

Amalgamated Histories: Tracing Quicksilver's Legacy through Environmental and Political Bodies in Andean and Amazonian mining

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Abstract

Agricola recounts how in antiquity the Romans used liquid mercury to concentrate fine particles of gold found in low grade ore and gold-bearing alluvial sediment. This ancient extractive technology continues in various forms today, practiced around the globe in artisanal and small-scale gold mining. This article argues that the history of mercury-gold amalgamation mining is crucial to contemporary debates in the Global North surrounding mercury pollution stemming from artisanal and small-scale gold mining in the Global South. We do so by interrogating the history of the development and spread of mercury amalgamation in Latin America. Drawing from archival, ethnographic, and scientific research together with historical findings that examine Spanish colonial and Indigenous metallurgical knowledge, we resituate the history of mercury amalgamation mining in Latin America, focusing on the Colombian Andes and the Peruvian Amazon – two regions where mercury pollution from artisanal and small-scale gold mining provokes international concern. Mercury amalgamation has a long history, particularly in countries once part of the Spanish empire, and colonial subjects made significant contributions to what was framed as early modern European metallurgical innovation, an assertion that we upend. We identify the harm caused by overlooking the untold histories of the mercury amalgamation process and the European contribution to global mercury emissions rooted in these histories by critically examining the curation of presentist histories in UNESCO's memorialisation of mercury mines as World Heritage Sites, such as the mining park at Almadén in Spain, that also underpin initiatives by the United Nations to bring about a "mercury-free world." We show how the ahistorical narratives that are crafted around mercury and gold, advanced through heritage sites and by policy makers, contribute to the criminalization of artisanal and small-scale gold miners, not only in Perú and Colombia but also worldwide, in the name of environmental preservation. Our findings present an important first step in bringing to light histories of mercury and gold in the hands of artisanal and small-scale gold mining in Latin America.

Introduction

Agricola recounts how, in antiquity, the Romans used liquid mercury to concentrate fine particles of gold found either in low grade ore or gold-bearing alluvial sediment.² This mercury-gold amalgamation mining technology continues in various forms around the globe today. Its main practitioners are involved in artisanal and small-scale gold mining. The United Nations Environment Programme's Minamata Convention on Mercury defines artisanal and small-scale gold mining (often referred to by the acronym, ASGM) "as gold mining conducted by individuals or small enterprises with limited capital investment

¹ The authors have co-written the Introduction, Part 1, the opening section of Part 2, and the concluding remarks. Jimena Diaz Leiva wrote the section on current day Perú and Sebastián Rubiano-Galvis the section on current day Colombia.

² Agricola, *De Re Metallica*, Translated by H. Hoover (New York: Kessinger Publishing, 1912).

and production.”³ In Latin America, the mercury amalgamation technique enabled the exploitation of gold and silver mines for over three hundred years, during European colonialism. According to Peruvian historians and archeologists as well as recent scholarship from US geologists, mercury amalgamation was also used by certain Indigenous populations in the pre-colonial period. Today, the persistence of this technique and its widespread use in artisanal and small-scale gold mining today has become the target of international efforts to phase it out. The United Nations intends to eliminate all anthropogenic mercury emissions in a treaty known as the Minamata Convention on Mercury, signed in 2013 after four years of negotiation. In efforts to promote adoption of the Convention, which purports to bring about a mercury-free world, gold miners have been made the subject of narratives that sideline long histories of the use of mercury amalgamation and cast blame on miners for bringing about ecological destruction through mercury pollution. At the same time, the memorialisation of mercury mines named as World Heritage Sites also present a detrimental appropriation of history that fails to acknowledge the long legacy of environmental harm caused by mercury use and extraction in the Americas, before and during European colonization.

This article presents a critical examination of the use of history in relation to the environment. We argue that the lesser known (but no less documented) history of mercury amalgamation that includes pre-colonial Andean peoples, Spanish conquistadors, and colonized peoples in Latin America is crucial to debates surrounding current concerns of global mercury pollution. We do so by interrogating the history of the development and spread of mercury amalgamation in Latin America. Drawing from archival, ethnographic, and scientific research together with historical findings on Spanish colonial and Indigenous metallurgical knowledge, we resituate the history of mercury amalgamation in Latin America, focusing on the Colombian Andes and the Peruvian Amazon, two regions where mercury pollution from artisanal and small-scale gold mining provokes international concern. Mercury amalgamation with gold as well as silver has a long history, particularly in countries once part of the Spanish empire. Colonized subjects contributed to what was deemed solely a European metallurgical invention, an assertion we upend. We contend that the UN’s aspiration to bring about a mercury-free world through a multilateral agreement and UNESCO’s memorialisation of Almadén’s mercury mines as a World Heritage Site overlook untold histories of the mercury amalgamation process that precede the current, often violent interventions in the sector of artisanal and small-scale gold mining. These ahistorical narratives contribute to the criminalization of artisanal and small-scale gold miners, not only in Perú and Colombia, but also worldwide.

³ Planet Gold, “ASGM 101: A Primer on Mercury Use in Artisanal and Small-Scale Gold Mining”: <https://www.planetgold.org/asgm-101> (accessed 13 February 2023).

In 2017, Geneva hosted the first Conference of the Parties (COP-1)⁴ to the UN Minamata Convention on Mercury. The COP-1 brought together over one hundred and sixty countries to address the elimination of mercury pollution; an event heralded by organisers as a landmark display of international cooperation. There, attendees entered an art installation prominently situated outside the United Nations Palais des Nations designed as a giant inflatable dome constructed using a silver-coloured material intended to symbolize the “last drop of mercury in the world.”⁵ [Figure 1] Photographs depicting artisanal and small-scale gold miners were placed outside the installation to symbolize the “human face” of mercury pollution. These miners commonly use the application of liquid mercury to concentrate fine particles of gold, an extraction technique termed mercury amalgamation, and they work with varying kinds of tools and machinery. They are currently identified as the principal source of anthropogenic mercury emissions. COP-1 of the Minamata Convention issued statements pinpointing artisanal and small-scale gold mining as an impediment to a mercury-free world, with the deputy director of the United Nations Environment Programme (UNEP) citing Colombia as one of the critical sites where international mercury governance should be enacted. The two subsequent COP meetings also gave special prominence to artisanal and small-scale gold mining, using images of miners employing mercury in Madre de Dios, Perú in slideshows and videos during UN events to illustrate the environmental damage they perpetrated. While anthropogenic emissions also stem from other industrial activities, such as coal combustion and chlorine production, artisanal and small-scale gold mining stands in the spotlight for policymakers: UNEP estimates that artisanal and small-scale gold mining accounts for 38% of the planet’s overall mercury pollution.⁶ Countries with substantial artisanal and small-scale gold mining activity like Perú and Colombia have become central to the narrative of artisanal gold miners perpetuating global harm through mercury amalgamation.

⁴ A Conference of the Parties or COP is the periodic meeting that signatories to an international treaty hold to review the treaty’s implementation, discuss amendments, and address administrative matters like funding or financial assistance. The Minamata Convention COP-1 was held in 2017 in Geneva.

⁵ UNEP, “First Meeting of the Conference of the Parties to the Minamata Convention on Mercury (COP-1),” Geneva, Switzerland (24–29 September 2017): <https://www.mercuryconvention.org/en/meetings/cop1> (accessed 22 December 2022).

⁶ UNEP, “Historic Milestone Reached in Global Fight Against Mercury Pollution”: <https://www.unep.org/news-and-stories/press-release/historic-milestone-reached-global-fight-against-mercury-pollution> (accessed 3 January 2023).



Figure 1. The mercury “last drop” on display outside the Palais des Nations in Geneva, Switzerland.

