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Bitcoin and Potosí Silver

Historical Perspectives on Cryptocurrency

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ABSTRACT: Bitcoin, the digital cryptocurrency, has been celebrated as the future of money on the Internet. Although Bitcoin does present several forward-looking innovations, it also integrates a very old concept into its digital architecture: the mining of precious metals. Even though Bitcoin explicitly invokes mining as a metaphor and gold as an example for understanding the cryptocurrency, there has been little critical work on the connections between Bitcoin and previous metalist currency regimes. The following essay proposes a historical comparison with colonial South American silver mining and the global currency regime based on the New World silver peso it created as a way to interrogate Bitcoin. The comparison with colonial South America, and specifically the silver mining economy around the Cerro Rico de Potosí, will help to develop a historical and political understanding of Bitcoin's stakes, including questions of resources, labor, energy, and ecology. Mining and the extractive apparatus that accompanies it always imply massive-scale earthworks that reshape the planet itself, a process known as terraforming. The Potosí comparison will reveal Bitcoin to form part of a similar process of digital primitive accumulation we can provisionally name cryptoforming.

"The specter of exhaustion always hovers over a mine."
—Daviken Studnicki-Gizbert, "Deep Space Mining Time"

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Introduction

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In a recent article, Finn Brunton proposed that new cryptocurrencies like Bitcoin are metaphysically elegant parallel constructions that unite computing and money, two pillars of a globalizing economy. Although there have been previous historical attempts to create "digital money," Bitcoin (which first appeared in 2009) offered an innovative solution to the underlying cryptographic problem with an open-source digital money system: the technology anonymized buyers and sellers while transparently publishing the transaction record to eliminate double spending of the same "Bitcoin." This solution is based on a "proof-of-work" scheme that, in turn, is built upon an extractive metaphor: users "mine" Bitcoins with powerful hardware, and this expenditure of computational energy is rewarded with new Bitcoins "extracted" from the digital bedrock.

This technological innovation purportedly allows for the disintermediation of financial transactions, eliminating the need for a central bank or other authority to issue and police currency. How strange, then, that this high-tech development brings us back to an earlier moment in the history of money: the extraction and circulation of resources, with scarcity itself as the guarantor of value. Many of the minds behind Bitcoin take Austrian economics to be gospel, the true "gold standard" in currency matters.[1] It is no coincidence, then, that the entire rhetorical structure around this and other cryptocurrencies is built upon an extractive metaphor that takes gold mining as its first instance.

By hardcoding various baseline assumptions into their networked ecosystems—assumptions about economy, sociality, labor, and exchange generally—Bitcoin and other cryptocurrencies provide an unexpectedly candid and transparent starting point for the critical thinking of money in a networked and digital environment. In the following paper, I will take the Bitcoin rhetoric of metalist metaphors as a starting point in order to elaborate a critique of the cryptocurrency. It bears emphasizing that the mining metaphor at the heart of Bitcoin is not of my own creation; it is, rather, fundamental to the architecture, rhetoric, and structure of Bitcoin itself. My project is to push the mining metaphor to its rhetorical limit in order to reveal the problematic nature of basing what pretends to be the next generation of digital currency on an extractivist and metalist metaphor.

I am specifically interested in four themes revealed—perhaps inadvertently—by Bitcoin's code and surrounding infrastructure: extraction, inflation, ecology, and work. In order to think through these four themes, I propose to historicize them through a comparison between contemporary cryptocurrency mining practices and a previous historical moment when mining and technology coincided with such force that it altered the landscape of the global economy. It is not gold that calls our attention, how-

1. Jeffrey A. Tucker, "The Austrian Influence on Bitcoin."

ever, but rather silver, and specifically the silver extracted from the Potosí mine in colonial South America.

Potosí accounted for a plurality of sixteenth-century New World silver, and New World silver made up three-fourths of the global supply in the sixteenth century.[2] The silver strike at the Cerro Rico had rapid and massive economic, social, and political impacts that reverberated around the entire globe. As I'll argue, the silver extracted from the Viceroyalty of Peru (and later of New Spain) can serve as a material and historical analog to the supposedly frictionless circulation of digital Bitcoins that characterizes our contemporary technological boom.

There is a well-established bibliography analyzing the impact of Potosí silver on the European and global sixteenth-century economy, while recent scholarship has reassessed Potosí from ecological perspectives, emphasizing the absolute tragedy that the Cerro Rico represented in terms of environmental degradation and human suffering.[3] There are also significant historical studies of the *mita*, the Andean forced-tribute labor system, as it relates to Potosí.[4] I will use these four themes—extraction, inflation, ecology, and work—to think through the deeper implications of Bitcoin and the creation of value within cryptocurrencies in general, and to highlight a comparative historical example when technology, colonialism, and imperial expansion conspired to radically reshape money and the global political economy.

As I will detail below, the silver strike in Potosí represented the discovery of a new resource of unprecedented value, but it was only with a technological development—mercury amalgamation—that the imperial-scale exploitation of that resource became possible. This, in turn, led to a global shift in the monetary supply, and the kind of systemic, worldwide changes of which Bitcoin enthusiasts dream and prophesize. By paying attention to the socio-technological materiality surrounding the development of the first truly global minted currency—Spanish silver—and comparing that moment to the contemporary Bitcoin moment, we can begin to understand the true challenge posed by cryptocurrencies. As Rob Trump has written:

> Advanced technology could easily make transfers between such currencies low-friction and inexpensive. But it will require a rediscovery

2. Ward Barrett, "World Bullion Flows, 1450–1800," 224–25.

3. For the global effects, see Earl J. Hamilton's classic study *American Treasure and the Price Revolution in Spain, 1501–1650*, and Dennis O. Flynn and Arturo Giráldez's important revisions of Hamilton's thesis to include Asia and the Pacific, along with Carlos Sempat Assadourian's "The Transfer of the European System of Production to New Spain and Peru." The most important recent contribution to the ecological debate is Nicholas A. Robins's *Mercury, Mining, and Empire*.

4. Peter Bakewell has been the historical authority and should be paired with Carlos Sempat Assadourian's *El sistema de la economía colonial*, but for more recent theoretical readings see Jason Moore's "Silver, Ecology, and the Origins of the Modern World" and Orlando Bentancor's "Matter, Form, and the Generation of Metals."

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> of the social purpose of money, conspicuously absent in cryptocurrencies like Bitcoin. Really, the most disheartening thing about Bitcoin is that any sense of purpose at all is absent. If money is, ultimately, a tool rather than an end to itself, then a reinvention of money requires a rethinking of what that tool is and should accomplish.[5]

If we accept the challenge of Bitcoin and the other cryptocurrencies, we must be daring enough to ask ourselves: What exactly about currency do we wish to adopt and preserve in the digital age? If this is the moment when we truly rethink money for a post-Internet society, a digitizing and globalizing world, why are we valuing the most regressive, monopolistic elements of currency tied to its metalist past? The comparison with Potosí will guide us as we begin to answer the questions Bitcoin poses, questions of extraction, inflation, ecology, and work. Or rather, the comparison will guide us to reformulate those questions in a fashion appropriate for interrogating the Bitcoin moment. But first we must understand exactly how Bitcoin asserts its digital metalism within our networked, globalizing economy.

