mina de azogue de Huancavelica,” 15.
46. “Memoria sobre la mina de azogue de Huancavelica,” 129–32.
47. “Memoria sobre la mina de azogue de Huancavelica,” 133, 136; Brown, “Workers’ health,” 480.
48. “Memoria sobre la mina de azogue de Huancavelica,” 134.
49. Brown, “Workers’ health,” 491–95; Wiedner, “Forced labor in colonial Peru,” 372; Cook, *Demographic Collapse*, 205.
50. Acosta, *Historia natural*, 245; Liñán y Cisneros, “Relacion de Don Melchor de Liñán y Cisneros,” 313; Cantos de Andrade, “Relación de la Villa Rica de Oropesa,” 307–8; Patiño Paúl Ortiz, *Huancavelica colonial*, 35; Carrasco, *Cronología de Huancavelica*, 127; Contreras, *La ciudad del mercurio*, 51; Bidstrup, *Toxicology and Mercury*, 6, 37–42.
51. Lohmann Villena, *Las minas de Huancavelica*, 421, 460; Patiño Paúl Ortiz, *Huancavelica colonial*, 39; Armendaris, “Relacion del estado de los reynos del Perú,” 153; Navarra y Roaful, “Relacion del estado del Perú,” 175; José de la Riva Aguero, “Descripción anónima del Perú y de Lima a principios del siglo XVII,” *Revista Histórica*

(Lima) 21 (1954): 30; Lohmann Villena, *Las minas de Huancavelica*, 433. The regulated size of one load was a bag that was about fifteen inches wide and sixteen inches deep.

52. Armendaris, "Relacion del estado de los reynos del Perú," 162; Torres de Portugal, "Memoria gubernativa," 207; Navarra y Roaful, "Relacion del estado del Perú," 164; Lohmann Villena, *Las minas de Huancavelica*, 81–82, 175, 232, 386–87; Patiño Paúl Ortiz, *Huancavelica colonial*, 220.

53. Lohmann Villena, *Las minas de Huancavelica*, 177, 241, 453.

54. Lohmann Villena, *Las minas de Huancavelica*, 156, 189, 304, 309–10, 354, 378, 385, 427, 431, 460; Brown, "Workers' health," 469; Francisco de Borja, Príncipe de Esquilache, "Relación que hace el Príncipe de Esquilache al Señor Marqués de Guadalcasar, sobre el estado en que deja las provincias del Perú," in *Memorias de los virreyes que han gobernado el Perú durante el tiempo del coloniaje español*, vol. 1, ed. M. A. Fuentes (Lima: Librería Central de Felipe Bailly, 1859), 85.

55. "Memoria sobre la mina de azogue de Huancavelica," 90, 1B; Molina Martínez, *Antonio de Ulloa*, 82; Fisher, *Silver Mines and Silver Miners*, 92. Those provinces remitting money were Yauyos, Castrovirreina, Tayacaja, Aymaraes, Parinacochas, Huanta, Vilcashuamán, Andahuaylas, Lucansa, and Jauja. By 1783, Yauyos and Jauja were relieved of the burden.

56. Lohmann Villena, *Las minas de Huancavelica*, 242, 253, 330–33, 353, 382; Brown, "Workers' health," 485.

57. "Pareceres de los Padres de la Compañía de Jesús de Potosí," 17.

58. Matienzo, *Gobierno de Perú*, 17–18. See also the views of Antonio de Ulloa, in Ulloa, *Noticias Americanas*, 318, 332; Molina Martínez, *Antonio de Ulloa*, 85; and López de Velasco, *Geografía y descripción universal*, 30.

59. Matienzo, *Gobierno de Perú*, 17–18.

60. Matienzo, *Gobierno de Perú*, 35, 135.

61. Matienzo, *Gobierno de Perú*, 135.

62. Capoche, *Relación general de la Villa Imperial de Potosí*, 109; Mendoza y Luna, "Relación del estado," 18.

63. Lizárraga, *Descripción del Perú*, 201. See 202–11 for more information.

64. Lizárraga, *Descripción del Perú*, 202–3.

65. Capoche, *Relación general de la Villa Imperial de Potosí*, 141.

66. Molina Martínez, *Antonio de Ulloa*, 85.

67. Ulloa, *Noticias Americanas*, 329.

68. Ulloa, *Noticias Americanas*, 332.

69. Carrión de la Vadera, *El Lazarillo*, 156, 232.

70. Lohmann Villena, *Las minas de Huancavelica*, 9, 242, 305.

71. Lohmann Villena, *Las minas de Huancavelica*, 9, 104, 183, 416; Lohmann Villena, *El Conde de Lemos*, 229.

72. ABNB, ALP Minas 129/3, 3.

73. Acosta, *Historia natural*, 389–90.

74. Acosta, *De procuranda salute*, vol. 1, ed. L. Pereña et al. (Madrid: Consejo Superior de Investigaciones Científicas, 1984) 193, 431.

75. Acosta, *De procuranda salute*, 447.
76. Ramírez, “Descripción del reyno,” 298–301.
77. Cieza de León, *Crónica del Perú*, 291, 299–301, 304; Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 29, 276, 284. See also Murua, *Historia general del Perú*, 565.
78. Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 277, 287.
79. Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 291.
80. Toledo y Leiva, “Parecer del P. Manuel Toledo y Leiva,” 172–73; see also 174–75.
81. ABNB, ALP Minas 129/3, 3.
82. Avendaño, à *esaurus Indicus*, 257; “Pareceres de los Padres de la Compañía de Jesús de Potosí,” 122; Oñate, “Parecer del P. Pedro de Oñate,” 142; Barnadas, *Charcas*, 274–75; Caravantes, *Noticia general del Perú*, 4:47, 4:213; Castañeda Delgado, “Un capítulo de ética Indiana española,” 829–34, 843; Cortés Salinas, “Una polemica en torno a la mita,” 131–32; Nicolás Sánchez Albornoz, “El trabajo indígena en los andes: Teorías del siglo XVI, Woodrow Wilson International Center for Scholars working paper no. 122 (Washington, D.C.: Woodrow Wilson International Center for Scholars, 1982). This view was also shared by Viceroy Toledo, Escuilache, Liñan y Cisneros, Manso de Velasco, and Luis de Velasco. See Toledo, “Memorial que D. Francisco de Toledo dió al Rey nuestro señor,” 92; Borja, “Relación que hace el Príncipe de Esquilache al Señor Marqués de Guadalcasar,” 81; Liñan y Cisneros, “Relacion de Don Melchor de Liñan y Cisneros,” 305; Manso de Velasco, “Relacion que escribe el conde de Superunda,” 151; Velasco, “Relación del Sr. Virrey,” 120.
83. Caravantes, *Noticia general del Perú*, 4:52; Zimmerman, *Francisco de Toledo*, 263–66; Ruben Vargas Ugarte, *Historia general del Perú. Virreinato (1542–196)*, vol. 2 (Lima: Carlos Milla Batres, 1966), 202, 204; Lohmann Villena, *Las minas de Huancavelica*, 99–102; Ezquerro Abadia, “Problemas de la mita,” 485; Bakewell, *Miners of the Red Mountain*, 64.
84. Vargas Ugarte, *Historia general del Perú*, 2:202; Ezquerro Abadia, “Problemas de la mita,” 485.
85. Vargas Ugarte, *Historia general del Perú*, 2:203.
86. Vargas Ugarte, *Historia general del Perú*, 2:203.
87. K. V. Fox, “Pedro Muñiz, dean of Lima and the Indian labor question (1603),” *Hispanic American Historical Review* 42, no. 1 (1962): 70.
88. Avendaño, à *esaurus Indicus*, 257; “Pareceres de los Padres de la Compañía de Jesús de Potosí,” 118; Castañeda Delgado, “Un capítulo de ética Indiana española,” 878–89; Acosta, *De procuranda indorum salute*, 528–29.
89. Acosta, *De procuranda indorum salute*, 525.
90. Castañeda Delgado, “Un capítulo de ética Indiana española,” 883; Fox, “Pedro Muñiz,” 71; Acosta, *Historia natural*, 220, 234; Hanke, *Bartolomé Arzáns de Orsúa y Velasco’s History of Potosí* (Providence, R.I.: Brown University Press, 1965), 7; Caravantes, *Noticia general del Perú*, 4:215–16; Avendaño, à *esaurus Indicus*, 271; Mesía Venegas, “Memorial del P. Alfonso Mesía Venegas,” 94–95, 100, 15; Oñate, “Parecer

del P. Pedro de Oñate,” 142; Acosta, *De procuranda indorum salute*, 515–19, 523, 531. See also Toledo y Leiva, “Parecer del P. Manuel Toledo y Leiva,” 180; Cole, *à e Potosí Mita*, 20.

91. Caravantes, *Noticia general del Perú*, 4:214–15.
92. Ayans, “Breve relación de los agravios,” 61.
93. Bakewell, *Miners of the Red Mountain*, 134.
94. Caravantes, *Noticia general del Perú*, 4:220–21; Lohmann Villena, *Las minas de Huancavelica*, 294–300; Casteñeda Delgado, “Un capítulo de ética Indiana española,” 908, 914–16; Juan Sebastián et al., “Parecer de los PP. de la Compañía de Jesús, Juan Sebastián, Estebán de Avila, Manuel Vásquez, Juan Pérez Menacho y Francisco de Vitoria, dado al Virrey D Luis de Velaso, sobre si es lícito repartir indios a las minas que de nuevo se descubrieren. 1599,” in *Pareceres jurídicos en asuntos de indias (1601–1718)*, ed. Rubén Vargas Ugarte (Lima: CIP, 1951), 89–90, 92.
95. Sala Catala, “Vida y muerte,” 194; Buechler, *à e Mining Society of Potosí*, 43; Cole, *à e Potosí Mita*, 66; Ezquerra Abadia, “Problemas de la mita,” 485; Fox, “Pedro Muñiz,” 64–65; Fisher, *Silver Mines and Silver Miners*, 212; Lohmann Villena, *Las minas de Huancavelica*, 185–87, 189; Patiño Paúl Ortiz, *Huancavelica colonial*, 218.
96. Patiño Paúl Ortiz, *Huancavelica colonial*, 218–9.
97. Lohmann Villena, *Las minas de Huancavelica*, 185–87, 189, 91, 97, 206.
98. Basadre, *El Conde de Lemos*, 142–44; Crespo Rojas, “La ‘mita’ de Potosí,” 181; Lohmann Villena, *Las minas de Huancavelica*, 401–2; Lohmann Villena, *El Conde de Lemos*, 267, 271; Patiño Paúl Ortiz, *Huancavelica colonial*, 225, 252–53, 255; Cole, *à e Potosí Mita*, 98, 100.
99. Fernández de Castro y Andrade, “Carta del Conde de Lemos a S.M.,” 161–62; Basadre, *El Conde de Lemos*, 144; Crespo Rojas, “La ‘mita’ de Potosí,” 181; Patiño Paúl Ortiz, *Huancavelica colonial*, 225; Vargas Ugarte, *Historia general del Perú*, 2:206.
100. Brown, “Workers’ health,” 483.
101. Cobb, *Potosí y Huancavelica*, 13–15; Roel Pineda, *Historia social y económica*, 103–4; Alvaro Jara, *Tres ensayos sobre economía minera hispanoamericana* (Santiago: Universidad de Chile, 1966), 73; Patiño Paúl Ortiz, *Huancavelica colonial*, 160; Cobb, “Supply and transportation,” 40–41.
102. ABNB, ALP Minas, 123/2, 1; ABNB, CPLA, vol. 20, 264; ABNB, CPLA, vol. 12, 305; Mendoza y Luna, “Relación del estado,” 45–47; Montesinos, *Anales del Perú*, 2:94; Murua, *Historia general del Perú*, 550; Acosta, *Historia natural y moral de las Indias*, 245; Bargallo, *La amalgamación*, 344; Patiño Paúl Ortiz, *Huancavelica colonial*, 160; Cobb, *Potosí y Huancavelica*, 112–4, 17–18; Cobb, “Supply and transportation,” 40, 42.
103. CNMAH, CGI/M-64/26, 1; Platt, “Container transport: From skin bags to iron flasks. Changing technologies of quicksilver packaging between Almadén and America (1788–1848),” *Past and Present*, in press, 12.
104. Platt, “Container transport,” 7, 12, 22–23, 25; Rafael Dobado González, “Las minas de Almadén, el monopolio del azogue y la producción de plata en Nueva España en el siglo XVIII,” in *La savia del imperio: Tres estudios de economía colonial*,

ed. Julio Sánchez Gómez, Guillermo Mira Delli-Zotti, and Rafael Dobado (Salamanca, Spain: Ediciones Universidad Salamanca, 1997), 435; D'Itri and D'Itri, *Mercury Contamination*, xxi.