Photo by Sebastián Rubiano-Galvis

The COP-1 “last drop of mercury” art installation is part of the Minamata Convention’s broader vision for a mercury-free world. The Minamata Convention’s framing of an idyllic, mercury-free future as a break from mercury’s volatile past aligns with ways this element is commemorated in elite international society, seen, for example, in the designation of one of the most important sites for mercury mining in the world as a European cultural asset. The area around Almadén, Spain holds the world’s largest reserves of cinnabar (mercuric sulfide), the mineral from which mercury is extracted. Since Roman times, an estimated 250,000 tons of mercury have been extracted from Almadén – put another way, Almadén accounts for approximately one-third of all mercury ever mined across two thousand years of operation.⁷

In 2012, just one year before the treaty of the Minamata Convention on Mercury was introduced,⁸ UNESCO designated the Almadén Mining Park as a World Heritage Site because of its “international significance,” and for the role mercury from Almadén played in “the working of gold and silver mines in America,”⁹ language that obfuscates the role of mercury in the Iberian colonization of Indigenous people during the early modern period. There is a stark irony in elevating European mercury mines to the status of World Heritage Sites, celebrated for driving world progress, while characterising Latin American countries as mercury polluters through artisanal and small-scale gold mining activity. In doing so, international policymakers and organizations craft a gold-mercury narrative that valorises European

⁷ Pablo Higuera, Roberto Oyarzun, Harald Biester, Javier Lillo, Saturnino Lorenzo, “A First Insight into Mercury Distribution and Speciation in Soils from the Almadén Mining District, Spain,” *Journal of Geochemical Exploration*, 80 (2003): 95–104 and John E. Gray, Michael J. Pribil, Pablo L. Higuera, “Mercury Isotope Fractionation during ore Retorting in the Almadén Mining District, Spain,” *Chemical Geology*, 357 (2013): 150–57.

⁸ While the first Conference of Parties (COP-1) occurred in 2017, the agreement to create the treaty came in 2013.

⁹ UNESCO, “Heritage of Mercury”: <https://whc.unesco.org/en/list/1313/> (accessed 22 December 2022).

achievement and belies the history of the development and use of mercury amalgamation around the Atlantic Ocean and the Americas, and also conceals the politics of metallurgical knowledge production and circulation that the transit of gold and mercury engenders. Almadén embodies these entangled histories as it marks a point of origin from where some of the “first drops of mercury” spread around the globe. UNESCO’s unproblematic memorialisation of Almadén, its lack of recognition of Almadén’s millennia-long contribution to mercury pollution, stands in sharp contrast to its participation in the creation of narratives surrounding the artisanal and small-scale gold miners from the Global South who are held responsible as culprits in a toxic global economy.¹⁰

In complicating such narratives of responsibility given to artisanal and small-scale gold mining activity in South America’s Andean and Amazon regions, a clearer picture of mercury-gold histories comes into relief. The persistence of mercury amalgamation in South America is better understood as part of a larger historical global ecology of power comprised of exchanges and merging of various sources of mineralogical knowledge at both sides of the Atlantic, of specific initiatives to improve mining in Colombia and Perú in the name of empire, Enlightenment, and modernization, and ways in which these legacies factor into the integration of the young Latin American nations into global markets. Such processes had reverberations in multiple fields of knowledge and practice in postcolonial landscapes, including exclusionary implications for Indigenous and non-European traditions of mining and metallurgy.¹¹ It is not just written histories that shape our understanding of who is responsible for mercury pollution. Landscapes also tell these stories. Places like Almadén in Spain and Huancavelica in Perú – two of the largest cinnabar deposits in the world – testify to ways in which the production and circulation of ideas, technologies, and materials made the mercury amalgamation technique a crucial component of the European colonial project of resource extraction to support empire-building and its economic maintenance. Examined together, Almadén and Huancavelica expand conversations about ecologies of power, knowledge, and culpability in mercury amalgamation and contamination. Such conversations are needed to critically interrogate the reputation that artisanal and small-scale gold miners have acquired for destroying the environment and rendering it a wasteland. While we acknowledge the deleterious consequences of mercury use for human and environmental health in artisanal and small-scale gold mining, we challenge the politics of blame surrounding “ASGM” in asking: What of the corporations and government bodies who buy the gold, stimulating, and maintaining, its global demand? The modern-day

¹⁰ Ruth Goldstein, “Life in Traffic: Riddling Field Notes on the Political Economy of ‘Sex’ and Nature,” *Cultural Anthropology* 37 (2022): 251–85.

¹¹ See Ralph Bauer, *The Alchemy of Conquest: Science, Religion, and the Secrets of the New World*, (Charlottesville, VA: University of Virginia Press, 2019) and Allison Margaret Bigelow, *Mining Language: Racial Thinking, Indigenous Knowledge, and Colonial Metallurgy in the Early Modern Iberian World* (Chapel Hill: University of North Carolina Press, 2020).

circulation of gold from Latin America is to the Global North as it was during the colonial period. The miners, like their colonized forebears, are seen as incapable of knowing about mercury toxicity or of protecting the ecosystems in which they mine.

Current discussions around mercury amalgamation foreground a flattened view of history in presenting narratives of harm perpetrated against bodies and environments through continued use of mercury amalgamation by artisanal and small-scale gold mining. Indeed, there is a massive body of policy and academic literature about mercury amalgamation and its effects on waterways, soil ecology, and human life.¹² This corpus of research into artisanal and small-scale gold mining sites generally attributes the persistence of mercury amalgamation to such factors as the miners' lack of technological capacity and innovation,¹³ the cultural or social conditions of reception or rejection of mercury-free processing techniques,¹⁴ informality and poverty,¹⁵ or the artisanal miners' situated historical development of locally appropriate mining methods.

We advance two lines of analysis that call into question such ahistorical depictions of artisanal and small-scale gold mining: first, we reappraise the historiography of mining in South America that attends to Indigenous or colonized people's metallurgical knowledge and practices;¹⁶ and second, we present recent research using mercury stable isotopes to enable a reconstruction of the history of mercury releases.¹⁷ We argue that in rethinking the characterisation of mercury amalgamation as an irresponsible practice by modern-day artisanal and small-scale gold mining – i.e. an extraction technique used only by careless miners who create “disabled” wastelands that can no longer sustain life or the reproduction of life – mercury *itself* must be understood as a material symbol of empire and the project of modernization in the mining sector, and as a symbol of the technological achievement of European science and engineering. While the Spanish brought to the Americas much of the mercury that sustained colonial silver extraction during the early modern period, they were not the sole bearers of the knowledge of how

¹² See for example Louisa J. Esdaile and Justin M. Chalker, “The Mercury Problem in Artisanal and Small-Scale Gold Mining,” *Chemistry – A European Journal*, 24.27 (2018): 6905–16; Herman Gibb and Keri Grace O’Leary, “Mercury Exposure and Health Impacts among Individuals in the Artisanal and Small-Scale Gold Mining Community: A Comprehensive Review,” *Environmental Health Perspectives*, 122.7 (2014): 667–72.

¹³ Jennifer J. Hinton, Marcello M. Veiga, and A. Tadeu C. Veiga, “Clean Artisanal Gold Mining: A Utopian Approach?” *Journal of Cleaner Production*, 11 (2003): 99–115.

¹⁴ Marieke Heemskerk, “Collecting Data in Artisanal and Small-Scale Mining Communities: Measuring Progress Towards More Sustainable Livelihoods,” *Natural Resources Forum*, 29 (2005): 82–7.

¹⁵ Boris Verbrugge, “The Economic Logic of Persistent Informality: Artisanal and Small-Scale Mining in the Southern Philippines. Development and Change,” *Development and Change* 46 (2015): 1023–46.

¹⁶ Jimena Diaz Leiva, *Ecologies of Gold: Understanding the Social, Political, and Ecological Impacts of Mercury Use in Informal, Small-Scale Gold Mining in Madre De Dios, Perú* (Dissertation, University of California, Berkeley, 2021).

¹⁷ Colin A. Cooke, Prentiss H. Balcom, Harald Biester, and Alexander P. Wolfe, “Over Three Millennia of Mercury Pollution in the Peruvian Andes,” *PNAS* 106 (2009): 8830–34; Colin A. Cooke, Holger Hintelmann, Jay J. Ague, Richard Burger, Harald Biester, Julian P. Sachs, and Daniel R. Engstrom, “Use and Legacy of Mercury in the Andes,” *Environmental Science & Technology*, 47 (2013): 4181–88.

to locate, process, and use minerals like cinnabar. Mercury amalgamation has a long, fluid history of regional significance, of various sources of unevenly credited metallurgical knowledge, and of local variations in use and adoption.