Bitcoin's Digital Metalism

The history of Bitcoin has been told and retold many times already. In fact, we can already categorize three main narrative threads that all tell some version of the same tale. First, there is the dry documentation, the digital paper trail left behind by those involved in designing and perfecting the code. Second, there is the evangelizing narrative, with authors ranging from those connected to Bitcoin's early development to next-generation start-up CEOs promoting a variety of services built on top of the Bitcoin core, accompanied by a chorus of cheering economists and technologists. This second narrative thread quite frequently adopts a mythological or prophetic register. Third, there is the critical perspective, with authors less invested—financially or ideologically—in the widespread adoption of any particular cryptocurrency, and more committed to an abstract rethinking of currency itself.[6] All three of these narratives, however, share a common starting point: Satoshi Nakamoto's original Bitcoin white paper.

5. Rob Trump, "The Paper Chase."

6. I borrow the term "digital metalism" from Bill Maurer, Taylor C. Nelms, and Lana Swartz's 2013 article "When Perhaps the Real Problem Is Money Itself! The Practical Materiality of Bitcoin." The first category of narratives can be found collected in the developer documentation page: https://Bitcoin.org/en/developer-documentation; the second proliferate in Silicon Valley-based journalism and press releases; some of the best Anglophone representatives of the third category are Finn Brunton, Maurer, Nelms, and Swartz, and Brett Scott. Most recently, a new narrative has emerged about an impending "hard fork" in Bitcoin's code, a debate that was still very much in flux in early 2016.

We only know Bitcoin's original voice in the machine by a pseudonym: Satoshi Nakamoto.[7] Bitcoin is not the first attempt at a digital currency, and all digital currencies are preceded by a long and fascinating history of alternative currency experimentation.[8] Bitcoin falls into the category of a "disintermediating" currency: those currencies that seek to remove any kind of central authority necessary for their proper functioning. Particularly concerning to Nakamoto are the financial institutions built into the current economic infrastructure of Internet-based commerce. These financial institutions—whether private like a commercial bank, non-profit cooperative like the NACHA (National Automated Clearing House Association), or quasi-public like the Federal Reserve—must act as "trusted third party" intermediaries to guarantee trust in the financial system at large. The role of the trusted third party is to prevent double spending and to mediate disputes between transacting parties. Double spending is a particularly difficult problem to solve in the digital realm, since any unit of digital currency ultimately reduces to a series of digits in a string of binary code. Unlike a minted coin, a paper bank note, or a cowrie shell, the series of digits that represents a particular unit of digital currency can be copied and circulated infinitely for negligible cost. How, then, to guarantee that my digital "Bitcoin" is the original "coin" that belongs to me, and not simply a copy of someone else's "coin" that I hope to pass off as my own?

It is here where Bitcoin offers a truly novel technological solution to this problem, which is a specific instance of the Byzantine Generals' problem.[9] Nakamoto's solution to the double-spending problem is the blockchain: a public record of all Bitcoin transactions that uses a mixture of public key cryptography and proof-of-work to create a secure system without relying on trusted third parties. Bill Maurer, Taylor Nelms, and Lana Swartz describe the block chain: "Bitcoin's work-around, embedded in its code, is a decentralized verification system, in which the combined processing power of computers connected to one another over the Bitcoin network is put to use authenticating and recording every Bitcoin transaction."[10] This decentralized verification system—the blockchain—harnesses the raw computing power of every node connected to the network to solve very difficult mathematical problems. When nodes present successful solutions to these problems, they broadcast their solutions to all other nodes; this broadcast solution is the "proof of work" and becomes part of all future iterations of the

7. The mystery surrounding the founding father of Bitcoin's identity has propelled much of the popular interest in that cryptocurrency. See, for instance, Joshua Davis's *New Yorker* profile "The Crypto-Currency: Bitcoin and Its Mysterious Inventor."

8. See, for example, Steven Levy's 1994 *Wired* feature on DigiCash, "E-Money (That's What I Want)" and Peter North's *Money and Liberation*.

9. Leslie Lamport, Robert Shostak, and Marshall Pease, "The Byzantine Generals' Problem." The Byzantine Generals' problem has been the focus of cryptographic research for quite some time, and appears in many cryptography textbooks.

10. Maurer, Nelms, and Swartz, "The Practical Materiality of Bitcoin," 264.

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blockchain. Included with the most recent successful solution is the network's entire transaction history; the individual transactions are dissociated from each member's true identity via public key cryptography. The "work" that goes into this verification project is called "mining," and the network currently rewards participants in the mining process by generating new Bitcoins.

I would like to focus on the two mechanisms that allow this network to function: the public key cryptography and the mining metaphor that underlies the proof-of-work function. In short: why is the network *crypto*, and why must it *mine*?

The critical narrative of Bitcoin understands the network's emphasis on cryptography to betray the currency's profoundly antisocial nature. In the words of an entrepreneur closely affiliated with the Bitcoin community, "Requiring users to neither trust nor depend on someone's goodwill could be transformative for those of us with access to mature financial systems and for the billions of people not being served by today's transactional systems."[11] This celebratory image of Bitcoin's empowering capability can easily be shifted into the dystopian register, which Brett Scott has named the "techno-Leviathan": "The vision thus is not one of bands of people getting together into mutualistic self-help groups. Rather, it is one of individuals acting as autonomous agents, operating via the hardcoded rules with other autonomous agents, thereby avoiding those who seek to harm their interests." Note the underlying dim view of human nature. While [libertarian] anarchist philosophers often imagine alternative governance systems based on mutualistic community foundations, the "empowerment" here does not stem from building community ties. Rather it is imagined to come from retreating from trust and taking refuge in a defensive individualism mediated via mathematical contractual law.[12]

In these terms, Bitcoin is antisocial in the most materialist sense: it seeks to engineer away the problem of the social in currency.[13] By maintaining anonymity, network users guarantee a certain level of privacy in their financial doings; by eliminating the need to trust other individuals or governing bodies, the network has found a way to allow precisely that anonymity which otherwise would cause the system to fail. The blockchain unites the unit of account—Bitcoin—with that unit's payment system infrastructure, and it is public key cryptography that mediates the union. Cryptography, in turn, allows the currency to fulfill its function as a medium of exchange without the social baggage that accompanies a personal check, a bank-issued credit card, or a convertible currency. Money without trust; exchange without custom.[14] Strangely enough, this antisocial

11. Austin Hill, "Blockstream Closes $21M Seed Round."
12. Brett Scott, "Visions of a Techno-Leviathan."
13. Beat Weber, "Bitcoin and the Legitimacy Crisis of Money."
14. Nigel Dodd, *The Social Life of Money*, 362.

currency is based on a surprisingly rigid morality, and this morality posits work itself as the guarantor of the system's integrity. The work, in turn, manifests as mining.