3. BLOOD SILVER

1. Buechler, à e *Mining Society of Potosí*, 42.
2. Guaman Poma de Ayala, *Nueva crónica y buen gobierno*, 2:333; Crespo Rojas, "La 'mita' de Potosí," 172; Crespo Rojas, "El reclutamiento y los viajes," 474.
3. ABNB, Ruck 1/4,284; García Sarmiento de Sotomayor, "Relación del estado," 246; Bakewell, *Miners of the Red Mountain*, 99, 100; Crespo Rojas, "La 'mita' de Potosí," 173; Basadre, *El Conde de Lemos*, 133; Cole, à e *Potosí Mita*, 30; ABNB, ALP Minas 125/4, 3.
4. Cole, à e *Potosí Mita*, 9, 31; Crespo Rojas, "La 'mita' de Potosí," 171, 173; ABNB, Cédulas Reales 545, 1; Ramírez, "Descripción del reyno," 347; Zimmerman, *Francisco de Toledo*, 185.
5. Caravantes, *Noticia general del Perú*, 4:84.
6. "Pareceres de los Padres de la Compañía de Jesús de Potosí," 120.
7. Basadre, "El régimen de la mita," 346; Arias de Ugarte, "Carta a S. M.," 362; ABNB ALP Minas 129/15, 148; Crespo Rojas, "La 'mita' de Potosí," 174; Tandeter, "Forced and free labor," 120; Tandeter, *Coercion and Market*, 57.
8. Murua, *Historia general del Perú*, 565.
9. Castañeda Delgado, "Un capítulo de ética Indiana española," 837.
10. Cañete y Domínguez, *Guía histórica*, 57; Ulloa, *Noticias Americanas*, 235.
11. Galancha, *Crónica moralizada*, 5:168.
12. Acosta, *Historia natural y moral de las Indias*, 236–37.
13. Murua, *Historia general del Perú*, 565.
14. Cobo, *Historia del Nuevo Mundo*, 1:51.
15. Toledo y Leiva, "Parecer del P. Manuel Toledo y Leiva," 181.
16. Toledo y Leiva, "Parecer del P. Manuel Toledo y Leiva," 183.
17. Arzáns de Orsúa, *Historia de la Villa Imperial*, 1:66.
18. Caravantes, *Noticia general del Perú*, 4:130; Capoche, *Relación general de la Villa Imperial*, 109; Cañete y Domínguez, *Guía histórica*, 112; Riva Aguero, "Descripción anónima del Perú," 30; Cobb, *Potosí and Huancavelica*, 81–82; Bakewell, *Miners of the Red Mountain*, 144–45.
19. Mesía Venegas, "Memorial del P. Alfonso Mesía Venegas," 105.
20. Benino, "Relacion muy particular," 368.
21. Torres de Portugal, "Memoria gubernativa," 210; Ezquerra Abadia, "Problemas de la mita," 498.
22. Mendoza y Luna, "Relación del estado," 38; Cañete y Domínguez, *Guía histórica*, 112–3; Basadre, *El Conde de Lemos*, 134–36; Basadre, "El régimen de la mita," 346; Crespo Rojas, "La 'mita' de Potosí," 173–74; Bakewell, *Miners of the Red Mountain*, 153; Tandeter, *Coercion and Market*, 38, 40–41, 127, 154, 156; Don Rodrigo de

Mendoza y Manrique, 13; Arias de Ugarte, "Carta a S. M." 361; CNMAH, CGI/M-65/14, 1; Cole, *à e Potosí Mita*, 14, 24. Mitayos were to bring twenty-five botas of ore, and each bota was four arrobas, each of which was twenty-five pounds, and twenty-five botas was one palla.

23. Tandeter, *Coercion and Market*, 39–41.
24. Cañete y Domínguez, *Guía histórica*, 112–3.
25. Capoche, *Relación general de la Villa Imperial de Potosí*, 158–59.
26. ABNB, ALP, Minas 60/6, 1; Torres de Portugal, "Memoria gubernativa," 210; Ayans, "Breve relación de los agravios," 62; Cepeda, "Carta a S. M. del Presidente de Charcas, Licenciado Cepeda, dando noticia del laboreo de las minas y trabajo de los indios en las mismas; sobre la navegación del mar del Norte; despacho del gobernador de Filipinas D. Pedro Ronquillo; necesidad de que los encomenderos residen en el lugar de sus encomiendas; excesos del gobernador de Tucumán Hernando de Lerma; conveniencia de sujetar a servidumbre a los chiriguanaes y relación de los extrajeros que residen en la tierra," in *La audiencia de Charcas: Correspondencia de presidentes y oidores. Documentos del Archivo de Indias*, vol. 2, ed. Roberto Levillier (Madrid: Imprenta de Juan Pueyo, 1922), 31; Cobb, *Potosí y Huancavelica*, 66; Bakewell, *Miners of the Red Mountain*, 147.
27. Capoche, *Relación general de la Villa Imperial*, 158.
28. Capoche, *Relación general de la Villa Imperial*, 159. See also 346.
29. Capoche, *Relación general de la Villa Imperial*, 158.
30. Ayans, "Breve relación de los agravios," 38. Concerning other mine fatalities, see CNMAH, CGI/M-36/19; ABNB, ALP, Minas, 131/9; ABNB, ALP Minas 131/6; and ABNB, ALP Minas 96/11.
31. Arzáns de Orsúa, *Historia de la Villa Imperial*, 1:65–66; Ramírez, "Descripción del reyno," 346; Cepeda, "Carta a S. M. del Presidente de Charcas," 31.
32. Martínez y Vela, *Anales de la Villa Imperial*, 50, see also 62; Arzáns de Orsúa, *Historia de la Villa Imperial*, 1:304, 2:146, 3:153.
33. Capoche, *Relación general de la Villa Imperial*, 158–59.
34. Capoche, *Relación general de la Villa Imperial*, 159.
35. ABNB, ALP Minas 96/11, 9–10, 12; ABNB, ALP Min 131/7 1–3, 8; Murua, *Historia general del Perú*, 570; Bakewell, *Miners of the Red Mountain*, 148–49.
36. Acosta, *Historia natural y moral de las Indias*, 235.
37. Ayans, "Breve relación de los agravios," 60.
38. Arias de Ugarte, "Carta a S. M." 361.
39. ABNB, ALP Min 131/7 1–3.
40. Buechler, *à e Mining Society of Potosí*, 276; Mendoza y Luna, "Relación del estado," 38; Ramírez, "Descripción del reyno," 348; "Descripción de la villa y minas," 377; Murua, *Historia general del Perú*, 565.
41. Capoche, *Relación general de la Villa Imperial*, 150–51, 161; Josep Barnadas, "Una polemica colonial: Potosí, 1579–1584," in *Jahrbuch fur Geschichte von Staat, Wirtschaft und Gesellschaft Lateinamerikas*, vol. 10 (Cologne: Bohlau Verlag, 1973), 17–18.

42. Fray Miguel Agia, *Servidumbres personales de indios*, ed. Javier de Ayla (Seville, Spain: Escuela de Estudios Hispanos-Americanos, 1946), 63.
43. ABNB, Ruck 80.25; Brading and Cross, "Colonial silver mining," 555.
44. ABNB, Ruck 80, 11.37–38; Llano Zapata, *Memorias histórico*, 164; Rose M. Buechler, "Technical aid to Upper Peru: The Nordenfli ht expedition," *Journal of Latin American Studies* 5, no. 1 (1973): 53; Bakewell, "Registered silver production," 82; Purser, *Metal Mining in Peru*, 29–30; Alvaro Alonso Barba, *Arte de los metales, en que se enseña el verdadero beneficio de los de oro y plata por azogue* (Potosí: 1967), 1B; Fisher, *Silver Mines and Silver Miners*, 58; Ulloa, *Noticias Americanas*, 244. Other negrillo ores were called *acerado*, *cochizo*, *soroche menudo* and *soroche grueso*, and *rosicler*.
45. Cobo, *Historia del Nuevo Mundo*, 1:47.
46. Mendoza y Manrique, 6, 9; ABNB, ALP Minas, 131/3,1; Arzáns de Orsúa, *Historia de la Villa Imperial*, 1:71; Murua, *Historia general del Perú*, 570; Cobo, *Historia del nuevo mundo*, 1:46–47; "Descripción o historia geográfica del terreno y lugares conmarcanos de Potosí," 258; Cobb, *Potosí y Huancavelica*, 91, 93; Buechler, & e *Mining Society of Potosí*, 240; Bakewell, *Miners of the Red Mountain*, 20. See also Visita que el Lic. Martín de Arriola, oidor de la Real Audiencia, tomó del asiento de minas de Nuestra Señora de Buen Suceso de Chocaya la Nueva, provincia de los Chichas, para establecer las condiciones del trabajo, Nuestra Señora de Buen Suceso de Chocaya la Nueva, April 10, 1684, ABNB, ALP Minas 131/4.
47. Capoche, *Relación general de la Villa Imperial*, 122; "Descripción de la villa y minas de Potosí," 379; Arzáns de Orsúa, *Historia de la Villa Imperial*, 1:169; Cobo, *Historia del Nuevo Mundo*, 1:47; ABNB, Ruck 11.23–37 31,35; Cobb, *Potosí y Huancavelica*, 91, 93; Bargallo, *La amalgamación*, 213; Bakewell, *Miners of the Red Mountain*, 20, 24.
48. Buechler, & e *Mining Society of Potosí*, 277; Capoche, *Relación general de la Villa Imperial*, 122; Arzáns de Orsúa, *Historia de la Villa Imperial*, 1:169; Ramírez, "Descripción del reyno," 348; Cobo, *Historia del Nuevo Mundo*, 1:47; Bakewell, *Miners of the Red Mountain*, 20–21; Cobb, *Potosí y Huancavelica*, 91; Tandeter, *Coercion and Market*, 42, 46.
49. Cobo, *Historia del nuevo mundo*, 1:47. For biographical background and context on Cobo, see Francisco Mateos, *Introducción to Historia del Nuevo Mundo*, ed. Bernabé Cobo and Francisco Mateos (Madrid: Ediciones Atlas, 1956), vii–xlvii.
50. Cañete y Domínguez, *Guía histórica*, 69.
51. Cañete y Domínguez, *Guía histórica*, 72.
52. ABNB, Ruck 801.
53. ABNB, Ruck 80, 1–2.
54. ABNB, Ruck 80, 3.
55. ABNB, Ruck 80, 3.
56. ABNB, Ruck 80, 33.
57. ABNB, Ruck 80, 39, 40–4, 50–51; Cañete y Domínguez, *Guía histórica*, 66; Bargallo, *La amalgamación*, 296; Brading and Cross, "Colonial silver mining," 554.

58. Capoche, *Relación general de la Villa Imperial*, 123; ABNB, Ruck 80, 12–B; Cobo, *Historia del Nuevo Mundo*, 1:147; Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 264; Ulloa, *Noticias Americanas*, 256; Llano Zapata, *Memorias histórico*, 169; Bakewell, *Miners of the Red Mountain*, 21; John Fisher, “Silver production in the viceroyalty of Peru, 1776–1824,” in *Mines of Silver and Gold in the Americas*, ed. Peter Bakewell (Brookfield, Vt.: Variorum, 1997), 289; Tristan Platt, “The alchemy of modernity: Alonso Barba’s copper cauldrons and the independence of Bolivian metallurgy (1790–1890),” *Journal of Latin American Studies* 32, no.1 (2000): 3; “Descripción de la villa y minas de Potosí,” 375; ABNB, Ruck 80, 39.

59. ABNB, Ruck 80, 12.

60. Caravantes, *Noticia general del Perú*, 4:104–5; Cañete y Domínguez, *Guía histórica*, 65; Capoche, *Relación general de la Villa Imperial*, 123; Cobo, *Historia del Nuevo Mundo*, 1:147; Cobb, *Potosí y Huancavelica*, 95; Bakewell, *Miners of the Red Mountain*, 21; ABNB, Ruck 80, 13–14, 21, 26, 52–53.