Only recently has the role of precolonial and colonized Indigenous peoples as contributors – not simply bystanders – to mineralogical knowledge and metallurgical practices become the subject of critical attention.¹⁸ Our findings extend the scope of this scholarship to present an important redress of artisanal and small-scale gold mining and its framing as an outsized contributor to global mercury pollution. We argue that the space of encounter between colonized and colonizer represents a “contact zone” of interactive knowledge, not simply subjection.¹⁹ We reveal sidelined histories of Indigenous knowledge – not only of mining technologies but also of mercury toxicity – to critically question mainstream discourse on mercury used in metal processing, and to interrogate the emphasis placed on artisanal and small-scale gold miners in debates around curtailing global mercury pollution. Our analysis of the human and environmental record renders visible colonial legacies of mercury contamination and methods of amalgamation to emphasise that how the history of mercury gets made, and told, matters for the design of actionable political interventions and environmental health on the global scale.

In what follows, we focus on two of Latin America’s largest mineral economies, Perú and Colombia, tracing the histories of pre-colonial mineral extraction and technologies through the early modern period to the present. Since mercury is extracted from cinnabar and used to mine not only gold but also silver, our examination of the history of the mercury amalgamation extraction technique probes a broader history of metallurgy, mining, and knowledge exchange, encompassing the circulation of knowledge on mining methods that include mercury-gold amalgamation. In Part I, we introduce “environmental archives,” where soil and sediment carry histories of mercury to be read as a text that testifies to precolonial, and then colonized people’s use of mercury. This knowledge became part of the cultural and linguistic transaction in the “contact zone” of European colonizers and Amerindian peoples. The contact zone, where “cultures, meet, clash and grapple with each other, often in contexts of highly asymmetrical relations of power, such as colonialism, slavery, or their aftermaths as they are lived out in many parts of the world today” is one in which colonized peoples in Perú held valuable metallurgical knowledge for the Spanish.²⁰ In Part II, we introduce chemical “body burdens,” defined as the total amount of a particular chemical in a human or nonhuman animal body, to explore the consequences of

¹⁸ Bigelow, *Mining Language*; William Brooks, “Industrial Use of Mercury in the Ancient World,” in *Mercury in the Environment*, ed. Michael Banks (Berkeley: University of California Press, 2012), 19-24; Robyn d’Avignon, *A Ritual Geology: Gold and Subterranean Knowledge in Savanna West Africa* (Durham: Duke University Press, 2022); Rafael Larco Hoyle, *Los Mochicas*, vol. 2 (Lima: Museo Arqueológico Rafael Larco Herrera, 2001).

¹⁹ Mary Louise Pratt, *Imperial Eyes: Travel Writing and Transculturation* (London: Routledge, 2007).

²⁰ Pratt, *Imperial Eyes*, 7.

framing artisanal and small-scale gold mining landscapes in Perú and Colombia as “disabled” or “impaired” bodies. We demonstrate how the use of these narratives can lead to coercive and militarized interventions framed as “care” for the environment. Finally, we conclude with a revisionist perspective on “making mercury history,” revisiting the Minamata Convention’s motto to propose that achievement of “the last drop of mercury” must begin with a critical, historically anchored understanding of how and where it began.

Part I: environmental archives and metallurgic knowledge in the contact zone

Examination of human and environmental records, together, reveals an entangled history. Reading with and against the grain of written archives,²¹ we add another archival source: the earth. With “environmental archives,”²² lake sediment, ice, tree leaves, and bark attest to centuries of mining mercury ore (cinnabar) as well as smelting mercury and amalgamation processes. Thus, the earth’s geology and biota can be read across the centuries to affirm or contest the role that mercury played for Pre-Incan and Andean peoples as well as the Spanish. Research using mercury stable isotopes (which act as a kind of fingerprinting tool that allow researchers to trace the origins of mercury in certain substances like soil or water back to their source)²³ confirms that the Inca and their conquered peoples mined for and processed mercury. Geologists and biogeochemists have traced mercury in lake core sediments from mining and smelting to the 1450s, during Incan rule.²⁴ The Inca, who ruled much of what became modern Perú from 1300 to 1533, primarily used cinnabar pigment as makeup for royal women;²⁵ however, they outlawed cinnabar mining as “*un metal maligno*” (a malignant metal) after observing its ill effects.²⁶ Archeological studies indicate that ancient Andeans in present-day Perú mined placer gold deposits using mercury to concentrate gold.²⁷ Environmental archives refocus our attention to overlooked avenues of investigation as the industrial use of cinnabar in antiquity and in early modern European contexts receives considerably more scholarly attention than does the use of mercury for amalgamation and recovery of gold and silver in pre-Columbian societies, which “is rarely discussed or is considered to have been a European technological import.”²⁸

²¹ Ann Laura Stoler, *Along the Archival Grain: Epistemic Anxieties and Colonial Common Sense* (Princeton: Princeton University Press, 2010).

²² Ruth Goldstein (forthcoming), “Los Contaminados and the Contaminating: Mercury as a Long-Range Global Pollutant.”

²³ Cooke et al. “Over Three Millennia of Mercury Pollution in the Peruvian Andes” and “Use and Legacy.”

²⁴ Cooke et al. “Over Three Millennia of Mercury Pollution in the Peruvian Andes” and “Use and Legacy.”

²⁵ Bigelow, *Mining Language*, 248.

²⁶ Rafael Larco Hoyle, *Los Mochicas*, 130.

²⁷ Cooke et al. “Over Three Millennia of Mercury Pollution in the Peruvian Andes” and “Use and Legacy.” See also José de Acosta, *Historia natural y moral de las Indias*. (Madrid, Spain: Ramón Anglés Impresor, 1894 [1590]).

²⁸ Brooks, “Industrial Use of Mercury in the Ancient World,” 21.

Even so, the colonial European aspects of the mercury-gold story are crucial for re-evaluating artisanal and small-scale gold mining narratives. The Spanish used mercury, in staggering quantities, to advance imperial ambitions in the Americas during the colonial period. Mercury amalgamation constituted a critical technology that sustained the imperial economy by enabling large-scale extraction of silver from conquered territories.²⁹ Beginning in the 1530s, the Spanish Empire used mercury to process silver in the Viceroyalties of Perú and New Spain (present day Perú, Bolivia, and Mexico). Two mines on either side of the Atlantic were central to this enterprise: Almadén and Huancavelica. The Almadén cinnabar mine in Spain was first brought into production during the Roman empire. Between 1499 and 1937, the Almadén mine produced an estimated 5,985,495 flasks of mercury – about 206,396 metric tons of mercury.³⁰ This cargo was shipped primarily to colonial America’s mining centers in New Spain (Zacatecas) and the Andes (Potosí) and used to extract at least 136,000 tons of silver, translating to approximately 80% of global silver production between 1550 and 1800.³¹ Huancavelica was discovered in the Peruvian Andes in 1571 and brought into production under Spanish rule, expanding their access to the mercury needed to process precious metals. Between 1571 and 1820, Huancavelica produced an estimated 68,000 metric tons of mercury.³² Up until the 1840s, mercury from Huancavelica helped sustain the extraction of silver and gold in mining sites across the Americas, including the massive mine of Potosí (Bolivia).³³ Together, Almadén and Huancavelica supplied the Spanish colonial extractive enterprise for almost three hundred years.

The environmental impact of early modern Spanish mining activity using mercury amalgamation is now coming to light. Scientists estimate that mercury emissions from Huancavelica reached 17,000 tons between 1564 and 1810 during Spanish colonial rule.³⁴ The following estimation of mercury emissions and releases from these sites between 1580 and 1900 is based on examination of the

²⁹ Saul Guerrero, *Silver by Fire, Silver by Mercury: A Chemical History of Silver Refining in New Spain and Mexico, 16th to 19th Centuries* (Leiden: Brill, 2017).

³⁰ Ángel Hernández, Michel Jébrak, Pablo Higuera, Roberto Oyarzun, Diego Morata, and João Munhá, “The Almadén Mercury Mining District, Spain,” *Mineralium Deposita* 34 (1999): 539–48. For extensive histories of Almadén mines see Angél M. Hernández, *Los mineros del azogue*, (Madrid: Lozano Comunicación Gráfica, 2007) and Antonio Matilla Tascón, *Historia de las minas de Almadén*, vol.1, (Madrid: Minas de Almadén y Arrayanes, 1987).

³¹ Almadén is also where the commercial measurement for mercury export, “the flask,” was developed; see Delmar K. Meyers, “History of the Mercury Flask,” *Journal of Chemical Education* 28 (1951): 127. “The flask itself is made of welded steel, has a screw cap, and is about the size of a 2-L container. When filled, the flask weighs 34.5 kg, and 29 flasks of mercury are contained in a metric ton.” In Brooks, “Industrial Use of Mercury in the Ancient World,” 20.