This brings us to the second mechanism of interest: why mining? It is Nakamoto him/herself who proposes the original mining metaphor to describe the incentive system behind the blockchain: "The steady addition of a constant amount of new coins is *analogous to gold miners* expending resources to add gold to circulation. In our case, it is CPU time and electricity that is expended."[15] In an explanatory blog post written around the time of the white paper's release, Nakamoto elaborates on this digital metalism:

> In this sense, [Bitcoin is] more typical of a precious metal. Instead of the supply changing to keep the value the same, the supply is predetermined and the value changes. As the number of users grows, the value per coin increases. It has the potential for a positive feedback loop; as users increase, the value goes up, which could attract more users to take advantage of the increasing value.[16]

Hidden here is the deflationary tendency built into Bitcoin's very infrastructure. Interestingly enough, Nakamoto's paper makes no necessary connection between the problem Bitcoin solves—double spending—and the deflationary policy hardcoded into his/her solution, the blockchain. In other words, there is no technical reason why the proof-of-work mechanism must be linked to regulating the money supply in the network; it is, rather, an ideological choice that Nakamoto built into the Bitcoin architecture.

Even though Nakamoto does not defend rhetorically the necessity of a hard cap on Bitcoins in his earliest writings, he certainly advances the computational centrality of that feature. The blockchain limits the number of possible Bitcoins in existence to around 21 million, and the blockchain regulates itself so that those coins will be released into the network with geometrically reducing frequency until the last coin is "minted" circa 2140. This feature, like any other feature in the Bitcoin universe, could conceivably be changed with the consensus of the community, but given the construction of the network and its extreme bias towards early adopters, it seems increasingly unlikely to change.[17]

If the hard cap on Bitcoins is not strictly necessary for the network to function—and, indeed, there are other competing cryptocurrencies that impose no limit on digital coinage—the critical perspective must ask: why insert an arbitrary scarcity into the network? Why not, instead, assume a productive model of abundance? Why are Bitcoins "mined" instead of

15. Satoshi Nakamoto, "Bitcoin," 4 (my emphasis).

16. Nakamoto, "Bitcoin Open Source Implementation of P2P Currency."

17. This point has only become more evident, as witnessed by the current (2015–2016) block size debate which seems to point towards a hard fork, given that community consensus has been essentially impossible to achieve.

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"farmed?"[18] The arguments in favor of the hard cap tend to be boorishly transitive: Bitcoin is modeled on gold, gold is a scarce commodity (and the model money form for Austrian school economics), and therefore any digital currency must be scarce. In fact, the currency should model gold as completely as possible: gold's desirability arises from the fact that it is scarce, durable, and requires significant work to bring into circulation, i.e. mining. Accordingly, Bitcoin should be scarce, durable, and produced through a labor-intensive process of mining.[19]

From a different perspective, Bitcoin's mining metaphor is in fact a felicitous one, as it paints a clear image of the ideology behind the Bitcoin moment. In the environmental critique of neoliberal economics, the global financial system is constitutively incapable of conceiving of externalities beyond the market. And, as Studnicki-Gizbert puts it, mining's product is pure externality.[20] In fact, there is no better example to truly understand the economic concept of externality than the mining process: exploitative labor practices, environmental degradation, political instability—all of these elements vanish behind the glow of the pure universal exchange value form, metal wrenched from the deepest layers of the biosphere. Everything besides the metal is external to production.[21]

If we extend the mining metaphor so that it becomes the operative concept behind Bitcoin's rhetoric, we'll see the techno-utopianism surrounding this global digital currency dissolve into a dystopian realm of scarcity and misery, buried deep within the infernal depths of the earth. If we pay attention to the logic of extraction hardcoded into the blockchain's very essence—and do not allow ourselves to be distracted by digital goldbugs—we'll see a much more fitting historical and metallic comparison. Spanish silver sustained one of history's great empires. The metal wrenched from the ground of the New World produced the first truly global minted currency.[22] The piece of eight solidified a global trade network, it reoriented hierarchies of power the world over, and, during the late sixteenth and early seventeenth centuries, most of it came from one single mountain deep in the Viceroyalty of Peru.

18. We could spin out this thought experiment even further, with reference to Silvio Gesell's demurrage: What if, instead of a hard-capped currency, the units themselves had lifespans, growing into Bitcoins and then exhausting themselves in circulation, only to be replaced by a new crop of "farmed" coins?

19. Peter Surda, "The Origin, Classification, and Utility of Bitcoin"; Konrad S. Graf, "On the Origins of Bitcoin."

20. Daviken Studnicki-Gizbert, "Deep Space Mining Time," 4.

21. Stuart Kirsch, *Mining Capitalism*.

22. Dennis O. Flynn and Arturo Giráldez, "Born with a 'Silver Spoon.'"

Potosí

At the height of its imperial powers and pretentions, Spain ran an ocean-spanning empire. Perhaps the image that best captures that moment is the Flota de Indias, the Spanish Treasure Fleet, heading now east, loaded down with American silver, now west, ferrying a cabin full of eager priests, bureaucrats, and conquistadores to the New World. Of course, these ships weren't the only ones transiting the empire: Spanish silver slipped across the Pacific to Manila, and human beings traveled below deck as hostages and captives, prisoners in the transatlantic slave trade.

The Spanish crown financed much of its empire with wealth plundered from its New World colonies, and no object exemplified New World wealth better than a Spanish coin minted with American silver. Spanish silver, Ward Barrett affirms, accounted for 74 percent of global silver production in the sixteenth century.[23] Of that enormous portion of sixteenth-century global silver flow, up to 60 percent of all silver mined on the entire planet came from one mountain deep in the Viceroyalty of Peru: the Cerro Rico de Potosí[24] (fig. 1).

The reddish cone of the Cerro Rico rises 4,782 meters, a modest-sized peak in the Andes, yet the mountain looms large over the city of Potosí. That peak, or better yet, the riches trapped beneath it, turned Potosí into one of South America's first boom-and-bust towns of early modern capitalism. Sources have led historians to believe that local indigenous residents, and perhaps the Incan empire at large, knew about the rich surface-level silver deposits on the Cerro Rico, but it wasn't until 1545 that the Spanish became aware of their existence.[25] As usually happened in colonial America, once the Spanish "discovered" a resource, it didn't take long for prospectors, clergy, and bureaucrats to set up shop; by 1573 the previously non-existent town of Potosí had grown to 120,000 residents.[26] Initially, the majority of the silver production process, from extraction to smelting, took place at the hands of laboring Indians working surface deposits.[27] These

23. Barrett, "World Bullion Flows, 1450–1800," 224–25. The details are incredible enough to warrant quotation in full: ". . . from 1493–1800, 85 percent of the world's silver and over 70 percent of its gold came from the Americas." This includes the period from 1493–1600 when 74 percent of the entire world's silver came from the Americas, with the majority of that coming from Potosí, both from the early smelting and the post-1570s amalgamation technological advancement.