61. Brading and Cross, “Colonial silver mining,” 554; “Descripción de la villa y minas de Potosí,” 375; Torres de Portugal, “Memoria gubernativa,” 208; Caravantes, *Noticia general del Perú*, 4:104–5; Cañete y Domínguez, *Guía histórica*, 65; Bargallo, *La amalgamación*, 229, 242–43, 260; Bakewell, “Registered silver production,” 82; Cobb, *Potosí y Huancavelica*, 94–95, 97; Patiño Paúl Ortiz, *Huancavelica colonial*, 188; Enriqueta Vila Vilar, “Ensayos metalúrgicos en Potosí: Carlos Corzo de Leca y su nuevo método de amalgamación,” in *Europa e Iberoamérica: Cinco siglos de Intercambios*, vol. 2, ed. María Justina Sarabia Viejo et al. (Seville, Spain: Asociación de Historiadores Latinoamericanistas Europeos/Consejería de Cultura y Medio Ambiente, 1992), 384–85; Bakewell, *Miners of the Red Mountain*, 25; Sánchez Gómez, “La técnica en la producción,” 152; Platt, “Container transport,” 35, 38.

62. ABNB, Ruck 80, 4–10; Montesinos, *Anales del Perú*, 2:61; “Descripción de la villa y minas de Potosí,” 376; Caravantes, *Noticia general del Perú*, 4:104–5; Cañete y Domínguez, *Guía histórica*, 65; Bargallo, *La amalgamación*, 283.

63. Capoche, *Relación general de la Villa Imperial*, 123; Cañete y Domínguez, *Guía histórica*, 50, 65, 71; Bargallo, *La amalgamación*, 192, 291; Brading and Cross, “Colonial silver mining,” 554; Fisher, *Silver Mines and Silver Miners*, 54; Vila Vilar, “Ensayos metalúrgicos en Potosí,” 383; Bakewell, *Miners of the Red Mountain*, 22; Platt, “The alchemy of modernity,” 3; ABNB, Ruck 80, 14; Arzáns de Orsúa, *Historia de la Villa Imperial*, 1:69; Purser, *Metal Mining in Peru*, 48.

64. John Fisher, “Tentativas de modernizar la tecnología minera en el virreinato del Perú: La misión minera de Nordenflyht (1788–1810),” in *Minería y metalurgia: Intercambio tecnológico y cultural entre América y Europa durante el período colonial español*, ed. Manuel Castillo Martos (Seville, Spain: Muñoz Moya y Montraveta, 1994), 330–36, 344–45; Fisher, *Silver Mines and Silver Miners*, 55, 58; Guillermo Lohmann Villena, “La minería en el marco del virreinato peruano: Invenciones, sistemas, técnicas y organización industrial,” in *La minería hispana e iberoamericana*, vol. 1 (León, Spain: Cátedra de San Isidoro, 1970), 449–50; Platt, “The alchemy of modernity,” 3; Renate Pieper, “Innovaciones tecnológicas y problemas del medio

ambiente en la minería novohispana (siglos XVI al XVIII),” in *Europa e Iberoamérica: Cinco siglos de Intercambios*, vol. 2, ed. María Justina Sarabia Viejo et al. (Seville, Spain: Asociación de Historiadores Latinoamericanistas Europeos/Consejería de Cultura y Medio Ambiente, 1992), 358; Buechler, “Technical aid to Upper Peru,” 55, 59–62; Sánchez Gómez, “La técnica en la producción,” 148–151, 215–17, 249–50, 204–5, 214; Whitaker, & e *Huancavelica Mercury Mine*, 68–71; Carlos Serrano Bravo, “Intercambio tecnológico en la amalgamación entre los centros mineros de América con sus homólogos europeos,” in *Minería y metalurgia: Intercambio tecnológico y cultural entre América y Europa durante el período colonial español*, ed. Manuel Castillo Martos (Seville, Spain: Muñoz Moya y Montraveta, 1994), 407–36. Concerning other innovative efforts, see ABNB, CPLA, vol. 20, 14–15; ABNB, ALP, Minas 120/11, 9; and ABNB, ALP Minas 146/6, 1.

65. Don Rodrigo de Mendoza y Manrique, 19, 97; “Descripción o historia geográfica del terreno y lugares comarcanos de Potosí,” Potosí, 1759, ABNB, PS 2010.8, original in British Library, Add. MS 17605, 214; Buechler, “Technical aid to Upper Peru,” 53; Platt, “The alchemy of modernity,” 3; Eduardo Saguier, “Los cálculos de rentabilidad en la crisis de la azoguería potosina: El refiado de metales a la luz de ocho visitas de ingenios desconocidas,” *Andes: Antropología e historia*, nos. 2–3, (1990–1991): 12.

66. Purser, *Metal Mining in Peru*, 49; ABNB, Ruck 80, 14–16, 28; Caravantes, *Noticia general del Perú*, 4:104–5; Cobo, *Historia del Nuevo Mundo*, 1:47.

67. ABNB, Ruck 80, 27–35.

68. Caravantes, *Noticia general del Perú*, 4:105; Arzáns de Orsúa, *Historia de la Villa Imperial*, 1:70; Cobo, *Historia del Nuevo Mundo*, 1:47–48; Buechler, “Technical aid to Upper Peru,” 53; Purser, *Metal Mining in Peru*, 50; Bakewell, *Miners of the Red Mountain*, 22; ABNB, Ruck 80, 20, 53. Other positions in the mill included *sivires*, who carried supplies to various parts of the mill; a *leñero*, who ensured a constant supply of firewood and combustible material; *carboneros*, who produced charcoal; a *hornero* or *quemador*, who operated the ovens; and a *benefiador*, a skilled refiner. Mine positions included *apiries*, mitayo ore carriers; *palliris*, ore sorters; *siquipichas*, who kept the mine shaft clear of debris; *pirquires*, who maintained the structural integrity of the shafts; and *pongos*, Indian foremen, who supervised around twenty apiries. See Don Rodrigo de Mendoza y Manrique, 1; Bakewell, *Miners of the Red Mountain*, 138–40.

69. Bakewell, *Miners of the Red Mountain*, 1B.

70. ABNB, Ruck 80, 12.

71. Caravantes, *Noticia general del Perú*, 4:105; Cobo, *Historia del Nuevo Mundo*, 1:48–49; Cañete y Domínguez, *Guía histórica*, 65; Bakewell, *Miners of the Red Mountain*, 22; Don Rodrigo de Mendoza y Manrique, 2; Capoche, *Relación general de la Villa Imperial*, 124; Arzáns de Orsúa, *Historia de la Villa Imperial*, 1:71; Purser, *Metal Mining in Peru*, 50; Cobb, *Potosí y Huancavelica*, 90. The scientific name for *yareta* is *Azorella compacta*; it is a member of the Apiaceae family.

72. Capoche, *Relación general de la Villa Imperial*, 124; Cañete y Domínguez,

- Guía histórica*, 65; Cobo, *Historia del Nuevo Mundo*, 1:48; Cobb, *Potosí y Huancavelica*, 90; Bakewell, *Miners of the Red Mountain*, 22; Bargallo, *La amalgamación*, 213
73. Barba, *Arte de los metales*, 108; Cañete y Domínguez, *Guía histórica*, 71; Buechler, “Technical aid to Upper Peru,” 54.
74. Agricola, *De Re Metalica*, 428.
75. “Descripción de la villa y minas de Potosí,” 376–77; ABNB, ALP Minas 131/2, 24; Cobo, *Historia del Nuevo Mundo*, 1:48; Capoche, *Relación general de la Villa Imperial*, 123; Purser, *Metal Mining in Peru*, 50.
76. Cobo, *Historia del Nuevo Mundo*, 1:49; Purser, *Metal Mining in Peru*, 51; Tandeter, *Coercion and Market*, 11; Bakewell, “Registered silver production,” 75–77.
77. Bakewell, *Miners of the Red Mountain*, 148–49; Capoche, *Relación general de la Villa Imperial*, 159.
78. Capoche, *Relación general de la Villa Imperial*, 159.
79. Calancha, *Crónica moralizada*, 5:1680.
80. ABNB, ALP Minas 129/8, 3.
81. ABNB, ALP Minas 129/8, 5.
82. ABNB, ALP Minas 129/3, 1.
83. Arzáns de Orsúa, *Historia de la Villa Imperial*, 2:33. See also 3:68.
84. Arzáns de Orsúa, *Historia de la Villa Imperial*, 3:151–52.
85. ABNB, ALP Minas 125/2, 4–5; ABNB, ALP Minas 131/16, 1–18; ABNB, ALP Minas 89/8, 1–11; Bakewell, *Miners of the Red Mountain*, 153.
86. ABNB, ALP Minas 130/1, 16.
87. ABNB, ALP Minas 130/1, 13.
88. ABNB, ALP Minas 130/1, 3.
89. ABNB, ALP Minas 130/1, 7, 10, 12, 24, 33, 67, 69.
90. Ulloa, *Noticias Americanas*, 279; Alfredo Menéndez Navarro, *Un mundo sin sol: La salud de los trabajadores de las minas de Almadén, 1750–1900* (Granada: Universidad de Granada, 1996), 104.
91. ABNB, ALP Minas 130/1, 3, B, 25.
92. ABNB, ALP Minas 130/1, 10.
93. ABNB, ALP Minas 130/157.
94. ABNB, ALP Minas 130/1, 66.
95. ABNB, ALP Minas 130/1, 70; ABNB, ALP Minas 130/4, 1, 2, B.
96. ABNB, ALP Min 129/16, B, 16; ABNB, MH 29/9, 46, 47, 58.
97. ABNB, ALP Minas 130/9, 1–4; Tandeter, *Coercion and Market*, 154; Arias de Ugarte, “Carta a S. M.,” 358.
98. *Isidro Ala, capitán enterador de los mitayos del ingenio de don Manuel Usín en la ribera de Potosí, sobre los malos tratamientos e inicuos entables con que les opriime dicho azoguero y mayordomo Ramos de tal, y el alcalde de minas de dicha villa, don Francisco Cortés*, La Plata, April 25, 1809, ABNB, ALP Minas 130/9, 1.
99. Isidro Ala, 1–2.
100. Isidro Ala, 2, 5.
101. ABNB, ALP Minas 131/16, 1, 3, 5–6, 8–26.