³² Nicholas Robins and Nicole Hagan, “Mercury Production and Use in Colonial Andean Silver Production: Emissions and Health Implications,” *Environmental Health Perspectives*, 120 (2012): 627–33.

³³ Carlos Contreras and Ali Diaz, “Los intentos de refluotamiento de la mina de azogue de Huancavelica en el siglo XIX,” *América Latina, en la Historia Económica* 29 (2008): 7–29.

³⁴ Robins and Hagan, “Mercury Production and Use in Colonial Andean Silver Production: Emissions and Health Implications.”

environmental archive.³⁵ Examination of the earth's record combine with written documents that detail the figures of annual silver and gold production, and records of mercury production – not only from Almadén and Huancavelica, but also from mercury mines in New Almadén (California) and Zacatecas (Mexico). The cumulative output of mercury into the environment from the production of precious metals in the Americas totaled 257,400 tons, with 196,000 tons dispersed in South and Central America and 61,380 tons in the US.³⁶ Approximately 60 to 65% of the mercury emitted is believed to have been released into the atmosphere. From these numbers, mercury emissions from colonial mining “are substantial and keep circulating in the global environment,”³⁷ suggesting that gold and silver mines were – and are – a dominant source of atmospheric mercury pollution.³⁸

In the Iberian extraction project, colonized peoples were more than labouring bodies, and interacted with Europeans on a number of different levels. Asymmetries of power notwithstanding, the Incan people contributed – some more willingly than others – to European knowledge about mercury mining and smelting. Church Fathers (*Padres*), mine overseers, refiners, and merchants who published texts about mining techniques, as well as the Spanish Crown's officials who adapted and implemented labor laws,³⁹ all drew from Indigenous metallurgical knowledge in the Americas as well as from Roman antiquity. In this “contact zone,” different techniques for mercury amalgamation emerged. Research by environmental historians and historians of mining and technology in Latin America such as Saul Guerrero, Allison Bigelow, and Nicholas Robins show that different versions of the mercury amalgamation method developed in the 1550s in the Viceroyalty of New Spain (present-day Mexico), and spread across Spanish America undergoing modifications along the way.⁴⁰ The Spanish merchant Bartolomé de Medina developed the so-called patio method (*método del patio*) to amalgamate silver with mercury. This consisted of four steps: crushing or stamping the ores to discard excess material; combining it with a mix of salt, water, copper sulfate, and mercury; stepping on the mixture in a shallow pit for six to eight weeks until an amalgam is formed; and heating the amalgam to vaporize the mercury and recover the silver. The colder Andean climate necessitated smelting at higher temperatures. Mercury's chemical affinity with gold and silver enabled refiners to profitably extract ores from a wider variety of deposits

³⁵ See Goldstein (forthcoming), “Los Contaminados and the Contaminating: Mercury as a Long-Range Global Pollutant.”

³⁶ Jerome O. Nriagu, “Mercury Pollution from the Past Mining of Gold and Silver in the Americas,” *Science of the Total Environment*, 149 (1994): 167–81.

³⁷ Henrik Selin and Noelle E. Selin, *Mercury Stories Understanding Sustainability through a Volatile Element* (Boston, MA: MIT Press, 2020), 44.

³⁸ See Nriagu 1994, and Helen Amos, Jeroen Sonke, Daniel Obrist et al., “Observational and Modeling Constraints on Global Anthropogenic Enrichment of Mercury,” *Environmental Science and Technology*, 49 (2015): 4036–47.

³⁹ Nicholas Robins, *Mercury, Mining, and Empire* (Bloomington: Indiana University Press, 2011).

⁴⁰ See Guerrero, *Silver by Fire, Silver by Mercury*; Bigelow, *Mining Language*; Contreras and Diaz, “Los intentos de reflotamiento de la mina de azogue de Huancavelica en el siglo XIX.”

ranging from unmixed metals to various combinations of ferrous, cupric, and sulfuric elements.⁴¹ Medina is often credited as the sole inventor of the patio method; however, he worked in concert with “Indigenous miners, colonial agents, and Fugger agents stationed in Pachuca, Mexico.”⁴² Alonso de Barba, a physician and metallurgist working in Perú during the 1590s, developed a variation on the patio method, termed *metodo de cajones*.⁴³ Barba improved the furnaces used to distill mercury from cinnabar (called *jabecas*), boosting Spanish imperial productivity by increasing the availability of quicksilver, and making gold and silver processing more efficient. Barba also developed the bucket method (*metodo de los cazos*), in which the amalgamation stage of the patio method was performed in buckets instead of open pits, a technique widely used in the Americas from the early seventeenth century to the nineteenth century.

The techniques developed by Medina and Barba were at first largely ignored by European metallurgists who believed the American way to be inferior, inefficient, and unsuitable for treating the low-grade silver ores mined in Europe.⁴⁴ However, these methods eventually worked their way into European mercury mining practice.⁴⁵ Despite initial disdain for processing methods developed in the Americas, European metallurgists began to pay closer attention to colonial knowledge about mercury amalgamation even as they disavowed the origins of their innovations in published accounts of their work. The work and writing of Ignaz von Born, an Austrian metallurgist, exemplifies this. In 1786, Born innovated upon Medina’s open-air method in developing a version of amalgamation using closed barrels that slurried the mix with mercury and water in heated copper kettles; this enabled silver to be processed in less than a day, whereas Medina’s patio method required at least ten days.⁴⁶ However, despite making the process less expensive, Born’s method consumed more mercury and produced less silver.⁴⁷ Born valorised his version of the method for its enlightened use of mathematical measurements, characterising the American method as “retrograde.”⁴⁸ Other sources have Born acknowledge the American origin of amalgamation in more amicable terms.⁴⁹ Until recently, Born has been credited as “the first inventor of

⁴¹ Luis Muro, “Bartolome de Medina, introductor del beneficio de patio en Nueva España,” in *Historia de la ciencia y la tecnología*, eds. Germán Somolinos, Manuel Maldonado, Emilio Uranga et al., (México: D. F. El Colegio de México, 1964), 203–17.

⁴² Bigelow, *Mining Language*, 239.

⁴³ Orlando Paez Courreau, *Tecnología minera y metalúrgica en la Nueva Granada del siglo XVI al XIX* (Bogotá: Instituto Colombiano de Antropología e Historia – ICAHN, 2003).

⁴⁴ Mikulas Teich, “Born’s Amalgamation Process and the International Metallurgic Gathering at Skleno in 1786,” *Annals of Science*, 32 (1975): 305–429.

⁴⁵ Robins, *Mercury Mining and Empire*, 58.

⁴⁶ Lyman Caswell and Rebecca Stone-Daley, “The D’Elhuyar Brothers, Tungsten, and Spanish Silver,” *Bulletin for the History of Chemistry*, 23 (1999): 11–19.

⁴⁷ Juan Manuel López de Azcona, *Minería iberoamericana: repertorio bibliográfico y biográfico. Biografías (1492–1892)* (Madrid: Instituto Tecnológico Geominero de España, 1992), 113; Iago Gil Aguada, “La expedición minera del barón de Nordenflicht y las autoridades Peruanas,” *Anuario de Estudios Americanos* 72 (2015): 263–88.

⁴⁸ Teich, “Born’s Amalgamation,” 311.