24. Flynn and Giráldez, "Born with a 'Silver Spoon,'" 209.

25. Bakewell, *Miners of the Red Mountain*, 8–9. For the silver discovery story, a tale of racism and betrayal involving an escaped llama, a local Indian, and his Spanish master, see Robins, *Mercury, Mining, and Empire*, 16.

26. Jorge Espinoza Morales bases the 120,000 inhabitant figure on Toledo's 1573 census (*Minería boliviana*, 18); Robins calculates a population of 120,000 in 1602 (*Mercury, Mining, and Empire*, 39); while Espinoza Morales places the peak colonial population at 160,000 in 1650 (*Minería boliviana*, 10).

27. The indigenous workforce itself was subdivided into several different classes be-

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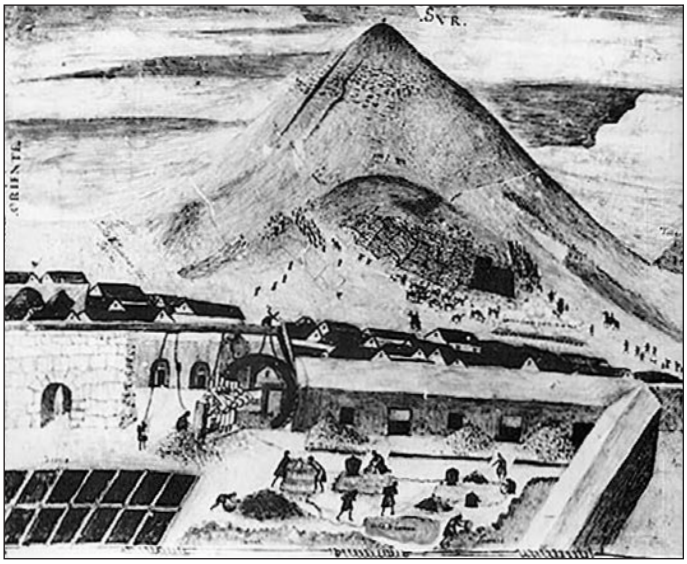

FIG. 1 The Cerro Rico of Potosí. The foreground illustrates the patio amalgamation process, the technological development in silver refining that arrived to the area with Viceroy Toledo in the early 1570s. (Source: Courtesy of the Hispanic Society of America, New York, Ms. K3.)

small-scale operations used indigenous mining and refining technology, including the *guayra*, a wind-blown furnace for smelting silver ore. The guayra became one of the icons of the first period of colonial mining in Potosí, so much so that the *cronista* Cieza de León described thousands of them dotting the hillside during his 1549 visit: "These vessels are called guayras, and at night there are so many of them all over the countryside and hillsides that they look like decorative lights (luminarias). And when the wind blows hard, much silver is extracted. When the wind falls, they can extract none"[28] (fig. 2). From the guayras, the smelted silver made its way to the pockets of the Spanish masters (although certain classes of indigenous laborers were able to keep any silver produced in excess of a quota), and from there, into the vast and dispersed network of world bullion flows. The Cerro Rico's unusually rich silver content allowed for this process to continue for around twenty years, although the lack of firewood in the surrounding barren peaks presented a particular challenge. Enterprising colonists also began to construct larger facilities, both for tunneling into the mountain and, back in the town itself, for grinding and smelting the extracted ore.

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fore the imposition of the forced labor draft, or *mita*. See Bakewell, *Miners of the Red Mountain*, 33–60.

28. Quoted in Bakewell, *Miners of the Red Mountain*, 16–17.

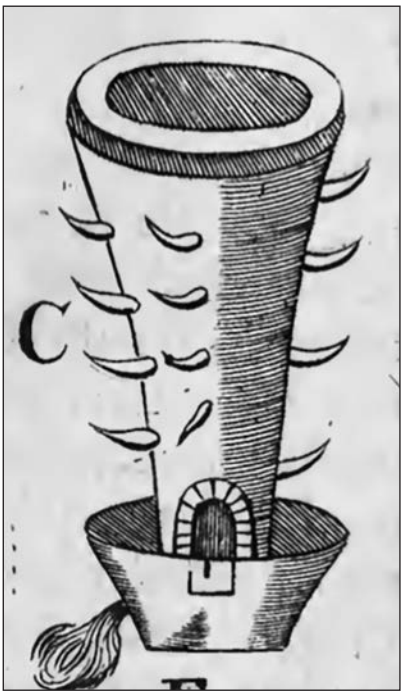

FIG. 2 A *guayra* (or *huayra*). Source: Book IV Chapter VI of Álvaro Alonso Barba's *Arte de los metales, en que se enseña el verdadero beneficio de los de oro, y plata por azogue. El modo de fundirlos todos, y como se han de refinar, y apartar unos de otros* (1640 [Lima 1817]).

Within twenty years, the surface deposits were exhausted, and silver production dropped dramatically from 1565 onward.[29] The Spanish crown, unsympathetic to arguments about declining richness of the ore and depleted resources such as wood, demanded reforms in order to increase silver production from the region. Those changes arrived in the figure of Viceroy Toledo, the crown's newly appointed authority for all of Peru. Toledo's reforms extended well beyond those pertaining to silver production, and colonial South American history writ large is divided into the pre-Toledo and post-Toledo periods (with the Viceroy's arrival in 1569 marking the turning point). Peter Bakewell has described Toledo as the "bureaucratic Pizarro," "the final bearer in Peru of the conquistador's energy," and his legacy was that of consolidating power and authority in the recently conquered territory, and completing the transition of the Viceroyalty of Peru into a productive and relatively stable colony.[30] That stability was accomplished by extreme violence, including the establishment of the Inquisition

29. Ibid., 26.
30. Ibid., 119.

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in Peru (1570), the execution of Túpac Amaru, the last indigenous Incan ruler (1572), and one of the largest forced displacements in history, the General Resettlement of Indians.[31]

As far as silver mining is concerned, Toledo brought about three substantial shifts: changes in mining labor structure, the adoption of new refining technology, and a colony-wide plan for resource management. These three interconnected reforms occurred more or less simultaneously; Toledo's draft labor system, known as the *mita*, provided the workers necessary to carry out the mercury amalgamation process—the technological advance responsible for the massive 1570s spike in otherwise stagnant silver production—and much of the mercury used in the so-called patio amalgamation process came from the Huancavelica mercury mines, which relied, in turn, on the *mitayo* laborers.[32] Jason Moore gives a succinct summary of the connection between Toledo's reforms and the surge of silver production in Potosí:

> Potosí's revival depended on two decisive innovations: (1) the replacement of smelting with an amalgamation process that used mercury to extract silver from the ore; and (2) the large-scale replacement of voluntary with forced labor through a system of rotating forced labor drafts, called the *mita*. The first presupposed the second. The perfection of an amalgamation process adapted to Andean conditions preceded by just a year Toledo's proclamation of a geographically expansive *mita* in 1572. Mercury amalgamation made possible the profitable extraction of silver from low-grade ores, but it demanded a huge and tractable labor supply. Thus amalgamation and the *mita* were at the core of a series of socioecological transformations that were profoundly implicated in the commodification of land and labor throughout the region and its deepening articulation with a globalizing capitalist system.[33]

Toledo's success was undeniable: between the Viceroy's reforms and the peak years of Potosí's activity, silver production increased almost eightfold.[34] Toledo also created a local branch of the Spanish imperial treasury, the Casa de Moneda, in the early 1570s, confirming Potosí's global centrality in the late sixteenth century.