102. ABNB, ALP Minas 150/1, 1–5, 21, 27
103. Arias de Ugarte, “Carta a S. M.” 359; Mendoza y Luna, “Relación del estado,” 40; ABNB, ALP Minas 129.8, 3; García Sarmiento de Sotomayor, “Relación del estado,” 247; Torres de Portugal, “Memoria gubernativa,” 210; Navarra y Rocafull, “Relacion del estado del Perú,” 2:240; Bakewell, *Miners of the Red Mountain*, 97, 105–7; Crespo Rojas, “La ‘mita’ de Potosí,” 178; Wiedner, “Forced labor in colonial Peru,” 368; Cole, *à e Potosí Mita*, 24; Caravantes, *Noticia general del Perú*, 4:85; Crespo Rojas, “El reclutamiento y los viajes,” 470.
104. Tandeter, *Coercion and Market*, 9, 11, 47, 107–8, 110–11 Cole, *à e Potosí Mita*, 133.
105. ABNB, ALP Minas 129/7, 1–2; Capoche, *Relación general de la Villa Imperial*, 142; Bakewell, *Miners of the Red Mountain*, 80, 97; Cole, *à e Potosí Mita*, 11, 17; Contreras, *La ciudad del mercurio*, 64; Tandeter, *Coercion and Market*, 37, 52; Crespo Rojas, “La ‘mita’ de Potosí,” 173.
106. Capoche, *Relación general de la Villa Imperial*, 173–74; Montesinos, *Anales del Perú*, 2:74; Fernández de Castro y Andrade, “Carta del Conde de Lemos a S. M.” 157; Mesía Venegas, “Memorial del P. Alfonso Mesía Venegas,” 1B; Bakewell, *Miners of the Red Mountain*, 100–101, 122–24, 127–28, 134, 181; Crespo Rojas, “La ‘mita’ de Potosí,” 174; Fisher, *Silver Mines and Silver Miners*, 10; Wiedner, “Forced labor in colonial Peru,” 369–70; ABNB, Ruck 11, 48, 50, 52; Lohmann Villena, *Las minas de Huancavelica*, 82.
107. Ayans, “Breve relación de los agravios,” 35–36; Basadre, “El régimen de la mita,” 349; Martín José de Mugica, “Abusos: De varias clases de mitas y Carácter perezoso del Indio,” in “Las mitas de Huamanga y Huancavelica,” ed. Luis J. Basto Girón, *Perú Indígena* 5, no. 13 (December 1954): 223; Cañete y Domínguez, *Guía histórica*, 105–6; Arena, *Las minas de azogue del Perú*, 13; Bakewell, *Miners of the Red Mountain*, 90–91; Cole, *à e Potosí Mita*, 25; ABNB, Ruck 1/4:284; ABNB, ALP Minas 127/V, 1–3; ABNB ALP Minas, 123/10; 1–5; CNMAH, CGI/M-65/14, 1; ABNB, ALP Minas 128.3, 1, 4, 12–14; ABNB, ALP Min 126/12, 1, 23; ABNB ALP Minas 129/15, 148; Guaman Poma de Ayala, *Nueva crónica y buen gobierno*, 2:333; Mesía Venegas, “Memorial del P. Alfonso Mesía Venegas,” 99; Mendoza y Luna, “Relación del estado,” 45; Crespo Rojas, “La ‘mita’ de Potosí,” 173; Cobb, *Potosí y Huancavelica*, 74; Crespo Rojas, “El reclutamiento y los viajes,” 475; Ezquerro Abadia, “Problemas de la mita,” 497; Tandeter, *Coercion and Market*, 55–56; Tandeter, “Forced and free labor,” 19.
108. ABNB, ALP Minas 129/2, 7; Arias de Ugarte, “Carta a S. M.” 366; ABNB, ALP Minas 129/8, 2; Ramírez, “Descripción del reyno,” 347; “Pareceres de los Padres de la Compañía de Jesús de Potosí,” 19; Capoche, *Relación general de la Villa Imperial*, 160; Ayans, “Breve relación de los agravios,” 60; Mesía Venegas, “Memorial del P. Alfonso Mesía Venegas,” 105; Bakewell, *Miners of the Red Mountain*, 104–5; Crespo Rojas, “La ‘mita’ de Potosí,” 175; Cobb, *Potosí y Huancavelica*, 65; Tandeter, *Coercion and Market*, 57–58; Tandeter, “Forced and free labor,” 99.
109. Dobyns, “An outline of Andean epidemic history,” 512–B; Zulawski, “Wages, ore sharing and peasant agriculture,” 417; Sánchez Albornoz, *à e Population of Latin America*, 17.

110. Crespo Rojas, “La ‘mita’ de Potosí,” 182; Sánchez Albornoz, “Mita, migraciones y pueblos,” 32; Evans, “Census enumeration,” 28–29; Saignes, “Las etnias de Charcas,” 49.

111ABNB Ruck 1/4,446–51;ABNB, Ruck 1/4,278–81;Crespo Rojas, “La ‘mita’ de Potosí,” 182; Sánchez Albornoz, “Mita, migraciones y pueblos,” 32; Evans, “Census enumeration,” 28–34; Jeffrey Cole, “Viceroyal persistence versus Indian mobility: The impact of the Duque de la Palata’s reform program on alto Peru, 1681–92,” *Latin American Research Review*19 (1984): 40, 43; Cole, *à e Potosí Mita*, 105–6; Tandeter, *Coercion and Market*, 30–31; Ezquierro Abadia, “Problemas de la mita,” 491–92.

112. Garrió de la Vandera, *El lazaroillo*, 110; Tandeter, *Coercion and Market*, 90.

113. ABNB, CPLA, vol. 8, 128; Torres de Portugal, “Memoria gubernativa,” 212; Mendoza y Luna, “Relación del estado,” 43; Capoche, *Relación general de la Villa Imperial*, 152; Ramírez, “Descripción del reyno,” 348; Baquijano, “Historia del descubrimiento,” 43; Cañete y Domínguez, *Guía histórica*, 58; Lohmann Villena, *Las minas de Huancavelica*, 441; Cole, *à e Potosí Mita*, 63; Zulawski, *à ey Eat from à eir Labor*, 112;Bakewell, *Miners of the Red Mountain*, 79. On *corpa* in Oruro, see Ann Zulawski, “Wages, ore sharing and peasant agriculture,” 405–30.

114. Capoche, *Relación general de la Villa Imperial*, 158; Arzáns de Orsúa, *Historia de la Villa Imperial de Potosí*, 3:151; Carrió de la Vandera, *El lazaroillo*, 110.

115. Tandeter, *Coercion and Market*, 73, 87, 97; Enrique Tandeter, “Mineros de week-end: Los ladrones de minas de Potosí,” *Todo es Historia* (Buenos Aires) 174 (1978): 35, 41–42; Eduardo Martire, “Tolerancias, prevenciones y regulación participadora de los indios ‘capchas’ de Potosí, en la explotación del cerro,” in *Estudios sobre política indigenista española en America*, vol. 3 (Valladolid, Spain: Universidad de Valladolid, 1977), 292, 294, 296–98.

116. Carrió de la Vandera, *El lazaroillo*, 110;“Descripción o historia geográfica del terreno y lugares conmarcanos de Potosí,” 255; Tandeter, *Coercion and Market*, 90.

117. Arzáns de Orsúa, *Historia de la Villa Imperial*, 3:358; Martire, “Tolerancias, prevenciones y regulación participadora,” 293, 301,303; Tandeter, *Coercion and Market*, 85, 90–91, 109; Tandeter, “Mineros de week-end,” 37; Cole, *à e Potosí Mita*, 14.

118.Torres de Portugal, “Memoria gubernativa,” 212; Arzáns de Orsúa, *Historia de la Villa Imperial de Potosí*, 3:358; Cañete y Domínguez, *Guía histórica*, 58; Tandeter, *Coercion and Market*, 96, 107.

119. Ulloa, *Noticias Americanas*, 255;Tandeter, *Coercion and Market*, 92; Tandeter, “Mineros de week-end,” 38–40, 43; Tandeter, “Forced and free labor,” 135; Braiding and Cross, “Colonial silver mining,” 567; Martire, “Tolerancias, prevenciones y regulación participadora,” 296, 302.

4. CONNECTING THE DROPS

1. D’Itri and D’Itri, *Mercury Contamination*, 118;Evans, “Mercury,” 997; Goldwater, *Mercury*, 2, 4; USEPA, *Mercury Study*, 2-1.

2. USEPA, *Mercury Study*, vol. 1, 0-1, 0-4, 3-5, 3-7; Evans, “Mercury,” 997; Murua, *Historia general del Perú*, 569; Fuentes Bajo, “El azogue en las postrimerías

del Perú colonial," 84; Mira Delli-Zotti, "Reformas bourbónicas," 217; Lohmann Villena, *Las minas de Huancavelica*, 167. The average of 165 metric tons annually volatilized in the city of Potosí is derived from the total registered silver production in the district of Potosí between 1574 and 1735. To this figure is added 25 percent to account for contraband, and 75 percent of that total reflects the approximate amount of silver produced in the city of Potosí. The resulting 34,887,311 pounds of silver is then multiplied by 1.7 pounds of mercury volatilized per pound of silver produced, which reflects approximately 15 percent lost in runoff. The result is an average of approximately 165 metric tons of mercury volatilized in the city of Potosí per year, or approximately 39,000 metric tons over a 236-year span ending in 1810. See Bakewell, "Registered silver production," 93–100.

3. L. D. Lacerda and R. V. Marins, "Anthropogenic mercury emissions to the atmosphere in Brazil: The impact of gold mining," *Journal of Geochemical Exploration* 58 (1997): 224; USEPA, *Mercury Study*, 0-1, 2-1, 2-4, 3-1, 3-3.

4. William E. Brooks, "Industrial use of mercury in the ancient world," in *Mercury in the Environment: Pattern and Processes*, ed. M. S. Bank (Berkeley: University of California Press, 2011); D'Itri and D'Itri, *Mercury Contamination*, 5–7, 120; Bidstrup, *Toxicology and Mercury*, 1; "Health effects," 226; L. D. Lacerda, "Global mercury emissions from gold and silver mining," *Water, Air and Soil Pollution* 97 (1997): 210.

5. Barba, *Arte de los metales*, 93; D'Itri and D'Itri, *Mercury Contamination*, 7, 106, 122; Goldwater, *Mercury*, 24, 264–66, 269; Bidstrup, *Toxicology and Mercury*, 1; "Health effects," 226; Menéndez Navarro, *Un mundo sin sol*, 79, 83, 154. The full title of Ulrich Ellenborg's book is *Von den giftigen Besen Tempffen und Reüchen: Der Metal, als Silber, Quecksilber, Bley und anders So die Edlenhandt werck des Goltschmidens und ander arbaiter in des feürsich gebrauchen mussen. Wie sie sich da mit halten und die gift vertreibe solle* (Augsburg: Melchoir Ramminger, 1524); the title of the work of Gabriele Fallopius is *De Meteallis et Fossilibus*.

6. D'Itri and D'Itri, *Mercury Contamination*, 105, 130–33, 136; Goldwater, *Mercury*, 270.

7. D'Itri and D'Itri, *Mercury Contamination*, 3, 107; Goldwater, *Mercury*, 127–28; Schutte et al., "Mercury and its compounds," 550; Waldron and Scott, "Metals," 102; "Health effects," 125; USEPA, *Mercury Study*, 0-3, 2-1, 3-73-8.

8. D'Itri and D'Itri, *Mercury Contamination*, 105, 118; Goldwater, *Mercury*, 127–28; David O. Marsh, "Organic mercury: Methylmercury compounds," in *Handbook of Clinical Neurology*, vol. 36, ed. P. Vinken and G. Bruyn (New York: Elsevier, 1979), 73; Waldron and Scott, "Metals," 102.

9. USEPA, *Mercury Study* 2-1, 3-8, 3-16, 3-21.

10. Waldron and Scott, "Metals," 102–3; "Health effects," 107, 124, 161, 169, 221.

11. Waldron and Scott, "Metals," 103; Keith Yeates and Mary Ellen Mortensen, "Acute and chronic neuropsychological consequences of mercury vapor poisoning in two early adolescents," *Journal of Clinical and Experimental Neuropsychology* 16, no. 2 (1994): 211; Gary Marsh, "Epidemiology of occupational diseases," in

Environmental and Occupational Medicine, 3rd ed., ed. William Rom (New York: Lippincott-Raven, 1998), 39–55; Schutte et al., “Mercury and its compounds,” 553; D’Itri and D’Itri, *Mercury Contamination*, 135; “Health effects,” 327.

12. D’Itri and D’Itri, *Mercury Contamination*, 2, 23; Hugh L. Evans et al., “Behavioral effects of mercury and methylmercury,” *Federation Proceedings* 34, no. 9 (August 1975), 1860, 1865; Marsh, “Organic mercury,” 74–75; Schutte et al., “Mercury and its compounds,” 551; Waldron and Scott, “Metals,” 102.

13. Bakir et al., “Methylmercury poisoning in Iraq,” 230–232, 234, 236, D’Itri and D’Itri, *Mercury Contamination*, 2, 37; Marsh, “Organic mercury,” 73.

14. D’Itri and D’Itri, *Mercury Contamination*, 24–26, 28; Marsh, “Organic mercury” 74.

15. Bakir et al., “Methylmercury poisoning in Iraq,” 231; D’Itri and D’Itri, *Mercury Contamination*, 2–3, 47–51, 63–64; Evans, “Mercury,” 999.

16. “Health effects,” 29–30, 171, 173, 182; USEPA, *Mercury Study*, 0-3, 3-23; Schutte et al., “Mercury and its compounds,” 552; Waldron and Scott, “Metals,” 103; Bidstrup, *Toxicology and Mercury*, 8, 43, 60, “Health effects,” 31, 33, 47–49, 54–55, 58, 162, 163, 185–86, 264–65, 268, 272; Helena Hanninen, “Behavioral effects of occupational exposure to mercury and lead,” *Acta Neurologica Scandinavica* 66, Supp. 92 (1982): 172.