⁴⁹ Caswell and Stone-Daley, “The D’Elhuyar Brothers.”

the amalgamation method,”⁵⁰ a Eurocentric account that erases both the colonial contributions of Medina and Barba,⁵¹ and the bodies of knowledge, exchange networks, and labour of Indigenous metallurgists, traders, and workers who were instrumental in the advancement of Spanish mercury amalgamation methods and its adoption, first in the Americas and then more broadly in Europe.⁵² By the eighteenth and nineteenth centuries, European chemistry and mining engineering, and their attendant political and economic reconfigurations on both sides of the Atlantic, reframed mercury amalgamation as a European invention despite the fact it emerged and developed in the “contact zone” of Indigenous and European metallurgists.⁵³

These early modern histories of mercury amalgamation in the contact zone are critical to understanding the deep roots of the issues surrounding artisanal and small-scale gold mining in Latin America today. Following the independence of Central and South American countries from Spain in the early nineteenth century, mercury amalgamation was not entirely abandoned. Metallurgists, engineers, and investors kept the technique alive, but by this time it was being used to concentrate gold instead of silver.⁵⁴ A key difference: no longer was it Spanish or German metallurgists and chemists who spread the mercury amalgamation technique and encouraged its use; rather, mercury amalgamation was encouraged by mining engineers working for US and British companies that invested in the region and eventually trained local mining engineers.⁵⁵ Moreover, until the twentieth century, the environmental health effects of mercury were not as widely understood, and as such, mercury amalgamation was still considered a standard processing method and prevalent in operations that could not use cyanide heap leaching.⁵⁶ Increased awareness of mercury’s toxicity in the mid-twentieth century resulted in a movement away from mercury amalgamation methods. Until recently, mercury amalgamation in Colombian mining

⁵⁰ Nature, “Ignaz von Born,” *Nature*, 150 (1942): 763.

⁵¹ Jakob Vogel, “Lost in Imperial Translation? Circulating Mining Knowledge between Europe and Latin America around 1800,” in *Transnational Cultures of Expertise: Circulating State-Related Knowledge in the 18th and 19th centuries*, eds. L. Schilling and J. Vogel (Berlin, Boston: De Gruyter Oldenbourg, 2019), 129–46.

⁵² Bigelow, *Mining Language*. See also Carlos Contreras, “Transferencia de tecnologías e Imperio. El caso de la minería andina en el siglo XVIII,” *Diálogo Andino - Revista de Historia, Geografía y Cultura Andina* 33 (2009): 29–42.

⁵³ Pratt, *Imperial Eyes*.

⁵⁴ Sebastián Rubiano-Galvis, *Toxic Residues and Amalgamated Injustices: A Political Ecology of Mercury and Gold Extraction in Colombia* (Dissertation, University of California, Berkeley, 2022).

⁵⁵ J. R. C. Deustua, “Society, Science, and Technology: Mariano de Rivero, Mining and the Birth of Perú as a Republic, 1820-1850,” *Apuntes-Revista De Ciencias Sociales* 80 (2017): 51–77.

⁵⁶ Cyanidation was invented in the 1890s and spread rapidly across mining areas in South Africa and the Americas. However, it required equipment and expertise accessible only to the largest mining operations, some which continued using mercury amalgamation. See, among others: Edward Beatty, *Cyanide and Silver: Technology and the Search for Progress in Modern Mexico* (Oakland, CA: University of California Press, 2015); Armando Valenzuela and Kostas Fytas, “Mercury Management in Small-Scale Mining, *International Journal of Surface Mining*,” *Reclamation and Environment* 16 (2002): 2–23; and Boris Verbrugge, Cristiano Lanzano, and Matthew Libassi, “The Cyanide Revolution: Efficiency gains and exclusion in artisanal and small-scale gold mining,” *Geoforum* 126 (2021): 267–76.

historiography was understood to have come from the nineteenth-century wave of British capital investment in the country's mining sector, along with other technological innovations like stamping mills and hydraulic hammers.⁵⁷

Part II: body burdens and disabled ecologies

The text of the United Nations Minamata Convention on Mercury signed in 2013 is silent about the legacies of three centuries of mercury use in colonial mining in the Americas. In turn, UNESCO's 2012 declaration of Almadén's cinnabar mines as a World Heritage Site reframes its entangled history as a valorisation of European mining knowledge and technology (namely, the invention of the amalgamation method), and sanitizes for public consumption the mine's harsh reality as a major player in global mercury toxic assets. In Part I, we showed how the amalgamation method embodies a fluid history of metallurgic knowledge production, circulation, appropriation, and use. In this section, we extend our argument to a reinterpretation of its legacies in two countries currently considered to be among the largest mercury polluters: Perú and Colombia. Given the long history of mercury pollution, we aim to historicise the toxic burdens of colonial mercury use through an extensive understanding of toxic bodily harms beyond individual bodies or landscapes. We extend the definition of a "body burden" to refer to nonhuman bodies, such as bodies of water (lakes and oceans, streams, and creeks); and bodies of land (sediment, rocks, and soil as well as trees and other plants that absorb mercury). The body burdens traced through lake sediments or histories of mining and metallurgy are not the only "texts" that can be used to read mercury's entanglements in global environmental politics. In this section, we also delve into the political bodies of Perú and Colombia as constituted by and through mercury toxicity. To do so, we center both the human and the political body as key analytics to think about toxicity, and also to shed light on the embodied narratives that countries and international organizations produce about artisanal and small-scale gold mining.

In both countries, wildlife ecologists and mercury researchers often refer to mercury-polluted artisanal and small-scale mining landscapes as "unproductive," "damaged," or "barren." In other words, these landscapes are considered "disabled."⁵⁸ Sunaura Taylor, a scholar of disability studies and the environment, proposes the notion of disabled ecologies, defined as "webs of disability that are created,

⁵⁷ See E. Vargas Pimiento, *Huellas al futuro, 125 años de la Ingeniería de Minas en Colombia*, (Medellín: Universidad Nacional de Colombia, 2012); Gabriel Poveda Ramos, "Ingenieros, inmigrantes y minería en la Antioquía del siglo XIX," *Ciencia Tecnología Desarrollo* 11 (1987): 1–2; Gabriel Poveda Ramos, Ed. *Ingeniería e Historia de las Técnicas – Tomo V. Historia Social de la Ciencia en Colombia* (Bogotá: Colciencias, 1993).

⁵⁸ Sunaura Taylor, *Disabled Ecologies: Living with Impaired Landscapes* (Berkeley: UC Berkeley's Institute for Othering and Belonging, 2019) and "Age of Disability: On Living Well with Impaired Landscapes," *Orion* 2021: <https://orionmagazine.org/article/age-of-disability/> (accessed 31 July 2022).

spatially and temporally, when ecosystems are corrupted and profoundly altered. Disabled ecologies are the material and cultural ways in which disability is manifested and produced among human and nonhuman entities.”⁵⁹ Very much like disability justice scholars and activists have proposed to rethink disability in human bodies as socially constructed, Taylor asks us to imagine what forms of care, treatment, and assistance ecologically damaged landscapes require for us to acknowledge and repair the relational harm of multispecies disability. While we do not deny the very real environmental, social, and health consequences of mercury use in artisanal and small-scale gold mining, we contend that it is critical to challenge such terms that frame labouring miners as the sole protagonists in environmental damage by demonstrating the consequences of the deployment of these narratives.

The language of ecological disablement or impairment that Taylor engages is, in fact, how some global policymakers, journalists, and environmental researchers refer to “ASGM” landscapes – profoundly altered and unable to reproduce (on their own). Various reports describe Colombia as “bathing in mercury,”⁶⁰ “a failed state,”⁶¹ “unlivable,” and undergoing a “humanitarian crisis”⁶² due to mercury-intensive mining that turned areas “unproductive.”⁶³ Similar labels are often also used to describe Perú. It is important to note that while centering disabled ecologies can nurture a recognition and possibly resistance to “ableist ecologies” (where “sacrifice zones” are rendered acceptable),⁶⁴ care for disabled landscaped can also be deployed to assert state control and authority to further dispossess marginalised peoples. That is, in both Colombia and Perú, governmental actors actively use the language of wastelands that can no longer (re)produce because of the miners who degrade the land through their use of mercury. This often promotes a sentiment of outrage from the public, garnering support for armed evictions of gold miners, without addressing the global demand for gold or the historical precedent for mining that undergirds such exploitation of land.

Two regions typically referred to as disabled due to mercury-polluting gold mining activities are Antioquia in the Colombian Andes, and Madre de Dios in the Peruvian Amazon. They are part of a network of sites across the Andean-Amazon region that constitute, paraphrasing Taylor, a transnational disabled ecology: a set of extractive landscapes connected through toxic disablement and tragic

⁵⁹ Taylor, “Age of Disability.”

⁶⁰ El Espectador, “¡Bañados en mercurio!” 2015: <https://www.elespectador.com/actualidad/banados-en-mercurio-article-578797/> (accessed 1 December 2022).

⁶¹ Leonardo Güiza and Juan Aristizábal, “Mercury and Gold mining in Colombia: A Failed State,” *Universitas Scientiarum* 18 (2013): 33–49.