We can call this historical convergence of resource, technology, and labor the Potosí constellation. It is instructive to think through the global effects of the Potosí constellation, since it will guide us in understanding

31. On the Inquisitions, see Teodoro Hampe-Martinez's 1996 review article "Recent Works on the Inquisition and Peruvian Colonial Society, 1570–1820"; on the General Resettlement of Indians, see Jeremy Ravi Mumford's *Vertical Empire*.

32. For the history of the patio amalgamation process in the Americas, see Robins, *Mercury, Mining, and Empire*, 25–26.

33. Moore, "Silver, Ecology, and the Origins of the Modern World," 131.

34. Bakewell, *Miners of the Red Mountain*, 25–29.

our contemporary Bitcoin moment and the cryptocurrency constellation under which it develops.

The Potosí Constellation

To the three material points in the Potosí constellation detailed above —resource, technology, and labor—we must add two more: ecology and global trade. These two supplements, however, move in and out of focus, acting now as points in the constellation, now as the background against which the other points emerge. In fact, all of the points in the Potosí constellation overlap: technology is bound together with human labor, which together join the more abstract category of energy; resources can be understood as commodities like mercury, wood, and silver, as human labor under the guise of biopower, or as landownership structures themselves, and all of these elements are clearly tied to ecology; finally, this entire constellation coalesces underneath the sign of nascent global capitalism. In what follows, I will briefly examine the components of the Potosí constellation, in isolation and in their intersections. As we prepare the ground for the comparison with the cryptocurrency constellation, many of the connections will become quite apparent.

Even pre-amalgamation, the silver economy had ravaged the landscape of Potosí and the surrounding highlands, stripping the land of all vegetation for fuel and materials. By the time of Toledo's arrival to the region, "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." And yet this surface-level environmental degradation was only prelude to what Nicholas Robins calls "one of the largest and longest-lasting ecological disasters ever known, and one that continues to this day in Huancavelica and Potosí."[35]

The introduction of the patio amalgamation process in the 1570s shifted the primary energy input demands away from the wood used to stoke the *guayras* and towards hydropower, used in several steps of the amalgamation process. From a resource perspective, this shift couldn't have come at a better time, since the surrounding region had been picked absolutely clean of any combustible fuel. Instead, Toledo organized the construction of an elaborate system of dams and canals flowing down from the nearby foothills and valleys. Flowing water powered stamp mills, washed the ore, blended the amalgamation tanks, and separated the amalgam.

As the ore quality diminished and the small-scale *guayra* operations became less feasible for free and wage laborers, there was also a growing demand for new and dangerous tasks associated with the amalgamation process. Human labor continued to extract and transport ore, but now the

35. Robins, *Mercury, Mining, and Empire*, quotes 178 and 177, respectively.

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large-scale processing plants needed bodies to stir, wash, clean, and separate the toxic silver-mercury amalgam, and also to extract the mercury itself from cinnabar deposits in nearby Huancavelica. These unsavory, poisonous, and often deadly jobs became the responsibility of the *mitayos*, the temporarily relocated workers in Toledo's draft labor force.

The *mita* and the fate of the *mitayos* has been one of the most studied elements of colonial life in the Peruvian Viceroyalty, due in no small part to the rich documentary trail established by one of history's most powerful global bureaucracies. Although there are differing interpretations regarding the specifics of Toledo's *mita*, which had some historical precedent in the pre-conquest Incan empire, all historians agree that the Spanish draft labor system fractured traditional communities, profoundly disrupted social life, and devastated both Indian workers and their families.[36] Workers from communities scattered across the entire realm would be forced to relocate to mining centers, where they spent a year providing tribute labor to the mine operators. The journey itself was arduous, and upon arrival, the work was even more taxing. Citing two colonial sources, Daniel Nesmer highlights the macabre fate that awaited the *mitayos*:

> Acosta concedes that "it is a known fact that the silver mines were also a vast Indian graveyard." Cutting minerals from the mountain, the mitayos dig their own graves. . . . In the refineries, as Antonio de la Calancha would later suggest, it is not only these minerals but Indians themselves that are ground into powder in preparation for amalgamation. In this powerful image, indigenous bodies are literally worked into the metal that enters into circulation as coin.[37]

These images—the Cerro Rico as graveyard, the Potosí mills as grinders of human flesh—circulated during the colonial period, and encouraged workers to flee from their communities to avoid the *mita*. As can be imagined, the massive population shifts further eroded whatever fragile stability communities might have rescued from the continent-wide plague of European diseases.

Not only did Toledo control the indigenous workforce through the *mita*; the Viceroy also managed to centralize silver production while at the same time maintaining the pretense of independent silver operators throughout the region. This was accomplished when Toledo declared a

36. Bakewell, p. 146, believes that the archival evidence supports a lower death rate than understood by other historians and that over half of the workforce was *minga*, i.e., contract labor entered voluntarily. That said, he does not disagree about the abysmal working conditions faced by all mine workers, both contract and *mita*. Bakewell's conclusions about worker mortality, however, need to be reassessed in light of Robins's findings related to mercury poisoning and silicosis, as Bakewell focused mainly on dismemberment and death within the mines and mills themselves.

37. Daniel Nesmer, "Primitive Spiritual Accumulation and the Colonial Extraction Economy"; translation slightly modified.

state monopoly on the Huancavelica mines and the mercury contained within: "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."[38] Given that the majority of mercury used in Potosí's amalgamation process came from Huancavelica, Toledo's proto-nationalization allowed the viceroy to conduct a rough measurement on expected silver production, using mercury exports to Potosí as a proxy figure, and to guarantee a mechanism of centralized control in South American silver production, even as the Viceroyalty and Spanish crown continued to distribute land grants under the *encomienda* system.

The mercury used to process and refine the extracted ore allowed for a massive increase in Potosí's silver production, especially in the early years when previously discarded tailings could be pulverized and fed into the amalgamation tanks. Yet the technological innovation also implied a new form of toxicity and ecological devastation, as the muddy and barren mining camps further degraded into full-scale toxic disasters. As Robins describes:

> 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 volatized, 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. 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 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.[39]

The *mita* forced workers to relocate to a supremely toxic environment, and rewarded those newly arrived bodies with poison and abuse.

It is from this material world that the first truly global minted currency emerges, for as Dennis Flynn and Arturo Giráldez have argued, "The singular product most responsible for the birth of world trade was silver."[40] The silver peso quickly became the perfect money commodity for the colonial age, merging standardized weight, high silver quality (fineness), and widespread trust.[41] There is no better example of the universal trust put into

38. Robins, *Mercury, Mining, and Empire*, 29.
39. Ibid., 8–9.
40. Flynn and Giráldez, "Born with a 'Silver Spoon,'" 208.
41. Carlos Marichal, "The Spanish-American Silver Peso," 30.