17. Evans, “Mercury,” 1001; Neal et al., *Mercurialism and Its Control in the Felt-Hat Industry*, 122; Hanninen, “Behavioral effects,” 170. The EPA defines short-term exposure as repeated exposure through skin, mouth, or lungs for twenty-four hours to thirty days; subchronic involves repeated exposure through the same means from thirty days up to 10 percent of lifespan; and chronic exposure is repeated exposure from more than 10 percent of the lifespan of humans. See U.S. Environmental Protection Agency, *A Review of the Reference Dose and Reference Concentration Processes*, EPA/630/P-02/002F, Risk Assessment Forum (Washington, D.C.: EPA, 2002), 4-1–4-3.

18. Schutte et al., “Mercury and its compounds,” 552; Waldron and Scott, “Metals,” 103; Bidstrup, *Toxicology and Mercury*, 8, 43, 60; “Health effects,” 31, 33–34, 43, 47–49, 51, 54–55, 58, 162, 163, 185–86, 264–65, 268, 272; USEPA, *Mercury Study*, 0-3. Nonlethal symptoms have been demonstrated among people exposed to vapors for four to eight hours at concentration levels of 44.3 mg/m³.

19. Schutte et al., “Mercury and its compounds,” 552.

20. Waldron and Scott, “Metals,” 104–5; Piikivi et al., “Psychological performance,” 35; Schutte et al., “Mercury and its compounds,” 553; Soleo et al., “Effects of low exposure,” 105; Bidstrup, *Toxicology and Mercury*, 42; Kishi et al., “Residual neurobehavioural effects,” 36–38; Neal et al., *Mercurialism and Its Control in the Felt-Hat Industry*, 122; “Health effects,” 44, 56.

21. Waldron and Scott, “Metals,” 104–5; Piikivi et al., “Psychological performance,” 35; Schutte et al., “Mercury and its compounds,” 553; Soleo et al., “Effects of low exposure,” 105; Bidstrup, *Toxicology and Mercury*, 42; “Health effects,” 58, 220; Ehrenberg et al., “Effects of elemental mercury exposure,” 500; Evans, “Mercury,”

1001; Neal et al., *Mercurialism and Its Control in the Felt-Hat Industry*, 122; Hanninen, "Behavioral effects," 170.

22. Neal et al., *Mercurialism and Its Control in the Felt-Hat Industry*, 92–93.
23. Piikivi et al., "Psychological performance," 25; N. M. Cherry, "Neurotoxic effects of workplace exposures," in *Hunter's Diseases of Occupations*, 8th ed., ed. P. A. B. Raffl et al. (London: E. Arnold, 1994), 79; P. J. Smith, "Effects of occupational exposure to elemental mercury on short term memory," *British Journal of Industrial Medicine* 40 (1983): 413, 417; Bidstrup, *Toxicology and Mercury*, 43; Barbara Uzzell and Jacqueline Oler, "Chronic low-level mercury exposure and neuropsychological functioning," *Journal of Clinical and Experimental Neuropsychology* 8, no. 5 (1986): 581–8. This was a study of thirteen female dental assistants who had a mean exposure of 15.3 years and blood levels of mercury ranging from 25 to 15 ug/g. Chronic exposure at these levels led to increased frequency of obsessive-compulsive behavior, psychotic breakdowns, and a decreased ability to concentrate.
24. Yeates and Mortensen, "Acute and chronic neuropsychological consequences," 209–211, 214, 218. The eight-hour time-weighted average of the vapor concentration was 50 micrograms per cubic meter.
25. Kishi et al., "Residual neurobehavioural effects," 35, 40; I. M. Falanga, Tusek-Znidaric, et al., "Mercury, selenium, and cadmium in human autopsy samples from Idrija residents and mercury mine workers," *Environmental Research* 84, sect. A (2000): 211, 213. The miners had between fourteen and twenty-two years of experience.
26. Toyoto Iwata, Mineshi Sakamoto, et al., "Effects of mercury vapor exposure on neuromotor function in Chinese miners and smelters," *International Archive of Occupational Environmental Health* 80 (2007): 381, 386–387 (the duration of exposure was unknown as these were illegal artisan operations); Li Ping, Xinbin Feng, et al., "Mercury exposures and symptoms in smelting workers of artisanal mercury mines in Wuchuan, Guizhou, China," *Environmental Research* 107 (2008): 108–9; Li Ping, Xinbin Feng, et al. "Mercury exposure in the population from Wuchan mercury mining area, Guizhou, China," *Science of the Total Environment* 395 (2008): 72, 76.
27. Kishi et al., "Subjective symptoms and neurobehavioral performances of ex-mercury miners at an average of 18 years after the cessation of chronic exposure to mercury vapor," *Environmental Research* 62, no. 2 (1993): 293–95. On average, eighteen years before this study, this group had worked six and one-third hours a day in the mines for fifteen years.
28. Irma West and James Lim, "Mercury poisoning among workers in California's mercury mills," *Journal of Occupational Medicine* 10, no. 12 (December 1968): 698. Concerning mean mercury concentrations, in studies of Chinese smelting operations it was 40 mg/m³, and in a Japanese mine it ranged from 1.9 to 3.3 mg/m³ near the pitface. In California's mercury mills, the average concentration in air ranged from .3 mg/m³ to 1.2 mg/m³, which was the maximum reading on the detection instrument, while in Idria it was .17 to 1.9 mg/m³: .05 to 5.9 mg/m³ in the mine where there was only cinnabar, and .05 to 5.0 mg/m³ in a mine where

elemental mercury was present. See Ping, "Mercury exposures and symptoms," 112; Bidstrup, *Toxicology and Mercury*, 50; Kishi, "Subjective symptoms," 293; West and Lim, "Mercury poisoning among workers," 697.

29. Salgueiro Barboni, Mirella Telles, Marcelo Fernandes da Costa, et al., "Visual field losses in workers exposed to mercury vapor," *Environmental Research* 107 (2008): 124, 129. The study evaluated thirty-five workers, average age thirty-four years old, who had worked an average of ten years and had left seven and one-half years previously.

30. USEPA, *Mercury Study*, 2-6; D'Itri and D'Itri, *Mercury Contamination*, 15, 123, 142, 205; Schutte et al., "Mercury and its compounds," 551; Bidstrup, *Toxicology and Mercury*, 34; Cobb, "Supply and transportation," 40.

31. Arzáns de Orsúa, *Historia de la Villa Imperial*, 2:190.

32. Arena, *Las minas de azogue del Perú*, 82-83; Caravantes, *Noticia general del Perú*, 4:224; Patiño Paúl Ortiz, *Huancavelica colonial*, 163; Brown, "La crisis filantrópica," 352, 375; Whitaker, & e *Huancavelica Mercury Mine*, 6-7, 104; Roel Pineda, *Historia social y económica*, 105; ABNB, Ruck 249, vol. 3, 166; Richard Garner, "Long-term silver mining trends in Spanish America: A comparative analysis of Peru and Mexico," *American Historical Review* 93, no. 4 (1988): 898; Flynn and Giraldez, "China and the Manila galleons," 71. The approximate total of 26,000 metric tons is computed on the basis of Bakewell, "Registered silver production," 93-100 (for 1574-1735), and Cross, "South American bullion production," 422 (for 1736-1760). To account for 1761-1810, average production from 1736-1760 is extrapolated.

33. ABNB, ALP Minas 112/8, 1; Cañete y Domínguez, *Guía histórica*, 51; Acosta, *Historia natural*, 233; Roel Pineda, *Historia social y económica*, 105; Arena, *Las minas de azogue del Perú*, 82; Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 267; Calancha, *Crónica moralizada*, 5:1679; Luis Válcarcel, "El 'Memorial' del Padre Salinas," in *Memorial de las historias del nuevo mundo Pirú* (Lima: Universidad Nacional Mayor de San Marcos, 1957), xi; Warren Cook, "Fray Buenaventura de Salinas y Cordova. Su vida y su obra," in *Memorial de las historias del nuevo mundo Pirú* (Lima: Universidad Nacional Mayor de San Marcos, 1957), xxxv, xlvi; Gastón Arduz Eguía, *Ensayos sobre la historia de la minería altoperuana* (Madrid: Paraninfo, 1985), 71; Fisher, *Silver Mines and Silver Miners*, 6; Bakewell, "Registered silver production," 80; Cobb, *Potosí y Huancavelica*, 25; Cole, & e *Potosí Mita*, 57; Brown, "La crisis filantrópica," 352, 375; Whitaker, & e *Huancavelica Mercury Mine*, 104; Cross, "South American bullion production," 408.

34. Bakewell, "Registered silver production," 81; ABNB, ALP, Minas 142/1, 1; ABNB, ALP, Minas, 142/2, 1; ABNB, ALP Minas 146/14, 1; ABNB, ALP Minas 142/3, 31; ABNB, ALP Minas 142/4, 1; ABNB, ALP Minas 142; ABNB, ALP LAACH 9:360-61; ABNB, ALP Minas 149/10; ABNB, ALP Minas 137/5; ABNB, ALP Minas 135/3; ABNB, ALP Minas, 135/2; Enríquez de Guzmán, "Relacion que el Conde de Alba hace," 135; Montesinos, *Anales del Perú*, 2:74; Wiedner, "Forced labor in colonial Peru," 369; Lohmann Villena, *Las minas de Huancavelica*, 82.

35. Ramírez, "Descripción del reyno," 348, 353.

36. Cobo, *Historia del Nuevo Mundo*, 1:149.
37. Caravantes, *Noticia general del Perú*, 4:108; Ramírez, “Descripción del reyno,” 352; Cobo, *Historia del Nuevo Mundo*, 1:149; Cobb, *Potosí y Huancavelica*, 102; Bakewell, “Registered silver production,” 80; ABNB, ALP Minas 63/17, 1; Fisher, *Silver Mines and Silver Miners*, 20, 287; ABNB, ALP Minas 142/11, 1; “Relación que la Real Audiencia de Lima hace al exceilentísimo Sr. Marqués de Castel-Dosrius,” 293; Pedro Fernández de Castro y Andrade, Conde de Lemos, “Advertencias que hace el Conde de Lemos a la relación del estado del reino que le entregó la Real Audiencia de Lima del tiempo que gobernó en vacante de virrey que fue de año y más de ocho meses, dirigida a la reina nuestra señora en el real y supremo consejo de Indias,” in *Los virreyes españoles en America durante el gobierno de la casa de Austria. Perú*, vol. 4, ed. Lewis Hanke and Celso Rodríguez (Madrid: IMNASA, 1978), 259; Arzáns de Orsúa, *Historia de la Villa Imperial*, 2:416, 3:30; Fisher, “Silver production in the viceroyalty of Peru,” 287; Brading and Cross, “Colonial silver mining,” 561; Brown, “La crisis fi anciera,” 351.
38. Baltasar de la Cueva, Conde de Castellar, “Relacion general que el Excmo. Señor Conde de Castellar, Marqués de Malagon, Gentilhombre de la Cámara de su Majestad, de su Consejo, Cámara y Junta de Guerra de Indias, Virey, Gobernador y Capitan General que fué de estos Reinos, hace del tiempo que los gobernó, estado en que los dejó, y lo obrado en las materias principales con toda distinction,” in *Memorias de los virreyes que han gobernado el Perú durante el tiempo del coloniaje español*, vol. 1, ed. M. A. Fuentes (Lima: Librería Central de Felipe Bailly, 1859), 186; Fernández de Cabrera, “Relación del estado,” 90; *Memoria sobre la mina de azogue*, 17; Manso de Velasco, “Relacion que escribe el conde de Superunda,” 159, 161; Armendaris, “Relacion del estado de los reynos del Perú,” 162; Navarra y Rocaful, “Relacion del estado del Perú,” 175; Molina Martínez, *Antonio de Ulloa*, 109; Brown, “La crisis fi anciera,” 364–65, 375; Patiño Paúl Ortiz, *Huancavelica colonial*, 14; Lohmann Villena, *Las minas de Huancavelica*, 276; Bakewell, “Registered silver production,” 84; Álvarez de Toledo y Leyva, “Relacion del estado del gobierno,” 172; Fernández de Castro y Andrade, “Advertencias que hace el Conde de Lemos,” 255.
39. Molina Martínez, *Antonio de Ulloa*, 108; Whitaker, *æ Huancavelica Mercury Mine*, 41.
40. “Memoria sobre la mina de azogue de Huancavelica,” 135–36.
41. Arena, *Las minas de azogue del Perú*, 35–36; Fuentes Bajo, “El azogue en las postimerías,” 93; “Memoria sobre la mina de azogue,” 133, B6.
42. Ping et al., “Mercury exposures and symptoms,” 109, 112.
43. Brading and Cross, “Colonial silver mining,” 556.
44. Caravantes, *Noticia general del Perú*, 4:105; Caravantes, *Noticia general del Perú*, 6:97–98, Capoche, *Relación general de la Villa Imperial*, 149–50; Acosta, *Historia natural y moral de las Indias*, 245.
45. Capoche, *Relación general de la Villa Imperial*, 124; ABNB, ALP Minas 41/5, 2; Lohmann Villena, *Las Minas de Huancavelica*, 62; Brading and Cross, “Colonial silver mining,” 556, 570; ABNB, ALP, Minas 17/11, 1–2; Ulloa, *Noticias Americanas*,

243; Bakewell, "Registered silver production," 82; Fisher, *Silver Mines and Silver Miners*, 54–55; Puser, *Metal Mining in Peru*, 50.