⁶² Colombia Reports, “Mercury Poisoning Adds to Humanitarian Crisis in West Colombia: Govt,” 2014: <https://colombiareports.com/amp/colombians-forced-homes-lack-water/> (accessed 1 December 2022).

⁶³ Newton Fund, “Increasing Productivity and Removing Toxic Mercury from Colombia’s Gold Mines,” 2019: <https://www.newton-gcrf.org/impact/stories-of-change/increasing-productivity-and-removing-toxic-mercury-from-colombias-gold-mines/> (accessed 1 December 2022).

⁶⁴ Naomi Klein, *This Changes Everything. Capitalism vs. The Climate*. (New York: Simon and Schuster, 2015).

imaginaries of urgency, exception, and irreversibility of mercury pollution. In what follows, we trace the constitution of disabled political bodies in Perú and Colombia and examine the implications of these designations for gold miners who use mercury.

Perú

Contrary to narratives that characterise Perú's Amazonian region of Madre de Dios as a "new frontier" of gold extraction, the development of artisanal and small-scale gold mining began in the 1900s. Artisanal and small-scale gold mining took off in earnest in the mid twentieth century with a few distinct peaks in production.⁶⁵ One of these peaks stretched from the 1940s to the 50s, when migrants from the Andean highlands traveled to Madre de Dios under informal agreements of debt-peonage to work in alluvial gold mining.⁶⁶ In the 1970s, the development of the small-scale gold mining economy accelerated as immigration of *colonos* (colonists) from Andean regions drove population growth and new mining towns emerged.⁶⁷ The environmental impacts of gold mining also began to grow as non-mechanised technologies were replaced by dredges and motor-powered pumps used to suction river sediments.⁶⁸ In 1978, in the middle of a global rise in gold prices, the military-led government of President Morales-Bermudez approved the Law of Gold Mining Promotion (*Ley de Promoción de Minería Aurífera*), which formally declared gold mining an interest of the national state. The policies set under this law included financial and legal incentives to extract gold (Law No. 22178, Article II, 1978). Formal justification in the text of the law claimed that it was the government's obligation to "encourage mining at the national level, thus contributing to the development and accelerated integration of different regions into the country's socio-economic process (Article I)."

Twentieth century accounts of gold mining in Madre de Dios also indicate that mercury was widely used to concentrate gold.⁶⁹ However, during the 1970s, concerns over mercury pollution from small-scale gold mining had not yet entered into popular or government discourse.⁶⁴ These histories of gold mining and mercury use in the region are often neglected in current national-level debates

⁶⁵ Goldstein "Life in Traffic"; Óscar Paredes Pando, *Explotación del Caucho-Shiringa: Brasil, Perú, Bolivia. Economías extractivo-mercantiles en el Alto Acre - Madre de Dios* (Cusco: JL Editores, 2013).

⁶⁶ See Cesar Mosquera, "Desafío de la formalización en la minería artesanal y de pequeña escala: análisis de las experiencias en Bolivia, Colombia, Ecuador y Perú," (CooperAcción: Acción Solidaria para el Desarrollo, 2006); Victor Hugo Pachas, *Conflictos sociales en Madre de Dios: El caso de la minería en pequeña escala de oro y la ilegalidad*, (Lima: CEAS, 2009); and Lenin Valencia Arroyo, *Madre de Dios: Podemos Evitar la Tragedia?* (Lima, Peru: Sociedad Peruana para Derechos Ambientales, 2014).

⁶⁷ Lenin Valencia Arroyo, *Madre de Dios: Podemos Evitar la Tragedia?* (Lima, Peru: Sociedad Peruana para Derechos Ambientales, 2014).

⁶⁸ Jimena Diaz Leiva, "Appropriate Technologies and the Geosocial Evolution of Informal, Small-Scale Gold Mining in Madre de Dios, Perú," *The Extractive Industries and Society* (2022): 101165.

⁶⁹ Andrew Gray, "Y después de la fiebre del oro: Derechos humanos y autodesarrollo entre los amarakaeri del sudeste de Perú," *International Working Group for Indigenous Affairs* (1986), 39.
https://www.iwgia.org/images/publications/0373_5_Fiebre_Oro_Peru.pdf (accessed 3 January 2023).

surrounding the governance of informal gold mining in the region. Instead, presentist accounts of gold mining's "recent" explosion into areas deemed environmentally sensitive has prompted forceful action from state authorities who have gone as far as to declare a state of emergency in response to the expansion of gold mining and mercury pollution. Yet, while mercury is used in virtually all small-scale gold mining operations throughout Madre de Dios, only "illegal" mining (i.e. unlicensed concessions) has been called out as the source of mercury pollution, and thus a target of enforcement.⁷⁰

In Madre de Dios, a contested mining zone called "La Pampa" is one such target of militarized interventions, emblematic of a political rhetoric of care for "damaged" landscapes. On 18 February 2019, President Martin Vizcarra declared a sixty-day state of emergency in three districts of Madre de Dios. The Peruvian National Police Force (PNP), with support from the armed forces, were tasked with "maintaining internal order" in Madre de Dios, suspending some constitutionally assured rights (Article III).⁷¹ Following this declaration, on 19 February 2019, the Minister of the Interior, Carlos Moran, stepped out of a helicopter onto the sandy soil of La Pampa with the Minister of Defense at his side, and proclaimed the beginning of *Operativo Mercurio* (Operation Mercury) – a coordinated multi-ministry security intervention composed of one thousand two hundred PNP officers, three hundred members of the armed forces, and seventy special environmental prosecutors.⁷² Operation Mercury was a multi-phase security intervention. Its formally stated objective was the eradication of "illegal" gold mining from Zones of Mining Exclusion, areas where mining has been deemed off-limits, such as protected areas. During an intervention, groups of officers accompanied by specialised environmental prosecutors conduct raids of mining camps, destroying mining equipment and arresting any miners found working in off-limits areas. Such large-scale military interventions are only the latest in a series of coercive, state-led interventions inside La Pampa – an 11,000-hectare area composed of hundreds of informal, small-scale gold mines and mining camps.

Military interventions such as those in La Pampa are always well-documented. Photos of commandos in full tactical gear equipped with automatic weapons standing proudly in front of a blown-up motor or the flaming ruins of a mining camp, images that are reproduced in news reports and other media. Military personnel make note of how many dredges, motors, meters of PVC pipe, gallons of diesel, reams of carpet, and sluices they detonate. These numbers are added to a running total, often

⁷⁰ Antonio Brack Egg, Jose Álvarez, Victor Sotero, & Cesar A. Ipenza Peralta, *Minería Aurífera en Madre de Dios y contaminación con mercurio: Una bomba de tiempo*, (Lima, Perú: Ministerio del Ambiente 2011); and Katy Ashe, "Elevated Mercury Concentrations in Humans of Madre de Dios, Perú," *PloS One* 7.3 (2012): e33305.

⁷¹ <http://dataonline.gacetajuridica.com.pe/gaceta/admin/elPeruano/1822019/18-02-2019.pdf> (accessed 31 July 2022).

⁷² Ministerio del Interior, "Operación "Mercurio 2019 permitirá restituir el principio de autoridad en La Pampa," February 19, 2019: <https://www.gob.pe/institucion/mininter/noticias/25784-operacion-mercurio-2019-permitira-restituir-el-principio-de-autoridad-en-la-pampa> (accessed 31 July 2022).

repeated by commanding officers, as evidence of their progress towards “eradicating” illegal gold mining and illustrative of the “success” of Operation Mercury.⁷³ While these coercive governance interventions are lauded as a decisive step to eradicate illegal gold mining and its associated ills, these misguided and uneven efforts have done little to ameliorate the situation with respect to mercury pollution.

La Pampa is at the center of these military interventions largely because this area is located entirely within the buffer zone of the 274,690-hectare Tambopata National Reserve, a protected area established in 2000. State actors from the Ministry of the Environment – responsible for managing the Reserve and buffer zone – and extra-state conservation advocates and organizations claim that “environmentally sensitive” areas like the buffer zone, are under threat because of environmental degradation caused by small-scale gold mining. In fact, when the Tambopata Reserve was established, gold mining was already prevalent in the area to be zoned for the park but was less widespread. Yet, landscapes deemed “disabled” still have life in them, upsetting environmental categories of “virgin” rainforest and “barren” land. In some ways, these landscapes are a fusion of that which is considered beautiful and worth saving (gold), and the toxic utility of substances that must be eliminated (mercury).