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Spanish silver than the stipulation by China's Ming rulers in the 1570s that their subjects had to discharge their tax obligations in silver. In essence, this proclamation converted the sixteenth century's largest economy to silver; in practice, this meant that Chinese demand for New World silver skyrocketed, to the point that more New World pesos circulated in southern China than in Mexico.[42]

Indeed, even the dollar sign itself ($) arose from the legacy of the Potosí constellation: when the United States adopted the Spanish peso as currency in 1785 (pegged to a 1:1 exchange rate with the as-yet unminted U.S. silver dollar), it also adopted its modified symbol. During the eighteenth century, the Spanish crown used ps to symbolize the plural of "peso"; it has been hypothesized that, over time, the "p" and "s" were superimposed upon one another to create the $ symbol.[43] Some even speculate that the origin of $ sign is tied directly to the Cerro Rico, as the Potosí mint mark—a superimposed PTSI—bears a striking resemblance to it. Regardless of the origin of the $ sign, the fact that nearly all theories connect it to the Spanish American silver peso is evidence enough of that moment's centrality in the history of world trade and global currency. The Potosí discovery, the arrival of the "patio process," and the silverization of the Chinese economy all occurred within a few generations. It is the nexus of these global events—political-economic, technological, and geopolitical—that provides such an apt comparison with the Bitcoin moment.

The Cryptocurrency Constellation: Labor and Externality

With the example of the Potosí constellation to guide us, it is now possible to recast the Bitcoin moment with special attention to the five major points in the larger cryptocurrency constellation: technology, resource, ecology, labor, and global trade. As with colonial American silver mining, these five areas intersect and overlap, and can be understood in both narrow and broad terms. The ecology of the cryptocurrency constellation, for instance, includes the use of fossil fuel, geothermal, and hydroelectric energy generation that power the Bitcoin mining rigs, but it can also refer to the more abstract Internet ecology of data flows and software code. Likewise, we can understand the resources involved in the constellation as the raw computing power used to complete proof-of-work and secure the network, or, alter-

42. Flynn and Giráldez, "Born with a 'Silver Spoon,'" 208; Flynn and Giráldez, "Cycles of Silver," 413. In Flynn and Giráldez's expanded conception of world trade and bullion flows, the Price Revolution in Europe is a local manifestation of an intercontinental phenomenon, an interconnected network based around New World silver production and Chinese demand. On the scarcity of New World pesos on the Iberian Peninsula, see Modesto Ulloa, "Castilian Seigniorage," 476–77.

43. This is the explanation offered by the U.S. Department of the Treasury; see the Bureau of Engraving and Printing's FAQ, https://www.moneyfactory.gov/faqlibrary.html.

natively, as the physical materials used in the production of the specialty application-specific integrated circuit (ASIC) hardware, single-purpose machines built specifically and solely for cryptocurrency mining.

The technological evolution of the Bitcoin mining process shares a parallel development with the shift from artisanal smelting to proto-industrial amalgamation. The thousands of *guayras* dotting the Potosí foothills that in 1549 reminded Cieza de León of so many decorative lights can be thought of as the distant ancestors to the amateur mining rigs with overclocked graphics cards spewing heat into a dingy basement, those early home rigs that Joshua Davis so memorably described as backwoods digital moonshining.[44] And as the innovative amalgamation process extinguished those myriad small producers, so too have massive Bitcoin mining operations relegated the wildcat home rig to distant memory. No longer can home producers enter the game as miners using graphic card processors, much less the multipurpose CPU.[45] It is only with super-specialized hardware dedicated exclusively to cryptocurrency proof-of-work tasks that rigs can successfully mine new Bitcoins, and these ASIC rigs are only feasible at the largest of scales. Like the Spanish mills and amalgamation plants, large-scale Bitcoin operations mine a diminishing resource. As ore fineness dropped, refiners required increasingly more tonnage to yield a given weight of silver; so too does the mining process require exponentially increased processing power to yield a Bitcoin reward from the blockchain (figs. 3 and 4).

In the Bitcoin constellation we also see an analogous process of increased concentration of capital dedicated to extraction, with the centralized growth of material plant and infrastructure. Given Bitcoin's rhetorical celebration of financial disintermediation and decentralization, this concentration may seem to contradict the cryptocurrency's articulated ethos at first glance. While disintermediation and decentralization are certainly part of cryptocurrency's conceptual constellation, they do not provide an exhaustive description of Bitcoin's geopolitical architecture. They do not, for instance, allow us to answer the question of who or what produces the real, material work in the constellation. Bitcoin mining rigs are the rhetorical parallel to indigenous Andean miners in colonial Potosí, but where does the material labor—not the metaphorical or the immaterial—actually reside?

Such questions trouble the celebratory version of cryptocurrency as a

44. Davis, "The Crypto-Currency."

45. The central processing unit (CPU) is a multipurpose processor, competent at everything and great at concurrent low-intensity operations. Graphics cards are more specialized, optimized for a narrow set of operations but still flexible enough to handle multidimensional programs like immersive gaming or 3-D rendering. When compared with the generalist CPU, this semi-specialized graphics hardware is much better at doing the intensive and repetitive calculations demanded by Bitcoin mining. ASICs, as the name implies, are series of integrated circuits all optimized for one particular application, and thus categorically better at that particular application—be it cryptocurrency mining, be it GPS data processing—than any other piece of existing hardware.

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FIG. 3 A "wildcat" home Bitcoin mining rig, from VMAX137's flickr page. The miner notes that by 2013, "With ASIC and FPGA-based systems coming on line affecting the hash difficulty this miner is no longer effective and has retired from mining." (Source: [Wildcat home mine] CC Attribution-Noncommercial-NoDerivs 2.0 License. VMAX 137. https://flic.kr/p/nJGgNb.)

technopolitical panacea; when we insist on the materiality of the constellation, we see hardware plants and international trade agreements, digital divides and national utility grids.[46] As with many questions regarding the materiality of the so-called immaterial economy of cyberspace, it is in China that we can begin to locate that labor.