46. CNMAH, Cajas Reales 75; CNMAH, CR 810/238; CNMAH, Cajas Reales 554, 17–131, 1717–1734; CNMAH, CR 620, 13–196; CNMAH, CR 721, 9–81; CNMAH, CR 651/247; CNMAH, Cajas Reales 56.

47. Jerome Nriagu, "Legacy of mercury pollution," *Nature* 363, no. 6430 (June 17, 1993), 589.

48. Caravantes, *Noticia general del Perú*, 4:105.

49. I would like to reiterate my profound gratitude to Mark Morris, John Vandenberg, Nicole Hagan, Ted Palma, George Woodall, James Hirtz, James Thurman, and Roger Brode, all of the U.S. Environmental Protection Agency, for their strong support of, and personal dedication to, this project. Without them, this work would never have come to light.

50. AERMOD is an acronym for American Meteorological Society/Environmental Protection Agency Regulatory Model. Detailed information on the AERMOD model is available at http://www.epa.gov/scram001/dispersion_prefrec.htm#aermod (accessed October 30, 2010). For additional information concerning AERMOD, see USEPA, "AERMOD Implementation Guide," available at http://www.epa.gov/scram001/7thconf/aermod/aermod_implmtn_guide_19March2009.pdf (accessed October 30, 2010).

51. While AERMOD can derive elevation and other geographical input data from a program called AERMAP, meteorological data is generally drawn from the AERMET program, which uses one to five years of hourly measured meteorological data. Although situated in the altiplano, both Huancavelica and Potosí lie in valleys that are essentially flat, and as a result this limited the need to use the AERMAP program. As a result of a lack of available long-term measured meteorological data for both Huancavelica and Potosí, the models instead used a new program called MAKEMET. This program generates a matrix of meteorological conditions based on inputs such as the range of ambient temperature and land surface characteristics. When AERMOD is used with MAKEMET meteorological data, the resulting air concentration estimates are maximum one-hour concentrations, which are then extrapolated to estimate chronic levels. For more information on AERMAP, see http://www.epa.gov/scram001/dispersion_related.htm#aermap (accessed October 30, 2010), and for more information on AERMET, see http://www.epa.gov/scram001/metobsdata_procaccprogs.htm#aermet (accessed October 30, 2010).

52. Data from historical maps of Potosí and Huancavelica were transposed onto maps developed by Google Earth. The historical maps include ABNB, Ruck 249, vol. 3, 38; Potosí, 17th Century; map of Huancavelica, at end of Pedro Arena, *Las minas de azogue del Perú* (Lima: Imprenta de "El Lucero," 1901), no page number; Archivo General de Indias (hereafter AGI), Mapas y Planos, Peru y Chile 225.

53. "Health effects," 31; USEPA, *Mercury Study*, 0–2.

54. These model runs were based on the following parameters: A twenty-foot chimney (unless otherwise indicated), 25 percent contraband production, and a 25

percent emissions rate. Please refer to the preceding two sections for a discussion of these values. Smelter locations for all Huancavelica model runs are drawn from the following map of Huancavelica: AGI, Mapas y Planos, Peru y Chile 225. Concerning chimney height, see Toledo, *Ordenanzas*, 343; Bakewell, *Miners of the Red Mountain*, 144. The limited production of mercury in the vicinity of the pithead is incorporated in, and believed to have had a negligible impact on, the total dispersion estimates.

55. The model runs for Potosí were based on a twenty-foot chimney, 25 percent contraband silver production, 15 percent of mercury lost in runoff, and the remaining mercury ultimately being released into the environment either in initial processing or in reprocessing of runoff. Please refer to the preceding two sections for a discussion of contraband values. Because the exact location of the mills is not known, their locations have been evenly spread along the ribera, unless otherwise indicated. Location of the ribera is drawn from Vista de Potosí, Potosí, 17th Century, ABNB, Ruck.249.III.38; Gaspar Miguel de Berrio Bravo, "Descripción del Zerro Rico e Imperial, Villa de Potosí." Museo Colonial Charcas de la Universidad San Francisco Xavier, Sucre, Bolivia. Painting, 1758; Leonardo Olmos, Plano: Ciudad-Potosí, 1:5.000, 1910, CNMAH, MyP-101. For a sensitivity analysis of the Potosí model runs, see Nicole Hagan, Nicholas Robins, et al., "Estimating historical atmospheric mercury concentrations from silver mining and their legacies in present-day soils in Potosí, Bolivia." In *Atmospheric Environment*, in press.

56. Capoche, *Relación general de la Villa Imperial*, 124; Lohmann Villena, *Las Minas de Huancavelica*, 62; Brading and Cross, "Colonial silver mining," 556, 570.

57. Arena, *Las minas de azogue del Perú*, 82–83; Caravantes, *Noticia general del Perú*, 4:224; Patiño Paúl Ortiz, *Huancavelica colonial*, 163; Brown, "La crisis fi anciera," 352, 375; Whitaker, & e *Huancavelica Mercury Mine*, 6–7, 104; Roel Pineda, *Historia social y económica*, 105; Bakewell, "Registered silver production," 93–100; Cross, "South American bullion production," 422.

58. Murua, *Historia general del Perú*, 550.

59. Audiencia de Lima, "Relacion que la Real Audiencia de Lima hace al excelentísimo Sr. Marqués de Castel-Dosrius," 296; Luis de Velasco, "Relación del Sr. Virrey, D. Luis de Velasco," 111–12.

60. Guaman Poma de Ayala, *Nuevo crónica y buen gobierno*, 2:32–33.

61. Lizárraga, *Descripción del Perú*, 210–11.

62. Doña Nieves, "Trabajo y salud en las minas de plata Americanas," 278.

63. Murua, *Historia general del Perú*, 550.

64. Oñate, "Parecer del P. Pedro de Oñate," 141.

65. Oñate, "Parecer del P. Pedro de Oñate," 142, 147.

66. Solórzano y Pereyra, *Política Indiana*, 1:B1; Paulino Castañeda Delgado, "El tema de las minas en la ética colonial española," in *La minería hispana e iberoamericana*, vol. 1 (León, Spain: Cátedra de San Isidoro, 1970), 345.

67. Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 293–94.

68. Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 294–95.

69. D'Itri and D'Itri, *Mercury Contamination*, 127

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71. Sebastián de Sandóval y Guzman, *Pretensiones de la Villa Imperial de Potosí* (Madrid: Biblioteca Nacional de Bolivia, 1634), 50.
72. Acosta, *Historia natural*, 244.
73. Evans, "Mercury," 1001; Llano Zapata, *Memorias histórico*, 218; "Memoria sobre la mina de azogue de Huancavelica," 130; Brown, "Workers' health," 480; José Parés y Franqués, *Catástrophe morboso de las minas mercuriales de la villa de Almadén del azogue (1778)*, ed. Alfredo Menéndez Navarro (Cuenca, Spain: Ediciones de la Universidad de Castilla—La Mancha, 1998), 237.
74. "Health effects," 67, 161, 221, 278; Rowland et al., "The effect of occupational exposure," 28–34; Yeates and Mortensen, "Acute and chronic neuropsychological consequences," 209–10, 218; USEPA, *Mercury Study*, 0-3, 2-6; Kirsten Alcser et al., "Occupational mercury exposure and male reproductive health," *American Journal of Industrial Medicine* 15, no. 5 (1989): 517; S. M. Barlow et al., "Reproductive hazards at work," in *Hunter's Diseases of Occupations*, 8th ed., ed. P. A. B. Raffl et al. (London: E. Arnold, 1994), 729.
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77. Molina Martínez, *Antonio de Ulloa*, 151.
78. Montesinos, *Anales del Perú*, 2:187
79. Montesinos, *Anales del Perú*, 2:187; Ulloa, *Noticias Americanas*, 281; Brown, "Workers' health," 478, 485; Lohmann Villena, *Las Minas de Huancavelica*, 226; Sala Catala, "Vida y muerte," 195, 197, 200; Purser, *Metal Mining in Peru*, 44; Basadre, "El régimen de la mita," 348; Molina Martínez, *Antonio de Ulloa*, 89.
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81. ADC, Fondo Corregimiento, Legajo No. 7, No. 14, Cuaderno 3, 1–3; Toledo y Leiva, "Parecer del P. Manuel Toledo y Leiva," 18; Navarra y Rocaful, "Relacion del estado del Perú," 175; Patiño Paúl Ortiz, *Huancavelica colonial*, 65; Carrasco, *Cronología de Huancavelica*, 154; Contreras, *La ciudad del mercurio: Huancavelica, 1570-1700*, 49; Lohmann Villena, *Las minas de Huancavelica*, 224, 227, 434; Sala Catala, "Vida y muerte," 197.
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84. Parés y Franqués, *Catástrophe morboso*, 123.
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91. Capoche, *Relación general de la Villa Imperial*, 142.
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98. “Descripción o historia geográfica del terreno y lugares comarcanos de Potosí,” 217.
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140. Crespo Rojas, *La Guerra entre vicuñas y vascongados*, 48–54, 59; Helmer, “Luchas entre vascongados y vicuñas,” 187–89.
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142. Martínez y Vela, *Anales de la Villa Imperial*, 96, 102, 112; Crespo Rojas, *La Guerra entre vicuñas y vascongados*, 129, 134, 142–44, 151–53, 155; Helmer, “Luchas entre vascongados y vicuñas,” 191; Arzáns de Orsúa, *Historia de la Villa Imperial*, 1:399, 2:62, 2:98, 2:108, 2:109, 2:17, 2:120–21, 2:133–35, 2:141, 2:147, 2:165, 2:213–16, 2:220, 2:227, 2:231–233, 2:95–96; Cook, *Demographic Collapse*, 239–42.

5. FROM CORROSION TO COLLAPSE

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2. Ramírez, “Descripción del reyno,” 299, 348.
3. ABNB, ALP Minas 129/2, 2–5, 7–8; Mesía Venegas, “Memorial del P. Alfonso Mesía Venegas,” 100, 104–5; Ayans, “Breve relación de los agravios,” 35, 50; ABNB, ALP Minas 63/14, 35; Sarmiento de Sotomayor, “Relación del estado,” 254; Basadre, *El Conde de Lemos*, 140;
4. “Pareceres de los Padres de la Compañía de Jesús de Potosí,” 122.
5. Caravantes, *Noticia general del Perú*, 4:213–14.
6. Patiño Paúl Ortiz, *Huancavelica colonial*, 221.
7. Patiño Paúl Ortiz, *Huancavelica colonial*, 238–44.
8. Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 305; ABNB, Cédulas Reales 438, 1.
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10. Fernández de Castro y Andrade, “Carta del Conde de Lemos a S. M,” 155–56.
11. ABNB, ALP Minas 129.8, 6.