Framed as an ahistorical problem associated with gold mining alone, the solution to the problem of mercury pollution in Madre de Dios emphasises spatialised containment of “illegal” gold mining through militarized intervention, even though the same mercury use characterises mining outside of the Reserve and buffer zone’s formal boundaries. As has been true in small-scale gold mining frontiers around the world, formal attempts to contain mercury pollution have consistently created an “emergency” or crisis out of the growth of small-scale gold mining.⁷⁴ Such crisis narratives are commonplace in the performance of national emergencies that also claim that “illegal” miners are creating “wastelands,” or disabled landscapes no longer capable of sustaining life. These emergency policies are also substantiated by scientific studies, including those reliant on remote sensing techniques to track the “explosion” of “illegal” gold mining with ever increasing precision and ecotoxicology studies that measure mercury concentrations in people and wildlife.⁷⁵ The criminalization of small-scale gold mining in Madre de Dios is not only enforced through unevenly deployed territorial strategies of control, but also substantiated by

⁷³“Guillermo Reaño, “Minería ilegal en Madre de Dios: Operación Mercurio 2019, el baile de los que faltan,” March 19, 2019:

<https://www.actualidadambiental.pe/mineria-ilegal-en-madre-de-dios-operacion-mercurio-2019-el-baile-de-los-que-faltan/> (accessed 31 July 2022).

⁷⁴ Petra Tschakert and Kamini Singha, “Contaminated Identities: Mercury and Marginalization in Ghana’s Artisanal Mining Sector,” *Geoforum* 38 (2007): 1304–21; and Boris Verbrugge and Sara Geenen eds., *Global Gold Production Touching Ground: Expansion, Informalization, and Technological Innovation* (Cham, Switzerland: Palgrave Macmillan, 2020).

⁷⁵ Greg P. Asner and Raul Tupayachi, “Accelerated Losses of Protected Forests from Gold Mining in the Peruvian Amazon,” *Environmental Research Letters* 12 (2017): 094004; and Sarah E. Diringer et al., “River Transport of Mercury from Artisanal and Small-Scale Gold Mining and Risks for Dietary Mercury Exposure in Madre de Dios, Perú,” *Environmental Science: Processes & Impacts* 17.2 (2015): 478–87.

narratives that associate mercury use in gold mining with the creation of disabled landscapes and frame security interventions as care for these landscapes.⁷⁶ These presentist narratives obscure the legacy of decades of mercury releases from mining that was entirely legal and even promoted by state agencies. By examining the past history of state support for small-scale gold mining it becomes evident that the current “mercury problem” in Madre de Dios is part of a mercury-gold problem that gained momentum during Spanish colonial rule.⁷⁷

Colombia

The Colombian towns of Segovia and Remedios are located in the mountainous region of Antioquia, recognized as the largest gold producing and mercury emitting region in Colombia.⁷⁸ Northeastern Antioquia is also one of the epicenters of Colombia’s armed conflict.⁷⁹ Right-wing paramilitary squads operated in Northeastern Antioquia from 1986 until 2003 when the Uribe government approved an amnesty-like law that demobilised over 35,000 of their combatants. In response, smaller groups have taken over the drug trafficking routes, territorial control, and some segments of the gold supply chain.⁸⁰ In Antioquia, the demobilization of the Bloque Mineros, the largest paramilitary group in the region until 2003, was only partial – during the following decade, at least 13,000 combatants have regrouped into various atomised neo-paramilitary groups. Those groups, along with some remnants of the former FARC guerrilla, dispute control of the Northeastern Antioquia region and routinely extort both large-scale and small-scale miners, demand a cut of gold sales, and according to some reports, play a role in mercury trade too.⁸¹

Violence and toxicity are entangled in Antioquia as this was the first region in Colombia to use mercury amalgamation in the mid-nineteenth century and has since become the testing grounds for a slew of local and international efforts to address mercury pollution from artisanal and small-scale gold

⁷⁶ Brack Egg et al., “Minería Aurífera en Madre de Dios”; Ashe, “Elevated Mercury Concentrations in Humans of Madre de Dios, Perú”; and Barbara Fraser, “Peruvian Gold Rush Threatens Health and the Environment,” *Environment, Science, and Technology* 43 (2009): 7162–64.

⁷⁷ Guillermo Lohmann Villena, “Las minas de Huancavelica en los siglos XVI y XVII,” *Publicaciones de la Escuela de Estudios Hispano-Americanos de Sevilla* (1949): <https://repositorio.pucp.edu.pe/index/handle/123456789/181809> (accessed 1 August 2022).

⁷⁸ Ministerio de Minas, Unidad de Planeación Minero-Energética and Universidad de Córdoba, *Estudio de la cadena del mercurio en Colombia* (Bogotá: Ministerio de Minas y Energía, 2014); and Paul Cordy, Marcello Veiga, Ibrahim Salih et al., “Mercury Contamination from Artisanal Gold Mining in Antioquia, Colombia: The World’s Highest per capita Mercury Pollution,” *Science of the Total Environment*, vols. 410–411 (2011): 154–60.

⁷⁹ Centro Nacional de Memoria Histórica, *Silenciar la democracia: las masacres de Segovia y Remedios 1982–1997* (Bogotá: Centro Nacional de Memoria Histórica, 2013).

⁸⁰ Frédéric Massé and Philippe Le Billon, “Gold Mining in Colombia, Post-war Crime and the Peace Agreement with the FARC,” *Third World Thematics: A TWQ Journal* (2018): 1–19.

⁸¹ Anamaria Bedoya-Builes, *De oro están hechos mis días* (Medellin: Universilibros, 2011).

mining.⁸² Unlike alluvial deposits (such as those in Peru's Madre de Dios region), gold from underground mines in Antioquia is rarely found "free." Instead, it is "trapped" in other rocks and to extract it, and it is necessary to crush and grind the rocks and then process them with mercury or cyanide. The goal is to break gold's chemical bond with other non-valuable ores. When using mercury amalgamation, the lower the concentration of gold in the rocks and soil, the more mercury is required to extract it.

In 2013, Colombia's Congress approved a National Mercury Law mimicking the core provisions of the Minamata Convention but with an accelerated timeline for phasing out mercury use from artisanal and small-scale gold mining and other industries: the intention was to eliminate mercury use by 2018. Despite the ban, mercury continues to be imported and widely used in Colombia's goldfields. Since 2011, the Colombian government has launched a crackdown against "criminal" gold mining in Antioquia and other regions.⁸³ Former President Juan Manuel Santos (2010–2018) declared that mercury contamination was "an obstacle" to the post-conflict (or rather post-agreement) peacebuilding efforts since the substance was the manifestation of the "criminal" capture of gold mining supply chains. In the last decade, eradicating mercury use in all industries, especially in the small-scale mining sector, became a top national security priority with the twofold goal of cutting off a lucrative source of income for criminal armed groups and curbing mercury pollution in the country's rivers.

As small-scale or unlicensed gold mining has become criminalized so too have gold miners who are frequently depicted by government agencies and mining corporations as criminal actors. Antioquia's goldfields illustrate the connection between the marginalisation of small-scale gold miners and mercury reduction policies. Case in point: In 2017, a miners' strike erupted in Antioquia in which more than 30,000 small-scale miners across the region, including Segovia and Remedios, stopped working for forty-two days, protesting in the streets. Among the reasons fueling this protest were uncertainty surrounding the deadline for the mercury ban in gold mining and the increase in military crackdowns on artisanal miners. Given that small-scale gold miners in Antioquia produce about 60% of the gold in Colombia (the small-scale or informal sector produces 86% of the total national output),⁸⁴ the strike disrupted the entire

⁸² Unlike Perú and Mexico where mercury was used since the early colonial period, mercury amalgamation's adoption in New Granada (Colombia's name before its independence in 1819) only took place in the early nineteenth century when superficial alluvial deposits started to deplete and vein mining became attractive to colonial authorities. Before 1820, Indigenous and enslaved African peoples employed decomposed plant matter to wash sand extracted from alluvial deposits to obtain gold instead of using mercury; see Robert West, *Colonial Placer Mining in Colombia* (Baton Rouge: Louisiana State University, 1952). Although gold was lost with this technique, the abundance of free gold in alluvial deposits made the method profitable. This would change in the mid-nineteenth century when underground (or vein) mining began to boom in Antioquia, where nearly half of Colombia's gold has been produced; see Poveda, *Ingenieros, inmigrantes y minería en la Antioquia del siglo XIX*.