Vice News filmed a Chinese Bitcoin mine in 2014, and the story docu-

46. Adam Rothstein, "Bitcoin and the Speculative Anarchist."

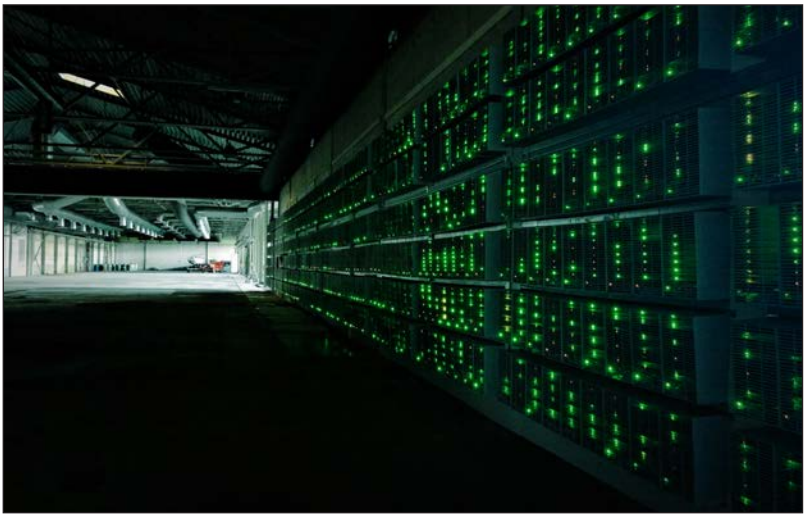

FIG. 4 A centralized, industrial-scale ASIC Bitcoin mining pool, from Marko Ahtisaari's flickr page. (Source: [ASIC Mining Pool] CC Attribution 2.0 License. Marko Ahtisaari. https://flic.kr/p/dSZw38).

ments the growth of massive-scale cryptocurrency operations.[47] The journalists travel to one of six connected mines in and around Dalian, China's northernmost warm-water port. The mines hum and glow: blasting fans constantly cool the radiating machines, while blinking indicator lights bathe the otherwise dark room in an LED green. The rigs inhabit metal shelving units which run down the long length of a warehouse, and the collected cables occupy so much floor space they are crisscrossed above by makeshift wooden bridges providing passage across. In 2014, that network of six Dalian mines represented 3 percent of the total blockchain network computing power. Each site uses 1,250 kWh per month, generating a monthly electrical bill of $80,000. Even at this state-of-the-art operation some of the hardware was not current enough, as evidenced by the pile of nearly 900 discarded ASIC miners, some cannibalized for parts, others simply tossed aside as obsolete. These piles of trashed processers and casings accumulate like mine tailings, most certainly destined for the landfill.

Perhaps the real flesh-and-blood miners are the young men who will haul those carcasses to the landfill. Their lives are almost inconceivably better than those of the men working the *mita*. Yes, they live at the mining site and work long solitary shifts, but their task is merely to ensure a steady electrical current and a well-circulating HVAC. Their worksite is not inherently toxic or dangerous. Yet the cryptocurrency constellation also includes the workers churning out ASIC hardware at the plants of the

47. Erik Franco, "Inside the Chinese Bitcoin Mine That's Making $1.5M a Month."

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Taiwan Semiconductor Manufacturing Company, and the builders constructing China's continental-scale electrical generation facilities.

While the working conditions in our two constellations are drastically different for the humans involved, the structures of extractive-based capital are disturbingly familiar. Mining rarely if ever leads to decentralization; on the contrary, diminishing ore quality demands the opposite. Once artisanal miners exhausted the rich surface deposits, the only way to continue extracting silver from the diminished ore was to employ the capital-intensive patio process; the patio process could only work on the largest of scales. Potosí, lest it be forgotten, represented the "greatest single concentration of medieval mill technology anywhere in the world."[48]

This situation also describes the current Bitcoin mining universe: technological innovation that leads to increased concentration and—irrespective of Bitcoin's articulated ethos—growing centralization. As Bitcoin mining facilities spring up in locations blessed with cheap, abundant, and hopefully subsidized energy, and with sufficient technical infrastructure, the industrial-scale rigs only further codify Bitcoin's extreme preference for early adopters. The structural bias towards early adopters relates back to the cryptocurrency's antisociality. It should be no surprise that if money is to serve principally as a store of value—even at the expense of its life as a circulating currency—it will reward everyone who hoards and punish all who spend. It creates a digital coin rush that rewards miners who most efficiently centralize and consolidate their operations. The contours of the global mining landscape draw a new map of primitive accumulation, this iteration hardcoded into the architecture of the blockchain itself.

Rather than proclaim this digital process to be truly and constituently decentralized, we must remember that mining is always an act of terraforming, of remaking the earth itself on a geological scale.[49] The blockchain can be more accurately understood as terraforming the digital financial realm, rather than decentralizing it.[50] Bitcoin is *cryptoforming* the Internet, with the goal of transitioning the financial sphere into an environment of digital metalism. As extractive terraforming unfolds in the realm of primitive accumulation—remember that mining is one of Marx's principal examples of the phenomenon—so too must we understand the Bitcoin moment as one of digital primitive accumulation, in addition to whatever liberatory claims cryptocurrency might promise.[51]

Cryptocurrency scholars have questioned whether Bitcoin should be

48. William E. Randolph, quoted in Studnicki-Gizbert, "Deep Space Mining Time," 22.

49. Studnicki-Gizbert, "Deep Space Mining Time," 27.

50. On the risk of Bitcoin's potential for oligarchical drift, see Weber, "Bitcoin and the Legitimacy Crisis of Money," 14.

51. See chapter 31 of *Capital Volume 1*, "The Genesis of Industrial Capital," where Karl Marx memorably describes the New World mines, the African slave trade, and colonialism in the global south generally as the "rosy dawn of the era of capitalist production."

described as a currency, or if it is better understood as a proprietary exchange network like ACH or Mastercard. Is Bitcoin, they ask, trying to unify all of the different networks for monetary exchange (credit cards, check-clearing houses, currency exchanges) into one meta-network, or is it attempting to create a new currency that will trade over that new network as a universal deflationary unit of exchange? From the perspective of cryptoforming, the question of currency versus network resolves itself into two components linked in a process of primitive accumulation. Like the New World silver peso, Bitcoin is both currency and network, an integrated monopoly that is yet another example of the cryptocurrency's fundamental contradiction.[52]

The parallel between terraforming and cryptoforming is also instructive in that it focuses our attention to the planetary scale of the respective operations. Robins's study on the ecological consequences of the Potosí constellation suggests that cryptocurrency's externalities may have an analogous ecological impact. Yet ecology represents a vexing question for Bitcoin, one that is usually argued only in half-measures.[53] Although the blockchain is sustained by pure expenditure of energy in the form of computing power, it is difficult to calculate the carbon footprint or the environmental impacts of that expenditure. Accordingly, comparisons of the ecological sustainability of digital-crypto currencies versus fiat-printed currencies come to radically divergent conclusions, depending on the variables measured and the calculations performed. In fact, the Bitcoin network eliminates many of the labor-intensive stages of minted or printed currency, including transportation and distribution in a global network. Furthermore, the blockchain could possibly power itself using purely renewable energy, since the electricity used to power the proof-of-work could be sourced in a renewable fashion. The minting and transportation of paper money and coins could never be fully converted to renewables. Yet such claims must be balanced against the cavalier discarding of obsolete single-purpose hardware like the 900 junked ASIC rigs in the Dalian

52. Although this paper is focused on the mining rhetoric at the heart of the early Bitcoin network, it is important to acknowledge that much of the growing enthusiasm surrounding the blockchain has shifted away from the money/token aspect so central to the Bitcoin constellation (in part because of the limits and problems outlined above). The most interesting and promising contemporary experimentation focuses on the potential for blockchain technology to function as a distributed ledger-keeping device. See Quinn DuPont and Bill Maurer, "Ledgers and Law in the Blockchain." Needless to say, further comparison between the Spanish notarial/bureaucratic empire in the New World and blockchain law is a quite promising vein of research, and Kathryn Burns's study of notarial practices in colonial Cuzco, *Into the Archive*, would be an obvious place to start.