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15. ABNB, EC.1755.91, 2–3; ABNB, EC.1755.44, 1–4; ABNB, EC.1758.22, 1; ABNB, EC.1771.4, 1–3; ABNB, EC.1756.130, 8; Zimmerman, *Francisco de Toledo*, 222.
16. Acosta, *De procuranda salute*, 505.
17. Matienzo, *Gobierno de Perú*, 21–24; Sarmiento de Sotomayor, “Relación del estado,” 87.
18. ABNB, ALP Min 129/16, 1–6, 13, 17, 20–36; ABNB, ALP Minas 128/2, 1; ABNB, ALP Minas 126.20, 3–4, 21; ABNB, EC.1765.77, 1–21; ABNB, ALP Minas 149/3, 2–5, 12–86, 15; ABNB, EC.1755.44, 3–4; ABNB, Ruck 13, 2–7, 13–31, 108–09.
19. ABNB, EC.1755.91, 3.
20. ABNB, ECAD 1771.39, 1.
21. ABNB, ECAD 1771.39, 1.
22. ABNB, EC. 1755.56, 2.
23. ABNB, EC. 1755.56, 2, 8, 57.
24. ABNB, EC. 1755.56, 3–5, 13, 36–84, 78, 96–98, 17; ABNB, EC 1753.125, 1–5; ABNB, EC 1751.10.
25. ABNB, EC.1759.69, 1–3; ABNB, EC.1761.93, 1–4.
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27. Ayans, “Breve relación de los agravios,” 40.
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37. ABNB, EC. 1772.59, 1; Garci Diez de San Miguel, *Visita hecha a la provincia de Chucuito por Garci Diez de San Miguel en el año de 1567*, ed. Waldemar Espinosa Soriano (Lima: Casa de la Cultura del Perú, 1964), 36; Scarlett O’Phelan Godoy, *Rebellions and Revolts in Eighteenth-Century Peru and Upper Peru* (Cologne: Bohlau Verlag, 1985), 99–102, 109.

38. Garci Diez de San Miguel, *Visita hecha a la provincia de Chucuito*, 36; ABNB, EC. 1758.1, 1, 12.

39. ABNB, EC. 1758.1, 2, 6, 12.

40. ABNB, ECAd 1761.10, 22.

41. ABNB, EC Ad 1761.10, 1–4, 27

42. ABNB, ECAd. 1760.4, 1; ABNB, EC. 1759.137, 1, 3–5, 10–11, 46–47.

43. ABNB, EC. 1760.116, 1, 3, 6, 24–36, 81, 86.

44. ABNB, EC. Ad 1767.31, 1.

45. ABNB, EC. Ad 1767.31, 26, 29.

46. ABNB, EC. 1768.60, 2–3, 7.

47. ABNB, EC. 1768.18, 2; ABNB, EC. 1766.20, 1–2, 4, 8, 11, 2730, 31, 33.

48. ABNB, EC. 1758.1, 2, 6, 12.

49. ABNB, ALP Minas 131/10, 1, 3; ABNB, ALP Minas 148/13, 1–2, 8–10, 23.

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51. ABNB, EC. 1759.77, 1.

52. ABNB, EC. 1760.75, 29; Cahill, “Curas and social conflict,” 259, 262. See also Juan and Ulloa, *Discourse and Political Reflections*, 102–25, 280–316, and Nicholas Robins, *Priest–Indian Conflict in Upper Peru: à e Generation of Rebellion, 1750–1800* (Syracuse, N.Y.: Syracuse University Press, 2007), 47–76.

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CONCLUSION

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9. ABNB, ALP Minas 149/14, 1; ALP, Minas 127/12,1; ABNB, ALP Minas 127/2, 1–2; Ayans, “Breve relación de los agravios,” 36–39; Mesía Venegas, “Memorial del P. Alfonso Mesía Venegas,” 120; Arias de Ugarte, “Carta a S. M.,” 364; Caravantes, *Noticia general del Perú*, 2:84; Guaman Poma de Ayala, *Nueva crónica y buen gobierno*, 333; Oñate, “Parecer del P. Pedro de Oñate,” 143; Liñan y Cisneros, “Relacion de Don Melchor de Liñan y Cisneros,” 305; Luis de Velasco, “Relación del Sr. Virrey, D. Luis de Velasco,” 109; Victorián de Villaba, “Vista del fiscal Victorían de Villaba, sobre los abusos de la mita,” lvii; “Pareceres de los Padres de la Compañía de Jesús de Potosí,” 120–21; Fisher, *Silver Mines and Silver Miners*, 10; Castañeda Delgado, “Un capítulo de ética Indiana española,” 815; Wiedner, “Forced labor in colonial Peru,” 368, 372; Choque Canqui, “El papel de los capitanes,” 120–21, 124; Cañedo-Arguelles Fábrega, *Potosí: La version aymará de un mito europeo*, 81, 83–85; Sánchez Albornoz, *Indios y tributos*, 70; Sánchez Albornoz, “Mita, migraciones y pueblos,” 37; Buechler, *& e Mining Society of Potosí*, 44; Saignes, “Las etnias de Charcas,” 28; Cook, *Demographic Collapse*, 210; Evans, “Census enumeration,” 27; Cole, *& e Potosí Mita*, 26–27.

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11. Guaman Poma de Ayala, *Nueva crónica y buen gobierno*, 333; Crespo Rojas, “La ‘mita’ de Potosí,” 172, 179–80; Crespo Rojas, “El reclutamiento y los viajes,” 473–74; Lohmann Villena, *Las minas de Huancavelica*, 460; Patiño Paúl Ortiz, *Huancavelica colonial*, 39; ABNB, ALP Minas 127/20, 1; Arias de Ugarte, “Carta a S. M.,” 363, 365; Matienzo, *Gobierno de Perú*, 80; Ayans, “Breve relación de los agravios,” 37; Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 283; ABNB, ALP Minas 129.8, 2, 9; Fernández de Castro y Andrade, “Carta del Conde de Lemos a S. M.” 156, 158; ABNB, ALP Minas 130/1, 41; Basadre, *El Conde de Lemos*, 133; Choque Canqui, “El papel de los capitanes,” 123; Tandeter, “Forced and free labor,” 128; Tandeter, *Coercion and Market*, 68–69; Buechler, *& e Mining Society of Potosí*, 138; Cole, *& e Potosí Mita*, 36, 92; Saignes and Loza, “Pleito entre Bartolomé Qhari,” 36–37; Cañedo-Arguelles Fábrega, *Potosí*, 73–74, 78–79; ABNB, ALP Minas 129.8, 8; Capoche, *Relación general de la Villa Imperial*, 146; ABNB, ALP Minas 127/5, 1, 8, 15, 22, 27, 29, 37; Manso de Velasco, “Relacion que escribe el conde de Superunda,” 184; ABNB, ALP Minas 125/2; ABNB, ALP Min 151/1, 2–5; ABNB, ALP Minas 127/2.

12. Petición que presenta don José Sáenz de Mendoza, minero y azoguero de la villa de Huancavelica, 1–3; Ayans, “Breve relación de los agravios,” 60; Arias de Ugarte, “Carta a S. M.,” 361; Acosta, *Historia natural y moral de las Indias*, 235; Mendoza y Luna, “Relación del estado,” 38; Cañete y Domínguez, *Guía histórica*, 1B; Basadre, *El Conde de Lemos*, 134–36; Basadre, “El régimen de la mita,” 346; Crespo Rojas, “La ‘mita’ de Potosí,” 173–74; Bakewell, *Miners of the Red Mountain*, 153; Tandeter, *Coercion and Market*, 41, 127

13. Audiencia de Lima, “Audiencia de Lima al Señor Virrey Conde de Lemos, que le entró á gobernar en 21 de noviembre de 1667,” 202; Navarra y Rocaful, “Relacion del estado del Perú,” 166; “Memoria sobre la mina de azogue de Huancavelica,” 129, 131, 133–34, 136; Brown, “Workers’ health,” 480–83, 490, 495; Purser, *Metal Mining in Peru*, 44; Patiño Paúl Ortiz, *Huancavelica colonial*, 137; Lohmann Villena, *Las minas de Huancavelica*, 333, 353; Molina Martínez, *Antonio de Ulloa en Huancavelica*, 89.

14. Pedro Muñiz, “El Dr. Muñiz de Lima sobre el serujo de los Indios,” in “Pedro Muñiz, Dean of Lima and the Indian Labor Question (1603)” by K. V. Fox, *Hispanic American Historical Review* 42, no. 1 (1962): 76.

15. Muñiz, “El Dr. Muñiz de Lima,” 83.

16. Muñiz, “El Dr. Muñiz de Lima,” 85.

17. Agia, *Servidumbres*, 62.

18. “Memoria sobre la mina de azogue de Huancavelica,” 90, 1B; Molina Martínez, *Antonio de Ulloa*, 82; Fisher, *Silver Mines and Silver Miners*, 92; Lohmann Villena, *Las minas de Huancavelica*, 242, 253, 330–33, 353, 382; Brown, “Workers’ health,” 485.

19. ABNB, CPLA, vol. 20, 264; ABNB, CPLA, vol. 12, 305; ABNB, ALP Minas, 123/2, 1; Mendoza y Luna, “Relación del estado,” 45–47; Montesinos, *Anales del Perú*, 2:94; Murua, *Historia general del Perú*, 550; Acosta, *Historia natural y moral*

de las Indias, 245; Bargallo, *La amalgamación*, 344; Patiño Paúl Ortiz, *Huancavelica colonial*, 160; Cobb, *Potosí y Huancavelica*, 112–1, 17–18; Cobb, “Supply and transportation,” 40, 42; Platt, “Container transport,” 7, 12, 22–23, 25; Dobado González, “Las minas de Almadén, el monopolio del azogue,” 435.

20. Arzáns de Orsúa, *Historia de la Villa Imperial*, 1:66.

21. ABNB, ALP Min 131/7 1–3; Ayans, “Breve relación de los agravios,” 60; Arias de Ugarte, “Carta a S. M.,” 361; ABNB, ALP Minas 15/1, 19, 97; Brown, “Workers’ health,” 471; Buechler, “Technical aid to Upper Peru,” 53; Platt, “The alchemy of modernity,” 3.

22. CNMAH, CGI/M-65/14, 1; ABNB, ALP Minas 129/3, 1–2; Brown, “Workers’ health,” 475; Bakewell, *Miners of the Red Mountain*, 148–49; ABNB, ALP Minas 129.8, 9; CNMAH, CGI/M-65/14, 1; Tandeter, *Coercion and Market*, 54.

23. Cañete y Domínguez, *Guía histórica*, 1B; Tandeter, *Coercion and Market*, 39–42, 46.

24. ABNB, CPLA, vol. 8, 128; Torres de Portugal, “Memoria gubernativa,” 212; Mendoza y Luna, “Relación del estado,” 43; Capoche, *Relación general de la Villa Imperial*, 152; Ramírez, “Descripción del reyno,” 348; Baquijano, “Historia del descubrimiento,” 43; Ulloa, *Noticias Americanas*, 255; Carrión de la Vadera, *El Lazarillo*, 110; Cañete y Domínguez, *Guía histórica*, 58; Lohmann Villena, *Las minas de Huancavelica*, 441; Cole, à e Potosí Mita, 14, 63; Zulawski, à ey Eat from à eir Labor, 112; Bakewell, *Miners of the Red Mountain*, 79; Tandeter, *Coercion and Market*, 85, 90–92; Tandeter, “Mineros de week-end,” 37–40, 43; Tandeter, “Forced and free labor,” 135; Martire, “Tolerancias, prevenciones y regulación participadora,” 296, 301–3; Brading and Cross, “Colonial silver mining,” 567.

25. Caravantes, *Noticia general del Perú*, 4:224; Arena, *Las minas de azogue del Perú*, 82–83; Lohmann Villena, *Las minas de Huancavelica*, 485–87; Bakewell, “Registered silver production,” 84, 93–100; Patiño Paúl Ortiz, *Huancavelica colonial*, 163; Brown, “La crisis fi anciera,” 352, 375; Whitaker, à e *Huancavelica Mercury Mine*, 6–7, 104; Roel Pineda, *Historia social y económica*, 105.

26. Brown, “Workers’ health,” 480.

27. Matienzo, *Gobierno de Perú*, 135; Patiño Paúl Ortiz, *Huancavelica colonial*, 213; Juan Pérez Tudela y Bueso, “El problema moral en el trabajo minero del indio (siglos XVI y XVII),” in *La minería hispana e iberoamericana*, vol. 1 (Leon, Spain: Cátedra de San Isidoro, 1970), 364.