⁸³ Sebastian Rubiano-Galvis, "Toxicity, Violence, and the Legacies of Mercury and Gold Mining in Colombia," *Platypus* (2022): <https://blog.castac.org/2022/11/toxicity-violence-and-the-legacies-of-mercury-and-gold-mining-in-colombia/> (accessed 30 December 2022).

⁸⁴ Unidad de Planeación Minero-Energetica, *Censo Minero 2011* (Bogotá: Ministerio de Minas y Energía, 2019).

regional economy. Road blockades and clashes between police and protestors occupied center stage in the national media for several weeks. In Segovia and Remedios, anti-riot police killed three protestors and wounded another thirty. At the height of the protests, then-governor of Antioquia, Luis Pérez said that while he was willing to meet with the miners and listen to their concerns, he would not budge on enforcing the mercury ban.⁸⁵

During the protests, miners made reference to longstanding government acquiescence towards corporations who used mercury to mine gold. Large-scale gold mining companies in Antioquia claim that they either stopped using mercury decades ago or used retorts to capture and reuse mercury. However some mining corporations, such as Mineros S.A. (a Colombian-owned company that exploits alluvial gold in the Nechi River in the Lower Cauca Basin) claimed to only recently have stopped using mercury in 2012, one year before the Mercury Law was enacted.⁸⁶ The fact that the second largest gold mining operation in Antioquia publicly acknowledged having used mercury to process gold between 1908 and 2012 – when all large companies extracting gold in the country stopped using mercury – confirms the existence of a corporate toxic legacy that does not often feature in conversations around eliminating mercury use in artisanal and small-scale gold mining.

In Segovia and Remedios, the miners' protests were also intimately connected to sedimented layers of violence and toxicity produced by corporate and state power, one that reflects a continuation of Spanish colonial tactics of governance. Frontino Gold Mines, the company that extracted gold from Northeastern Antioquia between 1853 and 1975, declared bankruptcy in 1973, having been first owned by British investors and then sold to American owners in 1911. In 1975, the company signed an agreement in which they committed to transfer the company's assets to the workers, given that many of them were owed salaries and pensions. The agreement was shelved by the Colombian government until 2003 when the pro-corporate mining and right-wing government of Alvaro Uribe (2002–2010) advanced a rigged interpretation of the agreement to not return the company's assets to the workers as stipulated in 1975, including the ownership of the concession, which for the first time since 1853 would return to Colombian nationals. Instead, the Ministry of Mines granted the three-hundred-hectare concession to Zandor Capital, a Canadian mining company later acquired by a larger pool of Canadian investors and renamed Gran Colombia Gold Co. Since then, Gran Colombia Gold has held and exploited the mining concession,

⁸⁵ RCN Radio, "2.000 mineros marcharon contra multinacional en Segovia y Remedios" (19 April 2017): <https://www.rcnradio.com/colombia/antioquia/2-000-mineros-marcharon-multinacional-segovia-remedios> (accessed 30 December 2022).

⁸⁶ Centro Nacional de Producción Más Limpia, Ministerio de Medio Ambiente y Desarrollo Sostenible & UNIDO, *Preparación Temprana para el Convenio de Minamata sobre el Mercurio (MIA) en la República de Colombia* (Bogotá: UNIDO, 2017): https://archivo.minambiente.gov.co/images/AsuntosambientalesySectorialyUrbana/pdf/mercurio/Evaluacion_Institucional_MINAMATA.pdf (accessed 3 January 2023).

which covers 60% of Segovia's land, including the four mines that have been producing gold since the 1800s.⁸⁷ Despite this, more than two thousand informal miners have continued to work in these mines. Some miners have signed operation contracts with the company, which consists of two-year renewable agreements to exploit gold within the company's concession area, but without the chance to own it.

These events transformed former corporate mine workers and informal miners in Segovia's corporate-dominated goldfields into invaders and criminals. A few months after the 2017 strike ended, there was national outrage when the CEO of Gran Colombia Gold, renamed Aris Mining in 2022, sent a public letter to the Ministry of Defense explicitly asking for a firmer military response to the "massive illegal mining" taking place in some areas of the company's concession. The following year, the company sued the Colombian state before the World Bank arbitration panel for 800 million dollars, claiming that the government's delays in evicting unlicensed mining operations from the company's mining concession violated the US-Colombia Free Trade Agreement.⁸⁸

In Segovia and Remedios, there are more than two hundred mines considered illegal, producing more than 100,000 ounces of gold per year and employing around 30,000 people. For the Antioquia branch of Conalminercol (one of the largest small-scale miners' associations in the country), the mercury ban and the company's stigmatization strategy are part of the same logic of criminalization of small-scale mining. Beginning with Frontino Gold Mines, then Gran Colombia Gold, and now Aris Mining, all these large-scale mining corporations have played an active role in the production of the Northeastern Antioquia region as a toxic landscape, using mercury in their mines for more than a century. At the same time, Aris Mining now asks the government to prosecute and crackdown on small-scale miners who have already been denied their lawful rights to mine. While there is limited public access to records as to when Frontino Gold Mines Co. (1853–1973) and its corporate successor stopped its mercury use, the large-scale corporate extraction of gold with mercury during the twentieth century precedes the recent use of mercury in small-scale mining in the last few decades, and possibly supersedes it in magnitude.⁸⁹

In sum, exploitation and violence are the backdrop against which artisanal and small-scale gold mining occurs in Segovia and Remedios, and are intimately connected to colonial, corporate, and state power, as well as with armed violence in the region.

⁸⁷ Catalina Quiroga, "Hacia un territorio minero-campesino: propuestas territoriales desde el movimiento socioterritorial en el nordeste de Antioquia, Colombia," in *Extractivismo minero en Colombia y América Latina*, eds. Barbara Gobel and Astrid Ulloa (Bogotá: Universidad Nacional de Colombia, 2015), 283–320.

⁸⁸ Gran Colombia Gold Corp. v. Republic of Colombia (International Centre for Settlement of Investment Disputes, Case No. ARB/18/23). As of December 2022, the case is still pending.

⁸⁹ Rubiano-Galvis, "Toxicity, Violence, and the Legacies of Mercury and Gold Mining in Colombia."

Conclusion: (re)making mercury history

The Minamata Convention's First Conference of Parties began with an art installation of the "last drop of mercury," underscoring the international treaty's motto to "Make Mercury History" by eliminating the metal from industrial emissions. When confronted with promises of detoxified worlds and celebrations of European legacies of mining knowledge and technology in World Heritage Sites, interrogating the symbols and histories that bolster such cultural narratives is essential to understand how political interventions on toxic – or disabled – landscapes, predominantly in the Global South, become desirable and actionable, and with what consequences. Through these promises and narratives, intergovernmental organizations like the United Nations Environment Programme and UNESCO (re)produce partial histories of mercury and gold that glorify a European colonial past, void of its violence. Almadén mines, followed closely by Huancavelica's mercury mines in Perú, contributed the highest emissions of mercury and continue to contribute to global mercury emissions even if the "last drop" of mercury ore has been mined. Certainly, artisanal and small-scale gold mining is one of many contemporary human industries that produce mercury emissions that cause human and environmental damage. Decontextualizing artisanal and small-scale gold mining from its longer history of colonial extraction in Latin America, however, fails to provide actionable solutions to eliminate mercury. These crafted narratives that leave out the beginning of the history of mercury pollution are deployed to justify militarized interventions into Perú and Colombia that exacerbate social conflict and render polluted landscapes all the more "disabled."

Paying careful attention to the colonial legacies of mercury contamination that are not highlighted at UNESCO World Heritage Sites or within international toxics treaties, artisanal and small-scale gold miners appear not as rogue polluters but as actors enmeshed in a long history of mineral extraction. Such a reframing does not deny the fact that artisanal and small-scale gold mining contributes to mercury pollution and that this pollution should be addressed. Instead, we demonstrate that the human and environmental record of mercury-gold (and silver) amalgamation makes evident that the metal is not simply an isolated and ahistorical molecule – to be vanquished in its last drop – but is instead a deeply impactful and enduring element in all its forms.

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