53. A very useful Reddit thread explored the environmental issues in great detail. The community created a summary post, "Insights generated from the thread so far," which is helpful to consult: http://www.reddit.com/r/dogecoin/comments/1y2j0i/cryptocurrency_is_an_environmental_disaster/.

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mine, and the distribution network that constantly ships out new hardware to replace last year's model.

At a more abstract level, the use of proof-of-work to secure the blockchain seems profoundly unsustainable, as it is constituted by pure expenditure. Here we return to the "pure externality" mindset of mining and metalism. Capitalist industrial mining has rarely if ever been capable of accounting for the totality of its negative externalities, and there is little reason to believe that digital metalism and the "immaterial" mining at its core will behave any differently, crowdsourcing be damned.[54]

Although it is much too early to assess Bitcoin or other cryptocurrencies' effects on global trade, the Potosí constellation can help us calibrate our expectations. Carlos Assadourian, one of the principal contemporary historians of South American mining economies, reminds us:

> In the Peruvian case, that the rise of a new mercantile economy during the silver boom of the late sixteenth led quite logically, in the agrarian regions, to a restructuring of peasant access to land, of social relations governing the peasants' ability to use their own labor-time, and of colonial tribute requirements. The net effect of these changes was to allow for the continuation of an indigenous subsistence sector, while at the same time minimizing its access to resources and labor-time for subsistence production and luring or forcing indigenous peasants to provide cheap labor for commodity-producing enterprises.[55]

As we live through the Bitcoin moment and the cryptocurrency constellation expands, we must be attentive to the restructuring of access to online environments, to shifts in social media relations, and to redistributions of labor time. With Potosí in mind, we may be able to understand payments to Internet Service Providers (ISPs) under a colonial-mercantile logic of tribute requirements, or data mining operations as the so-called attention economy's de facto draft labor system. Are we, today, *mitayos* of social media corporations, providing our tribute labor through self-quantification and sacrificed privacy? In short: the comparison of these two linked constellations—Potosí and Bitcoin—brings into focus potential large-scale, *longue durée* historical shifts from a grounded, historical materialist perspective. This historicization will guard against the default techno-utopian perspective that fetishizes disruption. Ultimately, it will awaken us to the potential geopolitical impacts of promoting a digital metalism as the basis for the next generation of currency money.

54. On mining and negative externalities, see Stuart Kirsch, *Mining Capitalism*.
55. Steve J. Stern, "New Directions in Andean Economic History," 138–39.

Conclusion: Cryptoforming as Utopia in Action

I would like to conclude by pushing a bit harder on the comparison between the terraforming of colonial mining regimes and the cryptoforming of Internet infrastructure. I have alluded to the growth and development of Potosí as a center of the colonial Spanish mining empire; Daniel Nesmer and others have described this process as "geometrizing colonial space." By this, Nesmer names the architectonic logic that explicitly builds infrastructure in order to shape early modern social relations, specifically to orient and direct the circulation and extraction of bodies, commodities, value. Nesmer describes the process of terraforming the colonial city:

> If congregation sought to make colonial space legible, the orthogonal grid was both a means of representing this process cartographically and one of the tools used to realize it materially. The grid permits the measurement, classification, division, and apportionment of space, while facilitating the quantitative equivalencies that enable extraction, exchange, and accumulation. A gridded town composed of regular lots, for example, would allow for easier calculation of tribute obligations. At the same time, it attempts to capture and lock down the flexible, overlapping, and rotational social relations to which it is applied. At ground level, it offers extended lines of sight that facilitate the work of surveillance. But the grid not only fragments, it also homogenizes; through spatial abstraction, it tends toward neutralizing the particularities and peculiarities of a given terrain.[56]

Mining is always a terraforming operation. It reshapes the earth and its inhabitants in a profound way, one that resonates on the geological time scale. Human mining operations may be one of the fundamental pieces of material cultural evidence that the next millennium's archeologists use to periodize the anthropocene. Perhaps, then, it is fitting that mining be the operative metaphor that structures discourse surrounding cryptocurrency. Compare the language that accompanied the early Internet and the web: horizontality, distribution and dispersal of power, experimentation, freedom. Right now, global Bitcoin developers are adjudicating a dispute over whether the blockchain should prioritize decentralization or efficiency, and it threatens to fork the entire project. Even if Bitcoin itself does not survive the conflict, a new iteration of the blockchain will emerge. Thus it is imperative that we realize we do not merely witness the maturation of the next iteration of our digital universe, one that will intrude ever more robustly into our material universe. We also adopt its metaphorical structure as our social infrastructure. Horizontality becomes verticality; dis-

56. Nesmer, "Primitive Spiritual Accumulation," 340.

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persed power becomes centralized; experimentation becomes prospecting; and freedom becomes security.

New World silver became the substrate of a global social universe, connecting the entire planet for the first time in recorded history in a networked economy. These global flows of labor and accumulation were tied together by an extractive economy, and it is that extractive economy which Bitcoin seeks to reproduce in the digital universe. When we understand the contours of the Potosí constellation, we can then ask ourselves, in as informed a way as possible, why that extractive metalist model should become the guiding metaphor for the future of money. Why hardcode an insurmountable early adopter advantage into the blockchain's architecture? Why base digital currency on scarcity? Why assume that metaphor as opposed to other metaphors more commensurate with the radical promises of the Internet? Why not abundance, or resiliency?

These questions will hold Bitcoin to account for the social totality it hides within its code. The cryptocurrency constellation promotes the expenditure of energy for its own sake, and uses this pure expenditure as the currency's infrastructural guarantee. Yet it is not entirely accurate to call this expenditure useless, since all of the energy poured into the blockchain works diligently to repress money's social element. And by cutting all social ties, Bitcoin does indeed banish the most sociopathic denizens of the monetary universe, those too-big-to-fail banks and the craven regulators who abide their financial shenanigans. Yet in doing so, the blockchain assimilates the most regressive elements of historical money, those tied to ecological devastation, colonial subjugation, and primitive accumulation. Why not, instead, hardcode a different metaphor into future money, a metaphor as pervasive as Bitcoin's extractive model of expenditure, one that permeates every element of the currency?

There are, thankfully, many other alternative cryptocurrencies that experiment with different guiding metaphors. Each must be understood and interpreted with a similar historicizing scrutiny. Cryptocurrencies will always seek to cryptoform the digital universe, just as extractive industry seeks to terraform the planet. In a sense, cryptocurrencies themselves become a genre of utopian imagination, hardcoding blueprints for money's brave new world. Bitcoin's imaginary, however, is much closer to the infernal depths of Potosí, an antisocial dystopia carved into the very material substrate of digital primitive accumulation.

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