28. Acosta, *De procuranda indorum salute*, 525; Avendaño, à esaurus Indicus, 257; “Pareceres de los Padres de la Compañía de Jesús de Potosí,” 118; Casteñeda Delgado, “Un capítulo de ética Indiana española,” 878–89.

29. ABNB, EC.1758.22, 1–2; ABNB, ALP Min 129/16, 1–6, 13, 17, 20–36; ABNB, ALP Minas 128/2, 3–4, 21; ABNB, EC.1765.77, 1–21; ABNB, ALP CACh 1322, 1–2, ABNB, EC.1755.44, 3–4; ABNB, EC.1755.91, 2–3; ABNB, EC.1755.44, 1–4 ABNB, EC. 1771.74, 1–3; ABNB, EC.1756.130, 8; ABNB, ALP Minas 152/10, 16, 41; Ayans, “Breve relación de los agravios,” 39, 41, 53–55; Mesía Venegas, “Memorial del P. Alfonso Mesía Venegas,” 104; “Pareceres de los Padres de la Compañía,” 122; Toledo

y Leiva, "Parecer del P. Manuel Toledo y Leiva," 182; Pedro Fernández de Castro, Conde de Lemos, "Carta del Conde de Lemos a S.M. sobre la Mita de Potosí," in *Pareceres jurídicos en asuntos de indias (1601–1788)*, edited by Ruben Vargas Ugarte (Lima: CIP, 1951), 58; Zimmerman, *Francisco de Toledo*, 222.

30. ABNB, EC.1758.1, 2, 6, 12; ABNB, EC Ad 1761.10, 22; ABNB, ALP Minas 147.4, 1–3; ABNB, ALP Minas 96/5, 1–2; ABNB, EC.1772.59, 1; ABNB, ECAd.1760.4, 1; ABNB, EC.1760.116, 1, 3, 6, 34–36, 81, 86; Garcí Diez de San Miguel, *Visita hecha a la provincia de Chucuito*, 36; O'Phelan Godoy, *Rebellions and Revolts*, 25, 47–48, 71–72, 99–102, 109, 111, 119.

31. ABNB, EC.1776.186, 1; ABNB, EC.1760.75, 29; ABNB, EC.1754.49, 1–3; ABNB, EC.1772.104, 4; Luis Belsu, Acchilla, ABAS, Archivo Arzobispal, Clero, Acusaciones, 4; Antonio Risco, ABAS, Archivo Arzobispal, Clero, Acusaciones, 2; "Representación de la ciudad del Cusco," 36–37, 46–49; Pablo de Arcos, ABAS, Archivo Arzobispal, Clero, Acusaciones, 1, 2; Juan and Ulloa, *Discourse and Political Reflections*, 104–5; Celestino and Meyers, *Las Cofradías en el Perú*, 125, 134, 136; David Cahill, "Curas and social conflict," 244, 259, 262; Cahill, "Popular religion and appropriation," 67–11; Serulnikov, "Customs and rules," 254; Robins, *Priest–Indian Conflict*, 24–26, 28–31, 35–41.

32. ABNB, EC.1758.148, 1–3; ABNB, EC.1757.36, 1; ABNB, ALP Minas 151/12, 2, 8–10, 14, 16–18; *Provisión Real para que el Corregidor guarde, cumpla y ejecute lo que se ordena en este auto con respecto a los indios yanaconas*, La Plata, November 8, 1762; ABNB, EC.1762.29, 2; ABNB, EC.1756.40, 1–3, 5–7, 14–15; ABNB, EC.1751.9, 1–2, 4–7

33. Robins, *Priest–Indian Conflict*, 154–69.

34. Robins, *Priest–Indian Conflict*, 154–68.

35. Cañete y Domínguez (attributed), "Contestación al discurso 138; Buechler, à e Mining Society of Potosí, 139, 145, 156, 162–64, 170–71, 175, 181, 184; ABNB, ALP Minas 129.8, 4–5; Villaba, "Vista del fiscal Victorián de Villaba, sobre la servidumbre de los indios," lv; ABNB, ALP Minas 129/171, 1; ABNB, ALP Minas 130/6, 2; ABNB ALP Minas 130/8, 1, 4, 9; Levene, *Vida y obra de Victorián de Villaba*, 19–23.

36. Charles Gibson, introduction to à e *Black Legend: Anti-Spanish Attitudes in the Old World and the New*, ed. Charles Gibson (New York: Alfred A. Knopf, 1971), 8–10, 13, 24. Although the debate dates from the time of the conquest, the term "black legend" was coined by Julián Juderías y Loyot in his work *La leyenda negra: Estudios acerca del concepto de España en el extranjero* (Barcelona: Editorial Araluce, 1914). See also Rómulo D. Carbia's *La historia de la leyenda negra hispanoamericana* (Buenos Aires: Ediciones Orientación Española, 1943).

37. Benjamin Keen, "The black legend revisited: Assumptions and realities," *Hispanic American Historical Review* 49, no. 4 (November 1969): 703–19; Lewis Hanke, "A modest proposal for a moratorium on grand generalizations: Some thoughts on the black legend," *Hispanic American Historical Review* 51, no. 1 (1971): 112–27; Benjamin Keen, "The white legend revisited: A reply to Professor Hanke's 'Modest Proposal,'" *Hispanic American Historical Review* 51, no. 2 (1971): 336–55; Joseph P.

Sánchez, “The Spanish black legend: Origins of anti-Hispanic stereotypes,” Spanish Colonial Research Center Publication Series no. 2 (Albuquerque: National Park Service, 1990). For the origin of the black legend, see Bartolomé de Las Casas, *Apologética Historia Sumaria*, ed. Edmundo O’Gorman, 2 vols. (Mexico City: Universidad Nacional Autónoma de México, 1967), as well as his *Brevísima Relación de la Destrucción de las Indias*, ed. Isacio Pérez Fernández (Bayamón, Puerto Rico: Universidad Central de Bayamón, 2000).

38. Michael A. McDonnell and Dirk Moses, “Rafael Lemkin as historian of genocide in the Americas,” *Journal of Genocide Research* 7, no. 4 (December 2005): 501; Rafael Lemkin, *Axis Rule in Occupied Europe* (Washington, D.C.: Carnegie Council, 1944), 79, 514.

39. Frank Chalk and Kurt Jonassohn, “The conceptual framework,” in *The History and Sociology of Genocide: Analyses and Case Studies*, ed. Frank Chalk and Kurt Jonassohn (New Haven, Conn.: Yale University Press, 1990), 10. The United Nations defines genocide as such “acts committed with intent to destroy, in whole or in part, a national, ethnical, racial or religious group, as such: (a) Killing members of the group; (b) Causing serious bodily or mental harm to members of the group; (c) Deliberately inflicting on the group conditions of life calculated to bring about its physical destruction in whole or in part; (d) Imposing measures intended to prevent births within the group; (e) Forcibly transferring children of the group to another group.”

40. ABNB, Cédulas Reales 300, 1; Arzáns de Orsúa, *Historia de la Villa Imperial*, 2:169; Barnadas, *Charcas*, 149; Lockhart, *Spanish Peru*, 155; Castañeda Delgado, “Un capítulo de ética Indiana española,” 822; Hanke and Mendoza, “Bartolomé Arzáns de Orsúa y Vela,” 169; Gómez Rivas, *El virrey del Perú*, 152–53.

41. Stavig, *à la World of Túpac Amaru*, 22.

42. Cook, *Demographic Collapse*, 25, 89, 253; Zulawski, “Wages, ore sharing and peasant agriculture,” 415; Zulawski, *à la Eat from à lair Labor*, 67; Bonilla, “1492 y la población indígena,” 110; Nelson Manrique, *Colonialismo y pobreza campesina. Caylloma y el valle de Colca, siglos XVI–XX* (Lima: Desco, 1985), 138.

43. Pierre Duviols, *La destrucción de las religiones andinas* (Conquista y colonia) (Mexico City: UNAM, 1977), 9, 249–59, 373–77, 405–18, 422–24, 430; McDonnell and Moses, “Rafael Lemkin as historian of genocide in the Americas,” 508, 511, 54.

44. Nicholas Griffiths, *à la Cross and the Serpent: Religious Repression and Resurgence in Colonial Peru* (Norman: University of Oklahoma Press, 1996), 161, 245; Robins, *Priest–Indian Conflict*, 69–76.

45. ABNB, ALP Minas 146/12, 1–5; Salinas y Córdoba, *Memorial de las historias del nuevo mundo Pirú*, 295–96; ABNB, EC.1773.22, 1, 5–8, 15–17, 24; ABNB, EC.174.140, 1–3; ABNB, EC.1775.5, 1–2; ABNB, EC.1775.8, 1–2; ABNB, EC.1777.77b, 1–3; ABNB, EC. 1777.107, 2–4; ABNB, EC.1777.151, 1–2, 4–7; ABNB, EC.1777.181, 4–13; ABNB, EC.1779.219, 3; ABNB, EC.1774.99.

46. ABNB, CACH 728, 5; Fernández de Castro y Andrade, “Carta del Conde de Lemos a S. M.,” 158, 161; Mesía Venegas, “Memorial del P. Alfonso Mesía Venegas,”

100; "Pareceres de los Padres de la Compañía de Jesús de Potosí," 19; Muñiz, "El Dr. Muñiz de Lima," 76; Ayans, "Breve relación de los agravios," 43; Caravantes, *Noticia general del Perú*, 4:214; Cook, *Demographic Collapse*, 251; Manuel Ballesteros-Gaibrois, "Notas sobre el trabajo minero en los Andes, con especial referencia a Potosí (Siglos XVI y SS)," in *La minería hispana e iberoamericana*, 1:53; Doña Nieves, "Trabajo y salud en las minas de plata Americanas," 278.

47. Fernández de Castro y Andrade, "Carta del Conde de Lemos a S. M.," 158; "Pareceres de los Padres de la Compañía de Jesús de Potosí," 19; Bakewell, *Miners of the Red Mountain*, 110; Crespo Rojas, "La 'mita' de Potosí," 169; Sánchez Albornoz, "Mita, migraciones y pueblos," 42; Manrique, *Colonialismo*, 138; Cook, *Demographic Collapse*, 251.

48. Some writers, substituting historical research for polemic objectives, have asserted that up to 8,000,000 people perished in the mines of Potosí. Not only do they largely ignore the role of disease, but they confuse flight from communities to avoid the mines and mills with death in them. See, for example, Eduardo Galeano, *Las venas abiertas de América Latina* (Mexico City: Ediciones Siglo Veintiuno, 1971), 49, 59; K. G. Simon, "The man-eating mountain," in *Geo* 1 (1979): 76; Cañedo-Arguelles Fábrega, *Potosí: La versión aymará de un mito europeo*, 45; Manrique, *Colonialismo*, 138; and Roel Pineda, *Historia social y económica*, 83, 85–86. In a similar manner, other authors who attribute more weight to forced labor and abuses relative to disease include David Stannard, *American Holocaust: Columbus and the Conquest of the New World* (New York: Oxford University Press, 1992), and Ward Churchill, *A Little Matter of Genocide: Holocaust and Denial in the Americas 1492 to the Present* (San Francisco: City Lights Books, 1997).

49. Bakewell, *Miners of the Red Mountain*, 148–49.

50. Bakewell, *Miners of the Red Mountain*, 146; Manrique, *Colonialismo*, 138; Roel Pineda, *Historia social y económica*, 83; Doña Nieves, "Trabajo y salud en las minas de plata americanas," 278.

51. Cook, *Demographic Collapse*, 208; C. T. Smith, "Depopulation of the Central Andes in the 16th century," *Current Anthropology* 11, nos. 4–5 (1970): 460; Cole, *à la Potosí Mita*, 26.

52. These would come under the categories of what Lemkin referred to as cultural, physical, and biological genocide; see McDonnell and Moses, "Rafael Lemkin as historian of genocide in the Americas," 504.

53. Sánchez Albornoz, *Indios y tributos en el Alto Perú*, 73; Carlos Sempat Assadourian, "La crisis demográfica del siglo XVI y la transición del Tawantinsuyo al sistema mercantil colonial," in *Población y mano de obra en América Latina*, ed. Nicolás Sanchez Albornoz (Madrid: Alianza Editorial, 1985), 74; Zulawski, *à la Eat from à lair Labor*, 63–66.

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